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RESEARCH ARTICLE

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Notulae to the Italian flora of algae, bryophytes, fungi and lichens: 13

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Abstract

In this contribution, new data concerning bryophytes, fungi and lichens of the Italian flora are presented. It includes new records and confirmations for the bryophyte genera *Bryum*, *Cryphaea*, *Didymodon*, and *Grimmia*; the fungal genera *Bryostigma*, *Cercidospora*, *Conocybe*, *Cortinarius*, *Endococcus*, *Inocybe*, *Psathyrella*, and *Sphaerellothecium*; the lichen genera *Agonimia*, *Anisomeridium*, *Bilimbia*, *Diplotomma*, *Gyalecta*, *Huneckia*, *Lecidella*, *Lempholemma*, *Myriolecis*, *Nephroma*, *Pannaria*, *Pycnothelia*, *Pyrrhospora*, *Rinodina*, *Stereocaulon*, *Thalloidima*, *Trapelia*, *Usnea*, *Variospora*, and *Verrucaria*.

Keywords

Ascomycota, Basidiomycota, Bryidae

How to contribute

The text of the records should be submitted electronically to: Cecilia Totti (c.totti@univpm.it) for algae, Marta Puglisi (mpuglisi@unict.it) for bryophytes, Alfredo Vizzini (alfredo.vizzini@unito.it) for fungi, Sonia Ravera (sonia.ravera@unipa.it) for lichens. Each text should be within 1,000 characters (spaces included).

Floristic records

BRYOPHYTES

Bryum violaceum Crundw. & Nyholm (Bryaceae)

+ **TAA**: North of Torbole (Trento), near S. Luigi (UTM WGS84: 32T 646149.5083779) in an arable field, 72 m, 8 January 2022, *F. Prosser* (ROV No. BR05987). – Species new for the flora of Trentino-Alto Adige.

According to Aleffi et al. (2020), the only report for Italy of *B. violaceum* is for Vietri sul Mare in Campania (Preston and Blockeel 2006). It is a temperate species, quite common in various European countries (Hodgetts and Lockhart 2020) and probably under-recorded in Italy. It can be distinguished from other species of rhizoid tuber-bearing species of *Bryum* by the combination of rhizoids with a purple violet colour and abundant small spherical, red to purple-red or orange rhizoidal tubers.

F. Prosser

Cryphaea heteromalla **(Hedw.) D.Mohr (Cryphaeaceae)**

+ **TAA**: On the shore of Lake Idro in Porto Camarella (UTM WGS84: 32T 619235.5073347), 369 m, 7 October 2021, on a branch of *Salix alba* L., *F. Prosser* (ROV BR05670). – Species confirmed for the flora of Trentino-Alto Adige.

Cryphaea heteromalla is not common in northern Italy, where it was mostly reported before 1968 (Aleffi et al. 2020); in particular, in Trentino-Alto Adige, it was previously known for Merano, Bolzano, and Riva del Garda (Dalla Torre and Sarnthein 1904). In the new site, *C. heteromalla* was fertile and accompanied by *Amblystegium serpens* (Hedw.) Schimp., *Hypnum cupressiforme* Hedw., *Orthotrichum affine* Schrad. ex Brid., and *Radula complanata* (L.) Dumort.

F. Prosser

Didymodon umbrosus **(Müll.Hal.) R.H.Zander (Pottiaceae)**

+ **TAA**: North of Torbole (Trento), near S. Luigi (UTM WGS84: 32T 646163.5083992) in an apple orchard, 73 m, 8 January 2022, *F. Prosser* (ROV No. BR05986). – Species new for the flora of Trentino-Alto Adige.

Didymodon umbrosus is an European–Southwest Asian species, reported in Italy only for Lazio, Marche, and Sicilia (Aleffi et al. 2020), so this new record is the first for northern Italy. So far, it is not reported for Austria (Köckinger et al. 2022) and Switzerland (Swissbryophytes 2022), and the only data for the Alps are probably from the surroundings of Nice and Monaco (INPN 2022). It is probably a spreading neophyte of American origin, first found in Europe in Great Britain in 1958 (Blockeel et al. 2014). In this new site, this species was found on clayey-sandy soil and at the base of the apple trees up to the graft level.

F. Prosser

Didymodon sinuosus **(Mitt.) Delogne (Pottiaceae)**

+ **VEN**: Along Adige River near Begosso (Verona) (UTM WGS84: 32T 688223.5001986), 11 m, 22 October 2021, *F. Prosser* (ROV BR05671). – Species new for the flora of Veneto.

Didymodon sinuosus was previously reported by Aleffi et al. (2020) in northern Italy for Piemonte, Emilia-Romagna, and Friuli-Venezia Giulia. This specimen was collected at the foot of a large poplar together with *Leskea polycarpa* Hedw. The presence of silt in the sample indicates submersion during exceptional floods.

F. Prosser

Grimmia unicolor **Hook. (Grimmiaceae)**

+ **TAA**: Lagorai chain, below Cima Valcigolera (Trento) (UTM WGS84: 32T 711223.5126118), 2205 m, 1 September 2021, south-facing quartz phyllite cliff, *F. Prosser* (ROV No. BR05669). Lagorai chain Monte Ziolera (Trento), cliff towards

Passo Manghen (UTM WGS84: 32T 689199.5116204), 2248 m, 21 July 2021, porphyry cliff facing south, *F. Prosser* (ROV No. BR05929). – Species confirmed for the flora of Trentino-Alto Adige.

Grimmia unicolor is boreal-montane species rare in Italy, where it is known only from Valle d'Aosta, Piemonte and, with old reports, from Lombardia, Trentino-Alto Adige and Veneto. In Trentino-Alto Adige, it was previously signalled from Val Venezia in Val Pejo, Malga Bedole in Val Genova, Val di Fumo near Merano (Dalla Torre and Sarnthein 1904), and near Innichen/S. Candido before 1920 (FloraFaunaSüdtirol). In the new site of Cima Valcigolera, this species was found together with *Anomobryum concinnatum* (Spruce) Lindb.

F. Prosser

FUNGI

Bryostigma molendoi (Heufl. ex Arnold) S.Y.Kondr. & Hur (Arthoniaceae)

+ **LIG**: via Iulia Augusta, strada per Verzi (Savona) on *Calogaya saxicola* (Hoffm.) Vondrák (UTM WGS84: 32T448864.4893367), 103 m, 11 July 2012, leg. *A. Guttová*, *L. Paoli*, det. *V. Darmostuk* (SAV sub *Solenopsora candicans* (Dicks.) J. Steiner). – Species new for the flora of Liguria.

Bryostigma molendoi is a common lichenicolous fungus in Italy known from several administrative regions (Nimis 2016). Most previous records of this fungus on *Xanthoria* sp. belong to *Bryostigma parietinarium* (Hafellner & Fleischhacker) S.Y.Kondr. & Hur (Fleischhacker et al. 2016).

V. Darmostuk, A. Guttová, L. Paoli

Cercidospora macrospora (Uloth) Hafellner & Nav.-Ros. (Dothideales, incertae sedis)

+ **PIE**: Valli di Lanzo, along the path "sentiero balcone", Usseglio (Torino) on apothecia of *Protoparmeliopsis muralis* (Schreb.) M.Choisy (UTM WGS84: 32T 3600004.5010842), 1570 m, 22 December 2021, leg. *A. Chiariglione*, det. *D. Isocrono*, conf. *W. v. Brackel* (ORO n. 1302) – Species new for the flora of Piemonte.

Cercidospora macrospora is a lichenicolous fungus, with perithecioid ascomata partially immersed in the host and appearing black under the magnifying lens. The ascomata wall is bluish-greenish, intensively pigmented near the ostiolum. Asci are cylindrical, fissitunicate, with a small apical chamber, and four hyaline 1-septate asco spores measuring 20–25(–30) × 5–7 µm. Similar 4-spored asci also occur in *C. crozalsiana* (H.Olivier) Nav.-Ros., Cl.Roux & Casares and *C. stenotropae* Nav.-Ros. & Hafellner, that can be distinguished by the asci and ascospore size (Navarro-Rosines et al. 1995; Calatayud et al. 2013). *Cercidospora macrospora* is considered a holarctic taxon (Hafellner 1987), and this is the first record for the western sector of the Italian Alps (Brackel 2016).

D. Isocrono, W. v. Brackel

Conocybe velata **(Velen.) Watling (Bolbitiaceae)**

+ **CAL**: Botanical Garden of the University of Calabria, Rende (Cosenza), on the ground between the edge of a riparian wood, *Populus canescens* (Aiton) Sm. as prevailing species (UTM WGS84: 33S 605842.4357370), 200 m, 19 October 2018, *N.G. Passalacqua, A.B. De Giuseppe, G. Sicoli* (CLU No. F317). – Species new for the flora of Calabria.

A couple of slender, small-sized and mycenoid basidiomata referable to the genus *Conocybe* Fayod (due to the campanulate and ochraceous-yellowish pilei, exannulate stipe, and rust-brown spore print) was detected in the grassy litter at the edge of a poplar stand. This saprotrophic fungus was macroscopically identified as *C. velata* due to white and appendiculate velar rests at the pileus margin, and microscopically on account of the shape of cheilocystidia which appeared not only lageniform, but also cylindrical and sometimes even subcapitate. The spores were brown, smooth, ellipsoid, with a prominent germ pore, and 7–10 × 4–5 µm in size (Watling 1992). *Conocybe velata* seems to occur mainly in the central regions of Italy, where it has been more commonly reported as *C. appendiculata* Watling (Onofri et al. 2013).

G. Sicoli, A.B. De Giuseppe, N.G. Passalacqua

Cortinarius confirmatus **Rob.Henry (Cortinariaceae)**

+ **LIG**: Trigoso, Sestri Levante (Genova), under *Quercus ilex* L., and *Arbutus unedo* L. (UTM WGS84: 32T 535636.4900878), 152 m, 29 December 2015, *F. Boccardo* (Herb. GDOR 3803). – Species new for the flora of Liguria.

The diffusion of *C. confirmatus* is widely documented in France, based on morphological and genetic evidence, but it is also present in Spain, Italy (Calabria), and Iran, highlighting a Eurasian distribution (Liimatainen et al. 2017; Ravera et al. 2021b). *Cortinarius confirmatus* is a polymorphic species in terms of basidioma colour, spore shape, habitat, and habitus. The typical form is characterized by cespitose habit, brown basidioma without violet tint, universal veil white, negative reaction to Guaiac tincture, raphanoid smell, and ellipsoidal spores (7)7.5–9.5(10) × 4.5–5.5(6) (Bidaud et al. 2015). This record is the first for Liguria.

F. Dovana, F. Boccardo, M. Clericuzio

Endococcus collematis **Brackel (Dothideomycetes)**

+ **BAS**: Forest near Castelluccio Superiore (Potenza), on *Lathagrium* sp. (UTM WGS84: 33T 583982.4429563), 779 m, 1 February 2015, leg. *A. Guttová, L. Paoli*, det. *V. Darmostuk* (SAV sub *Solenopsora candicans* (Dicks.) J. Steiner). – Species new for the flora of Basilicata.

+ **TOS**: Mt. Civitella, Monte Penna Natural Reserve, Castell'Azzara (Grosseto), on *Lathagrium auriforme* (With.) Otálora, P.M.Jørg. & Wedin (UTM WGS84: 32T 718100.4739032), 1024 m, 10 April 2010 leg. *A. Guttová*, *L. Paoli*, det. *V. Darmostuk* (SAV sub *Solenopsora candicans* (Dicks.) J. Steiner). – Species new for the flora of Toscana.

Our specimen from Toscana is characterized by globose shiny black perithecioid ascomata, up to 150 µm diameter, 8-spored asci and pale brown narrowly ellipsoid ascospores with rounded ends, (8.4–)10.2–13.8(–16.0) × (3.2–)3.4–4.4(–4.8) µm, l/b = (2.1–)2.4–3.4(–4.8) (n = 35). This recently described fungus was reported on the thallus of several *Collema* and known from Germany, Italy (Abruzzo, Calabria, and Campania), and Switzerland (Brackel 2021). Probably, some specimens of *E. collematis* are included in the broad concept of *Endococcus pseudocarpus* Nyl. Therefore, *E. collematis* is likely to be more widely distributed in Europe.

V. Darmostuk, A. Guttová, L. Paoli

***Inocybe acuta* Boud. (Inocybaceae)**

+ **CAL**: Botanical Garden of the University of Calabria, Rende (Cosenza), on the ground at the margin of an artificial carr, where *Populus*, *Salix*, *Typha*, and *Cladium* are the prevailing growing plant genera (UTM WGS84: 33S 605982.4357356), 200 m, 17 September 2021, *A.B. De Giuseppe, N.G. Passalacqua, G. Sicoli* (CLU No. F319). – Species new for the flora of Calabria.

A group of solitary, but gregarious, basidiomata belonging to *I. acuta* were observed on the ground close to culms of *Typha angustifolia* L. and in the vicinity of willow plants at the edge of an artificial pond. The pilei were conical and initially acutely umbonate, then almost applanate, dark umber, fibrillose, and 2–3 cm wide. The stipe was rather short, brownish and with a small, paler bulb at the base. The gills were brown and the spores strongly nodulose, 9–11 × 6–7 µm in size. Hymenial cystidia were ventricose-lageniform and mostly crested (Printz 1992; Courtecuisse and Duhem 1995; Kokkonen and Vauras 2012). In Italy *I. acuta* seems so far to have been reported only in Toscana and Veneto (Onofri et al. 2013).

G. Sicoli, A.B. De Giuseppe, N.G. Passalacqua

***Psathyrella badiophylla* (Romagn.) Bon (Psathyrellaceae)**

+ **CAL**: Botanical Garden of the University of Calabria, Rende (Cosenza), on the ground at the edge of a riparian wood, *Populus canescens* (Aiton) Sm. as prevailing species (UTM WGS84: 33S 606002.4357361), 200 m, 13 October 2021, *G. Sicoli, A.B. De Giuseppe, N.G. Passalacqua* (CLU No. F318). – Species new for the flora of Calabria.

Solitary psathyrelloid small basidiomes were observed on the ground along a sandy track at the edge of a poplar stand flanking a carr. Pilei were campanulate, striate and 2 cm in diameter. They were also clearly hygrophanous since initially brownish tending to become ochraceous while drying. A slender, pale and exannulate stipe was sustaining brown straight to slightly ventricose gills. No pleurocystidia but utriform cheilocystidia were observed. The spores were dark brown, smooth, ellipsoid, with a distinct germ pore, and 11–15 × 6.5–7 µm in size. The above morphological characteristics led us to identify the fungus as *P. badiophylla* (Kits van Waveren 1985; Vesterholt and Knudsen 1992).

G. Sicoli, A.B. De Giuseppe, N.G. Passalacqua

Sphaerellothecium parietinarium **(Linds.) Hafellner & V. John (Mycosphaerellaceae)**

+ SAR: Dune di Piscinas, Arbus (Sud Sardegna), on apothecia of *Xanthoria parietina* (L.) Th.Fr. (UTM WGS84: 32S 453194.4376787) 14 m, 18 June 2021, *D. Isocrono*, conf. *W. v. Brackel* (ORO n. 1301). – Species new for the flora of Sardegna.

Sphaerellothecium parietinarium is a lichenicolous fungus with crowded black perithecia partially immersed (up to 2/3) in the host tissue (apothecia and occasionally thalli of *Xanthoria* species). It bears saccate asci with two-celled and smooth-walled ascospores, irregularly arranged in the asci. This species is not reported for Sardegna (Brackel and Berger 2019), and this is the third record for Italy where it is known from Campania (Puntillo and Brackel 2017) and Calabria (Brackel and Puntillo 2016). The specimen from Sardegna was found on *Xanthoria parietina* apothecial discs growing on twigs of *Juniperus macrocarpa* Sm. in sand dunes.

D. Isocrono, W. v. Brackel

LICHENS

Agonimia opuntiella **(Buschardt & Poelt) Vězda (Verrucariaceae)**

+ **SAR**: near the road 2 km SW of San Pantaleo, Arzachena (Sassari), on bark of *Quercus coccifera* L. (UTM WS84: 32T 537499.4542800) 40 m, 30 April 2012, *J. Malíček* (PRA). – Species new for the flora of Sardegna.

Agonimia opuntiella is a usually sterile microlichen with squamulose thallus with more or less developed hyaline hairs. It grows on various substrates, such as bryophytes, plant debris, calcareous soil, rarely also on rocks and tree bark. This species, recently collected for the first time in other central-southern Italian administrative regions (Ravera et al. 2017; Caporale and Ravera 2020), seems to be rare but likely underestimated in Italy (Nimis 2016).

J. Malíček, S. Ravera

Anisomeridium biforme **(Schaer.) R.C.Harris (Monoblastiaceae)**

+ **TOS**: Piteglio (Pistoia), on *Castanea sativa* Mill. (UTM WGS84: 32T 641833.4875706), 750 m, 28 January 2022, leg. *R. Benesperi, E. Bianchi, L. Di Nuzzo, L. Paoli, S. Ravera*, det. *S. Ravera* (PAL). – Species new for the flora of Toscana.

Anisomeridium biforme is a nearly cosmopolitan pyrenocarpous lichen, common on deciduous trees in open woodlands or sheltered open situations mostly in areas with a humid-warm climate (Nimis 2016). This specimen was collected on an old chestnut tree.

E. Bianchi, L. Di Nuzzo, S. Ravera

Bilimbia accedens **Arnold (Ramalinaceae)**

+ **LOM**: Valle del Venerocolino, Schilpario (Bergamo), on moss above base-rich siliceous rock in a moist coniferous forest (UTM WGS84: 32T 589454.5097752),

1250 m, 30 August 2021, leg. *G. Gheza*, det. *G. Gheza, F. Bottegoni* (BOLO). – Species confirmed for the flora of Lombardia.

Bilimbia accendens is a muscicolous species with optimum in upland areas (Nimis 2016). Nimis (2016) quoted for Lombardia only an old record by Jatta (1909–1911).

G. Gheza, F. Bottegoni

***Diplotomma glaucoatrum* (Nyl.) Cl.Roux (Caliciaceae)**

+ **TOS**: Arcipelago Toscano National Park, Elba island, Sorgente shore (Livorno), on granite (UTM WGS84: 32T 604849.4741994), 3 m, 14 July 2021, *J. Nascimbene* (BOLO). – Species new for the flora of Toscana.

This species, belonging to the *Diplotomma alboatrum*-complex, is restricted to coastal-maritime environments and, in Italy, it was previously reported only from Sardegna (Nimis 2016). The record reported here refers to a site with ecological conditions similar to those of the Sardinian locality, i.e., siliceous boulders on steep slopes with garrigue at seashore, just above high-water level.

J. Nascimbene

***Gyalecta arbuti* (Bagl.) Baloch & Lücking (Gyalectaceae)**

+ **EMR**: Granaglione (Alto Reno Terme), on a chestnut trunk (UTM WGS84: 32T 656948.4886382), 740 m, 26 January 2022, leg. *R. Benesperi, E. Bianchi, L. Di Nuzzo, D. Isocrono, L. Paoli, S. Ravera*, det. *D. Isocrono, S. Ravera* (ORO 1303). – Species new for the flora of Emilia Romagna.

Gyalecta arbuti is a crustose lichen found in humid-warm environments. It is related to *G. carneola* (Ach.) Hellb. with which it is misidentified due to their similar ecology (Nimis 2016). Thallus and apothecia are also similar; smaller ascospores (29–50 × 3–5 µm vs. 53–90 µm) with fewer septa (6–12 vs. 10–18) allow to distinguish it from *G. carneola*. In Italy, this species was known, mainly from old collections, for Liguria and Sardegna (Nimis 1993 and references therein). It was recently discovered in Toscana and Campania (Ravera et al. 2021a) and recollected in Liguria (Giordani and Incerti 2008). The Italian Red List of epiphytic lichens listed *G. arbuti* under the "Data deficient" category (Nascimbene et al. 2013).

R. Benesperi, D. Isocrono, L. Paoli

***Huneckia pollinii* (A. Massal.) S.Y.Kondr., Elix, Kärnefelt, A.Thell, J.Kim, A.S.Kondratiuk & J.-S.Hur (Teloschistaceae)**

+ **LOM**: Pista degli Abeti, Schilpario (Bergamo), on bark of *Fraxinus excelsior* L. at the edge of a moist coniferous forest near a stream (UTM WGS84: 32T 592612.5096572), 1207 m, 5 September 2020, leg. *G. Gheza*, det. *G. Gheza, F. Bottegoni, C. Vallese* (BOLO). – Species confirmed for the flora of Lombardia.

Huneckia pollinii is found mostly on trees with smooth bark along watercourses, as in the case of the record reported here. It was recorded previously in Lombardia by

Anzi (1860) from the surroundings of Como and Val Chiavenna, as abundant on bark of several tree species. It is listed as "Near-threatened" in the Red List of the epiphytic lichens of Italy (Nascimbene et al. 2013).

G. Gheza, C. Vallese, F. Bottegoni

Lecidella flavosorediata **(Vězda) Hertel & Leuckert (Lecanoraceae)**

+ **CAL**: Sila Piccola, Trepidò, Cotronei (Crotone), on bark of *Pinus nigra* subsp. *laricio* (UTM WGS84: 33S 644624.4340015), 1297 m, 10 August 2021, *D. Puntillo* (CLU No. 17977). – Species new for the flora of Calabria.

Lecidella flavosorediata is characterized by a yellowish sorediate indistinct thallus forming a subleprose crust with farinose soredia, sometime gathered into larger consoredia. Apothecia are rare. This species is widely diffused in the pine forests of the Sila plateau where it colonizes wide portions of bark at the base of *Pinus nigra* J.F.Arnold subsp. *laricio* Palib. ex Maire trunks.

D. Puntillo

Lempholemma cladodes **(Tuck.) Zahlbr. (Lichinaceae)**

+ **ITA** (**VEN**): Dolomiti Bellunesi National Park, Vette Feltrine, Mt. Pavionet (Belluno), on calciferous rocks, Formazione di Fonzaso (UTM WGS84: 32T 720600.5108735), 2070 m, 9 August 2021, *J. Nascimbene* (BOLO). – Species new for the flora of Italy (Veneto).

This species is widespread in the Northern Hemisphere (Scandinavia, North America) and was rarely collected in the Alps, being only known from Switzerland (Nimis et al. 2018). It has a micro-fruticose thallus forming spreading cushions. The record reported here refers to material collected on Mesozoic calciferous rocks with periodical percolation of water colonized by other cyanolichens such as *Placynthium garovaglii* (A.Massal.) Malme and *P. filiforme* (Garov.) M.Choisy.

J. Nascimbene, P.L. Nimis

Myriolecis liguriensis **(B.De Lesd.) Cl.Roux (Lecanoraceae)**

+ **TOS**: Arcipelago Toscano National Park, Elba island, Sorgente shore (Livorno), on granite (UTM WGS84: 32T 604849.4741994), 3 m, 14 July 2021, *J. Nascimbene* (BOLO). – Species new for the flora of Toscana.

This is a poorly known taxon related to *M. albescens* (Hoffm.) Śliwa, Zhao Xin & Lumbsch, that was previously reported only from Liguria and Sardegna (Nimis 1993) in Italy. It is related to coastal environments, being confined to the salt-spray belt (Nimis 2016).

J. Nascimbene

Nephroma tropicum **(Müll.Arg.) Zahlbr. (Nephromataceae)**

+ **ITA** (**VEN**): Val Visdende, Costa d'Antola (Belluno), on spruce (UTM WGS84: 32T 320236.5165788), 1320 m, 7 December 2018, leg. *J. Nascimbene*, det. *E. Timdal*

(BOLO) [GenBank MZ130553 (ITS), MZ133754 (mtSSU)]. – Species new to the flora of Italy (Veneto).

This species belongs to the *Nephroma helveticum* Ach. species complex, a circumpolar, boreal-temperate element occurring in North America, Europe, and Asia (Timdal et al. 2021). In Europe, *N. tropicum* is currently known only from three localities in Norway, Germany, and Italy. The record reported here refers to a cold-humid site in the north-eastern part of the Belluno province, where *N. tropicum* was found together with several species that were also present in the Scandinavian site, such as *Evernia divaricata* (L.) Ach., *Ramalina obtusata* (Arnold) Bitter, and *R. thrausta* (Ach.) Nyl. (Timdal et al. 2021).

J. Nascimbene, P.L. Nimis, E. Timdal

***Pannaria conoplea* (Ach.) Bory (Pannariaceae)**

+ **LOM**: Bagni di Masino, Valmasino (Sondrio), on granite boulders and bark of *Fraxinus excelsior* L. at the edge of a moist coniferous forest (UTM WGS84: 32T 546196.5121355), 1172 m, 24 August 2019, *G. Gheza* (PAV); valley bottom of Val di Mello, Valmasino (Sondrio), on mossy granite boulders in a moist coniferous forest (UTM WGS84: 32T 552371.5123599), 1200 m, 26 August 2019, *G. Gheza* (PAV); western side of the lower Valle del Vò, Schilpario (Bergamo), on a mossy schist rock (UTM WGS84: 32T 588683.5097526), 1140 m, 26 August 2021, *G. Gheza* (PAV). – Species confirmed for the flora of Lombardia.

Pannaria conoplea is a cyanolichen currently declining in northern Italy (Nimis 2016), and reported from Lombardia only by Garovaglio (1838), Anzi (1860) and Giacomini (1937). It is listed as "Near-threatened" in the Red List of the epiphytic lichens of Italy (Nascimbene et al. 2013). The record from Schilpario is the first from the Orobic Alps.

G. Gheza

***Pycnothelia papillaria* Dufour (Cladoniaceae)**

+ **LIG**: Passo della Forcella (Genova), in xeric grassland on schist near the roadside (UTM WGS84: 32T 526710.4923271), 880 m, 20 August 2015, *W. v. Brackel* (GE). − Species confirmed for the flora of Liguria.

Pycnothelia papillaria is an extremely nitrophobic lichen growing on acid soil in heaths and open grassland, strongly declining in most parts of Europe, except for the Alps, due to the general eutrophication of the landscape. According to Nimis and Martellos (2022), it is rare in the Italian Alps and very rare in the higher elevations of the northern Apennines. There are several historical records of this species from Liguria (Nimis 1993 and references therein), the last dating back more than 80 years (Sbarbaro 1941, as *Cladonia papillaria*), from four localities. In the Passo della Forcella, we found it growing on open soil together with *Cladonia foliacea* (Huds.) Willd., *C. furcata* (Huds.) Schrad., *C. pyxidate* agg., *Leptogium lichenoides* agg., *Monerolechia badia* (Fr.) Kalb, *Xanthoparmelia conspersa* (Ach.) Hale, and *X. stenophylla* (Ach.) Ahti & D.Hawksw.

W.v. Brackel, P. Giordani

***Pyrrhospora quernea* (Dicks.) Körb. (Lecanoraceae)**

+ **VEN**: Monte Baldo (Verona) (UTM WGS 84: 32T 642981.5064682), 1855, *A. Massalongo* (Herb. Massalongo MSNVE 25752). – Species historically recorded for the flora of Veneto.

Collected and identified by A. Massalongo, this specimen is stored in a collection preserved at the Natural History Museum (NHM) of Venice. The collection was originally donated by Massalongo to the Società Veneta di Scienze Naturali, and then transferred to the NHM of Venice. *Pyrrhospora quernea* is a mainly Mediterranean-Atlantic, epiphytic species, abundant in humid coastal-Mediterranean sites, much rarer elsewhere. It occurs rarely, and mostly in the sterile state, in the Insubrian District of Lombardia, while it is probably extinct in other portions of northern Italy.

S. Martellos, P.L. Nimis, L. Seggi

***Rinodina albana* (A.Massal.) A.Massal. (Physciaceae)**

+ **LOM**: above Bagni di Masino towards Rifugio Omio, Valmasino (Sondrio), on bark of *Fagus sylvatica* L. in a beech forest (UTM WGS84: 32T 545468.5121688), 1278 m, 24 August 2019, *leg. G. Gheza*, det. *H. Mayrhofer* (PAV). – Species confirmed for the flora of Lombardia.

The epiphytic *Rinodina albana* is reported here from a forest stand attributed to the Natura 2000 Habitat 9110 ("*Luzulo-Fagetum* beech forests"). According to Nimis (1993), previous records from Lombardia come from exsiccata by Garovaglio (Lich. Ital. XXXIX n. 10) and Anzi (Lich. Rar. Langob. n. 304), but the one by Garovaglio is, in fact, *Lecanora polytropa* (Hoffm.) Rabenh. (Tomaselli 1946) and the one by Anzi contains *R. sophodes* (Ach.) A.Massal., *R. oleae* Bagl., and *R. polyspora* Th.Fr. (Magnusson 1947; Ropin and Mayrhofer 1993; Giralt and Mayrhofer 1995). Magnusson (1947) reported it from Valtellina (Lombardia) based on another exsiccatum by Anzi (Lich. Prov. Sondr. n. 133), following Anzi (1860).

G. Gheza, S. Assini, H. Mayrhofer

***Stereocaulon vesuvianum* var. *nodulosum* (Wallr.) I.M.Lamb (Stereocaulaceae)**

+ **ITA** (**LOM**): eastern side of the lower Valle del Vò, Schilpario (Bergamo), on siliceous stones in a scree (UTM WGS84: 32T 588548.5098017), 1190 m, 31 October 2021, leg. *G. Gheza*, det. *G. Gheza, F. Bottegoni, J. Nascimbene* (BOLO). – Variety new for the flora of Italy (Lombardia).

Stereocaulon vesuvianum var. *nodulosum* is a fruticose lichen dwelling on metal-rich rocks. It is a rare taxon, that has been reported previously in the Alps only from Tyrol (Nimis et al. 2018). It can be distinguished from the more widespread *S. vesuvianum* var. *vesuvianum* by means of the glabrous surface of pseudopodetia, the usual presence of soredia, and the confluent peltate phyllocladia (Nimis 2021).

G. Gheza, F. Bottegoni, J. Nascimbene

***Thalloidima toninianum* (A.Massal.) A.Massal. (Ramalinaceae)**

+ **LOM**: road between Dezzo and Dosso, Azzone (Bergamo), on a fissured calcareous rock cliff overhanging the road (UTM WGS84: 32T 586164.5091593), 770 m, 9 October 2021, *G. Gheza* (BOLO). – Species confirmed for the flora of Lombardia.

Thalloidima toninianum is a calciphilous, mainly Mediterranean species, that can reach the subalpine belt in the Alps (Timdal 1991). The only previous record from Lombardia is from serpentine rocks in the mountains surrounding Bormio (Anzi Lich. Rar. Langob. Exs. n. 462, cited by Baumgartner 1979 and Timdal 1991). This is the first record from the Orobic Prealps. In the reported site, this rare species occurred together with the more common *Thalloidima candidum* (Weber) A.Massal., *Thalloidima sedifolium* (Scop.) Kistenich, Timdal, Bendiksby & S.Ekman, *Endocarpon pusillum* Hedw., and *Romjularia lurida* (Ach.) Timdal.

G. Gheza

***Trapelia corticola* Coppins & P.James (Arnold) Bitter (Trapeliaceae)**

+ **LIG**: 0.5 km E of Cascina Zattera, Levanto (Provincia della Spezia), on bark of *Castanea sativa* Mill. along road (UTM WS84: 32T 554686.4889408), 430 m, 29 April 2012, *J. Malíček* (PRA). – Species new for the flora of Liguria.

This species is a crustose lichen, usually sterile, characterized by punctiform, markedly convex C+ red soralia, locally frequent on decaying wood or bark of trees in sheltered, humid woodlands. In Italy, it was previously reported only from Lombardia (Stofer 2006), Toscana (Coppins and James 1984; Purvis et al. 1992), and Sicilia (Ottonello and Merlo 1991; Nimis et al. 1994). It is listed as "Endangered" in the Red List of the epiphytic lichens of Italy (Nascimbene et al. 2013).

J. Malíček, S. Ravera

***Trapelia placodioides* Coppins & P.James (Arnold) Bitter (Trapeliaceae)**

+ **LIG**: Passo della Forcella (Genova), on schist rocks near the roadside (UTM WS84: 32T 526710. 4923271), 880 m, 20 August 2015, *W. v. Brackel* (GE). – Species new for the flora of Liguria.

Trapelia placodioides is an epipetric crustose lichen on base-rich siliceous rocks and pebbles. Apothecia are very rare and the species occurs mostly only with soralia; this may be the reason why it is widely underrecorded. It is characterized by an aerolate, whitish to pale pink thallus with marginal, pale greenish soralia, the thallus reacting red with calcium hypochlorite. In Italy, this species was known so far only for Trentino-Alto Adige, Friuli-Venezia Giulia, Piemonte, Toscana, and Campania (Nimis and Martellos 2022). In the Passo della Forcella, we found it growing together with *Acarospora fuscata* (Schrad.) Arnold, *Diploschistes scruposus* (Schreb.) Norman, *Lecanora polytropa* agg., *Lecidea fuscoatra* (L.) Ach., *Porpidia crustulata* (Ach.) Hertel & Knoph, *Rhizocarpon geographicum* (L.) DC., *R. lecanorinum* Anders, and other crustose epipetric lichens.

W.v. Brackel, P. Giordani

***Usnea cavernosa* Tuck. (Parmeliaceae)**

+ **VEN**: Dolomites, Misurina (Belluno), on spruce (UTM WGS84: 33T 290004.5162589), 1650 m, 12 February 2003, *J. Nascimbene* (BOLO). – Species new for the flora of Veneto.

This species, that forms long (up to 60 cm), pendulous, thalli on the branches of coniferous or deciduous trees, is widespread throughout the Alps where it is usually restricted to damp montane to subalpine forests (Nimis et al. 2018). The record reported here refers to a very humid montane spruce forest on the shores of the lake of Misurina, in the Dolomites, that hosts abundant communities of hair-lichens. Except for Trentino-Alto Adige, the other records from the Italian Alps are relatively old (Nimis 1993, 2016).

J. Nascimbene

***Usnea florida* (L.) F.H.Wigg. (Parmeliaceae)**

+ **UMB**: Terne, Sellano (Perugia), on *Fagus sylvatica* L. (UTM WGS84: 33T 327259.4753306), 710 m, 25 January 2022, leg. *R. Galli*, det. *P. Giordani*, *S. Ravera* (PAL). – Species new for the flora of Umbria.

This is a fruticose-filamentous species, with optimum, in Italy, in the upper montane and subalpine belts (Nimis 2016). In this specimen, the medulla reacts K- and P- (chemotypes with squamatic acid).

R. Galli, P. Giordani, S. Ravera

***Variospora thallincola* (Wedd.) Arup, Frödén & Søchting (Teloschistaceae)**

+ **TOS**: Arcipelago Toscano National Park, Elba island, Capoliveri, Barabarca shore (Livorno), on acid rock (UTM WGS84: 32T 611206.4734152), 3 m, 17 July 2021, *J. Nascimbene* (BOLO). – Species new for the flora of Toscana.

This species, characterized by a crustose-placodioid, episubstratic, bright golden yellow, usually epruinose thallus forming small, orbicular rosettes, is a typical coastal lichen confined to the salt-spray belt (Nimis 2016). In Italy it was previously known only from the western coast of Sardegna. Similar to several other coastal lichens, it was likely overlooked in Italy.

J. Nascimbene

***Verrucaria rupestris* Schrad. (Verrucariaceae)**

+ **VEN**: Tregnago (Verona), on calcareous rocks (UTM WGS 84: 32T 669000.806, 5042180.329), 1855(?), *A. Massalongo* (Herb. Massalongo MSNVE 25489). – Species historically recorded for the flora of Veneto.

This specimen was collected and identified as "*Amphoridium rupestre* Massal." by A. Massalongo, probably in 1855 (as most of the other specimens in the same collection), in his hometown (Tregnago). It is preserved at the Natural History Museum of Venice, in an herbarium donated by Massalongo to the Società Veneta di Scienze

Naturali, and then transferred to the NHM of Venice. *Verrucaria rupestris* is an early coloniser of pebbles, mortar walls, brick and roofing tiles, until recently confused with *V. muralis* Ach., from which it differs in the endolithic thallus and the perithecia, which are immersed in the thallus and in the rock. In Italy, it was known only from Emilia-Romagna and Trentino-Alto Adige (Nimis 2016), but is likely to be more widespread.

S. Martellos, P.L. Nimis, R. Trabucco

References

Aleffi M, Tacchi R, Poponessi S (2020) New checklist of the bryophytes of Italy. Cryptogamie, Bryologie 41: 147–195. https://doi.org/10.5252/cryptogamie-bryologie2020v41a13

Anzi M (1860) Catalogus lichenum quos in Provincia Sondriensi et circa Novum-Comum collegit et in ordinem systematicum digessit presbyter Martinus Anzi. Tipografia C. Franchi, Como, 126 pp.

Baumgartner H (1979) Revision der europäischer Arten der Gattung *Toninia* (Massal.) Th.Fr. Thesis. München.

Bidaud A, Bellanger J-M, Carteret X, Reumaux P, Moënne-Loccoz P (2015) Atlas des Cortinaires 23: 1921–2016.

Blockeel TL, Bosanquet SDS, Hill MO, Preston CD (2014) Atlas of British and Irish bryophytes. 2 vol. Pisces Publications, Newbury.

Brackel W von (2016) Preliminary checklist of the lichenicolous fungi of Italy. Notiziario della Società Lichenologica Italiana 29: 95–146.

Brackel W von (2021) Lichenicolous fungi from Campania (Italy). Borziana 2: 31–68.

Brackel W von, Berger F (2019) Lichenicolous fungi from Sardinia (Italy): new records and a first synopsis. Herzogia 32: 444–471. https://doi.org/10.13158/heia.32.2.2019.444

Brackel W von, Puntillo D (2016) New records of lichenicolous fungi from Calabria (southern Italy), including a first checklist. Herzogia 29: 277–306. https://doi.org/10.13158/heia.29.2.2016.277

Caporale S, Ravera S (2020) Lichen diversity on Trees Outside Forest in Molise (Central Italy). Borziana 1: 67–75. https://doi.org/10.7320/Borz.001.067

Calatayud V, Navarro-Rosines P, Hafellner J (2013) Contributions to a revision of *Cercidospora* (Dothideales), 2: Species on *Lecanora* s.l., *Rhizoplaca* and *Squamarina*. Mycosphere 4: 539–557. https://doi.org/10.5943/mycosphere/4/3/8

Coppins BJ, James PW (1984) New or interesting British lichens. V. Lichenologist 16: 241–264. https://doi.org/10.1017/S0024282984000451

Courtecuisse R, Duhem B (1995) Mushrooms and Toadstools of Britain and Europe. HarperCollinsPublishers, Ramsbury, Wiltshire.

Dalla Torre KW, Sarnthein L (1904) Flora der gefürsteten Grafschaft Tirol, des Landes Vorarlberg und des fürstenthumes Liechtenstein. V. Die Moose (Bryophyta) von Tirol, Vorarlberg und Liechtenstein. Wagner, Innsbruck, 671 pp.

Fleischhacker A, Grube M, Frisch A, Obermayer W, Hafellner J (2016) *Arthonia parietinaria* – a common but frequently misunderstood lichenicolous fungus on species of the

Xanthoria parietina-group. Fungal Biology 120: 1341–1353. https://doi.org/10.1016/j.funbio.2016.06.009

FloraFaunaSüdtirol (2021) Das Portal für Tier- und Pflanzenarten in Südtirol. Naturmuseum Südtirol, Bozen. https://www.florafauna.it [accessed 30 September 2021]

Garovaglio S (1838) Catalogo di alcune crittogame raccolte nella provincia di Como e nella Valtellina. Parte II. Licheni. Tipografia Ripamonti Carpano, Milano, 56 pp.

Giacomini V (1937) Licheni di Valle Camonica. Atti dell'Istituto Botanico e del Laboratorio Crittogamico dell'Università di Pavia (serie 4) 9: 123–149.

Giordani P, Incerti G (2008) The influence of climate on the distribution of lichens: a case study in a borderline area (Liguria, NW Italy). Plant Ecology 195: 257–272. https://doi.org/10.1007/s11258-007-9324-7

Giralt M, Mayrhofer H (1995) Some corticolous and lignicolous species of the genus *Rinodina* (lichenized Ascomycetes, Physciaceae) lacking secondary compounds and vegetative propagules in Southern Europe and adjacent regions. Bibliotheca Lichenologica 57: 127–160.

Hafellner J (1987) Studien über lichenicole Pilze und Flechten VI. Ein verändertes Gattungskonzept für *Cercidospora*. Herzogia 7: 355–365.

Hodgetts N, Lockhart N (2020) Checklist and country status of European bryophytes – update 2020. Irish Wildlife Manuals, No. 123. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Ireland, 214 pp.

INPN (2022) Inventaire national du patrimoine naturel (INPN). https://inpn.mnhn.fr/ [accessed 13 January 2022]

Jatta A (1909–1911) Flora Italica Cryptogama. Pars III. Lichenes. Tipografia Cappelli, Rocca di San Casciano, 958 pp.

Kits van Waveren E (1985) The Dutch, French and British species of *Psathyrella*. Persoonia 2(Suppl.): 1–300.

Köckinger H, Schröck C, Krisai R, Zechmeister HG (2022) Checklist of Austrian Bryophytes. https://cvl.univie.ac.at/projekte/moose/ [accessed 13 January 2022]

Kokkonen K, Vauras J (2012) Eleven new boreal species of *Inocybe* with nodulose spores. Mycological Progress 11: 299–341. https://doi.org/10.1007/s11557-011-0783-9

Liimatainen K, Carteret X, Dima B, Kytövuori I, Bidaud A, Reumaux P, Niskanen T, Ammirati JF, Bellanger J-M (2017) *Cortinarius* section *Bicolores* and section *Saturnini* (Basidiomycota, Agaricales), a morphogenetic overview of European and North American species. Persoonia 39: 175–200. https://doi.org/10.3767/persoonia.2017.39.08

Magnusson AH (1947) Studies in non-saxicolous species of *Rinodina* mainly from Europe and Siberia. Meddelanden från Göteborgs Botaniska Trädgård 17: 191–338.

Nascimbene J, Nimis PL, Ravera S (2013) Evaluating the conservation status of epiphytic lichens of Italy: a red list. Plant Biosystems 147: 898–904. https://doi.org/10.1080/11263504.2012.748101

Navarro-Rosinés P, Roux C, Casares M (1995) Hongos liquenícolas de *Squamarina* II: Sobre la identidad de "*Didymella*" *crozalsiana* (Ascomycetes). Cryptogamie, Bryologie, lichénologie 16: 99–103.

Nimis PL (1993) The lichens of Italy: an annotated catalogue. Monografie XII. Museo Regionale di Scienze Naturali di Torino, Torino, 897 pp.

Nimis PL (2016) The lichens of Italy – A second annotated catalogue. EUT Edizioni Università di Trieste, Trieste, 740 pp.

Nimis PL (2021) Keys to the lichens of Italy – 49) *Stereocaulon*. http://italic.units.it/flora/index.php?procedure=ext_key_home&key_id=2977 [accessed December 2021]

Nimis PL, Martellos S (2022) ITALIC – The Information System on Italian Lichens. Version 6.0. University of Trieste, Dept. of Biology. www.italic.units.it [accessed 24 January 2022]

Nimis PL, Poelt J, Tretiach M, Ottonello D, Puntillo D, Vězda A (1994) Contributions to lichen floristics in Italy. VII. The Lichens of Marettimo (Egadi Islands, Sicily). Bulletin de la Société Linnéenne de Provence 45: 247–262.

Nimis PL, Hafellner J, Roux C, Clerc P, Mayrhofer H, Martellos S, Bilovitz PO (2018) The lichens of the Alps – an annotated checklist. MycoKeys 31: 1–634. https://doi.org/10.3897/mycokeys.31.23568

Onofri S, Bernicchia A, Filipello Marchisio V, Padovan F, Perini C, Ripa C, Savino E, Venturella G, Vizzini A, Zotti M, Zucconi L (2013) Checklist of the macrobasidiomycetes of Italy. http://dryades.units.it/macrobasidiomiceti/index.php [accessed 11.2.2022]

Ottonello D, Merlo F (1991) Contributions to the knowledge of the lichen flora of Marettimo (Egadi Islands, Sicily). Botanika Chronika 10: 921–929.

Preston CD, BlockeeL TL (2006) Field meeting, February-March 2006, Salerno-Italy. Bulletin British Bryological Society 90: 38–45.

Printz P (1992) *Inocybe* (Fr.) Fr. In: Hansen L, Knudsen H (Eds) Nordic Macromycetes, Vol. 2. Nordsvamp, Copenhagen.

Puntillo D, Brackel W (2017) Lichenicolous fungi from Ischitella (Castel Volturno-Costa Licola Nature Reserve, S-Italy). Notiziario della Società Lichenologica Italiana 30: 76–79.

Purvis OW, Coppins BJ, Hawksworth DL, James PW, Moore DM [Eds] (1992) The Lichen Flora of Great Britain and Ireland. Natural History Museum Publications in association with the British Lichen Society, London, 710 pp.

Ravera S, Bianchi E, Brunialti G, Ciotti R, Di Nuzzo L, Isocrono D, Gheza G, Giordani P, Guttova A, Maliček J, Pandeli G, Paoli L, Pittao E, Potenza G, Stentella G (2021a) Studia Lichenologica in Italy. I. New records of red-listed species. Borziana 2: 87–108.

Ravera S, Vizzini A, Cogoni A, Aleffi M, Assini S, Bergamo Decarli G, Bonini I, von Brackel W, Cheli F, Darmostuk V, Fačkovcová Z, Gavrylenko L, Gheza G, Guttová A, Mayrhofer H, Nascimbene J, Paoli L, Poponessi S, Potenza G, Prosser F, Puddu D, Puntillo D, Rigotti D, Sguazzin F, Tatti A, Venanzoni R (2017) Notulae to the Italian flora of algae, bryophytes, fungi and lichens: 4. Italian Botanist 4: 76–86. https://doi.org/10.3897/italianbotanist.4.21671

Ravera S, Puglisi M, Vizzini A, Aleffi M, Benesperi R, Decarli GB, Berta G, Bianchi E, Boccardo F, Briozzo I, Clericuzio M, Cogoni A, Croce A, Dagnino D, De Agostini A, De Giuseppe AB, Di Nuzzo L, Dovana F, Fačkovcová Z, Gheza G, Loppi S, Malicek J, Mariotti M, Nascimbene J, Nimis PL, Paoli L, Passalacqua NG, Plasek V, Poponessi S, Prosser F, Puntillo D, Puntillo M, Rovito S, Sguazzin F, Sicoli G, Tiburtini M, Tomaselli V, Turcato C, Vallese C (2021b) Notulae to the Italian flora of algae, bryophytes, fungi and lichens: 12. Italian Botanist 12: 49–62. https://doi.org/10.3897/italianbotanist.12.76124

Ropin K, Mayrhofer H (1993) Zur Kenntnis corticoler Arten der Gattung Rinodina (lichenisierte Ascomyceten) in den Ostalpen und angrenzenden Gebieten. Herzogia 9: 779–835.

Sbarbaro C (1941) Lichenes ligustici novi vel rariores. Annali del Museo Civico di Storia Naturale di Genova 61: 18−49.

Stofer S [Ed.] (2006) Working Report ForestBIOTA. Epiphytic Lichen Monitoring. https://www.icp-forests.org/forestbiota/docs/report_lichens_20060503.pdf [accessed 3 February 2022]

Swissbryophytes (2022) Moosflora der Schweiz. www.swissbryophytes.ch [accessed 13 January 2022]

Timdal E (1991) A monograph of the genus *Toninia* (Lecideaceae, Ascomycetes). Opera Botanica 110: 1–137.

Timdal E, Hofton TH, Westberg M, Bendiksby M (2021) The *Nephroma helveticum* complex (Peltigerales, lichenized Ascomycota) in the Nordic countries. Graphis Scripta 33: 86–110.

Tomaselli R (1946) Revisione critica dei licheni delle collezioni di Santo Garovaglio esistenti nell'Istuto Botanico dell'Università di Pavia (Parte II). Atti dell'Istituto Botanico e del Laboratorio Crittogamico dell'Università di Pavia, serie 5, 6: 129–149.

Vesterholt J, Knudsen H (1992) Psathyrella (Fr.) Quél. In: Hansen L, Knudsen H (Eds) Nordic Macromycetes, Vol. 2. Nordsvamp, Copenhagen, Denmark.

Watling R (1992) *Conocybe* Fayod. In: Hansen L, Knudsen H (Eds) Nordic Macromycetes, Vol. 2. Nordsvamp, Copenhagen.

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SHORT COMMUNICATION

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Haplophyllum patavinum in its relic habitats on the Euganean Hills (northeastern Italy), 300 years after its discovery (1722–2022)

Corrado Tietto[1]

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Abstract

This short paper outlines the discovery and current knowledge of the Euganean populations of *Haplophyllum patavinum* (L.) G.Don, 300 years after this species was found on the Euganean Hills (NE Italy) by botanists Pier Antonio Micheli and Giovanni Girolamo Zannichelli.

Keywords

Colli Euganei, conservation, flora, Pier Antonio Micheli

In June 1722 Florence-born Pier Antonio Micheli, during a walking tour on the Euganean Hills with his Venetian friend Giovanni Girolamo Zannichelli, collected a species previously unknown to science, which was named *Pseudoruta patavina* (Micheli 1729; Zannichelli 1730). The time when Micheli and Zannichelli collected this plant can be inferred from a letter that Antonio Vallisneri (Professor at the University of Padua) wrote to Giuseppe Giorgi, a Florentine physician, dated 5th June 1722 and stored at the National Library of Florence, in the Magliabechi collection. In this letter, Vallisneri reported that Micheli and Zannichelli paid him a visit at home, on their way back from a walking tour which had started the previous day (4th June 1722) on the Euganean Hills, heading to Venice in order to collect algae from the lagoon (Targioni-Tozzetti 1858).

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The following year (Tilli 1723), this species was already included in the catalogue of plants grown at the Botanic Garden of Pisa. In this catalogue, Tilli wrote that Micheli found this plant "*in agris et locis sterilioribus prope Arquatum*, *in Agro Patavino*, *cum Domino Zannichellio detecta fuit*" [discovered with Mister Zannichelli among the tilled and barren lands near Arquà, in the District of Padua]. Later, Micheli (1729) characterized the new species with a short description, along with a beautiful iconography, and specifying the place of collection, namely Sassonegro di Arquà, where this species still grows today. In the library of the Botanical Garden of Padua, there is also a watercolor painting of the species, contained in a volume *in folio* by G.G. Zannichelli that collects the preparatory coloured drawings for his works: it is the first color drawing of this species (Tietto and Chiesura Lorenzoni 2000b).

Linnaeus' (1753) species *Ruta patavina* is based on Micheli's works and his *Pseudo-Ruta* iconography (Fig. 1) was designated by Townsend (1986) as lectotype of the name (Peruzzi et al. 2019). Subsequently de Jussieu (1825) split the genus *Ruta* into *Ruta* and *Aplophyllum* [later corrected by Spach (1849) as *Haplophyllum*]. Eventually, *R. patavina* was attributed to *Haplophyllum* by Don (1831).

Later, this species was found and reported by numerous botanists who visited the Euganean Hills (Béguinot 1911), since this is the only area in Italy where the plant grows spontaneously.

Haplophyllum patavinum (L.) G.Don is an Illyrian species (Dolcher 1956–1957; Townsend 1986; Pignatti et al. 2017), occurring in Italy only in very small areas in the calcareous sectors around Arquà Petrarca near Padua, then in the mountains of Slovenian Karst, Croatia, Bosnia-Herzegovina, Montenegro, north-eastern Albania, Greece, and south-western Romania.

Accordingly, the Euganean Hills mark the westernmost limit of this species range (Cappelletti 1956–1957; Dolcher 1956–1957). These Italian populations are seen as the remains of a wider and continuous past distribution, which became fragmented due to the alternate climate changes in the post-glacial periods.

Haplophyllum patavinum is a pioneer species in the Euganean Hills. It settles on loose, superficial, dry and sunny land, where it grows in small scattered but dense groups on calcareous scree, free from the turf (Fig. 2). Its current habitat is made up of recently abandoned vineyards and orchards, low-density olive groves, tilled land allowed to rest, holes dug for reforestation and agricultural works, small recent landslides, road and path edges and superficially tilled land. These open environments have become increasingly rare on the Euganean Hills, so that the populations of *H. patavinum* are slowly becoming less dense. Once the vegetation canopy closes, these plants become at first small, weak and devoid of flowers, then within a few years the population disappears. One of the most interesting peculiarities of this species, whose persistence is notably jeopardised by the difficulty to reproduce sexually as well as the major modifications of its habitat, is its capacity to move from areas where its survival has already been compromised to more suitable areas, located at a relatively short distance.

Comparing recent observations with the data published about 20 years ago (Tietto and Chiesura Lorenzoni 2000a; Tietto et al. 2001; Masin and Tietto 2005; Rossi di

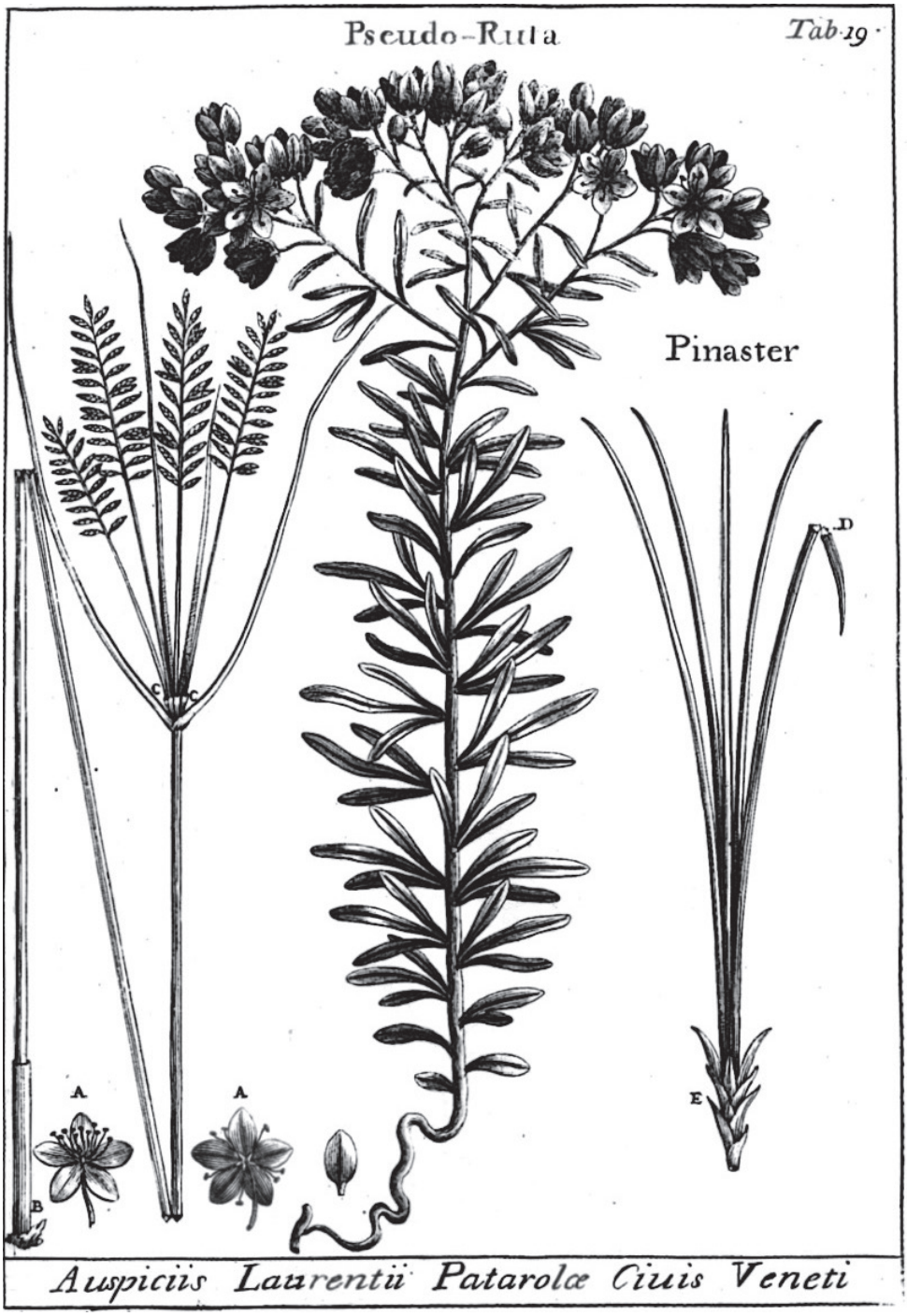

Figure 1. Iconography published in Nova Plantarum Genera (Micheli 1729) and designated as lectotype of *Ruta patavina*.

Figure 2. *Haplophyllum patavinum* (L.) G.Don in the Euganean Hills (Padua).

Schio et al. 2005), reveals that the populations of this species seem significantly depleted. A careful monitoring study carried out during the last three years (2019–2021) detected only nine localities (Fig. 3) out of the ca. 30 previously documented (Fig. 4). In all these localities small groups of plants can be found, due to vegetation closure and to invasive breaking up of the calcareous land to obtain space for new vineyards. Given the peculiar needs of this species, a continuous, weak and superficial disturbance should be carried out, to guarantee its survival. This species is listed as Vulnerable (VU [B1ab (iii) + 2ab (iii)]) in the Red List of threatened vascular plants in Italy (Orsenigo et al. 2020). Considering the new data provided here, *H. patavinum* could qualify for a higher risk category.

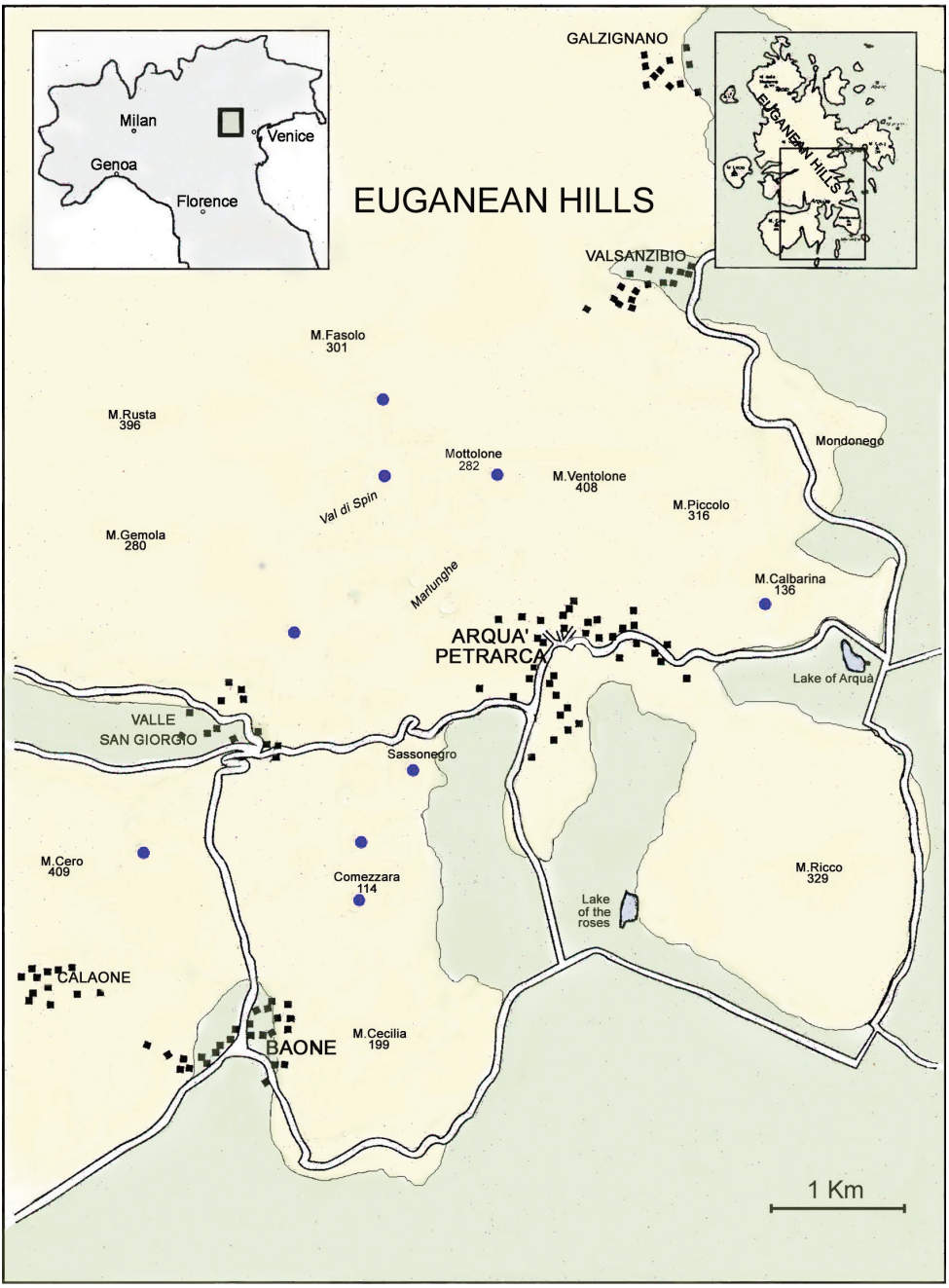

Figure 3. Distribution (blue dots) of *Haplophyllum patavinum* (L.) G.Don in the Euganean Hills (Padua) as resulting from the surveys carried out in the years 2019–2021.

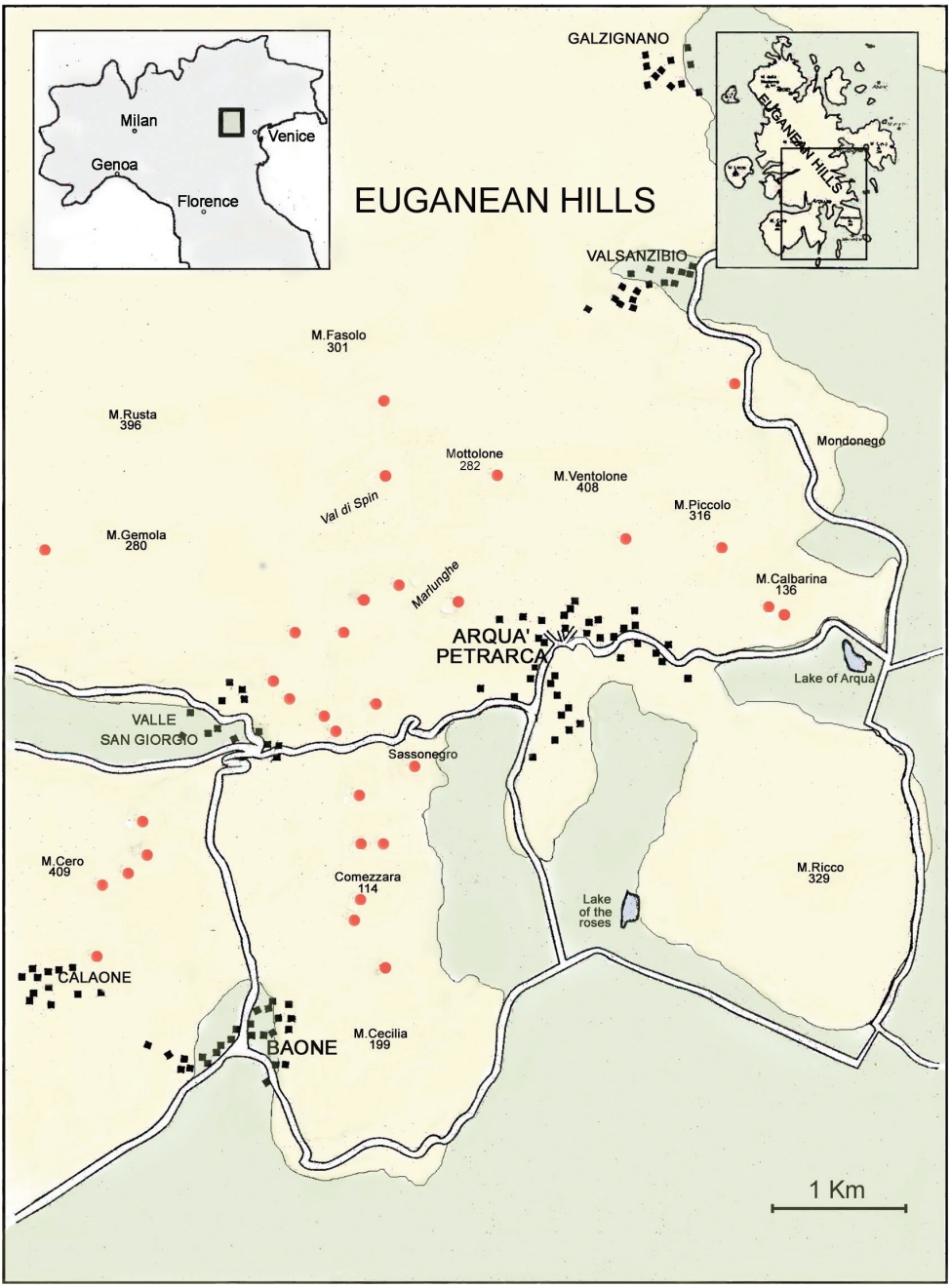

Figure 4. Distribution (red dots) of *Haplophyllum patavinum* (L.) G.Don in the Euganean Hills (Padua) as resulting from the surveys carried out in the years 1999–2005.

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References

Béguinot A (1911) Flora Padovana, ossia prospetto floristico e fitogeografico delle piante vascolari indigene, inselvatichite o largamente coltivate crescenti nella Provincia di Padova, con notizie storico-bibliografiche sulle fonti della flora ed illustrata da 20 Tavole. Tipografia del Seminario. Padova. Parte 2(fasc. II): 444–445.

Cappelletti C (1956–1957) Le attuali stazioni di *Ruta patavina* L. e sulla precarietà della loro esistenza. Atti dell'Istituto Veneto di Scienze Lettere ed Arti, Classe Scienze Matematiche e Naturali 115: 93–99.

Dolcher T (1956–1957) La posizione sistematica e geografica dell'*Haplophyllum patavinum* (L.) G. Don (= *Ruta patavina* L.) e i caratteri delle sue stazioni euganee. Atti dell'Istituto Veneto di Scienze Lettere ed Arti, Classe Scienze Matematiche e Naturali 115: 183–216.

Don G (1831) A General History of Dichlamydeous plants. Printed for JG and F Rivington. London 1: 780.

Jussieu de A (1825) Mémoire sur le groupe des Rutacées. Paris, Mémoire du Muséum d'Histoire Naturelle 12: 464.

Linnaeus C (1753) Species Plantarum. Holmiae 1: 383–384.

Masin R, Tietto C (2005) Flora dei colli Euganei e della pianura limitrofa. Sapi Editore, Padova.

Micheli PA (1729) Nova Plantarum Genera iuxta Tournefortii Methodum Disposita. Typis Bernardi Paperinii, Florentiae, 21–22.

Orsenigo S, Fenu G, Gargano D, Montagnani TA, Alessandrini A, Bacchetta G, Bartolucci F, Carta A, Castello M, Cogoni D, Conti F, Domina G, Foggi B, Gennai M, Gigante D, Iberite M, Peruzzi L, Pinna MS, Prosser F, Santangelo A, Selvaggi A, Stinca A, Villani M, Wagensommer RP, Tartaglini N, Duprè E, Blasi C, Rossi G (2020) Red list of threatened vascular plants in Italy. Plant Biosystems 155(2): 310–335. https://doi.org/10.1080/11263504.2020.1739165

Peruzzi L, Galasso G, Domina G, Bartolucci F, Santangelo A, Alessandrini A, Astuti G, D'Antraccoli M, Roma-Marzio F, Ardenghi N, Barberis G, Conti F, Bernardo L, Peccenini S, Stinca A, Wagensommer RP, Bonari G, Iamonico D, Iberite M, Viciani D, Del Guacchio E, Giusso del Galdo G, Lastrucci L, Villani M, Brunu A, Magrini S, Pistarino A, Brullo S, Salmeri C, Brundu G, Clementi M, Carli E, Vacca G, Marcucci R, Banfi E, Longo D, Di Pietro R, Passalacqua NG (2019) An inventory of the names of native, non-endemic vascular plants described from Italy, their loci classici and types. Phytotaxa 410(1): 1–215. https://doi.org/10.11646/phytotaxa.410.1.1

Pignatti S, Guarino R, La Rosa M (2017) Flora d'Italia. 2nd edn., Vol. 4. New Business Media, Milano, 1088–1089.

Rossi di Schio E, Tietto C, Chiesura Lorenzoni F (2005) Morfologia, fenologia e distribuzione di *Haplophyllum patavinum* (L.) G. Don sui Colli Euganei. Informatore Botanico Italiano 37(1): 366–367.

Spach E (1849) Conspectus genus *Haplophyllum*. Annales des Sciences Naturelles, Paris 11(3): 180–181.

Targioni-Tozzetti G (1858) Notizie della Vita e delle Opere di Pier Antonio Micheli Botanico Fiorentino. Le Monnier, Firenze.

Tietto C, Chiesura Lorenzoni F (2000a) Distribuzione, morfologia e fenologia di *Haplophyllum patavinum* (L.) G. Don (*Ruta patavina* L.) sui colli Euganei. Lavori Società Veneziana di Scienze Naturali 25: 79–104.

Tietto C, Chiesura Lorenzoni F (2000b) Giovanni Girolamo Zannichelli in un inedito disegno a colori di *Haplophyllum patavinum* (L.) G. Don (*Ruta patavina* L.). Lavori Società Veneziana di Scienze Naturali 25: 105–108.

Tietto C, Chiesura Lorenzoni F, Emo-Capodilista E (2001) Segnalazioni Floristiche Italiane: 952. *Haplophyllum patavinum* (L.) G. Don (Rutaceae). Informatore Botanico Italiano 32(1–3) [2000]: 42–43.

Tilli A (1723) Catalogus Plantarum Horti Pisanii. Typis Regiae Celsitudinis Apud Tartinium & Franchium. Florentiae, 140 pp.

Townsend CC (1986) Taxonomic revision of the genus *Haplophyllum* (Rutaceae). Hooker's Icones Plantarum. Bentham-Moxon Trustees, Royal Botanic Gardens Kew, London 40(3): 269–270.

Zannichelli GG (1730) Joannis Jerolimi Zannichelli Opuscola Botanica Posthuma. Typis Dominici Lovisa, Venetiis, 85 pp.

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RESEARCH ARTICLE

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Notulae to the Italian alien vascular flora: 13

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Abstract

In this contribution, new data concerning the distribution of vascular flora alien to Italy are presented. It includes new records, confirmations, exclusions, and status changes for Italy or for Italian administrative regions. Nomenclatural and distribution updates published elsewhere are provided as Suppl. material 1.

Keywords

Alien species, floristic data, Italy, nomenclature

How to contribute

The text for the new records should be submitted electronically to Lorenzo Lastrucci (lorenzo.lastrucci@unifi.it). The corresponding specimen along with its scan or photograph has to be sent to FI Herbarium: Museo di Storia Naturale (Botanica), Sistema Museale di Ateneo, Via G. La Pira 4, 50121 Firenze (Italy). Those texts concerning nomenclatural novelties (typifications only for accepted names), status changes, exclusions, and confirmations should be submitted electronically to Gabriele Galasso (gabriele.galasso@comune.milano.it). Each text should be within 1,000 characters (spaces included).

Floristic records

Acer negundo L. (Sapindaceae)

+ (INV) **TOS**. – Status change from naturalized to invasive alien for the flora of Toscana.

The presence of *Acer negundo* is increasingly common in disturbed areas of Toscana. Numerous individuals colonize urban areas and roadsides (Peruzzi and Bedini 2022+). From observations made in 2020 in the provinces of Siena and Arezzo, we noticed that in some areas with a strong disturbance the species grows abundant, sometimes in dense stands. In Chiusi [(Siena), fraz. Montallese, lungo la strada SP326, WGS84: 43.052790°N, 11.920611°E, margini stradali e ambienti ruderali, 255 m, 17 September 2021, *T. Fiaschi, E. Fanfarillo* (SIENA)] and other localities (e.g., Monteriggioni (Siena), WGS84: 43.392968°N, 11.217782°E), we observed abundant, fructifying adult individuals and seedlings. We therefore propose the change of status from naturalized to invasive.

C. Angiolini, E. Fanfarillo, T. Fiaschi

Allium tuberosum Rottler ex Spreng. (Amaryllidaceae)

+ (CAS) **LOM**: Seriate (Bergamo), Via G. Venezian, rotatoria del ponte sul Fiume Serio per Via C. Cerioli (CFCE: 0324/1) (WGS84: 45.689694°N, 9.721861°E), scarpata erbosa, 252 m, no exp., 13 November 2021, leg. *G. Federici*, det. *E. Banfi, G. Galasso* (BER-HbFAB No. 107483); *ibidem*, 15 November 2021, leg. *G. Federici*, det.

E. Banfi, G. Galasso (FI, MSNM Nos. 51386, 51387, 51388, 51389). – Casual alien species new for the flora of Lombardia.

G. Federici, E. Banfi, G. Galasso

***Amaryllis belladonna* L. (Amaryllidaceae)**

+ (CAS) **SAR**: Carbonia (Sud Sardegna), Domu Beccia (WGS84: 39.223889°N, 8.483611°E), scarpata incolta a bordo strada, 148 m, 16 September 2021, leg. *A. Mammoliti*, det. *V.L.A. Laface, C.M. Musarella, G. Spampinato* (FI). – Casual alien species new for the flora of Sardegna.

V.L.A. Laface, C.M. Musarella, G. Spampinato

***Ambrosia artemisiifolia* L. (Asteraceae)**

+ (NAT) **UMB**: Orvieto (Terni), Lago di Corbara (WGS84: 42.726658°N, 12.247858°E), greto sassoso della parte alta delle sponde del Lago di Corbara, con *Xanthium italicum*, 135 m, 28 August 2020, *R. Venanzoni, S. Praleskouskaya* (FI, PERU barcode PERU-2099). – Naturalized alien species new for the flora of Umbria.

R. Venanzoni, S. Praleskouskaya

***Ammannia verticillata* (Ard.) Lam. (Lythraceae)**

+ (NAT) **VEN**: Vigasio (Verona), Corte Brigafatta Nuova (WGS84: 45.327162°N, 10.970611°E), risaia, 37 m, 5 September 2021, leg. *G. Dal Corso*, det. *F. Prosser* (ROV No. 80116); *ibidem*, 7 October 2021, leg. *G. Dal Corso*, det. *F. Prosser* (FI). – Naturalized alien species confirmed for the flora of Veneto.

This species was historically widespread in the Venetian ricefields (Argenti et al. 2019), in which today it is almost totally replaced by *Ammannia coccinea* Rottb. Vigasio is among the localities reported by Goiran (1900) for the province of Verona.

G. Dal Corso, F. Prosser

***Bidens aurea* (Aiton) Sherff (Asteraceae)**

+ (CAS) **MAR**: Porto Sant'Elpidio (Fermo), Via XX Settembre, nei pressi di un cortile di una abitazione privata (WGS84: 43.237452°N, 13.756926°E), 21 m, 3 January 2021, *A. Pica, J. Lupoletti* (FI). – Casual alien species new for the flora of Marche.

The species covered about 10 m^2. It probably escaped from flowerbeds along the main road.

A. Pica, J. Lupoletti

***Bidens connata* Muhl. ex Willd. (Asteraceae)**

+ (NAT) **UMB**: Perugia (Perugia), fraz. Ponte San Giovanni, sponda destra del Tevere a monte del Nuovo Ponte vecchio (WGS84: 43.09193055°N, 12.45186388°E),

183 m, 18 October 2020, *R. Venanzoni, S. Praleskouskaya* (FI, PERU barcode PERU-2102). – Naturalized alien species new for the Flora of Umbria.

The species can be found sporadically to frequently along the banks of the river Tevere in Umbria.

R. Venanzoni, S. Praleskouskaya

***Bidens sulphurea* (Cav.) Sch.Bip. (Asteraceae)**

+ (CAS) **TAA**: Roncegno Terme (Trento), Cadenzi (WGS84: 46.052056°N, 11.403447°E), margine stradina presso orti, avventizia, 584 m, 18 October 2020, *F. Prosser* (FI). – Casual alien species new for the flora of Trentino-Alto Adige.

This species was also observed in San Lorenzo Dorsino (Trento), loc. Glolo (6 September 2021, obs. *M. Merli*, det. *E. Banfi*).

F. Prosser, M. Merli, E. Banfi

***Cardiospermum halicacabum* L. (Sapindaceae)**

+ (CAS) **LAZ**: Roma (Roma), parco pubblico presso Via di Grotta Perfetta (WGS84: 41.828746°N, 12.516325°E), siepe, dove si arrampica su individui di *Olea europaea*, *Pittosporum tobira* e *Phyllostachys* sp., ca. 254 m, 3 October 2021, *N. Olivieri* (FI). – Casual alien species new for the flora of Lazio.

N. Olivieri

***Cedrus atlantica* (Endl.) G.Manetti ex Carrière (Pinaceae)**

+ (CAS) **PIE**: Almese (Torino), al di sotto della pista tagliafuoco del Musinè (WGS84: 45.105475°N, 7.442177°E), popolamento misto di latifoglie autoctone e individui adulti di *Cedrus atlantica* derivanti da rimboschimento, 350 m, 20 May 2021, *D. Barberis, A. Mainetti, G. Nota* (FI). – Casual alien species new for the flora of Piemonte.

Several young individuals were found in a mixed stand with native broadleaf trees and a few planted *Cedrus atlantica* trees. The young specimens varied in height from 20 cm to 2 m.

D. Barberis, A. Mainetti, G. Nota

***Chamaecyparis lawsoniana* (A.Murray) Parl. (Cupressaceae)**

+ (CAS) **PIE**: Germagnano (Torino), loc. Colbeltramo, scarpata della strada che collega Colbeltramo a Castagnole (WGS84: 45.252557°N, 7.440891°E), scarpata stradale, 668 m, 2 April 2021, *M. Lonati, M. Pittarello, S. Ravetto Enri* (FI). – Casual alien species new for the flora of Piemonte.

A young individual, about 80 cm tall, was found in a shady area under broadleaf trees.

M. Lonati, M. Pittarello, S. Ravetto Enri

***Cotoneaster salicifolius* Franch. (Rosaceae)**

+ (CAS) **MAR**: Fermignano (Pesaro e Urbino), loc. Serra Alta (WGS84: 43.659679°N, 12.645607°E), scarpata stradale ai margini di una boscaglia diradata, ca. 340 m, 5 December 2021, *N. Hofmann* (FI, PESA). – Casual alien species new for the flora of Marche.

A single individual (2–3 m tall) has been observed.

L. Gubellini, N. Hofmann

***Cyperus odoratus* L. (Cyperaceae)**

+ (INV) **ITALIA** (**UMB**): Magione (Perugia), fraz. San Feliciano, Oasi La Valle (WGS84: 43.106111°N, 12.184722°E), sui resti del canneto degradato (morto!), vegetazione a dominanza di *Cyperus fuscus*, 280 m, 18 August 2021, *R. Venanzoni, S. Praleskouskaya* (FI, PERU barcode PERU-2091); Tuoro sul Trasimeno (Perugia), Punta Navaccia (WGS84: 43.189981°N, 12.075511°E), al margine del canneto, 258 m, 18 September 2021, *R. Venanzoni, S. Praleskouskaya* (PERU barcode PERU-2100). – Status change from naturalized to invasive alien for the flora of Italy; invasive alien species new for the Flora of Umbria.

In Umbria, *Cyperus odoratus* is found in the strongly nitrophilous muddy beach of Lake Trasimeno covered by vegetation with *Cyperus fuscus* L. and *Oxybasis chenopiodioides* (L.) S.Fuentes, Uotila & Borsch. In various sites, it tends to form locally dense populations of the sublittoral belt.

R. Venanzoni, S. Praleskouskaya

***Datura inoxia* Mill. (Solanaceae)**

– **CAM**. – Alien species to be excluded from the flora of Campania.

The indication in Galasso et al. (2018) is based on the report for Cilento ("Torre Ficaiola", i.e., Spiaggia Ficaiola near Torre Caprioli, Pisciotta municipality, Salerno province) by De Natale and Strumia (2007), already questioned by Del Guacchio and La Valva (2017). The relevant specimen (Torre Caprioli, 6 July 1998, *Herb. A. De Natale* No. 3671) is to be attributed to *Datura wrightii* Regel, indeed new to Cilento.

E. Del Guacchio, A. De Natale

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

+ (NAT) **MAR**. − Status change from casual to naturalized alien for the flora of Marche.

This species was recorded as casual in the Natural Reserve of Sentina (Conti and Bracchetti 2016), where it is no longer present due to the erosion of the coast. In the new locality [Grottammare (Ascoli Piceno), tra Cupra Marittima e Grottammare, WGS84: 43.008825°N, 13.865765°E, spiaggia, 1 m, 16 October 2018, *F. Conti, L. Bracchetti* (APP)], a well-established population can be found.

F. Conti, L. Bracchetti

***Elaeagnus pungens* Thunb. (Elaeagnaceae)**

+ (CAS) **TOS**: Pistoia (Pistoia), fraz. Santomoro, sopra il paese presso Case Buchetole (WGS84: 43.582308°N, 10.584183°E), margine sentiero, ca. 440 m, 12 December 2021, leg. *G. Gestri, P. Sandretti*, det. *G. Gestri. V. Lazzeri* (FI). – Casual alien species new for the flora of Toscana.

An adult plant with flowers and fruits occurs on the edge of a trail, with no current evidence of spontaneous reproduction.

G. Gestri

***Eragrostis pectinacea* (Michx.) Nees (Poaceae)**

+ (NAT) **TOS**. – Status change from casual to naturalized alien for the flora of Toscana.

This species is widespread in the lower stretch of the river Tevere [Pieve Santo Stefano (Arezzo), Lago di Montedoglio (WG84: 43.625417°N, 12.073081°E), sponde melmose originatesi al ritiro delle acque, 384 m, 20 August 2021, *R. Venanzoni* (FI, PERU barcode PERU-2113)]. It prefers the large stretches of stony and sandy beaches that emerge when the water withdraws.

R. Venanzoni, S. Praleskouskaya

***Erigeron lilacinus* (Sennikov & Kurtto) Sennikov (Asteraceae)**

+ (CAS) **LOM**: Milano (Milano), Parco Porto di Mare (WGS84: 45.431045°N, 9.231650°E), margine erboso, 103 m, no exp., 27 September 2020, *G. Galasso, E. Banfi* (MSNM No. 51428); *ibidem*, Via L. Ornato, lato dei numeri dispari, parcheggi sul lato della strada (WGS84: 45.520955°N, 9.191965°E), tra gli autobloccanti, 138 m, no exp., 19 June 2021, *G. Galasso* (FI). – Casual alien species new for the flora of Lombardia.

G. Galasso, E. Banfi

***Euphorbia nutans* Lag. (Euphorbiaceae)**

+ (NAT) **PUG**. – Status change from casual to naturalized alien for the flora of Puglia.

The population here reported [Taranto (Taranto), Mar Piccolo, Palude La Vela, WGS84: 40.476035°N, 17.325862°E, bordo strada, 10 m, 15 October 2021, *V. Tomaselli, F. Mantino* (FI, BI Nos. 42845, 42846, 42847, 42848)] consists of a few thousand individuals, regularly fruiting, widespread along roadsides.

V. Tomaselli, V. Cavallaro, F. Mantino

***Fraxinus pennsylvanica* Marshall (Oleaceae)**

+ (CAS) **ITALIA** (**VEN**): Verona (Verona), stazione dei treni di Verona Porta Nuova (CFCE: 0531/4) (WGS84: 45.428849°N, 10.977357°E), incolto ghiaioso, 64 m, 2 July 2021, leg. *F. Prosser, A. Bertolli, G. Tomasi*, det. *F. Prosser* (FI). – Casual alien species new for the flora of Italy (Veneto).

This species was identified according to Atha and Boom (2017). At least three 50–150 cm tall specimens were observed, born spontaneously from trees growing in the adjacent Via delle Coste. In some central European countries, *F. pennsylvanica* is an invasive species in riparian environments (Verloove 2016).

F. Prosser, G. Tomasi, A. Bertolli

***Gamochaeta pensylvanica* (Willd.) Cabrera (Asteraceae)**

+ (NAT) **TAA**: Trento (Trento), cortile in Via Vittorio Veneto (CFCE: 9932/2) (WGS84: 46.058487°N, 11.120500°E), aiuola erbosa poco curata, popolazione di oltre 100 esemplari (ca. 25 m^2) in fiore, in frutto e sterili, 194 m, 20 October 2021, *F. Prosser* (FI, ROV No. 80117). – Naturalized alien species new for the flora of Trentino-Alto Adige.

F. Prosser

***Hedera canariensis* Willd. (Araliaceae)**

+ (NAT) **TAA**: Bondone (Trento), a W di loc. Olte, a W di Baitoni (CFCE: 0129/3) (WGS84: 45.806493°N, 10.533911°E), boscaglia, 370 m, 18 October 2011, leg. *F. Prosser, A. Bertolli*, det. *F. Prosser* (FI, ROV No. 61339). – Naturalized alien species new for the flora of Trentino-Alto Adige.

F. Prosser, A. Bertolli

***Hedera hibernica* (G.Kirchn.) Bean (Araliaceae)**

+ (NAT) **VEN**: Bardolino (Verona), ca. 1 km a ENE di Bardolino, nella valletta con rivo a E di Monte Felice (CFCE: 0430/1) (WGS84: 45.554684°N, 10.739976°E), bosco termofilo, 180 m, 28 February 2004, *F. Prosser* (FI, ROV No. 44952); Torri del Benaco (Verona), a E di Punta Pontirola (WGS84: 45.618434°N, 10.701830°E), 240 m, 11 October 2006, leg. *F. Prosser, A. Bertolli*, det. *F. Prosser* (ROV No. 50876); Verona (Verona), fraz. Parona, stazione dei treni (CFCE: 0531/2) (WGS84: 45.477532°N, 10.941611°E), margine di massicciata, inselvatichita, tricomi appressati, in media con poco meno di 10 raggi, 75 m, 10 September 2020, leg. *F. Prosser, A. Bertolli, G. Tomasi*, det. *F. Prosser* (ROV No. 79310); *ibidem*, a W di Ca' di David presso Ca' Brusà (CFCE: 0631/2) (WGS84: 45.386698°N, 10.962959°E), siepe al margine della strada, 53 m, 27 October 2020, *F. Prosser, G. Tomasi, M. Gecchelin* (ROV No. 80038); Villafranca di Verona (Verona), lungo la linea ferroviaria dismessa a NW di Castel d'Azzano (CFCE: 0631/2) (WGS84: 45.364584°N, 10.920721°E), inselvatichita nel cespuglieto, 50 m, 27 October 2020, leg. *F. Prosser, G. Tomasi, M. Gecchelin*, det. *F. Prosser* (ROV No. 79588); Dolcè (Verona), fraz. Peri, stazione dei treni (WGS84: 45.660533°N, 10.901149°E), 129 m, 8 April 2021, *A. Bertolli, F. Prosser* (ROV No. 80123). – Naturalized alien species new for the flora of Veneto.

Hedera hibernica is quite widespread and was probably, at least partially, confused with *H. canariensis* Willd. by Argenti et al. (2019).

F. Prosser, A. Bertolli, F. Festi, G. Tomasi

***Jaborosa integrifolia* Lam. (Solanaceae)**

+ (NAT) **SAR**. – Status change from casual to naturalized alien for the flora of Sardegna.

Since the first report in 2011 (Podda et al. 2012), this species has been observed naturalized in the countryside of Batteria Boggio (Pula, Cagliari), near its first site known in loc. Is Loccis Santus (San Giovanni Suergiu, Sud Sardegna) and near Perdaxius and Terraseo (Narcao, Sud Sardegna).

G. Bacchetta, G. Calvia, A. Lallai

***Lagarosiphon major* (Ridl.) Moss (Hydrocharitaceae)**

+ (NAT) **EMR**: Sissa Trecasali (Parma), porto fluviale di Torricella di Sissa, vicino alla sponda (WGS84: 44.987640°N, 10.294034°E), profondità 0.5 m, 24 July 2019, *R. Bolpagni, A. Dalla Vecchia* (FI barcode FI065222). – Naturalized alien species new for the flora of Emilia-Romagna.

Lagarosiphon major is one of the most widespread and noxious invasive aquatic species in Europe and globally (Bolpagni 2021). It is, indeed, included in the European list of alien species of Union concern [Reg. (EU) no. 1143/2014]. In the river port of Torricella di Sissa, it forms small monophytic stands.

R. Bolpagni, A. Dalla Vecchia

***Miscanthus* ×*longiberbis* (Hack.) Nakai (Poaceae)**

+ (CAS) **ITALIA** (**LOM**): Iseo (Brescia), a S della rotonda tra Via per Rovato (Via Tangenziale Sud) e Viale Roma (WGS84: 45.649400°N, 10.042614°E), incolto, 191 m, no exp., 16 October 2021, leg. *A. Federici*, det. *E. Banfi, G. Galasso* (FI, MSNM Nos. 51406, 51407). – Casual alien nothospecies new for the flora of Italy (Lombardia).

This is a natural sterile hybrid between *Miscanthus sacchariflorus* (Maxim.) Benth. & Hook.f. ex Franch. (China, Korea, Japan) and *M. sinensis* Andersson (China, SE-Asia), no longer cultivated in Italy as an ornamental. It can be distinguished from *M. sinensis* by culms up to 2.5(–3.5) m, callus hairs 2–4 times as long as spikelet, spikelets unawned, and from *M. sacchariflorus* by pedicels of pedicellate spikelets mostly longer than 3 mm (Ibaragi et al. 2017).

E. Banfi, G. Galasso, A. Federici

***Nymphaea mexicana* Zucc. (Nymphaeaceae)**

+ (NAT) **TOS**: Castelnuovo Berardenga (Siena), nei pressi del Mulino di Piermaggiore sulla strada SP9 di Pievasciata (WGS84: 43.387002°N, 11.405236°E), laghetto artificiale, 272 m, 5 July 2021, leg. *G. Bonari, T. Fiaschi*, det. *C. Angiolini, G. Bonari, T. Fiaschi* (FI, SIENA). – Naturalized alien species new for the flora of Toscana.

This population widely colonizes the surface of an artificial lake. We detected numerous flowering individuals. This species is similar to the sterile hybrid *Nymphaea* × *thiona*

D.B.Ward, but the two taxa differ, according to Ward (1977), by the dimensions of the sepals (3–5 cm in *N. mexicana vs* 5–8 cm in *N.* × *thiona*).

C. Angiolini, G. Bonari, T. Fiaschi

***Opuntia anacantha* Speg. (Cactaceae)**

+ (CAS) **SAR**: Oschiri (Sassari), Diga Coghinas, rupi a ridosso della strada presso la chiesetta di Santa Barbara (WGS84: 40.788700°N, 9.024265°E), rupi, 205 m, 23 August 2019, *G. Calvia* (FI). – Casual alien species new for the flora of Sardegna.

In Oschiri the plant produces flowers and fruits, but its reproduction is primarily vegetative by cladode detachment or by the rooting of sterile fruits.

G. Calvia, A. Guiggi

***Opuntia engelmannii* Salm-Dyck ex Engelm. (Cactaceae)**

+ (NAT) **UMB**: Amelia (Terni), fraz. Fornole (WGS84: 42.539353°N, 12.459980°E), incolto con vegetazione a *Stipa bromoides* e *Cymbopogon hirtus*, 305 m, S-SE, 22 February 2022, *R. Venanzoni* (FI, PERU barcode PERU-2109); Montecchio (Terni), strada locale direzione Melezzole-Montecchio, scarpata inferiore della strada (WGS84: 42.668347°N, 12.305811°E), scarpata stradale, 633 m, S, 22 February 2022, *R. Venanzoni* (FI, PERU barcode PERU-2108); Spello (Perugia), fraz. Capitan Loreto, strada SS75bis Foligno-Perugia, prima dell'uscita per Capitan Loreto direzione Perugia, sommità della scarpata destra (WGS84: 43.017289°N, 12.647450°E), scarpata stradale, 210 m, SW, 22 February 2022, leg. *R. Venanzoni*, det. *F. Lucchese, A. Guiggi* (FI, PERU barcode PERU-2110). – Naturalized alien species new for the flora of Umbria.

Populations of this species have been observed for decades.

G. Ratini, A. Guiggi, F. Lucchese, R. Venanzoni

***Opuntia pilifera* F.A.C.Weber (Cactaceae)**

+ (CAS) **SIC**: Aci Castello (Catania), Scogliera Cannizzaro (WGS84: 37.538144°N, 15.131077°E), scogliera, 20 m, 10 October 2021, leg. *G. Spampinato*, det. *V.L.A. Laface, C.M. Musarella, G. Spampinato* (FI, REGGIO). – Casual alien species new for the flora of Sicilia.

In Sicily, *O. pilifera* grows along cliffs, on basaltic rocks of volcanic origin, where it lives with other *Opuntia* species.

V.L.A. Laface, C.M. Musarella, G. Spampinato

***Opuntia spinulifera* Salm-Dyck (Cactaceae)**

+ (NAT) **SIC**: Terrasini (Palermo), Baia San Cataldo (WGS84: 38.089721°N, 13.077674°E), sea cliffs, 20 m, 28 April 2021, *G. Domina* (FI, PAL). – Naturalized alien species new for the flora of Sicilia.

A discontinuous area of over 200 m^2 near the coast is covered by this species, which reproduces abundantly by seed and vegetatively. In the Favorita Park, in the suburbs of Palermo, some individuals of the same species reproduce by seed and propagate vegetatively.

G. Barone, G. Di Gregorio

Oxalis articulata **Savigny (Oxalidaceae)**

+ (CAS) **MAR**. – Alien status indication for the flora of Marche.

Oxalis articulata was indicated for the Marche without invasiveness status by Galasso et al. (2018). However, several individuals, escaped from cultivation, have been found by us in many localities of the municipalities of Cagli, Cantiano, Piandimeleto, and Mercatello. According to these observations, *O. articulata* should be considered casual for this administrative region.

G. Mei, A. Stinca

Panicum dichotomiflorum **Michx. (Poaceae)**

+ (NAT) **UMB**: Baschi (Terni), Lago di Corbara, sponda destra (WGS84: 42.718358°N, 12.258800°E), sponde ciottolose e sabbiose con vegetazione a *Xanthium italicum* e *Abutilon theophrasti*, 134 m, September 2020, leg. *R. Venanzoni, S. Praleskouskaya*, det. *F.M. Tardella* (FI, PERU barcode PERU-2104). – Naturalized alien species new for the Flora of Umbria.

R. Venanzoni, S. Praleskouskaya, F.M. Tardella

Persicaria filiformis **(Thunb.) Nakai (Polygonaceae)**

+ (CAS) **PIE**: Baveno (Verbano-Cusio-Ossola), Via Liberazione (WGS84: 45.911556°N, 8.504567°E), spigolo tra la strada e il marciapiede, 204 m, no exp., 1 October 2021, *G. Galasso* (FI, MSNM Nos. 51192, 51193); *ibidem*, leg. *A. Selvaggi*, det. *G. Galasso* (*Herb. A. Selvaggi*). – Casual alien species new for the flora of Piemonte.

A large clump of individuals of this species was observed.

G. Galasso, L. Gariboldi, A. Selvaggi

Physalis angulata **L. (Solanaceae)**

+ (NAT) **SAR**: Villaspeciosa (Sud Sardegna), loc. Cuaddu Moriscu, Lago del Cixerri (WGS84: 39.275651°N, 8.861169°E), pratelli umidi sulle rive del lago, 39 m, 26 October 2021, *A.P. Lecis, F. Mascia, L. Podda* (FI, CAG). – Naturalized alien species new for the flora of Sardegna.

Hundreds of individuals were found sparsely along the shores of the Cixerri dam, occupying an area of approximately 5,000 m^2. We observed a tendency of the species to colonise also the adjacent areas due to its edible fruits dispersed by animals.

A.P. Lecis, F. Mascia, L. Podda

***Pinus nigra* J.F.Arnold subsp. *nigra* (Pinaceae)**

+ (CAS) **SIC**: Isnello (Palermo), Madonie, Piano Zucchi, edge of the road SP54 (WGS84: 37.889805°N, 13.999320°E), on a stone wall, 1150 m, 3 June 2021, *E. Di Gristina* (FI, PAL). – Casual alien subspecies new for the flora of Sicilia.

Some individuals grow on a vertical stone wall in the Madonie Regional Park, born from seeds produced by trees growing in a nearby reforested area.

E. Di Gristina, G. Barone

***Portulaca grandiflora* Hook. (Portulacaceae)**

+ (CAS) **PUG**: Brindisi (Brindisi), Via Taranto tra i numeri civici 3 e 29 (WGS84: 40.633188°N, 17.943848°E), interstizi del marciapiede, 25 m, 23 June 2021, *F. Roma-Marzio 1416* (FI, PI No. 044613). – Casual alien species new for the flora of Puglia.

The flowers of *Portulaca grandiflora* may occur with petals of different colours from yellow to magenta, and can show a double whorl of petals (Ocampus and Travis Columbus 2012). About ten plants were found, all with yellow petals.

F. Roma-Marzio

***Pueraria lobata* (Willd.) Ohwi (Fabaceae)**

+ (INV) **TOS**: Scandicci (Firenze), in prossimità dell'ingresso del Centro Don Gnocchi (WGS84: 43.760264°N, 11.205463°E), area incolta adiacente a un'azienda vivaistica, in contesto periurbano, 14 September 2021, *G. Ferretti* (FI); *ibidem*, 10 November 2021, *G. Ferretti* (FI). – Invasive alien species new for the flora of Toscana.

Pueraria lobata is a particularly noxious, invasive, densely-packed climbing species, considered among the 100 world's most invasive alien species (Lowe et al. 2004) and included in the black list of invasive alien species of Union concern [Reg. (EU) no. 2016/1141]. It has invaded an area of about 200 m^2, even climbing on some trees. This species shows a strong tendency to expand, even when limited by an urban context.

G. Ferretti

***Rubus laciniatus* Weston (Rosaceae)**

+ (NAT) **TOS**. – Status change from casual to naturalized alien for the flora of Toscana.

The species was recently recorded as casual alien in Toscana by Canzonieri et al. (2022). In Agliana (Pistoia) a few fruiting plants of fair size were observed among other brambles and roses in an extended uncultivated ground periodically mowed only in the area facing the park (loc. Castelletto, di fronte al centro commerciale di Via E. Berlinguer, WGS84: 43.909620°N, 10.996292°E, ca 45 m, 3 July 2021, *A. Messina*, FI).

A. Messina, G. Gestri

***Sedum palmeri* S.Watson**

+ (NAT) **LOM**. – Status change from casual to naturalized alien for the flora of Lombardia.

In Milano *Sedum palmeri* is largely naturalized on the masonry banks of the Naviglio della Martesana, with dozens of individuals for a stretch of at least 1.7 km in length (WGS84: from 45.514009°N, 9.253945°E to 45.504995°N, 9.237820°E).

G. Galasso, E. Banfi

***Setaria adhaerens* (Forssk.) Chiov. (Poaceae)**

+ (NAT) **LOM**: Breno (Brescia), loc. Lavarino, a monte della strada (Via Laverino Inferiore) per Case Bruciate (WGS84: 45.959875°N, 10.315386°E), margine stradale erboso, ca. 340 m, WNW, 24 October 2020, leg. et det. *A. Federici*, conf. *E. Banfi, G. Galasso* (FI ex *Hb. E. Bona No. 071242*); *ibidem*, 9 November 2021, leg. et det. *A. Federici*, conf. *E. Banfi, G. Galasso* (MSNM No. 51401). – Naturalized alien species new for the flora of Lombardia.

The species was observed also along Via Vigne in Piancogno (Brescia province, WGS84: 45.929961°N, 10.238172°E, 383 m, SE, 2021, obs. *A. Federici*).

E. Banfi, A. Federici, G. Galasso

***Sicyos angulatus* L. (Cucurbitaceae)**

+ (NAT) **MOL**: Oratino (Campobasso), argini del Fiume Biferno in loc. Bivaro (WGS84: 41.584596°N, 14.559886°E), argine fluviale, 395 m, 25 September 2021, *G. Salerno, E. D'Alessandro, B. Paura* (FI, *Herb. G. Salerno*). – Naturalized alien species new for the flora of Molise.

G. Salerno, E. D'Alessandro, B. Paura

***Solanum sisymbriifolium* Lam. (Solanaceae)**

+ (NAT) **SIC**: Pozzallo (Ragusa), Lungomare Pietrenere (WGS84: 36.729444°N, 14.851944°E), aiuole, 3 m, 20 August 2018, *A. Soldano 18531* (FI). – Naturalized alien species new for the flora of Sicilia.

Many individuals were observed along the seafront where the species was missing in previous years.

A. Soldano

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

+ (NAT) **SAR**. – Status change from casual to naturalized alien for the flora of Sardegna.

This species was detected in 2016 (Campus and De Pascali 2017) near the Brotzu Hospital of Cagliari, where currently it has disappeared. In recent years, we have found it in Nora and Pula (Pula, Cagliari), where it was first introduced in green lawns and then started to produce viable seeds that are germinating in neighbouring areas.

M. Fois, A. Cuena-Lombraña, G. Campus

***Strigosella africana* (L.) Botsch. (Brassicaceae)**

+ (CAS) **TOS**: Montale (Pistoia), sopra Fognano, presso la zona di atterraggio elicotteri di soccorso (WGS84: 43.572342°N, 11.022752°E), incolto erboso periodicamente sfalciato, ca. 215 m, 14 April 2019, leg. *G. Gestri*, det. *G. Gestri, V. Lazzeri* (FI). – Casual alien species new for the flora of Toscana.

A few fruiting plants were observed.

G. Gestri, V. Lazzeri

***Styphnolobium japonicum* (L.) Schott (Fabaceae)**

+ (CAS) **SIC**: Catania (Catania), Via Ipogeo (WGS84: 37.512634°N, 15.079921°E), bordo strada, 38 m, 26 November 2021, leg. *C.M. Musarella*, det. *V.L.A. Laface, C.M. Musarella, G. Spampinato* (FI, REGGIO). – Casual alien species new for the flora of Sicilia.

V.L.A. Laface, C.M. Musarella, G. Spampinato

***Tagetes minuta* L. (Asteraceae)**

+ (CAS) **TAA**: Arco (Trento), tra Massone e Bolognano in loc. Gambor (CFCE: 0032/3) (WGS84: 45.919668°N, 10.908787°E), scarpata incolta, 1 pianta alta 1.5 m, molto ramificata, 150 m, 22 January 2022, leg. *M. Merli*, det. *G. Galasso* (FI, ROV No. 80115, *Herb. M Merli*). – Casual alien species new for the flora of Trentino-Alto Adige.

G. Galasso, M. Merli

***Tetradium daniellii* (Benn.) T.G.Hartley (Rutaceae)**

+ (CAS) **ITALIA** (**TAA**): Ala (Trento), al termine della stradina presso la sponda destra del Fiume Adige a NE di Chiesurone (CFCE: 0232/1) (WGS84: 45.786316°N, 11.016831°E), margine stradina nella boscaglia con robinia, 147 m, 10 October 2020, *F. Prosser* (FI, ROV No. 79638). – Casual alien species new for the flora of Italy (Trentino-Alto Adige).

This species was identified according to Zhang and Hartley (2008). It is a plant of melliferous interest, planted near an apiary in the indicated locality. It features

abundant renewal up to 15 m away. In Europe, it sporadically escapes from cultivation, for example in southwestern Germany (Mazomeit 2016).

F. Prosser

***Thinopyrum obtusiflorum* (DC.) Banfi (Poaceae)**

+ (NAT) **LAZ**: Cittaducale (Rieti), presso Grotti, strada SR578 "Salto Cicolana", presso lo svincolo (WGS84: 42.352123°N, 12.957368°E), incolto ruderale, 405 m, 23 November 2020, *G. Filibeck, L. Cancellieri* (*Herb. L. Cancellieri*); *ibidem*, 22 July 2021, *G. Salerno, S. Maestri* (FI, *Herb. G. Salerno*); Castel Madama (Roma), Via San Quirico (WGS84: 41.976970°N, 12.877654°E), 25 July 2021, *G. Salerno* (*Herb. G. Salerno*). – Naturalized alien species new for the flora of Lazio.

This species was sown in 2016 for "greening" of a highway escarpment at Grotti, and some individuals now grow also in ruderal meadows nearby. Near Castel Madama, a large population grows on a highway escarpment and nearby areas. The use of this species for embankment greening followed by local naturalization is already reported for N-Italy and Switzerland (Bertolli and Prosser 2014 and references therein; Röthlisberger 2010). A germination test on spikelets collected from the Grotti plants confirmed that the population is able to reproduce.

L. Cancellieri, G. Filibeck, S. Maestri, G. Salerno

***Triticum turgidum* L. subsp. *durum* (Desf.) Husn. (Poaceae)**

+ (CAS) **SIC**: Caltagirone (Catania) (WGS84: 37.126671°N, 14.519971°E), lungo il bordo del sentiero, 329 m, 8 April 2021, *D. Azzaro, S. Cambria* (FI, CAT); Terrasini (Palermo), Baia San Cataldo (WGS84: 38.088381°N, 13.079131°E), 40 m, 28 April 2021, *G. Domina* (SAF No. 100039). – Casual alien subspecies new for the flora of Sicilia.

D. Azzaro, G. Tavilla, M. Di Stefano

***Zizania latifolia* (Griseb.) Hance ex F.Muell. (Poaceae)**

+ (CAS) **ITALIA** (**VEN**): Sant'Urbano (Padova), sinistra idrografica del Canale Gorzone, ca. 220 m a E di Ponte Zane (WGS84: 45.143497°N, 11.646712°E), sponda di stagno, in bosco, 9 m, July 2021, *L. Tosetto* (FI). – Casual alien species new for the flora of Italy (Veneto).

This species was identified according to Liu and Phillips (2006). The plant is cultivated in China for food use of the young shoots and rhizomes when infected by the fungus *Ustilago esculenta* Henn. (Basidiomycota), which renders the indicated parts edible and inhibits the normal development of the synflorescence. Since the plants found do not bloom, their presence at the site is almost certainly related to this use.

E. Banfi, L. Tosetto, R.R. Masin, R. Pellegrini

Nomenclatural and distribution updates from other literature sources

Nomenclatural, status, distribution updates, and corrections to Galasso et al. (2018) are provided in Suppl. material 1.

G. Galasso, F. Bartolucci

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References

Argenti C, Masin R, Pellegrini B, Perazza G, Prosser F, Scortegagna S, Tasinazzo S (2019) Flora del Veneto dalle Dolomiti alla laguna veneziana, Vols 1–2. Cierre edizioni, Sommacampagna (Verona).

Atha D, Boom B (2017) Field guide to the ash trees of norteastern United States. Center for Conservation Strategy, The New York Botanical Garden, Bronx.

Bertolli A, Prosser F (2014) Segnalazioni floristiche tridentine. IX. Annali del Museo Civico di Rovereto. Sezione: Archeologia, Storia, Scienze Naturali 29[2013]: 131–174.

Bolpagni R (2021) Towards global dominance of invasive alien plants in freshwater ecosystems: the dawn of the Exocene? Hydrobiologia 848(9): 2259–2279. https://doi.org/10.1007/s10750-020-04490-w

Campus G, De Pascali M (2017) Rassegna di segnalazioni notevoli riguardanti la Sardegna comparse nel forum Acta Plantarum. Acta Plantarum Notes 5: 68–69.

Canzonieri A, Alessandrini A, Ardenghi NMG, Bellandi L, Colombo S, Faggi G, Ferrando U, Galasso G, Mazzeschi A, Messina A, Montanari S, Montevecchi P, Ottonello M, Paoletti R, Salvai G, Tognazzi F, Zambrini A, Zepigi M (2022) Rassegna di segnalazioni notevoli riguardanti la Toscana comparse nel forum Acta Plantarum. Acta Plantarum Notes 8: 161–165.

Conti F, Bracchetti L (2016) Contributo alla conoscenza della flora vascolare della Riserva Naturale Regionale Sentina (Italia Centrale, Marche). Natural History Sciences 3(1): 49−52. https://doi.org/10.4081/nhs.2016.261

De Natale A, Strumia S (2007) La flora della costa sabbiosa del Parco Nazionale del Cilento e Vallo di Diano (Salerno). Webbia 62(1): 53–75. https://doi.org/10.1080/00837792.2007.10670816

Del Guacchio E, La Valva V (2017) The non-native vascular flora of Campania (southern Italy). Plant Biosystems 152(4): 767–779. https://doi.org/10.1080/11263504.2017.1338626

Galasso G, Conti F, Peruzzi L, Ardenghi NMG, Banfi E, Celesti-Grapow L, Albano A, Alessandrini A, Bacchetta G, Ballelli S, Bandini Mazzanti M, Barberis G, Bernardo L, Blasi C, Bouvet D, Bovio M, Cecchi L, Del Guacchio E, Domina G, Fascetti S, Gallo L, Gubellini L, Guiggi A, Iamonico D, Iberite M, Jiménez-Mejías P, Lattanzi E, Marchetti D, Martinetto E, Masin RR, Medagli P, Passalacqua NG, Peccenini S, Pennesi R, Pierini B, Podda L, Poldini L, Prosser F, Raimondo FM, Roma-Marzio F, Rosati L, Santangelo A, Scoppola A, Scortegagna S, Selvaggi A, Selvi F, Soldano A, Stinca A, Wagensommer RP, Wilhalm T, Bartolucci F (2018) An updated checklist of the vascular flora alien to Italy. Plant Biosystems 152(3): 556–592. https://doi.org/10.1080/11263504.2018.1441197

Goiran A (1900) Le piante fanerogame dell'agro veronese. Censimento, Vol. 2. G. Franchini, Verona.

Ibaragi Y, Lim S-H, Yook M-J, Heo K-I, Chen W, Li L, Park J-S, Kim D-S (2017) A taxonomic note on the genus *Miscanthus* (Poaceae) in Korea. Journal of Japanese Botany 92(6): 349–368.

Liu L, Phillips SM (2006) Tribe Oryzeae. In: Wu ZY, Raven PH, Hong DY (Eds) Flora of China, Vol. 22. Science Press, Beijing, Missouri Botanical Garden Press, St. Louis, 181–187.

Lowe S, Browne M, Boudjelas S, De Poorter M (2004) 100 of the World's worst invasive alien species. A selection from the Global Invasive Species Database. Updated and reprinted version. Invasive Species Specialist Group (ISSG) of the Species Survival Commission (SSC) of the World Conservation Union (IUCN), Auckland.

Mazomeit J (2016) Verwilderungen von *Toona sinensis*, *Tetradium dan[i]elli[i]* und *Gymnocladus dioicus* in Mannheim und an anderen Orten. Floristische Rundbriefe 50: 175–182.

Ocampus G, Travis Columbus J (2012) Molecular phylogenetics, historical biogeography, and chromosome number evolution of *Portulaca* (Portulacaceae). Molecular Phylogenetics and Evolution 63(1): 97–112. https://doi.org/10.1016/j.ympev.2011.12.017

Peruzzi L, Bedini G [Eds] (2022+) Wikiplantbase #Toscana v2.1. http://bot.biologia.unipi.it/wpb/toscana/index.html [accessed 14.01.2022]

Podda L, Lazzeri V, Mascia F, Mayoral García Berlanga O, Bacchetta G (2012) The checklist of the Sardinian exotic flora: an update. Notulae Botanicae Horti Agrobotanici Cluj-Napoca 40(2): 14–21. https://doi.org/10.15835/nbha4028225

Röthlisberger J (2010) Die Steppenquecke *Elytrigia obtusiflora* – ein bemerkenswerter Neufund. Botanica Helvetica 120(1): 79–82. https://doi.org/10.1007/s00035-010-0074-0

Verloove F (2016) *Fraxinus pennsylvanica*. In: Manual of the alien plants of Belgium. Botanic Garden Meise, Belgium. https://alienplantsbelgium.myspecies.info/content/fraxinus-pennsylvanica [accessed 22.02.2022]

Ward DB (1977) Keys to the Flora of Florida – 4, *Nymphaea* (Nymphaeaceae). Phytologia 37(5): 443–448.

Zhang D, Hartley TG (2008) *Tetradium* Loureiro. In: Wu ZY, Raven PH, Hong DY (Eds) Flora of China, Vol. 11. Science Press, Beijing, Missouri Botanical Garden Press, St. Louis, 66–70.

Supplementary material 1

Supplementary data

Authors: Gabriele Galasso, Fabrizio Bartolucci

Data type: Species data

Explanation note: 1. Nomenclatural updates; 2. Note updates; 3. Distribution updates; 4. Synonyms, misapplied or included names.

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RESEARCH ARTICLE

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Spring composition of the macroalgal vegetation of a small offshore island in the north-western Mediterranean (Gallinara Island, Ligurian Sea)

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Abstract

Gallinara Island, a small island located 1.5 km off the shore of Liguria (Italy, north-western Mediterranean Sea) was included in a list of proposed Marine Protected Areas (MPA) in the early 90s. Since then, its benthic assemblages have been studied in detail and the main macrophytic communities have been mapped. A detailed assessment of its benthic macroalgal flora, however, has never been made. Gallinara was visited in the course of 5 consecutive years and its macroalgal flora was studied based on collections made by snorkelling and SCUBA diving. Overall, 141 macroalgal taxa were collected and identified (23 Chlorophyta, 94 Rhodophyta, 24 Ochrophyta); 91 of them represent new records for the island. One of the most notable new records is the non-indigenous red alga *Womersleyella setacea*, previously unreported from the island and widely distributed, particularly on the south-eastern shore. Observations made in the course of the surveys confirm the rarefaction of some large-sized brown algae (particularly *Sargassum vulgare*) but indicate also that others previously reported as rare (*Cystoseira compressa*, *Dictyopteris polypodioides*) are still common on the island.

Keywords

Biotic homogenization, Macroalgal floras, Marine Protected Areas, Mediterranean sea, non-indigenous species

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Introduction

Littoral systems around small islands often show peculiar characteristics, both biotic and abiotic, if compared with those of mainland coasts (Piazzi et al. 2004; Rindi and Guiry 2004). Differences in environmental factors such as wave exposure, currents, water transparency, sedimentation rate and interaction with pelagic systems are considered the main causes of these peculiarities (Piazzi et al. 2004). Such differences are usually more evident for islands located at greater distances from the mainland. In the last decades, anthropogenic impacts affecting many littoral habitats along continental shores have further contributed to increase these differences. This is a common situation in the north-western Mediterranean Sea, where the limited urbanization typical of many offshore islands has allowed the maintenance of a comparatively high environmental status, in contrast to the highly impacted continental shores in the region.

Gallinara is a small island located in the Ligurian Sea, approximately 1.5 km from the western shore of Liguria, in the Italian mainland. The island is not open to public access and its terrestrial biota, consisting mainly of Mediterranean shrublands, are generally well conserved, with the presence of rare and endemic species listed in Habitat Directive (e.g *Campanula sabatia* De Notaris 1844). Moreover, the island hosts one the main colonies of the seagull *Larus michahellis* Naumann 1840, of the Ligurian region. For this reason, a Natural Regional Reserve was established for the terrestrial environment in 1989 (Bianchi et al. 2018). The marine benthic communities of Gallinara were not studied in detail until the early 90s of last century (Balduzzi et al. 1992), when the island was included in a list of proposed Marine Protected Areas (MPA) in the framework of the Italian National Framework Law 394/91 on Protected Areas. To date a Marine Protected Area has not yet been established, but the island is included in a Special Area of Conservation (SAC "Fondali Santa Croce - Gallinara - Capo Lena", Natura 2000 code IT1324974). Despite of this, there is evidence that the rocky bottoms surrounding the island underwent major alterations due to increasing human impacts in the last 25 years, mainly in the form of anchoring and fishing, both artisanal and recreational (Bianchi et al. 2018).

The benthic macrophyte communities of Gallinara were characterized and mapped in several studies (Balduzzi et al. 1992; Tunesi et al. 2006, 2008; Bianchi et al. 2018) that provided a background of knowledge for the establishment of the MPA. Macrophytes (seagrasses and benthic macroalgae) are considered useful descriptors of environmental characteristics of coastal habitats (Pinedo et al. 2007; Balata et al. 2011). Attached algae, because of their sedentary condition, integrate the effects of long-term exposure to nutrients or other pollutants resulting in a decrease or even disappearance of the most sensitive species and its replacement by highly resistant, opportunistic species (Ballesteros et al. 2007). Therefore, these organisms are widely used for environmental assessments of coastal waters (Orlando-Bonaca et al. 2008; Orfanidis et al. 2011; Cecchi et al. 2014; D'Archino and Piazzi 2021) and the seaweed communities occurring in an area are an important aspect to take in account when the establishment of an MPA is considered.

Previous investigations have reported 71 species of macroalgae from Gallinara, but a detailed census of the macroalgal flora was not among their aims. In general, detailed recent studies focusing on the macroalgal diversity of the region where Gallinara is located (Liguria) are essentially lacking. We visited the island each year in a time span of 5 years (2013–2017) and made targeted collections and observations on the benthic macroalgae. This improved substantially the knowledge of the macroalgal vegetation, providing new valuable floristic information. Observations of the seaweed communities also allowed to compare the present distribution of several species with information available in the literature.

Materials and methods

Study site

Gallinara Island has a triangular outline and its perimeter measures approximately 1.4 km (Fig. 1). The coastline is entirely rocky and consists mostly of steep cliffs. With the only partial exception of the north-eastern shore where a small harbour is located, the island is characterized by wave-exposed conditions, due to exposure to southerly and south-easterly winds (that are the prevailing in the area). As in most of the Mediterranean Sea, the tidal range is limited and does not exceed 0.3 m (Bianchi et al. 2018). From the lithological point of view the island consists entirely of stratified quartzite (Bavestrello et al. 2000).

Methods

Gallinara Island was visited in June in 5 consecutive years (9–14 June 2013; 9–14 June 2014; 7–12 June 2015; 5–10 June 2016; 5–10 June 2017). Collections of benthic macroalgae were made from the mediolittoral, infralittoral and circalittoral zones, at depths ranging from the surface to approximately 45 m. Collections from the mediolittoral and shallow infralittoral (-1.5/2 m) zones were made by snorkeling along the whole shoreline of the island. Collections from the infralittoral and circalittoral zones were made from two sites, Punta Falconara (southern point of the island) and Punta Sciusciaù (eastern point of the island) by SCUBA diving. Sampling was based on targeted collections, made with the aim of collecting as many species as possible.

In addition, a visual census of the seaweed communities of the mediolittoral and shallow infralittoral zone (approximately 5 m depth) was carried out in June 2016. The whole perimeter of the island was checked by visual inspection and the species present were noted. For convenience, we present and discuss the results subdividing the island in 30 sectors of the four shores: north-eastern shore (NE, sectors 1–7), south-eastern shore (SE, sectors 8–19), western shore (W, sectors 20–29) and harbour (H, sector 30).

Algal samples were removed from the substratum using a sharp knife or hammer and chisel (except for some samples from the infralittoral zone, which were collected

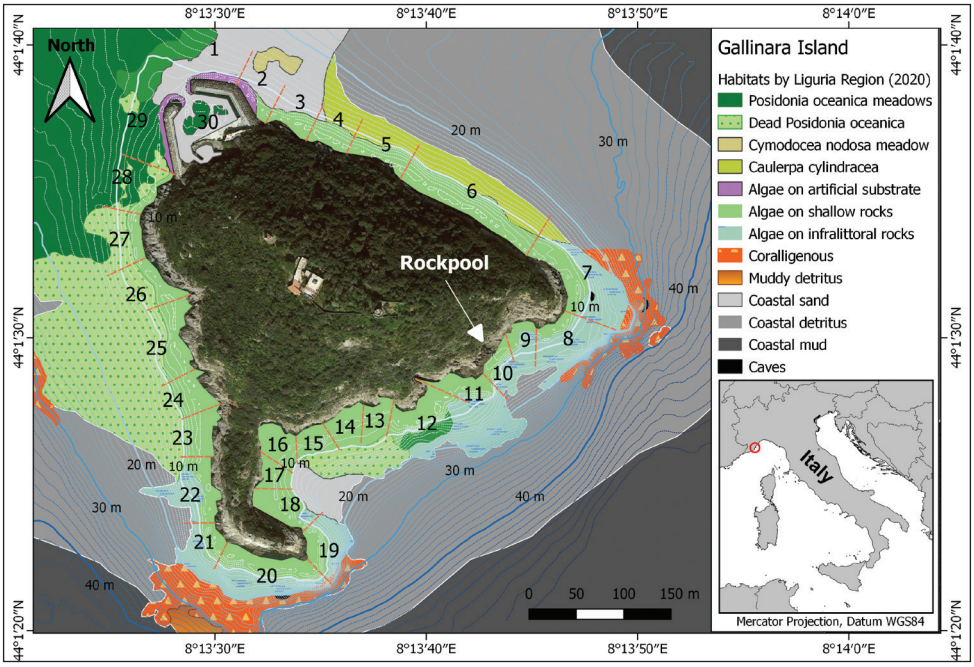

Figure 1. Map of Gallinara Island. Numbers indicate the study sectors around the island shore. Main benthic habitats are reported according to Regione Liguria (2020).

using a vacuum pump). The material was placed in sealed plastic bags and examined a few hours after collection using a binocular stereoscope and a light microscope. Part of the material was immediately identified, dried, and pressed for preparation of herbarium specimens. Some specimens that could not be readily identified were stored in a solution of 4% formalin in seawater and identified upon return to the laboratory at the Polytechnic University of Marche. Identifications were based on morphological characters and were obtained using descriptions and illustrations mainly in Coppejans (1983), Cormaci et al. (2012, 2014, 2017, 2020, 2021) and Rodriguez-Prieto et al. (2013). Voucher specimens were deposited in the herbarium JIWUKORI of the Universidad Nacional de Colombia, Bogotá (JIW) and in the phycological section of the Herbarium Anconitanum, Università Politecnica delle Marche, Ancona (ANC). Algal nomenclature and taxonomy follow AlgaeBase (Guiry and Guiry 2022).

Results

Overall, 141 macroalgal taxa were collected and identified in the study (23 Chlorophyta, 94 Rhodophyta, 24 Ochrophyta) (Table 1); 91 of these represent new records for the island (Table S1). In terms of distribution, 11 taxa were recorded from the harbour, 65 from the NE shore, 126 from the SE shore and 88 from the W shore (Table 1).

Table 1. List of macroalgal taxa collected and identified from Gallinara Island. Labels: H = harbour; NE = northeastern shore; SE = southeastern shore; W = western shore. Crosses indicate presence.

Phylum and taxon	Sector				Distributional notes
	H	NE	SE	W	
Chlorophyta					
Acetabularia acetabulum (Linnaeus) P.C. Silva		+	+	+	Widespread in the shallow part of the infralittoral zone (-1/5 m), particularly on the NE shore.
Anadyomene stellata (Wulfen) C. Agardh			+		Collected in 2017; some small thalli mixed with filamentous algae in the shallow infralittoral.
Bryopsis cf. *duplex* De Notaris		+	+	+	Some specimens mixed with filamentous algae in the photophilous turfs of the infralittoral fringe.
Bryopsis sp.			+		A few specimens with fir-like habit; collected in 2017.
Caulerpa cylindracea Sonder			+		In the infralittoral zone, with a wide depth range; more abundant around 10 m than at higher depths. Found also in the rockpool with *Cystoseira* and *Sargassum*, with a few filaments scattered in the underlayer.
Chaetomorpha aerea (Dillwyn) Kützing		+	+	+	Uncommon, mixed with other filamentous algae in mesolittoral turfs.
Chaetomorpha ligustica (Kützing) Kützing		+	+	+	Filaments mixed with other filamentous algae in both photophilous and sciophilous turfs of the mesolittoral and the infralittoral fringe. Particularly common in 2017, when it formed monospecific tufts in the lower mesolittoral.
Cladophora coelothrix Kützing			+	+	Some specimens mixed with other filamentous algae in the sciophilous turfs of the W shore; some plants collected also at Sciusciaù at 7/8 m depth.
Cladophora cf. *dalmatica* Kützing		+	+	+	Not frequent; some plants forming green tufts in the lower mesolittoral, especially in the sectors 2 and 3.
Cladophora pellucida (Hudson) Kützing			+		Collected in 2015.
Cladophora prolifera (Roth) Kützing			+		Collected in a vacuum pump sample taken at Sciusciaù at 20 m depth in 2014; found mixed with other filamentous algae in the infralittoral in 2017. Probably common in the infralittoral.
Codium bursa (Linnaeus) C. Agardh		+	+	+	Common in the infralittoral along the whole coastal perimeter. Particularly abundant in 2017.
Codium coralloides (Kützing) P.C. Silva	+				Collected in shaded crevices in the harbour in 2017.
Codium effusum (Rafinesque) Delle Chiaje				+	It formed an extended and continuous coverage on some small vertical walls in shaded crevices in the sectors 28–29.
Codium vermilara (Olivi) Delle Chiaje				+	Upper infralittoral; present mostly along the coast on the W side of the harbour.
Flabellia petiolata (Turra) Nizamuddin				+	In the upper infralittoral it is present only in shaded crevices on vertical walls of the west side. Found also in shaded crevices in the harbour in 2017.
Halimeda tuna (J. Ellis & Solander) J.V. Lamouroux	+	+	+	+	Abundant, common at all levels in the infralittoral. In the upper infralittoral it is present in some shaded crevices in the harbour and on vertical walls of the W shore.
Pedobesia simplex (Meneghini ex Kützing) M.J. Wynne & Leliaert	+				On the sandy bottom of the sheltered zone of the harbour (44°1'36.31"N, 8°13'29.56"E); several unattached thalli that form 4–5 cm wide tufts, free on the bottom.
Pseudobryopsis myura (J. Agardh) Berthold			+		Uncommon, mixed with filamentous red algae in the sciophilous turfs on the south-eastern side (sectors 15–16).
Pseudochlorodesmis furcellata (Zanardini) Børgesen		+	+	+	Widely distributed in the infralittoral, also present in the sciophilous turfs of the sectors 15–16 and 27–28. Found in the harbour in 2017, where it formed small epiphytic pompons on larger algae.
Ulva cf. *flexuosa* Wulfen		+	+	+	Not frequent, occasionally mixed with other algae in the photophilous turfs of the lower mesolittoral and the infralittoral fringe.
Ulva cf. *laetevirens* Areschoug			+		Laminar forms of *Ulva* were not observed in the mesolittoral and the upper infralittoral. A dense patch was observed in the rockpool of the sector 11 in 2014, in the only portion of the substratum not occupied by *Cystoseira* and *Sargassum*.
Valonia utricularis (Roth) C. Agardh				+	Mixed with other algae in both photophilous and sciophilous turfs of the mesolittoral and the infralittoral fringe; it forms small clusters in shaded crevices of the sectors 28–29. Epiphyte on *Stypocaulon scoparium* at 25/30 m depth at Sciusciaù.
Rhodophyta					
Acrosorium ciliolatum (Harvey) Kylin			+	+	Common in the filamentous turfs of sciophilous habitats, especially in the sectors 15–16 and 27–28. Present also in the underlayer of the rockpool of the sector 11 with *Cystoseira* and *Sargassum*.
Cf. *Acrosymphyton purpuriferum* (J. Agardh) Sjöstedt		+	+	+	Small specimens (2–3 cm tall) occasionally observed in the upper infralittoral (sectors 6, 7, 8, 9 and 21). Found also in the rockpool of the sector 11 with *Cystoseira* and *Sargassum* in 2017.

Phylum and taxon	Sector				Distributional notes
	H	NE	SE	W	
Acrothamnion preissii (Sonder) Wollaston			+		Infralittoral, observed in a single sample (epiphyte on the stipe of *Stypocaulon scoparium* at 7/8 m depth at Sciusciaù in 2014).
Aglaothamnion caudatum (J. Agardh) Feldmann-Mazoyer			+		Recorded in 2015 in sciophilous turfs.
Amphiroa rigida J.V. Lamouroux		+	+	+	Specimens observed in the upper infralittoral in the sectors 6, 7, 10, 13, 14, 16, 17, and 21. Sometimes mixed with filamentous species in the photophilous red algae turfs.
Antithamnion cruciatum (C. Agardh) Nägeli			+		Uncommon, recorded in some samples collected from vertical walls on the SE shore, mixed with other filamentous red algae.
Aphanocladia stichidiosa (Funk) Ardré			+	+	Common in the sciophilous turfs collected in the sectors 14–15 and 28–29.
Asparagopsis sp. (sporophyte *Falkenbergia*)		+	+	+	Common in the upper infralittoral of the whole island; particularly abundant in the sectors 13 and 14. When well developed, it forms pink tufts that were observed in all areas; often mixed with others filamentous algae in the turfs of the infralittoral fringe.
Bonnemaisonia asparagoides (Woodward) C. Agardh			+		Collected in the deep infralittoral in 2016 and in the rockpool with *Cystoseira* and *Sargassum* in 2017.
Botryocladia botryoides (Wulfen) Feldmann			+		Deep infralittoral, collected in 2017.
Cf. *Callithamnion corymbosum* (J.E. Smith) Lyngbye				+	Rare, mixed with other filamentous algae in the sciophilous turfs collected on the western side.
Callithamnion granulatum (Ducluzeau) C. Agardh		+	+	+	Common in the mesolittoral; more frequent in the sectors 9–13, where it formed 5–6 cm long tufts.
Carradoriella elongata (Hudson) Savoie & G.W. Saunders			+		Found in a single sample collected at 20 m depth in 2014.
Centroceras clavulatum (C. Agardh) Montagne		+	+	+	Not abundant, but widely distributed in the infralittoral; present in the sciophilous turfs collected in the upper infralittoral on the western side, in a collection made at 7–8 m depth at Sciusciaù and in vacuum pump samples taken at 20 m depth at Sciusciaù.
Ceramium ciliatum (J. Ellis) Ducluzeau		+	+	+	It is one of the most common algae in the mesolittoral and in the infralittoral fringe; in some spots it forms a continuous belt in the lower mesolittoral.
Ceramium codii (H. Richards) Feldmann-Mazoyer			+	+	Not abundant, but present at all levels of the infralittoral as epiphyte on larger algae.
Ceramium diaphanum (Lightfoot) Roth		+	+	+	Not abundant, but widely distributed in the infralittoral, mixed with other filamentous algae in the sciophilous turfs, found at 7–8 m depth at Sciusciaù and collected in the vacuum pump sample taken at 10 m depth at Falconara in 2014.
Ceramium siliquosum (Kützing) Maggs & Hommersand		+	+	+	Present in the infralittoral fringe, usually mixed with other filamentous algae in turfs.
Ceramium tenerrimum (G. Martens) Okamura		+	+	+	Present in the infralittoral fringe, usually mixed with other filamentous algae in turfs.
Ceramium virgatum Roth		+	+	+	Common in the lower mesolittoral and in the infralittoral fringe, usually mixed with other filamentous algae in turfs.
Champia parvula (C. Agardh) Harvey			+	+	Widely distributed in the infralittoral; found in the sciophilous turfs of the sectors 14–15 and 28–29, in turfs on the north-eastern side and in the vacuum pump sample taken at 20 m depth at Sciusciaù in 2014.
Chondria boryana (De Notaris) De Toni		+	+	+	Common in the lower mesolittoral and in the infralittoral fringe, especially on the south-eastern side.
Chondria capillaris (Hudson) M.J. Wynne				+	Some plants found in the sciophilous turfs collected on the west side.
Chondria cf. *mairei* Feldmann-Mazoyer			+		Collected in 2015, mixed with filamentous algae in the infralittoral.
Contarinia squamariae (Meneghini) Denizot				+	Epiphytic on some plants of *Peyssonnelia squamaria* collected in the sectors 27 and 28 in 2014.
Corallina officinalis Linnaeus		+	+	+	Uncommon, but observed on all sides of the island. It forms patches in some sheltered and partially shaded crevices.
Crouania attenuata (C. Agardh) J. Agardh			+	+	Small epiphyte present at all levels of the infralittoral. Present in the sciophilous turfs at 7/8 m depth at Sciusciaù, in the vacuum pump sample taken at 10 m depth at Falconara in 2014, and epiphyte on *Pterocladiella capillacea* in a shaded crevice in the sector 28.
Cryptonemia palmetta (S.G. Gmelin) Woelkerling, G. Furnari, Cormaci & J. McNeill			+		Some small thalli collected in the deep infralittoral mixed with filamentous algae.
Dasya ocellata (Grateloup) Harvey		+	+	+	Not abundant, but frequently observed in the photophilous turfs mixed with other filamentous algae.
Dasya rigidula (Kützing) Ardissone		+	+	+	Not abundant, but frequently observed in the photophilous turfs mixed with other filamentous algae.

Phylum and taxon	Sector				Distributional notes
	H	NE	SE	W	
Ellisolandia elongata (J. Ellis & Solander) Hind & Saunders		+	+	+	Very common in the upper infralittoral. Sometimes it forms more or less pure patches, but more often is mixed with filamentous (*Herposiphonia*, *Ceramium*, *Vertebrata*, *Polysiphonia*) and corticate (*Laurencia obtusa*) algae in turfs.
Erythrocystis montagnei (Derbès & Solier) P.C. Silva		+	+	+	Very common, parasite in the apical cavities of *Laurencia obtusa*.
Erythroglossum sandrianum (Kützing) Kylin			+		Found on a bryozoan collected at 30 m depth in 2017.
Erythrotrichia carnea (Dillwyn) J. Agardh		+	+	+	Small epiphyte observed on many larger seaweeds, probably common.
Eupogodon planus (C. Agardh) Kützing			+		Deep infralittoral, collected in 2017 mixed with other filamentous algae.
Feldmannophycus rayssiae (Feldmann & Feldmann-Mazoyer) Augier & Boudouresque			+	+	Occasionally mixed with filamentous algae in both sciophilous and photophilous turfs of the infralittoral fringe.
Gastroclonium clavatum (Roth) Ardissone		+	+	+	Small individuals (2–3 cm high) recognizable by the whitish iridescence. Frequent in the mesolittoral and in the infralittoral fringe, especially in the sectors 10–14 on the south-eastern side.
Gayliella mazoyerae Cho, Fredericq & Hommersand		+	+	+	Very common, epiphyte on larger algae in all levels of the infralittoral; observed in large quantities on *Codium effusum* and *Dictyota* spp.
Gelidium cf. *crinale* (Turner) Gaillon			+		Observed occasionally in the photophilous turfs of the infralittoral on the south-eastern side, mixed with filamentous algae.
Grateloupia filicina (J.V. Lamouroux) C. Agardh)		+			Rare; found in one mesolittoral turf collected on the north-eastern side in 2017.
Griffithisia phyllamphora J. Agardh			+	+	One of the most common species in the sciophilous turfs of the sectors 14–15 and 28–29; sometimes it forms small spherical aggregates around the axes of articulated corallinaceae or other algae. Collected in shaded crevices of the harbour in 2017.
Halopithys incurva (Hudson) Batters			+		Collected in the rockpool with *Cystoseira* and *Sargassum* in 2017.
Herposiphonia secunda (C. Agardh) Ambronn		+	+	+	Abundant; it is one of the most common species in the photophilous turfs of the infralittoral fringe. Present as epiphyte also at the deeper levels of the infralittoral.
Herposiphonia tenella (C. Agardh) Ambronn			+	+	Very common species in the sciophilous turfs of the sectors 14–15 and 28–29; sometimes it forms dense tufts almost monospecific.
Heterosiphonia crispella (C. Agardh) M.J. Wynne			+	+	Common in the sciophilous turfs collected in the sectors 14–15 and 28–29.
Hydroliython farinosum (J.V. Lamouroux) Penrose & Y.M. Chamberlain		+	+	+	Common as epiphyte on larger algae in the infralittoral.
Hydroliython farinosum var. *chalycodictyum* (W.R. Taylor) Serio			+		Deep infralittoral, found growing on a sponge.
Hypnea musciformis (Wulfen) J.V. Lamouroux		+	+	+	Epiphytic on *Cystoseira* in the rockpool with *Cystoseira* and *Sargassum*. Occasionally observed in the infralittoral fringe.
Hypoglossum hypoglossoides (Stackhouse) Collins & Hervey			+	+	Common in the sciophilous turfs collected in the sectors 14–15 and 28–29.
Jania rubens (Linnaeus) J.V. Lamouroux		+	+	+	Widespread at all levels in the infralittoral; sometimes abundant, but it never forms a belt.
Jania virgata (Zanardini) Montagne		+	+	+	Very common, epiphyte on larger algae. Widely spread at all levels of the infralittoral, but it never forms a belt.
Laurencia cf. *majuscula* (Harvey) Lucas			+		Collected in the infralittoral in 2017.
Laurencia obtusa (Hudson) J.V. Lamouroux		+	+	+	It is the most common and abundant alga in the upper infralittoral. Present mainly in form of erect thalli 4–5 cm high, but it is also common in the algal turfs in form of prostrate axes mixed with filamentous algae and articulated corallines.
Liagora cf. *viscida* (Forsskål) C. Agardh	+		+	+	Not frequent; isolated specimens observed in the sectors 13, 21–22 and 30.
Lithophyllum byssoides (Lamarck) Foslie		+	+	+	Present on almost the entire coastal perimeter in form of small isolated specimens (no more than 5 cm in diameter). A well-developed trottoir was not observed in any area.
Lithophyllum cf. *incrustans* Philippi		+	+	+	It forms patches in the upper infralittoral, in the part of substrate free from turfs or other algae.
Lithophyllum pseudoracemus Caragnano, Rodondi & Rindi			+		It forms rhodoliths at 40 m depth in the area of Punta Falconara.
Lithophyllum stictiforme (Areschoug) Hauck			+		Common in the deep infralittoral and circalittoral.
Lophosiphonia cristata Falkenberg		+	+	+	Common in the turfs of the infralittoral fringe, associated with *Polysiphonia opaca* and *Taenioma nanum*.
Nemalion elminthoides (Velley) Batters		+	+	+	Occasionally observed in the mesolittoral in form of isolated specimens (sectors 3 and 20). Unusually abundant and particularly developed in 2016.

Phylum and taxon	Sector				Distributional notes
	H	NE	SE	W	
Osmundea sp.			+		Mixed with filamentous algae in the photophilous turfs on the south-eastern side.
Peyssonnelia cf. *heteromorpha* (Zanardini) Athanasiadis	+				On stones in shaded crevices in the harbour in 2017.
Peyssonnelia cf. *rosa-marina* Boudouresque & Denizot			+		Collected at 10 m depth at Sciusciaù, probably common in the infralittoral and circalittoral.
Peyssonnelia rubra (Greville) J. Agardh			+		Common in the infralittoral, collected at 10 m depth at Sciusciaù.
Peyssonnelia squamaria (S.G. Gmelin) Decaisne	+	+			Common in some superficial shaded crevices on the western side and in the harbour.
Plocamium cf. *cartilagineum* (Linnaeus) P.S. Dixon	+		+	+	Sciophilous species present in shaded and sheltered crevices. It densely covered some vertical walls in the sectors 15 and 28. Collected also in a shallow shaded crevice in the harbour and in the underlayer of the rockpool with *Cystoseira* and *Sargassum*.
Polysiphonia flocculosa (C. Agardh) Endlicher		+	+	+	Common in the photophilous turfs of the lower mesolittoral and the infralittoral fringe, usually mixed with *Vertebrata fruticulosa* and articulated corallines.
Polysiphonia opaca (C. Agardh) Moris & De Notaris		+	+	+	Very common in the lower mesolittoral and in the infralittoral fringe, where it is one of the main components of the photophilous turfs.
Polysiphonia perforans Cormaci, Furnari, Pizzuto & Serio			+		Found on a thallus of *Peyssonnellia* collected in the deep infralittoral at Sciusciaù in 2017.
Polysiphonia cf. *scopulorum* Harvey			+		Epiphyte on *Peyssonnelia* at 7/8 m depth at Sciusciaù.
Polysiphonia sertularioides (Grateloup) J. Agardh		+	+	+	It forms brown patches that are clearly visible in the mesolittoral, especially in sectors 2,3 and 4.
Polysiphonia cf. *subulata* (Ducluzeau) Kützing		+	+	+	Common in the lower mesolittoral and in the infralittoral fringe, but in the form of juvenile individuals not identifiable with certainty at the species level.
Pterocladiella capillacea (S.G. Gmelin) Santelices & Hommersand			+	+	Collected in a shaded crevice in the sector 28 (with *Crouania attenuata* as epiphyte); present also in the understory of the rockpool with *Cystoseira* and *Sargassum* in the sector 10.
Pterothamnion crispum (Ducluzeau) Nägeli			+		Mixed with other filamentous algae in a collection made at 7/8 m depth at Sciusciaù in 2014.
Pterothamnion plumula (J. Ellis) Nägeli			+	+	Not frequent; some specimens observed in the sciophilous turfs collected in sectors 28–29. Epizooic on a bryozoan collected at 30 m depth in 2017.
Ptilothamnion pluma (Dillwyn) Thuret			+		Mixed with other filamentous algae in a collection made at 7/8 m depth at Sciusciaù.
Rhodophyllis divaricata (Stackhouse) Papenfuss			+	+	Common in the sciophilous turfs collected in sectors 14–15 and 28–29.
Cf. *Rhodymenia ardissonei* Feldmann	+		+		Not frequent, some specimens mixed with filamentous algae in the sciophilous turfs. Collected in shaded crevices in the harbour in 2017.
Rissoella verruculosa (A. Bertoloni) J. Agardh		+	+	+	Common in the mesolittoral but very irregularly distributed, in the form of isolated patches of variable extent (up to 1 m wide).
Rytiphlaea tinctoria (Clemente) C. Agardh			+		Found in the rockpool with *Cystoseira* and *Sargassum* in 2017.
Schottera nicaeensis (J.V. Lamouroux ex Duby) Guiry & Hollenberg			+		Found on a small vertical wall in the rockpool with *Cystoseira* e *Sargassum* in 2017.
Sphaerococcus coronopifolius Stackhouse	+				Found in shaded crevices in the harbour in 2017.
Spyridia filamentosa (Wulfen) Harvey		+	+	+	Occasionally found in the photophilous turfs of the infralittoral fringe.
Stylonema alsidii (Zanardini) Drew		+	+	+	Recorded as epiphyte on some larger algae in the infralittoral.
Stylonema cornu-cervi Reinsch		+	+	+	Recorded as epiphyte on some larger algae in the infralittoral.
Symphyocladiella parasitica (Hudson) D. Bustamante, B.Y. Won, S.C. Lindstrom & T.O. Cho			+		Found in a vacuum pump sample collected at 20 m depth at Falconara in 2014 and mixed with other infralittoral filamentous algae in 2017.
Taenioma nanum (Kützing) Papenfuss		+	+	+	Common in the photophilous turfs of the infralittoral fringe, usually associated with *Polysiphonia opaca* and *Lophosiphonia cristata*.
Tricleocarpa fragilis (Linnaeus) Huisman & R.A. Townsend			+		Collected at 7/8 m depth at Sciusciaù in 2014 and mixed with infralittoral filamentous algae in 2017.
Vertebrata fruticulosa (Wulfen) Kuntze		+	+	+	Common, widely distributed around the whole island. Mixed with other algae in the photophilic turfs of the lower mesolittoral and infralittoral fringe; noted in the upper infralittoral especially in the sectors 10–13.
Vertebrata furcellata (C. Agardh) Kuntze			+		Found in the vacuum pump samples collected at 20 m depth, both at Sciusciaù and Falconara in 2014.
Vertebrata subulifera (C. Agardh) Kuntze			+		Found in a vacuum pump sample collected at 20 m depth at Sciusciaù in 2014.
Vickersia baccata (J. Agardh) Karsakoff			+		Common in the sciophilous turfs collected in the sectors 14–15.
Womersleyella setacea (Hollenberg) R.E. Norris		+	+	+	Abundant, widely distributed at all levels of the infralittoral, both epilithic and epiphytic on other species. In the upper infralittoral is mixed with other filamentous algae in the turfs of shaded habitats.

Phylum and taxon	Sector				Distributional notes
	H	NE	SE	W	
Wrangelia penicillata (C. Agardh) C. Agardh		+	+	+	Lower mesolittoral and upper infralittoral; easily recognized by the whitish hairs present on the branches. Frequent, it is present mainly on the SE shore in sectors 10–14 and 16–17; observed also in sectors 22–24.
Wurdemannia miniata (Sprengel) Feldmann			+		Collected in 2015.
Ochrophyta					
Acinetospora crinita (Carmichael) Sauvageau			+		In 2015 it formed mucilages that covered larger infralittoral algae.
Cladostephus hirsutus (Linnaeus) Boudouresque & M. Perret-Boudouresque			+		Found in the rockpool with *Cystoseira* and *Sargassum* in 2017.
Colpomenia sinuosa (Mertens ex Roth) Derbès et Solier	+	+		+	Forming more or less extended patches in the infralittoral fringe, in the harbour and in sectors around the harbour (2–3-4–5-6, 14, 21–22–23, 28–29).
Cutleria cf. *multifida* (J.E. Smith) Greville (sporophyte *Aglaozonia*)			+		Only one plant collected at 25/30 m depth at Sciusciaù in 2014; probably common in the deep infralittoral.
Cystoseira compressa (Esper) Gerloff & Nizamuddin		+	+	+	Associated with *Ericaria amentacea*; it forms patches located immediately above those of *Ericaria amentacea* but more restricted, both horizontally and vertically. In June 2014 it was largely blackened due to drying out caused by low tides. Several large specimens occurring in the rockpool of the sector 11, together with *Sargassum vulgare* and *Gongolaria elegans*.
Dictyopteris polypodioides (A.P. De Candolle) J.V. Lamouroux	+	+	+	+	Common in a sheltered and partially shaded spot in the harbour; often observed in sheltered crevices in the upper infralittoral (where it was noticed mainly in sectors 9–17). Common in the deeper infralittoral.
Dictyota dichotoma (Hudson) J.V. Lamouroux		+	+	+	Common at all levels of the infralittoral.
Dictyota dichotoma var. *intricata* (C. Agardh) Greville		+	+	+	Abundant, one of the commonest algae in the infralittoral. In the upper infralittoral it is more common on the NE shore than on the others (where *D. fasciola*, *D. spiralis* and *T. atomaria* tend to prevail). At 10–15 m in the infralittoral is the most abundant species.
Dictyota fasciola (Roth) M.A. Howe		+	+	+	Common in the upper infralittoral, mainly on the SE shore and on the southern part of the W shore (sectors 20–24).
Dictyota implexa (Desfontaines) J.V. Lamouroux			+	+	Epiphyte on larger algae in the infralittoral; probably common.
Dictyota spiralis Montagne		+	+	+	Common in the upper infralittoral, mixed with *D. fasciola* and *Taonia atomaria*.
Ericaria amentacea (C. Agardh) Molinari & Guiry		+	+	+	Rare on the NE shore and absent in the part of the W shore closest to the harbour. Present in the form of more or less extended patches in the other parts of the coastal perimeter; on the SE shore it forms some stretches of continuous belt (usually 5–6 m long). Sectors 11–13 are those in which it appears most abundant and continuous.
Gongolaria elegans (Sauvageau) Molinari & Guiry			+		In the rockpool on the SE shore, together with *C. compressa* and *Sargassum vulgare*.
Halopteris filicina (Grateloup) Kützing		+	+	+	Common in the infralittoral and circalittoral; collected at 7/8 m depth at Sciusciaù; in the vacuum pump samples collected at 10 m depth at Falconara and at 20 depth m at Sciusciaù; epiphyte on *Lithophyllum stictiforme* in the circalittoral.
Halopteris scoparia (Linnaeus) Sauvageau	+		+		In the upper infralittoral it is present only in the harbour and in some shaded crevices in sectors 28 and 29. Abundant at deeper levels in the infralittoral zone, up to 30 m.
Nereia filiformis (J. Agardh) Zanardini			+		Some specimens epiphytic on *Peyssonnelia* at 10 m depth at Sciusciaù in 2014.
Padina pavonica (Linnaeus) Thivy		+	+	+	Common; widely distributed at all levels of the infralittoral; in the upper infralittoral noted especially in sectors 1–4, 8–14 and 27–29.
Ralfsia verrucosa (Areschoug) Areschoug		+			Not frequent, observed in the mesolittoral in the sectors 2 and 3.
Pseudolithoderma adriaticum (Hauck) Verlaque			+	+	Common in the upper infralittoral on the SE shore and in the southern part of the W shore (sectors from 7 to 23).
Sargassum vulgare C. Agardh			+		Several large specimens occurring in the rockpool of the sector 11 on the SE shore, together with *C. compressa* and *T. elegans*.
Sphacelaria cirrosa (Roth) C. Agardh		+	+	+	Common, mixed with other algae in the sciophilous turfs of the infralittoral fringe and epiphytic on many algae at deeper levels in the infralittoral. It forms small spherical aggregates around axes of articulated corallines or other algae in the shaded spots of the sectors 15–16 and 27–28.
Sphacelaria plumula Zanardini			+		Probably common in the deep infralittoral; recorded in the vacuum pump samples collected at 20 m depth at Falconara and Sciusciaù in 2014.
Sphacelaria rigidula Kützing			+	+	Recorded in the photophilous turfs of sectors 14–15 and 28–29.
Taonia atomaria (Woodward) J. Agardh		+	+	+	Abundant, very common in the upper infralittoral, especially on the SE shore; usually mixed with *Dictyota fasciola* and *D. spiralis*.

Algal assemblages of the mediolittoral zone had a patchy distribution and consisted mainly of pseudoparenchymatous red algae (*Nemalion elminthoides* (Velley) Batters, *Rissoella verruculosa* (A. Bertoloni) J. Agardh) and filamentous species (*Callithamnion granulatum* (Ducluzeau) C. Agardh, *Ceramium* spp., *Chaetomorpha* spp., *Cladophora* spp., *Polysiphonia sertularioides* (Grateloup) J. Agardh). The crustose coralline *Lithophyllum byssoides* (Lamarck) Foslie, typical of this shore level in the western Mediterranean, was found on most of the island shoreline. However, it occurred as scattered specimens up to 5 cm wide and never formed thick rims.

The composition of the algal assemblages of the infralittoral fringe (0.4/0.5 m) varied among different sectors of the shoreline, mainly in relation to morphology and inclination of the substratum. Well-developed populations of the fucalean brown algae *Ericaria amentacea* (C. Agardh) Molinari & Guiry and *Cystoseira compressa* (Esper) Gerloff & Nizamuddin occurred in some parts of the southern portion of the W shore and on the SE shore (where they occasionally formed stretches of continuous belt), whereas these species were scattered on the rest of the island. In parts of shoreline where these seaweeds were absent, the assemblages consisted of highly diverse turfs formed by articulated corallines (*Amphiroa rigida* J.V. Lamouroux, *Ellisolandia elongata* (J. Ellis & Solander) Hind & Saunders, *Jania* spp.), filamentous species (*Bryopsis* cf. *duplex*, *Falkenbergia* phase of *Asparagopsis* sp., *Ceramium* spp., *Dasya* spp., *Herposiphonia* spp., *Lophosiphonia cristata* Falkenberg, *Polysiphonia* spp., *Spyridia filamentosa* (Wulfen) Harvey, *Taenioma nanum* (Kützing) Papenfuss, *Vertebrata fruticulosa* (Wulfen) Kuntze, *Wrangelia penicillata* (C. Agardh) C. Agardh) and small-sized pseudoparenchymatous species (*Chondria boryana* (De Notaris) De Toni, *Dictyota* spp., *Gastroclonium clavatum* (Roth) Ardissone, *Gelidium* cf. *crinale* (Turner) Gaillon, *Laurencia obtusa* (Hudson) J.V. Lamouroux, *Osmundea* sp.) (Table 1). Algal turfs were also common in shaded habitats, particularly the steep cliffs of the SE shore near Punta Falconara (sectors 14–18). In these habitats, however, their composition was different: the most common species were *Acrosorium ciliolatum* (Harvey) Kylin), *Aphanocladia stichidiosa* (Funk) Ardré, *Champia parvula* (C. Agardh) Harvey, *Griffithsia phyllamphora* J. Agardh, *Herposiphonia tenella* (C. Agardh) Ambronn, *Heterosiphonia crispella* (C. Agardh) M.J. Wynne, *Hypoglossum hypoglossoides* (Stackhouse) Collins & Hervey, *Rhodophyllis divaricata* (Stackhouse) Papenfuss, *Sphacelaria* spp. and *Vickersia baccata* (J. Agardh) Karsakoff. A large upper littoral rockpool located on the SE shore (Fig. 2A; sector 10: 44°1'29.62"N, 8°13'42.97"E) hosted a distinct macroalgal assemblage, dominated by three fucalean browns (*Cystoseira compressa*, *Gongolaria elegans* (Sauvageau) Molinari & Guiry, *Sargassum vulgare* C. Agardh). During the study, some brown and red seaweeds (*Cladostephus hirsutus* (Linnaeus) Boudouresque & M. Perret-Boudouresque, *Halopithys incurva* (Hudson) Batters, *Rytiphlaea tinctoria* (Clemente) C. Agardh, *Schottera nicaeensis* (J.V. Lamouroux ex Duby) Guiry & Hollenberg) were recorded only from this rockpool, in the understory of the fucalean canopy.

The algal vegetation of the shallow infralittoral zone (up to 2/3 m depth) consisted mainly of dictyotalean brown algae (*Dictyopteris polypodioides* (A.P. De Candolle) J.V. Lamouroux, *Dictyota* spp., *Padina pavonica* (Linnaeus) Thivy, *Taonia atomaria*

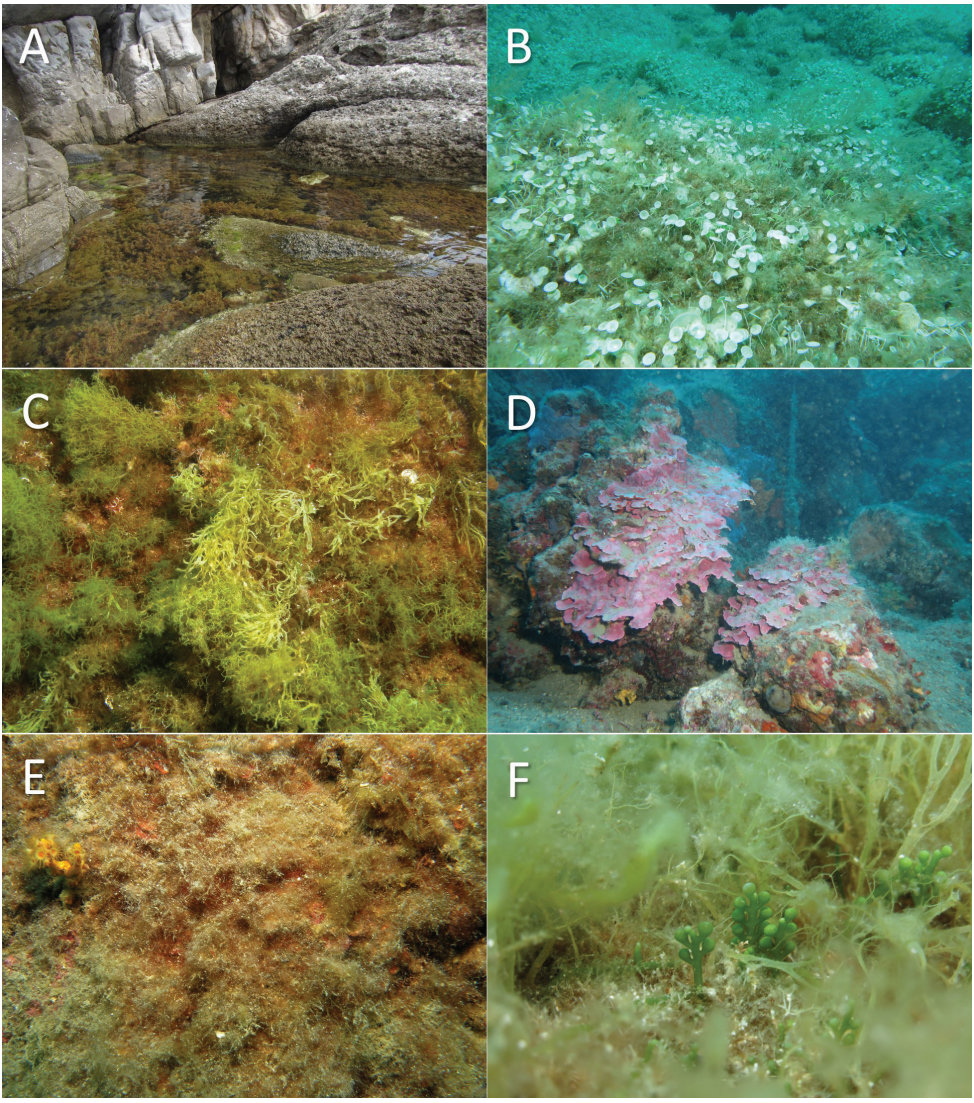

Figure 2. Details of algal communities of Gallinara Island **A** littoral rockpool on the SE shore colonized by a dense community of fucalean algae **B** a shallow infralittoral bottom at Punta Sciusciaù with a large population of *Acetabularia acetabulum* **C** a community dominated by dictyotalean brown algae (Punta Falconara, 10 m) **D** two large specimens of *Lithophyllum stictiforme* (Punta Sciusciaù, ~35 m) **E** a turf formed mostly by *Womersleyella setacea* (Punta Falconara, 30 m) **F** detail of some erect axes of *Caulerpa cylindracea* (Punta Sciusciaù, 10 m).

(Woodward) J. Agardh), patches of the articulated coralline *Ellisolandia elongata* and turfs of filamentous red algae similar to those of the infralittoral fringe. Other photophilic species typical of the north-western Mediterranean (*Acetabularia acetabulum* (Linnaeus) P.C. Silva, *Laurencia obtusa*, *Halopteris scoparia* (Linnaeus) Sauvageau) were

abundant (Fig. 2B) and thin articulated corallines (*Jania* spp.) were among the most common epiphytes. A peculiarity discovered in the shallow infralittoral zone was a population of the siphonous green alga *Pedobesia simplex* (Meneghini ex Kützing) M.J. Wynne & Leliaert formed by unattached specimens freely lying on sand in a sheltered inlet of the harbour (44°1'36.31"N, 8°13'29.56"E), at 0.5 m.

Deeper infralittoral and circalittoral zones were more heterogeneous. The parts of sea bottom towards the mainland (W-SW oriented) are characterised by a gentle slope and a patchy meadow of the seagrass *Posidonia oceanica* on sandy and coarse sediment, while toward the open sea (SE oriented) the island has steep rocky cliffs and landslide masses ending with detrital and muddy sediments at around 35 m depth, where a peculiar population of the boring sponge *Cliona viridis* (Schmidt, 1862) has been described in its gamma (massive) stage (Cerrano et al. 2007). The underwater seaward geomorphological profile at Punta Sciusciaù is characterized by vertical cliffs from the surface to 6 m depth, continuing with a plateau 20–30 m wide, with scattered rocks and pebbles with a very slight inclination down to 12 m depth, then from 12 to 24 m depth a second vertical cliff with some small terraces, followed by a gentler rocky slope from 24 m depth to 30 m depth, and then by scattered rocky blocks with coralligenous accretions. The underwater seaward profile at Punta Falconara is characterised by cliffs and landslides of boulders mixed to coarse sediments.

At the study time, exposed infralittoral rocks around 10 m depth were mainly covered by dictyotalean brown algae (Fig. 2C). Between 10 and 20 m the algal assemblages were rich and heterogeneous; they covered most of the rocky substrata and consisted mainly of *Acetabularia acetabulum*, *Codium bursa*, (Linnaeus) C. Agardh *Padina pavonica*, *Halimeda tuna* (J. Ellis & Solander) J.V. Lamouroux, *Valonia utricularis* (Roth) C. Agardh, *Bonnemaisonia asparagoides* (Woodward) C. Agardh, *Asparagopsis* sp., *Laurencia* spp., *Halopteris scoparia*, Caulerpa cylindracea Sonder, cf. Acrosymphyton purpuriferum (J. Agardh) Sjöstedt, *Ceramium* spp., *Halopteris filicina* (Grateloup) Kützing, *Tricleocarpa fragilis* (Linnaeus) Huisman & R.A. Townsend, *Peyssonnelia* spp., *Pseudochlorodesmis furcellata* and *Jania* spp. Circalittoral rocks around 30 m depth were less covered by algae. The most abundant seaweeds at these depths were *Peyssonnelia* spp., dictyotalean browns, *Lithophyllum stictiforme* (Areschoug) Hauck (Fig. 2D), *Halopteris filicina*, *Pseudochlorodesmis furcellata* (Zanardini) Børgesen, *Padina pavonica*, *Halimeda tuna*, *Valonia utricularis*, *Jania* spp. The non-indigenous filamentous red alga *Womersleyella setacea* was common both at 10 and 30 m depth, forming some nearly monospecific turfs between 20 and 30 m (Fig. 2E). The non-indigenous chlorophyte *Caulerpa cylindracea* had a similarly wide range, but it was more frequently observed at 10 m than at 30 m depth and was generally less abundant (2F).

Discussion

With 91 new records, our results increase substantially the number of macroalgal taxa for which the occurrence on Gallinara is documented. Combining our results with

information from relevant literature (Balduzzi et al. 1992; Mangialajo et al. 2004; Tunesi et al. 2006; Bianchi et al. 2018), the macroalgal flora of the island as currently known appears to consist of 162 taxa (28 Chlorophyta, 105 Rhodophyta, 29 Ochrophyta; Table S1). The number of taxa that we recorded is substantially higher than the estimate of 71 based on previous literature. Such increase is due mainly to the identification of numerous filamentous species that were not investigated in previous studies (which were based on visual census by SCUBA diving and ROV observations, methods inadequate to identify small-sized seaweeds). We believe, however, that the current estimate of 162 taxa is incomplete and probably not yet close to the actual total. Our investigations were carried out in early June, and therefore covered a limited span of the annual cycle. In the Mediterranean area early June is late spring; at this time of the year Mediterranean seaweed communities are highly species-diverse, with most species occurring in their fully developed habit. So, our sampling probably provided a good general representation of the macroalgal flora of the island. Nevertheless, it is obvious that our collections did not include seasonal species with temporal occurrence restricted to other periods (e.g., foliose red algae of the genus *Pyropia*, which in the Mediterranean occur in the mediolittoral zone in winter and early spring). In addition, our sampling could not cover the totality of benthic habitats around the island. In particular, we did not sample the meadows of *Posidonia oceanica* located in the harbour and near the northernmost part of the western shore. *Posidonia oceanica* meadows are three-dimensional environments characterized by a high associated biological diversity, with distinctive assemblages occurring on the leaves and on the rhizomes (Piazzi et al. 2002, 2015). So, almost certainly we missed some species known only or mainly as epiphytes of the leaves of this seagrass (e.g., the brown algae *Cladosiphon cylindricus* (Sauvageau) Kylin, *Giraudia sphacelarioides* Derbès & Solier, *Myriactula gracilis* van der Ben, *Myriactula rivulariae* (Suhr ex Areschoug) Feldmann and *Myrionema orbiculare* J. Agardh). We also remark that our identifications were based entirely on morphological grounds. It is now well known that this approach is insufficient to unravel the full diversity of macroalgal floras and should be integrated with DNA sequence data (Bartolo et al. 2020; Rindi et al. 2020a). This is especially true for small seaweeds with simple morphology, e.g. foliose or filamentous, which abound in the Mediterranean macroalgal flora. Cases of cryptic diversity are frequent in these algae and have been documented in the recent past (e.g., Wolf et al. 2018, 2019; Díaz-Tapia et al. 2020; Serio et al. 2020). In recent years we produced DNA sequence data from samples collected from Gallinara, as part of separate studies focusing on some species (Pezzolesi et al. 2017, 2019; Caragnano et al. 2020; Rindi et al. 2020b). One of these (Caragnano et al. 2020) unravelled a striking case of cryptic diversity: we described the new species *Lithophyllum pseudoracemus* Caragnano, Rodondi & Rindi based on samples collected from a rhodolith bed at -40 m in the area of Punta Falconara. This cryptic species was discriminated from *Lithophyllum racemus* (Lamarck) Foslie on molecular basis; probably, records of *Lithophyllum racemus* from Gallinara reported by Bianchi et al. (2018) should be referred to it. For the purpose of the present study, unfortunately, we could not generate molecular data.

Despite of these limitations, our results recovered a relatively species-diverse macroalgal flora that can be considered typical of the north-western Mediterranean. The flora of Gallinara has substantial similarities with those of north-western Mediterranean islands and coastal areas that have been floristically well investigated. Of the 162 taxa reported for Gallinara, about 110 are common to Gorgona Island (Piazzi et al. 2004), about 100 to Giannutri Island (Piazzi and Cinelli 2002) and 105–110 to the area of Calafuria, near Livorno (Rindi et al. 2002; Piazzi et al. 2009). However, the actual number of taxa common with these locations is probably higher. In our study we could not identify at species level several algae, due to the small size of the specimens or the lack of critical diagnostic features (e.g., *Bryopsis* cf. *duplex* De Notaris, *Bryopsis* sp., *Cladophora* cf. *dalmatica* Kützing, *Ulva* cf. *flexuosa* Wulfen, *Ulva* cf. *laetevirens* Areschoug, cf. *Acrosymphyton purpuriferum*, cf. *Callithamnion corymbosum* (J.E. Smith) Lyngbye, *Chondria* cf. *mairei* Feldmann-Mazoyer, *Gelidium* cf. *crinale*, *Liagora* cf. *viscida* (Forsskål) C. Agardh) (for this reason, in the floristic comparison with the abovementioned localities, we report approximate numbers). It is likely, however, that these belong to species widespread in the north-western Mediterranean.

The spatial coverage of our study does not fully correspond to previous work performed on Gallinara (Balduzzi et al. 1992; Mangialajo et al. 2004; Tunesi et al. 2006, 2008; Bianchi et al. 2018). Despite of this, our results allow some comparisons highlighting the recent changes that took place in the macroalgal communities. Our results confirm the rarefaction or loss of some large-sized brown algae, which seems to agree with the scenario of reduction of three-dimensional structure described by Bianchi et al. (2018). These authors reported a decrease of erect and canopy-forming species in parallel with an increase in filamentous algae, which caused homogenization of the epibenthic communities and destroyed the three-dimensional habitat structure that characterized Gallinara in the early 1990s. In particular, we did not record the brown seaweed *Sargassum vulgare*, either in our collections or visually, in any part of the island except the upper littoral rockpool of the SE shore. This macrophyte was common around Gallinara until 2009, when it used to form a conspicuous community in the infralittoral zone, best developed around 5 m depth (Bianchi et al. 2018). Its current rarity matches the decline described for the shores of Mediterranean France, for which habitat loss and pollution have been invoked as main causes (Thibaut et al. 2016). Similarly, we did not record two other fucalean brown algae previously reported from Gallinara, *Ericaria zosteroides* (C. Agardh) Molinari & Guiry (reported as common in the circalittoral of the SE shore by Balduzzi et al. 1992, as *Cystoseira zosteroides*; and still forming locally dense patches in the same area in July 2005, Mangialajo, personal communication) and *Gongolaria montagnei* (J. Agardh) Kuntze (reported from the W shore by Balduzzi et al. 1992, as *Cystoseira spinosa*). However, we did not investigate the deep infralittoral habitats occupied by these algae as carefully as the shallow infralittoral zone, so we may have missed them. Differently from Bianchi et al. (2018) we found that two other large brown seaweeds, *Cystoseira compressa* and *Dictyopteris polypodioides*, are still generally common on the island, although with distribution concentrated in certain habitats and certain parts of the shoreline (Table 1). These are two

widespread Mediterranean phaeophytes that thrive in a wide range of environmental conditions and may also occur at sites moderately affected by anthropogenic disturbances (Mangialajo et al. 2008; Mancuso et al. 2018; Orfanidis et al. 2021). We also confirm the presence of *Gongolaria elegans* in the rockpool on the SE shore, where this species was previously recorded by Mangialajo (2007).

However, the most remarkable difference is the widespread occurrence of the filamentous red alga *Womersleyella setacea* (Hollenberg) R.E. Norris, which was not reported in previous studies (although we suspect that the filamentous algae noted by Bianchi et al. (2018) might be mainly this species). In the 5 years of our investigation, *Womersleyella setacea* was widely distributed in the lower infralittoral and circalittoral zones, where it formed dense filamentous turfs at depths ranging between 10 and 30 m, both at Punta Sciusciaù ad Punta Falconara. The widespread presence of this alga in the north-western Mediterranean was first noted by Verlaque (1989); this author remarked its abundance in the Rade de Giens (Var, France; a bay located about 150 km from Gallinara). *Womersleyella setacea* is considered an introduction in the Mediterranean; in recent decades, dense turfs formed mostly by this species have become a feature of the seascape of several north-western Mediterranean locations (Piazzi and Cinelli 2001; Piazzi and Balata 2009; Cebrian and Rodriguez-Prieto 2012). Microscopic observation of samples from Gallinara did not reveal any reproductive structures, supporting the idea that in the Mediterranean this alga reproduces only vegetatively (as suggested by previous studies, e.g. Airoldi et al. 1995; Athanasiadis 1997; Rindi et al. 1999; Cebrian and Rodriguez-Prieto 2012). The creeping axes of this species are capable to spread quickly over the substrata occupied, covering large portions of bottom in which thick turfs develop and recruitment of seaweeds reproducing sexually or by spores is hampered (Airoldi 1998; Piazzi and Balata 2009). Ballesteros et al. (2009) suggested the development of *Womersleyella setacea* as a likely cause of the decline of *Ericaria zosteroides* (as *Cystoseira zosteroides*) in the Scandola Marine Reserve (Corsica). This scenario appears compatible with the situation observed in Gallinara. A quantitative assessment of the distribution of this species on the SE shore of Gallinara will be presented in a separate manuscript (Torsani et al., in preparation).

We also recorded two other non-indigenous species, *Caulerpa cylindracea* and *Acrothamnion preissi* (Sonder) Wollaston, known for the invasive traits that they have shown in the north-western Mediterranean. *Acrothamnion preissi* was found in very small amounts, but it might be more common than we were able to detect; this filamentous species is a common epiphyte on the rizomes of *Posidonia oceanica* (Piazzi et al. 2002). *Caulerpa cylindracea* spread aggressively in the Ligurian Sea in the last 20 years and in 2015 was reported to be still increasing its range and habitat occupancy (Montefalcone et al. 2015; Cerrano et al. 2017). Its presence on Gallinara has been known since 2005 (Tunesi et al. 2006) and Bianchi et al. (2018) reported an increase in abundance of the species in the last decade. In the course of our surveys we observed this species in the in the rockpool of the SE shore and the infralittoral zone of the SE shore where, however, it did not appear to be abundant. Future surveys will be necessary to assess whether this is indicative of a regression of *Caulerpa cylindracea* in the area or not.

Conclusions

Our results confirm that some large-sized seaweeds considered important as habitat formers have become rare or disappeared from Gallinara. Despite of this, our investigations revealed a macroalgal flora that is substantially more diverse than appreciated so far, particularly in the shallow infralittoral zone. The number of species currently documented (which, as remarked above, is certainly incomplete) is considerable for an island with a 1.4 km-long coastline. The loss or rarefaction of a few iconic species does not seem to us sufficient to conclude that the macroalgal vegetation of Gallinara must be considered impoverished. In particular, the large number of filamentous, turf-forming species, discovered should not be regarded as a reason to consider it a flora of low significance. There is a tendency to consider algal turfs as communities of lower value compared to canopy-forming species, and to treat all turfs as functionally equivalent units, regardless of their composition. In particular, most ecophysiological studies of algal turfs treat them at assemblage level and their species composition is often neglected (Provera et al. 2021). In fact, algal turfs may be very species-diverse and different turf-forming species, although morphologically similar, may respond differently to environmental change (Provera et al. 2021). So, even this component of benthic assemblages is important to study in detail in its all aspects (which has not been done for Gallinara so far).

Based on our results, we suggest that Gallinara is an interesting representative site that deserves further detailed investigation in relation to its benthic communities. In a more general perspective, considering the peculiarity of the island biodiversity, we also argue that plans for the creation of an MPA should be revitalized, in agreement with the urgent need to protect and conserve at least 30% of the Earth's lands and waters by 2030 as expected by the EU's biodiversity strategy.

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References

Airoldi L (1998) Roles of disturbance, sediment stress, and substratum retention on spatial dominance in algal turf. Ecology 79: 2759–2770. https://doi.org/10.1890/0012-9658(1998)079[2759:RODSSA]2.0.CO;2

Airoldi L, Rindi F, Cinelli F (1995) Structure, seasonal dynamics and reproductive phenology of a filamentous turf assemblage on a sediment influenced, rocky subtidal shore. Botanica Marina 38: 227–237. https://doi.org/10.1515/botm.1995.38.1-6.227

Athanasiadis A (1997) North Aegean marine algae IV. *Womersleyella setacea* (Hollenberg) R. E. Norris (Rhodophyta, Ceramiales). Botanica Marina 40: 473–476. https://doi.org/10.1515/botm.1997.40.1-6.473

Balata D, Piazzi L, Rindi F (2011) Testing a new classification of morphological functional groups of marine macroalgae for the detection of responses to stress. Marine Biology 158: 2459–2469. https://doi.org/10.1007/s00227-011-1747-y

Balduzzi A, Bianchi CN, Cattaneo-Vietti R, Cerrano C, Cocito S, Cotta S, Degl'Innocenti F, Diviacco G, Morgigni M, Morri C, Pansini M, Salvatori L, Senes L, Sgorbini S, Tunesi L (1992) Primi lineamenti di bionomia bentica dell'Isola Gallinaria (Mar Ligure). Atti Associazione Italiana di Oceanologia e Limnologia 10: 603–617.

Ballesteros E, Garrabou J, Hereu B, Zabala M, Cebrian E, Sala E (2009) Deep-water stands of *Cystoseira zosteroides* C. Agardh (Fucales, Ochrophyta) in the Northwestern Mediterranean: insights into assemblage structure and population dynamics. Estuarine Coastal and Shelf Science 82: 477–484. https://doi.org/10.1016/j.ecss.2009.02.013

Ballesteros E, Torras X, Pinedo S, Garcia M, Mangialajo L, de Torres M (2007) A new methodology based on littoral community cartography dominated by macroalgae for the implementation of the European Water Framework Directive. Marine Pollution Bulletin 55: 172–180. https://doi.org/10.1016/j.marpolbul.2006.08.038

Bartolo AG, Zammit G, Peters AF, Küpper FC (2020) The current state of DNA barcoding of macroalgae in the Mediterranean Sea: presently lacking but urgently required. Botanica Marina 63: 253–272. https://doi.org/10.1515/bot-2019-0041

Bavestrello G, Bianchi CN, Calcinai B, Cattaneo-Vietti R, Cerrano C, Morri C, Puce S, Sarà M (2000) Bio-mineralogy as a structuring factor for marine epibenthic communities. Marine Ecology Progress Series 193: 241–249. https://doi.org/10.3354/meps193241

Bianchi CN, Cocito S, Diviacco G, Dondi N, Fratangeli F, Montefalcone M, Parravicini V, Rovere A, Sgorbini S, Vacchi M, Morri C (2018) The park never born: outcome of a quarter of a century of inaction on the sea-floor integrity of a proposed but not established Marine Protected Area. Aquatic Conservation: Marine and Freshwater Ecosystems 28: 1209–1228. https://doi.org/10.1002/aqc.2918

Caragnano A, Rodondi G, Basso D, Peña V, Le Gall L, Rindi F (2020) Circumscription of *Lithophyllum racemus* (Corallinales, Rhodophyta) from the western Mediterranean Sea reveals the species *Lithophyllum pseudoracemus* sp. nov. Phycologia 59: 584–597. https://doi.org/10.1080/00318884.2020.1829348

Cebrian E, Rodriguez-Prieto C (2012) Marine invasion in the Mediterranean Sea: the role of abiotic factors when there is no biological resistance. PLoS ONE 7: e31135. https://doi.org/10.1371/journal.pone.0031135

Cecchi E, Gennaro P, Piazzi L, Ricevuto E, Serena F (2014) Development of a new biotic index for ecological status assessment of Italian coastal waters based on coralligenous macroalgal assemblages. European Journal of Phycology 49: 298–312. https://doi.org/10.1080/09670262.2014.918657

Cerrano C, Milanese M, Ponti M (2017) Diving for science – science for diving: Volunteer scuba divers support science and conservation in the Mediterranean Sea. Aquatic Conservation: Marine and Freshwater Ecosystems 27(2): 303–323. https://doi.org/10.1002/aqc.2663

Cerrano C, Sambolino P, Azzini F, Calcinai B, Bavestrello G (2007) Growth of the massive morph of *Cliona nigricans* (Schmidt 1862) (Porifera, Clionaidae) on different mineral substrata. Italian Journal of Zoology 74: 13–19. https://doi.org/10.1080/11250000600929370

Coppejans E (1983) Iconographie d'algues Méditerranées. Chlorophyta, Phaeophyta, Rhodophyta. Bibliotheca Phycologica 63: 1–28.

Cormaci M, Furnari G, Catra M, Alongi G, Giaccone G (2012) Flora marina bentonica del Mediterraneo: Phaeophyceae. Bollettino dell'Accademia Gioenia di Scienze Naturali di Catania 45: 1–508.

Cormaci M, Furnari G, Alongi G (2014) Flora marina bentonica del Mediterraneo: Chlorophyta. Bollettino dell'Accademia Gioenia di Scienze Naturali di Catania 47: 11–436.

Cormaci M, Furnari G, Alongi G (2017) Flora marina bentonica del Mediterraneo: Rhodophyta (Rhodymeniophycidae escluse). Bollettino dell'Accademia Gioenia di Scienze Naturali di Catania 50: 1–391.

Cormaci M, Furnari G, Alongi G (2020) Flora marina bentonica del Mediterraneo: Rhodophyta - Rhodymeniophycidae I. Acrosymphytales, Bonnemaisoniales, Gelidiales, Gigartinales, Gracilariales. Bollettino Accademia Gioenia di Scienze Naturali di Catania 53: 11–346. https://doi.org/10.35352/gioenia.v53i383.87

Cormaci M, Furnari G, Alongi G (2021) Flora marina bentonica del Mediterraneo: Rhodophyta - Rhodymeniophycidae II. Halymeniales, Nemastomatales, Peyssonneliales, Plocamiales, Rhodymeniales, Sebdeniales. Bollettino Accademia Gioenia di Scienze Naturali di Catania 54: 9–342. https://doi.org/10.35352/gioenia.v54i384.94

D'Archino R, Piazzi L (2021) Macroalgal assemblages as indicators of the ecological status of marine coastal systems: a review. Ecological Indicators 129: 107835. https://doi.org/10.1016/j.ecolind.2021.107835

Díaz-Tapia P, Ly M, Verbruggen H (2020) Extensive cryptic diversity in the widely distributed *Polysiphonia scopulorum* (Rhodomelaceae, Rhodophyta): molecular species delimitation and morphometric analyses. Molecular Phylogenetics and Evolution 152: 106909. https://doi.org/10.1016/j.ympev.2020.106909

Guiry MD, Guiry GM (2022) *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. https://www.algaebase.org [searched on 25 January 2022]

Mancuso FP, Strain EMA, Piccioni E, De Clerck O, Sarà G, Airoldi L (2018) Status of vulnerable *Cystoseira* populations along the Italian infralittoral fringe, and relationships with environmental and anthropogenic variables. Marine Pollution Bulletin 129: 762–771. https://doi.org/10.1016/j.marpolbul.2017.10.068

Mangialajo L (2007) A prospection of Fucales populations in the Liguria Sea rockpools. In: Pergent-Martini C, Pergent G, Hamza A, Harmelin JG (Eds) Proceedings of the 3d Mediterranean Symposium on Marine Vegetation. Regional Activity Center for Specially Protected Areas (RAC/SPA), Tunis, 282–284.

Mangialajo L, Barberis G, Cattaneo-Vietti R (2004) Contributo alla conoscenza della biodiversità macroalgale delle Aree Marine Protette Liguri. Informatore Botanico Italiano 36: 550–553.

Mangialajo L, Chiantore M, Cattaneo-Vietti R (2008) Loss of fucoid algae along a gradient of urbanisation, and structure of benthic assemblages. Marine Ecology Progress Series 358: 63–74. https://doi.org/10.3354/meps07400

Montefalcone M, Morri C, Parravicini V, Bianchi CN (2015) A tale of two invaders: divergent spreading kinetics of the alien green algae *Caulerpa taxifolia* and *Caulerpa cylindracea*. Biological Invasions 17: 2717–2728. https://doi.org/10.1007/s10530-015-0908-1

Orfanidis S, Panayotidis P, Ugland K (2011) Ecological Evaluation Index continuous formula (EEI-c) application: a step forward for functional groups, the formula and reference condition values. Mediterranean Marine Science 12: 199–232. https://doi.org/10.12681/mms.60

Orfanidis S, Rindi F, Cebrian E, Fraschetti S, Nasto I, Taskin E, Bianchelli S, Papathanasiou V, Kosmidou M, Caragnano A, Tsioli S, Ratti S, Fabbrizzi E, Verdura J, Tamburello L, Beqiraj S, Kashta L, Sota D, Papadimitriou A, Mahmoudi E, Kicaj H, Georgiadis K, Hannachi A, Danovaro R (2021) Effects of natural and anthropogenic stressors on fucalean brown seaweeds across different spatial scales in the Mediterranean Sea. Frontiers in Marine Science 8: e658417. https://doi.org/10.3389/fmars.2021.658417

Orlando-Bonaca M, Lipej L, Orfanidis S (2008) Benthic macrophytes as a tool for delineating, monitoring and assessing ecological status: the case of Slovenian coastal waters. Marine Pollution Bulletin 56: 666–676. https://doi.org/10.1016/j.marpolbul.2007.12.018

Pezzolesi L, Falace A, Kaleb S, Hernandez-Kantun JJ, Cerrano C, Rindi F (2017) Genetic and morphological variation in an ecosystem engineer, *Lithophyllum byssoides* (Corallinales, Rhodophyta). Journal of Phycology 53: 146–160. https://doi.org/10.1111/jpy.12488

Pezzolesi L, Peña V, Le Gall L, Gabrielson PW, Kaleb S, Hughey JR, Rodondi G, Hernandez-Kantun JJ, Falace A, Basso D, Cerrano C, Rindi F (2019) Mediterranean *Lithophyllum stictiforme* is a genetically diverse species complex: implications for species circumscription, biogeography and conservation of coralligenous habitats. Journal of Phycology 55: 473–492. https://doi.org/10.1111/jpy.12837

Piazzi L, Cinelli F (2001) Distribution and dominance of two introduced turf-forming macroalgae on the coast of Tuscany, Italy, northwestern Mediterranean Sea in relation to different habitats and sedimentation. Botanica Marina 44: 509–520. https://doi.org/10.1515/BOT.2001.057

Piazzi L, Cinelli F (2002) Contributo alla conoscenza dei popolamenti macroalgali dell'isola di Giannutri (Arcipelago Toscano). Informatore Botanico Italiano 34: 79–86.

Piazzi L, Balata D (2009) Invasion of alien macroalgae in different Mediterranean habitats. Biological Invasions 11: 193–204. https://doi.org/10.1007/s10530-008-9224-3

Piazzi L, Balata D, Cinelli F (2002) Epiphytic macroalgal assemblages of *Posidonia oceanica* rhizomes in the western Mediterranean. European Journal of Phycology 37: 69–76. https://doi.org/10.1017/S0967026201003432

Piazzi L, Balata D, Cinelli F (2004) Species composition and morphological groups of macroalgal assemblages around Gorgona Island (north-western Mediterranean Sea). Cryptogamie Algologie 25: 19–38.

Piazzi L, Cecchi E, Pardi G, Cinelli F (2009) I popolamenti macroalgali di Calafuria (Livorno). Atti della Società Toscana di Scienze Naturali, Memorie, Serie B 116: 81–90.

Piazzi L, Balata D, Ceccherelli G (2015) Epiphyte assemblages of the Mediterranean seagrass *Posidonia oceanica*: an overview. Marine Ecology 37: 3–41. https://doi.org/10.1111/maec.12331

Pinedo S, Garcia M, Satta MP, de Torres M, Ballesteros E (2007) Rocky-shore communities as indicators of water quality: a case study in the northwestern Mediterranean. Marine Pollution Bulletin 55: 126–135. https://doi.org/10.1016/j.marpolbul.2006.08.044

Provera I, Piñeiro-Corbeira C, Barreiro R, Diaz-Acosta L, Diaz-Tapia P (2021) Species identity matters: functional responses to warming in congeneric turfs differ from those of a canopy algae but are species-specific. Estuarine Coastal and Shelf Science 257: 107396. https://doi.org/10.1016/j.ecss.2021.107396

Regione Liguria (2020) Nuovo Atlante degli Habitat Marini sc. 1:10000. https://geoportal.regione.liguria.it/

Rindi F, Guiry MD (2004) A long-term comparison of the benthic algal flora of Clare Island, County Mayo, western Ireland. Biodiversity and Conservation 13: 471–492. https://doi.org/10.1023/B:BIOC.0000009496.32334.82

Rindi F, Guiry MD, Cinelli F (1999) Morphology and reproduction of the adventive Mediterranean rhodophyte *Polysiphonia setacea*. Hydrobiologia 398/399: 91–100. https://doi.org/10.1023/A:1017061428205

Rindi F, Pasella MM, Lee ME, Verbruggen H (2020b) Phylogeography of the Mediterranean seaweed *Halimeda tuna*. Journal of Phycology 56: 1109–1113. https://doi.org/10.1111/jpy.13006

Rindi F, Gavio B, Díaz-Tapia P, Di Camillo CG, Romagnoli T (2020a) Long-term changes in the benthic macroalgal flora of a coastal area affected by urban impacts (Conero Riviera, Mediterranean Sea). Biodiversity and Conservation 29: 2275–2295. https://doi.org/10.1007/s10531-020-01973-z

Rindi F, Sartoni G, Cinelli F (2002) A floristic account of the benthic marine algae of Tuscany (Western Mediterranean Sea). Nova Hedwigia 74: 201–250. https://doi.org/10.1127/0029-5035/2002/0074-0201

Rodríguez-Prieto C, Ballesteros E, Boisset F, Afonso-Carrillo J (2013) Guía de las macroalgas y fanerógamas marinas del Mediterráneo occidental. Ediciones Omega, S.A., Barcelona, 656 pp.

Serio D, Furnari G, Moro I, Sciuto K (2020) Molecular and morphological characterisation of *Melanothamnus testudinis* sp. nov. (Rhodophyta, Rhodomelaceae) and its distinction from *Polysiphonia carettia*. Phycologia 59: 281–291. https://doi.org/10.1080/00318884.2020.1752531

Thibaut T, Blanfuné A, Verlaque M, Boudouresque CF, Ruitton S (2016) The *Sargassum* conundrum: very rare, threatened or locally extinct in the NW Mediterranean and still lacking protection. Hydrobiologia 781: 3–23. https://doi.org/10.1007/s10750-015-2580-y

Tunesi L, Agnesi S, Di Martino V, Mo G, Molinari A, Mangialajo L, Bava S (2006) Evoluzione spazio-temporale dei popolamenti dei fondali dell'Isola Gallinaria (Mar Ligure). Biologia Marina Mediterranea 13: 104–105.

Tunesi L, Agnesi S, Di Nora T, Molinari A, Mo G (2008) Marine protected species and habitats of conservation interest in the Gallinaria Island (Ligurian Sea): a study for the establishment of the marine protected area. Atti Associazione Italiana di Oceanologia e Limnologia 19: 489–497.

Verlaque M (1989) Contribution à la flore des algues marines de Méditerranée: espéces rares ou nouvelles pour les côtes françaises. Botanica Marina 32: 101–113. https://doi.org/10.1515/botm.1989.32.2.101

Wolf MA, Buosi A, Juhmani AF, Sfriso A (2018) Shellfish import and hull fouling as vectors for new red algal introductions in the Venice Lagoon. Estuarine Coastal and Shelf Science 215: 30–38. https://doi.org/10.1016/j.ecss.2018.09.028

Wolf MA, Sciuto K, Betto VM, Moro I, Maggs CA, Sfriso A (2019) Updating *Ceramium* (Rhodophyta, Ceramiales) biodiversity in the North Adriatic Sea (Mediterranean): *Ceramium rothianum* sp. nov. and rediscovery of three forgotten species. European Journal of Phycology 54: 571–584. https://doi.org/10.1080/09670262.2019.1618919

Supplementary material 1

Table S1

Authors: Fabio Rindi, Brigitte Gavio, Laura Pezzolesi, Daniela Pica, Massimo Ponti, Fabrizio Torsani, Carlo Cerrano

Data type: docx. file

Explanation note: Summary table summarizing the macroalgal flora of Gallinara Island based on comparison of the floristic list of the present study with floristic information presented in the main literature reports.

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RESEARCH ARTICLE

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Notulae to the Italian native vascular flora: 13

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Abstract

In this contribution, new data concerning the distribution of native vascular flora in Italy are presented. It includes new records, confirmations, and exclusions to the Italian administrative regions. Nomenclatural and distribution updates, published elsewhere, and corrigenda are provided as Suppl. material 1.

Keywords

Endemic taxa, Floristic data, Italy

How to contribute

The text for the new records should be submitted electronically to Lorenzo Lastrucci (lorenzo.lastrucci@unifi.it). The corresponding specimen along with its scan or photograph have to be sent to FI Herbarium: Sezione di Botanica "Filippo Parlatore" del Museo di Storia Naturale, Via G. La Pira 4, 50121 Firenze (Italy). Those texts concerning nomenclatural novelties (typifications only for accepted names), status changes, exclusions, and confirmations should be submitted electronically to: Fabrizio Bartolucci (fabrizio.bartolucci@gmail.com). Each text should be within 1,000 characters (spaces included).

Floristic records of native taxa

***Ajuga chamaepitys* (L.) Schreb. subsp. *chamaepitys* (Lamiaceae)**

+ **CAL**: Oriolo (Cosenza), nei pressi della Cappella di San Francesco (WGS84: 40.059187°N, 16.430091°E), boscaglia mesofila con dominanza di *Quercus pubescens* e margini, 625 m, 22 May 2021, *F. Roma-Marzio 1414* (PI No. 054235). – Subspecies confirmed for the flora of Calabria.

This subspecies was recorded by Lorenzetti and Iamonico (2009) based on three old specimens collected in Castrovillari and Laino Borgo and kept in RO, but it was no longer found in Calabria before this report.

F. Roma-Marzio, L. Bernardo

***Avena barbata* Pott ex Link subsp. *castellana* Romero Zarco (Poaceae)**

+ **CAL**: Oriolo (Cosenza), C.da Serra Salice nei pressi del bivio che porta alla cappella di San Francesco (WGS84: 40.056238°N, 16.433910°E), margini stradali, 665 m, 19 May 2021, *F. Roma-Marzio 1420*, det. *E. Banfi* (FI). – Subspecies new for the flora of Calabria.

F. Roma-Marzio, E. Banfi

***Blackstonia acuminata* (W.D.J.Koch & Ziz) Domin subsp. *acuminata* (Gentianaceae)**

+**PIE**: Salbertrand (Torino), Regione Illes Neuves (WGS84: 45.074691°N, 6.893679°E), depositi golenali umidi adiacenti alla sponda sinistra della Dora Riparia, 997 m, 27 September 2021, *M. Lonati, D. Barberis, M. Pittarello* (FI). – Species confirmed for the flora of Piemonte.

Although *Blackstonia acuminata* is listed as absent in Piemonte (Bartolucci et al. 2018), this species was historically reported in the early 1900s (as *Chlora perfoliata* L. var. *serotina* Koch) in the hills around Turin (Negri 1905). Besides the locality recorded here, this species occurs also in a second close locality, along the right bank of the Dora Riparia. Several individuals grow on humid river sediments, together with *Typha minima* Funk ex Hoppe and *Epipactis palustris* (L.) Crantz.

M. Lonati, D. Barberis, M. Pittarello

***Brachypodium retusum* (Pers.) P.Beauv. (Poaceae)**

+ **MAR**: Monte Rosato (Fermo) (WGS84: 43.131194°N, 13.697722°E), pineta rada con suolo scoperto e crepato dal sole, argilla, versante nord, 4 June 2021, *M. Tiburtini* (FI). – Species new for the flora of Marche.

This species has been only reported in the southern part of the Italian Adriatic side, from Abruzzo to Puglia (Bartolucci et al. 2018).

G. Astuti, F. Roma-Marzio, M. Tiburtini

***Cyperus glomeratus* L. (Cyperaceae)**

+ **UMB**: Terni (Terni), F. Tevere (SS448) sotto il ponte tra i bivi della SP380 in sponda destra (WGS84: 42.7604555°N,12.347113°E), 145 m, 28 August 2020, *R. Venanzoni, S. Praleskouskaya* (FI, PERU barcode PERU-2106). – Species confirmed for the flora of Umbria.

R. Venanzoni, S. Praleskouskaya

***Crepis neglecta* L. subsp. *neglecta* (Asteraceae)**

+ **SIC**: Roccalumera (Messina), via Torrente Sciglio (Strada Provinciale 25/A) (WGS84: 37.982938°N, 15.395166°E), margini stradali, 19 May 2021, *F. Luchino* (FI). – Subspecies confirmed for the flora of Sicilia.

This species was recorded by Giardina et al. (2007) and Bartolucci et al. (2018) as doubtfully occurring in Sicilia.

F. Luchino, O. Caldarella, R. Guarino

***Cryptogramma crispa* (L.) R.Br. ex Hook. (Pteridaceae)**

+ **VEN**: Falcade (Belluno), Col Margherita (WGS84: 46366117°N, 11793935°E), macereto siliceo, 2460 m, 27 August 2021, leg. *A. Sebellin, S. Ballestrin*, conf. *C. Argenti* (FI). – Species confirmed for the flora of Veneto.

This species was reported for Veneto "nel Bellunese" by De Visiani and Saccardo (1869) and in "Monte Campomolon, Monte Melegnone" by Vasolin (1900). These old records have never been confirmed up to now, and recently they were considered as doubtful (Argenti et al. 2019).

A. Sebellin, S. Ballestrin, C. Argenti

***Dianthus brachycalyx* A.Huet & É.Huet ex Bacch., Brullo, Casti & Giusso (Caryophyllaceae)**

+ **UMB**: Norcia (Perugia), Monti Sibillini, M. Vettoretto, versante SO-O (WGS84: 42.803295°N, 13.260340°E), pascolo su suolo calcareo, 1870 m, 27 July 2021, leg. *F. Falcinelli*, det. *V. Ferri, D. Gigante, F. Falcinelli* (PERU-DSA3); *ibidem*, Scoglio del Lago, versante S (WGS84: 42.819251°N, 13.256761°E), pascolo su suolo calcareo, 2375 m, 27 July 2021, leg. *F. Falcinelli*, det. *V. Ferri, D. Gigante, F. Falcinelli*

(FI, PERU-DSA3); *ibidem*, tra Scoglio del Lago e Punta di Prato Pulito (WGS84: 42.819252°N, 13.256798°E), pascolo su suolo calcareo, 2380 m, 3 August 2021, leg. *F. Falcinelli*, det. *V. Ferri, D. Gigante, F. Falcinelli* (PERU-DSA3). – Species confirmed for the flora of Umbria.
+ **MAR**: Arquata del Tronto (Ascoli Piceno), Monti Sibillini, M. Vettore, versante SO nelle vicinanze della Punta di Prato Pulito (WGS84: 42.816353°N, 13.263387°E), pascolo su suolo calcareo, 2330 m, 27 July 2021, *F. Falcinelli* (PERU-DSA3); *ibidem*, M. Vettore, versante SO presso Prato Pulito (WGS84: 42.816410°N, 13.264755°E), pascolo su suolo calcareo, 2290 m, 3 August 2021, *F. Falcinelli* (PERU-DSA3); Montemonaco (Ascoli Piceno), Monti Sibillini, tra Scoglio del Lago e Punta di Prato Pulito (WGS84: 42.819941°N,13.256534°E), pascolo su suolo calcareo, 2380 m, 3 August 2021, *F. Falcinelli* (FI, PERU-DSA3). – Species new for the flora of Marche.

V. Ferri, D. Gigante, F. Falcinelli

***Echinaria capitata* (L.) Desf. (Poaceae)**

+ **CAL**: Oriolo (Cosenza), calanchi fra Arma dei Lettieri e Manca del Cerro (WGS84: 40.043090°N, 16.420399°E), calanchi e vegetazione arbustiva termofila, 770 m, 23 May 2021, *F. Roma-Marzio 1417* (FI, PI No. 049547). – Species confirmed for the flora of Calabria.

Echinaria capitata was reported by Tenore (1824–1829, 1831), Parlatore (1848), and Pignatti (1982) as generically occurring in Calabria. Besides these reports, only old records for the province of Reggio Calabria are available (Porta 1879; Gentile and Di Benedetto 1962). For these reasosns, it was indicated by Bartolucci et al. (2018) as doubtfully occurring in Calabria.

F. Roma-Marzio, L. Bernardo

***Ephedra major* Host subsp. *major* (Ephedraceae)**

+ **EMR**: Montecopiolo (Rimini), loc. Villagrande di Montecopiolo, versante S del M. Montone (WGS84: 43.841913°N, 12.357388°E), pareti rocciose, suolo calcareo, 950–955 m, 9 May 2005, leg. *L. Gubellini*, det. *S. Di Massimo* (PESA, sub *Ephedra nebrodensis* Guss. subsp. *nebrodensis*). – Species new for the flora of Emilia-Romagna.

L. Gubellini, N. Hofmann

***Festuca rubra* L. subsp. *rubra* (Poaceae)**

+ **CAL**: Oriolo (Cosenza), calanchi fra Arma dei Lettieri e Manca del Cerro (WGS84: 40.043090°N, 16.420399°E), calanchi e vegetazione arbustiva termofila, 770 m, 23 May 2021, *F. Roma-Marzio 1419*, det. *E. Banfi* (FI). – Subspecies new for the flora of Calabria.

Three different subspecies of *Festuca rubra* L. are reported from Calabria: *F. rubra* subsp. *commutata* (Gaudin) Markgr.-Dann., *F. rubra* subsp. *juncea* (Hack.) K.Richt., and *F. rubra* subsp. *microphylla* St.-Yves (Bartolucci et al. 2018).

F. Roma-Marzio, E. Banfi

Filipendula vulgaris **Moench (Rosaceae)**

+ **CAL**: Oriolo (Cosenza), nei pressi della fiumana in C.da Santa Marina lungo la strada che porta a San Giorgio Lucano (WGS84: 40.092577°N, 16.436941°E), prati e margini di bosco mesofilo, 630 m, 17 May 2021, *F. Roma-Marzio 1413* (FI). – Species new for the flora of Calabria.

According to Tenore (1830, 1831, under the name *Spiraea filipendula* L.), this species occurred in Pollino area, and it was later recorded also by Longo (1905) for Piano Novacco (Saracena). Then, Pignatti (1982) and Pignatti et al. (2017) quoted this species generically for Pollino. More recently, Bartolucci et al. (2018) reported this species as not occurring in the region.

F. Roma-Marzio, L. Bernardo

Fumaria gaillardotii **Boiss. (Papaveraceae)**

+ **MAR**: Potenza Picena (Macerata), loc. Porto Potenza Picena (WGS84: 43.376514°N, 13.690634°E), pendici erbose della massicciata ferroviaria, tra la S.S. 16 e la ferrovia, c. 3 m, suolo prevalentemente ghiaioso-sabbioso, humus nullo, 13 February 2022, *L. Gubellini* (FI, PESA). – Species new for the flora of Marche.

L. Gubellini, N. Hofmann

Gladiolus illyricus **W.D.J.Koch (Iridaceae)**

– **TOS**. – Species to be excluded from the flora of Toscana.

Gladiolus illyricus was reported as doubtfully occurring in Toscana (Bartolucci et al. 2018), based on the only record published by Di Gaeta and Garbari (2009). However, the specimen linked to this publication and preserved in PI (No. 058973) is actually *Gladiolus italicus* Mill.

L. Pinzani, F. Roma-Marzio, G. Astuti

Globularia cordifolia **L. subsp.** ***cordifolia*** **(Plantaginaceae)**

+ **UMB**: Cascia (Perugia), M. Pizzuto (o M. Pozzoni) versante SO-O presso Costa delle Cavalle (WGS84: 42.656776°N, 13.153102°E), pascolo arido su suolo calcareo, 1750 m, 30 June 2021, leg. *F. Falcinelli*, det. *F. Bonini, D. Gigante, F. Falcinelli* (FI, PERU-DSA3); M. Pizzuto (o M. Pozzoni) versante O presso Costa delle Cavalle (WGS84: 42.659016°N, 13.152364°E), rupe su suolo calcareo, 1730 m, 30 June 2021, leg. *F. Falcinelli*, det. *F. Bonini, D. Gigante, F. Falcinelli* (PERU-DSA3). – Species and subspecies confirmed for the flora of Umbria.

F. Bonini, D. Gigante, F. Falcinelli

Gratiola officinalis **L. (Plantaginaceae)**

– **CAM**. – Species to be excluded from the flora of Campania.

Tenore (1824–1829) reported this species for "Terra di Lavoro", for two localities actually placed in Lazio: Fondi [province of Latina] and San Germano [= Piedimonte San Germano, province of Frosinone] (NAP-Collection Tenore!). The same localities were listed by Caruel (1884), but later they were altogether reported as "T. di Lavoro" (Fiori and Béguinot 1900–1902), or, even more vaguely, as "Camp." (Fiori 1926), and "Pal. Pontine, Camp." (Pignatti 1982). No further specimen or literature data has been traced for Campania.

E. Del Guacchio, P. Caputo

***Hieracium exilicaule* Gottschl. (Asteraceae)**

+ **MAR**: Frontone (Pesaro e Urbino), Gruppo del M. Catria, nella Valle della Porta (WGS84: 43.476607°N, 12.704984°E), macereti e luoghi sassosi, suolo calcareo, humus scarso o subnullo, 800–825 m, 9 May 1986, leg. *A. Brilli-Cattarini*, *L. Gubellini*, det. *S. Di Massimo* (sub *Hieracium* ? *bifidum* Kit.), rev. *G. Gottschlich* (PESA). – Species new for the flora of Marche.

G. Gottschlich, L. Gubellini, N. Hofmann

***Hieracium neoplatyphyllum* Gottschl. subsp. *neoplatyphyllum* (Asteraceae)**

+ **UMB**: Gubbio (Perugia), Serre di Picognola nel versante NW del M. di Picognola (WGS84: 43.413747°N, 12.622776°E), boschi radi (cerreta mista), suolo arenaceo, humus scarso, 875–900 m, 22 September 1978, leg. et det. *A. Brilli-Cattarini* (sub *Hieracium sabaudum* L.), rev. *G. Gottschlich* (PESA); *ibidem* (WGS84: 43.415097°N, 12.620879°E), fruticeti e boschi radi (cerreta mista), suolo arenaceo, humus subnullo, 800–850 m, 20 July 1978, leg. et det. *A. Brilli-Cattarini* (sub *Hieracium* cfr. *sabaudum* L.), rev. *G. Gottschlich* (PESA). – Species new for the flora of Umbria.

G. Gottschlich, L. Gubellini, N. Hofmann

***Hieracium neyranum* Arv.-Touv. subsp. *neyranum* (Asteraceae)**

+ **MAR**: Montemonaco (Ascoli Piceno), M. Sibillini, nell'alto Pian della Gardosa sotto il Fosso del Miracolo (WGS84: 42.853895°N, 13.259251°E), luoghi erboso-sassosi, suolo calcareo, humus scarso o subnullo, 1175–1200 m, 25 July 1986, leg. *A. Brilli-Cattarini, L. Gubellini*, det. *A. Brilli-Cattarini* (sub *Hieracium ? glaucum* All. *s.l.*), rev. *G. Gottschlich* (PESA). – Species new for the flora of Marche.

G. Gottschlich, L. Gubellini, N. Hofmann

***Hieracium pallescens* Waldst. & Kit. subsp. *oxyodontiforme* (Zahn) Murr (Asteraceae)**

+ **LOM**: Bormio (Sondrio), near Spondalunga between Bormio und Passo di Stelvio (WGS84: 46.513°N, 10.408°E), 2150 m, 30 July 1995, *G. Gottschlich et M. Nydegger* (FI, *Herb. Gottschlich-30534*). – Subspecies new for the flora of Lombardia.

G. Gottschlich

***Hieracium picroides* Vill. subsp. *trichopicris* (Zahn) Zahn (Asteraceae)**

+ **TAA**: Pfossental (Bolzano) between Nassreid and Vorderkaser, north of the tunnel (WGS84: 46.72813°N, 10.92962°E), 1620–1650 m s.n., *Alnus* shrubs, silicates, 23 July 2000, *G. Gottschlich*-41561 (Hieracia Euopaea Selecta No. 992: B, FI, FR, H, IBF, LI, M, MSTR, PAL, W, *Herb. Brandstätter*, *Herb. Dunkel*, *Herb. Gottschlich*). – Subspecies confirmed for the flora of Trentino-Alto Adige.

G. Gottschlich

***Hieracium pseudogrovesianum* Gottschl. subsp. *pseudogrovesianum* (Asteraceae)**

+ **MAR**: Montegallo (Ascoli Piceno), gruppo del M. Ceresa nel versante N del M. Pianamonte alla Valle fredda (WGS84: 42.838667°N, 13.371140°E), luoghi boschivi (castagneto), suolo arenaceo, humus da scarso a +/- abbondante, 800–850 m, 12 June 1989, leg. *A. Brilli-Cattarini, L. Gubellini*, det. *S. Di Massimo* (sub *Hieracium* ? *argillaceum* Jordan *s.l.*), rev. *G. Gottschlich* (PESA); Montegallo (Ascoli Piceno), gruppo del M. Ceresa lungo il Fosso di Forca (WGS84: 42.827008°N, 13.345178°E), luoghi boschivi (castagneto, ostrieto), suolo arenaceo, humus da scarso a +/- abbondante, 800–850 m, 15 June 1983, leg. *A. Brilli-Cattarini, L. Gubellini*, det. *L. Gubellini* (sub *Hieracium murorum s.l.*), rev. *G. Gottschlich* (PESA); Rotella (Ascoli Piceno), lungo il fosso dell'Inferno presso Rovetino (WGS84: 42.969714°N, 13.548357°E), luoghi boschivi (carpineto, querceto mesofilo), suolo arenaceo, humus da subnullo a +/- abbondante, 325–375 m, 28 May 1981, Leg. *A. Brilli-Cattarini, L. Gubellini*, det. *A. Brilli-Cattarini* (sub *Hieracium murorum* L. *s.l.*), rev. *G. Gottschlich* (PESA). – Species new for the flora of Marche.

G. Gottschlich, L. Gubellini, N. Hofmann

***Hieracium scorzonerifolium* Vill. (Asteraceae)**

+ **MAR**: Bolognola (Macerata), M. Sibillini, nel versante N del Pizzo Acuto dei tre Vescovi (WGS84: 42.958605°N, 13.219632°E), luoghi sassosi, suolo calcareo, humus nullo, 1675–1700 m, 16 July 1990, leg. *A. Brilli-Cattarini, L. Gubellini* et *M. Rocchi*, det. *S. Di Massimo* (sub *Hieracium villosum* Jacq.), rev. *G. Gottschlich* (PESA); Montefortino (Fermo), M. Sibillini, sulla cresta NE della Cima della Vallelunga (WGS84: 42.892421°N, 13.243316°E), luoghi rocciosi e sassosi, suolo calcareo, humus nullo o subnullo, 2175–2200 m, 11 July 1988, leg. *A. Brilli-Cattarini, L. Gubellini*, det. *S. Di Massimo* (sub *Hieracium villosum* Jacq.), rev. *G. Gottschlich* (PESA). – Species new for the flora of Marche.

G. Gottschlich, L. Gubellini, N. Hofmann

***Koeleria lucana* Brullo, Giusso & Miniss. (Poaceae)**

+ **CAL**: Oriolo (Cosenza), 2,5 km a NE del paese, lungo la SP147 sul versante orientale del M.te Guardia Cappello, pratelli terofitici a bordo strada, 650 m (WGS84:

40.06894°N, 16.47083°E), 18 May 2021, *F. Roma-Marzio 1418*, det. *E. Banfi* (FI). – Species new for the flora of Calabria.

Koeleria lucana is an Italian endemic species reported for Lazio, Campania, and Basilicata (Bartolucci et al. 2018, 2019b).

F. Roma-Marzio, E. Banfi

***Koeleria subcaudata* (Asch. & Graebn.) Ujhelyi (Poaceae)**

+ **TOS**: San Marcello Pistoiese (Pistoia), wood edges along the trail from Bivacco le Roncole to the crest (WGS84: 44.103000°N, 10.811000°E), sandstone, ca. 1400 m, 19 June 2021, leg. *V. Lazzeri*, det. *V. Lazzeri, G. Gestri* (FI). – Species new for the flora of Toscana.

V. Lazzeri, G. Gestri

***Littorella uniflora* (L.) Asch. (Plantaginaceae)**

EX **VEN**. – Extinct species for the flora of Veneto.

This species once occurred in the wetlands along Lake Garda (Pollini1822–1824; Goiran 1897–1904, as *Littorella lacustris* L.) as well documented also by several herbarium specimens in VER (AMG423b, AMG423c, AM394, AG2525b, AG2525c, CT327). It was then indicated as doubtfully occurring in the region (Conti et al. 2005; Bartolucci et al. 2018). The confirmation of the abovementioned herbarium specimens, together with the recent floristic researches conducted in the area, suggest that this species should be considered regionally extinct in Veneto (Buffa et al. 2016).

S. Andreatta, F. Prosser

***Micromeria graeca* (L.) Benth. ex Rchb. subsp. *tenuifolia* (Ten.) Nyman (Lamiaceae)**

+ **PUG**: Andria (Barletta-Andria-Trani), località Punta di Bosco Spirito all'interno del Parco nazionale dell'Alta Murgia (WGS84: 41.138338°N, 16.214347°E), prato-pascolo su substrato calcareo affiorante, 290 m s.l.m. 13 May 2018, *G. Buccomino* (FI). – Subspecies confirmed for the flora of Puglia.

This subspecies is reported as no longer recorded for Puglia (Badino and Peruzzi 2009; Bartolucci et al. 2018).

G. Buccomino, E.V. Perrino

***Oxybasis chenopodioides* (L.) S.Fuentes, Uotila & Borsch (Amaranthaceae)**

+ **UMB**: S. Feliciano (Perugia), Oasi la valle (WGS84: 43.106111°N, 12.1847222°E), 258 m, 18 August 2021, *R. Venanzoni*, *S. Praleskouskaya* (FI, PERU barcode PERU-2112); Tuoro (Perugia), Punta Navaccia, spiaggia fronte al canneto (WGS84: 43.1899777°N, 12.075508333°E), 258 m, 18 September 2021, *R.Venanzoni, S. Praleskouskaya* (PERU barcode PERU-2100). – Species new for the Flora of Umbria.

R. Venanzoni, S. Praleskouskaya

***Phelipanche ramosa* (L.) Pomel (Orobanchaceae)**

+ **UMB**: Coldipeccio (Perugia) (WGS84: 43.404940°N, 12.750890°E), area marginale su coltivi abbandonati 580 m, 2 June 2021, *G. Mei* (FI, *Herb. G. Mei*). – Species confirmed for the flora of Umbria.

This is the first recent finding of this species for the region (Barberis and Domina 2010).

G. Mei

***Pilosella corvigena* (Gottschl.) Gottschl. (Asteraceae)**

+ **TAA**: Ledro (Trento), in loc. Colonghe all'ingresso della Val Sacher (WGS84: 45.893609°N, 10.657582°E), prato magro ripido su calcare, 890 m, 3 Juny 2013, leg. et det. *F. Prosser*, rev. *G. Gottschlich* (ROV No. 67167). – Species new for the flora of Trentino-Alto Adige.

G. Gottschlich, F. Prosser

***Pilosella ziziana* (Tausch) F.W.Schultz & Sch.Bip. (Asteraceae)**

+ **TOS**: Massa, Canale Regollo, versante sinistro (WGS84: 44.107942°N, 10.170100°E), 770 m s.l.m., 20 June 2020, leg. *A. Soldano*, det. *G. Gottschlich* (FI, *Herb. Soldano* No. 18686). – Species new for the flora of Toscana.

A. Soldano, G. Gottschlich

***Quercus suber* L. (Fagaceae)**

+ **MOL**: Jelsi (Campobasso), Masseria della Vedova (WGS84: 41.537266°N, 14.814841°E), uncultivated on marly-arenaceous substrate, 471 m, 25 September 2021, *B. Paura* (FI). – Species new for the flora of Molise.

We found an isolated plant in Jelsi (Campobasso), quite distant from the rural construction Masseria della Vedova, and therefore we can exclude that it was cultivated for ornamental purposes. The cultivation of *Q. suber* in Molise for the production of acorns is also unlikely. The hypothesis that *Q. suber* is native in Molise is supported by the numerous (unpublished) reports of *Q.* × *crenata* Lam. that testify, for this region, a greater demographic incidence of *Q. suber* in the past.

B. Paura, M. Terzi

***Ranunculus polyanthemophyllus* W.Koch & H.E.Hess (Ranunculaceae)**

+ **TOS**: Cutigliano (Pistoia), wood edge along the trail that connects Melo to the crest, near Poggio de' Cristalli (WGS84: 44.144000°N, 10.741000°E), ca. 1300 m, 27 June 2021, leg. *V. Lazzeri*, det. *V. Lazzeri, G. Gestri* (FI). – Species new for the flora of Toscana.

V. Lazzeri, G. Gestri

***Rosa gallica* L. (Rosaceae)**

+ **CAL**: Oriolo (Cosenza), C.da Careto, bosco con prevalenza di roverella e carpino nero (WGS84: 40.059084°N, 16.406448°E), 685 m, 28 May 2021, *F. Roma-Marzio 1415* (PI No. 054234). – Species confirmed for the flora of Calabria.

Rosa gallica was recorded in the past for the Pollino area (Petagna et al. 1827; Tenore 1830) and for Reggio Calabria at Capo Spartivento (Macchiati 1884). Both these localities were also reported by Caruel (1884), while Fiori (1924) indicated this species only for Pollino. More recently, Pignatti (1982) reported it generically for Calabria while Pignatti et al. (2017) state that it is missing in the region. Based on these data, Bartolucci et al. (2018) reported this species as historically occurring in Calabria.

F. Roma-Marzio, L. Bernardo

***Rosa montana* Chaix (Rosaceae)**

+ **TOS**: Val Serenaia (Lucca), tra il Parcheggio Val Serenaia e Il Rif. Donegani (WGS84: 44.813394°N, 10.19666°E), arbusteto rado, 1100 m, 26 Aug 2021, *L. Pinzani* (FI). – Species new for the flora of Toscana.

Rosa montana was reported as occurring in Toscana by Conti et al. (2005). However, Roma-Marzio et al. (2016) did not find bibliographic references or herbarium vouchers referring to this species, which was therefore considered as reported by mistake for the region.

L. Pinzani

***Sabulina glaucina* (Dvořáková) Dillenb. & Kadereit (Caryophyllaceae)**

+ **TOS**: San Marcello Pistoiese (Pistoia), along the trail from Podere Montaglioni to the crest near Prato della Madonna (WGS84: 44.091000°N, 10.803000°E), ca. 1300 m, 19 June 2021, leg. *V. Lazzeri*, det. *V. Lazzeri, G. Gestri* (FI). – Species new for the flora of Toscana.

V. Lazzeri, G. Gestri

***Sambucus racemosa* L. (Fabaceae)**

– **LAZ**. – Species to be excluded from the flora of Lazio.

This species was considered as doubtfully occurring in Lazio by Anzalone et al. (2010), who cited Valle di Canneto (Picinisco) as the only location in the region, based on an old record by Tenore (1835: "Sorgente della Melfa", a site erroneously referred to Abruzzo by Pignatti et al. 2018) and Tenore and Gussone (1842). However, there isn't any specimen from this area labelled as *S. racemosa* in either Tenore or Gussone collections in NAP. Moreover, despite our field searches, we never found this species at the site where, instead, *S. nigra* L. is very common. The latter is not mentioned in the detailed floristic list of Valle di Canneto by Tenore and Gussone (1842): it was probably misnamed as *S. racemosa.*

G. Filibeck, L. Cancellieri, F. Conti

***Trifolium montanum* L. subsp. *montanum* (Fabaceae)**

+ **TOS**: Pontremoli (Massa e Carrara), Appennino tosco-emiliano, presso il Passo della Cisa (poco a N sopra la strada) (WGS84: 44.471330°N, 9.927770°E), a margine di un sentiero erboso, ca 1100 m s.l.m., 18 June 2021, *G. Gestri, B. Pierini* (FI). – Subspecies new for the flora of Toscana.

G. Gestri, B. Pierini

***Typha shuttleworthii* W.D.J. Koch & Sond. (Typhaceae)**

+ **MAR**: Monte Cerignone (Pesaro e Urbino), fiume Conca (WGS84: 43.842013°N, 12.411527°E) a bordo alveo, 470 m s.l.m., 31 July 2021, *T. Bruschi, P. Laghi, F. Santi* (FI). – Species new for the flora of Marche.

T. Bruschi, P. Laghi, F. Santi

***Ulex europaeus* L. subsp. *europaeus* (Fabaceae)**

0 **UMB**: Bosco del giardino dei Murelli presso Perugia, 11 May 1906, *G. Cicioni* (PERU barcode PERU-00721811). – Species not recently confirmed for the flora of Umbria.

Ulex europaeus subsp. *europaeus* was recorded by Bartolucci et al. (2018) as doubtfully occurring for Umbria, although its presence was already reported for Monte Malbe near Perugia by Batelli (1887) and Barsali (1932) based on samples collected by Giulio Cicioni. The analysis of the herbarium Cicioni in PERU (Mazzerioli et al. 1996) allowed us to trace the aforementioned exsiccatum and to confirm the historical presence of this taxon in Umbria.

R. Venanzoni, A. Stinca

***Vinca difformis* Pourr. subsp. *difformis* (Apocynaceae)**

+ **CAL**: Oriolo (Cosenza), lungo la strada che da C.da Scalapitta sale verso l'agriturismo Cervinace (WGS84: 40.038855°N, 16.454164°E), margine di siepi a bordo strada, 385 m, 5 Jan 2022, *F. Roma-Marzio 1796* (FI, PI No. 054085). Oriolo (Cosenza), C.da Serra Salice, circa 1 km a NE del paese (WGS84: 40.058201°N, 16.435657°E), margine di siepi a bordo strada, 667 m, 5 Jan 2022, *F. Roma-Marzio 1797* (PI No. 054084). – Species new for the flora of Calabria.

Vinca difformis subsp. *difformis* is a west Mediterranean taxon that reach its eastern distribution limit in Italy (Marhold 2011+), where it is reported as rare in several regions from Liguria to Puglia (Bartolucci et al. 2018; Pignatti et al. 2018). Actually, this species was also reported in the past for the southern part of Calabria (Bisogni 1896, under the name *Vinca media* Hoffmanns. & Link). We found two different localities, distant from each other about 3 km, and about 3 km southeast from Basilicata, from which this species was recently excluded (Bartolucci et al. 2019a).

F. Roma-Marzio, L. Bernardo

Floristic records of regional alien taxa

***Andryala integrifolia* L. (Asteraceae)**

+ (CAS) **LOM**: Cremona (Cremona), via E. Assi e via N. Calipari (WGS84: 45.141337°N, 10.028715°E), bordo di via lastricata e via in ghiaia tra loro collegate, 45 m, no exp., 4 June 2021, *F. Bonali* (FI, *Herb. F. Bonali*). – Casual regional alien species new for the flora of Lombardia.

F. Bonali

***Anethum piperitum* Ucria (Apiaceae)**

+ (CAS) **VEN**: Verona (Verona), stazione dei treni di Verona Porta Nuova (WGS84: 45.425064°N, 10.980756°E), 64 m, 9 June 2021, *F. Prosser, G. Tomasi* (ROV No. 80119, sterile individual); *ibidem*, 5 August 2021, *G. Tomasi, A. Bertolli* (FI, ROV No. 80120). – Casual regional alien species confirmed for the flora of Veneto.

F. Prosser, G. Tomasi, A. Bertolli

***Catananche caerulea* L. (Asteraceae)**

+ (CAS) **VEN**: Peschiera (Verona), a S di Mano di Ferro, presso il Forte Ardietti (WGS84: 45.423713°N, 10.693057°E), pendio boscato arido, 90 m, 20 June 2020, *F. Festi* (FI, ROV No. 80066). – Casual regional alien species new for the flora of Veneto.

F. Festi

***Crepis bursifolia* L. (Asteraceae)**

+ (NAT) **LOM**: Milano (Milano), Viale Monza, c/o incrocio con Via Isocrate, margine erboso (WGS84: 45.507948°N, 9.223087°E), 135 m, no exp., 20 June 2021, *D. Saiani* (FI, *Herb. Saiani*); *ibidem*, Viale Monza, c/o incrocio con Via privata Chioggia, spartitraffico (WGS84: 45.499760°N, 9.220784°E), margine erboso, 129 m, no exp., 1 July 2021, *G. Galasso* (FI, MSNM Nos. 51158, 51159); *ibidem*, Viale Monza, c/o incrocio con Via privata della Torre, spartitraffico (WGS84: 45.500967°N, 9.221150°E), margine erboso, 130 m, no exp., 1 July 2021, *G. Galasso* (MSNM No. 51160); *ibidem*, Viale Monza, tra Via P. Petrocchi e Via privata G. Puecher, spartitraffico (WGS84: 45.502699°N, 9.221686°E), margine erboso, 131 m, no exp., 1 July 2021, *G. Galasso* (FI, MSNM Nos. 51161, 51162); *ibidem*, Piazza Precotto (WGS84: 45.513400°N, 9.224771°E), margine erboso, 133 m, no exp., 1 July 2021 (MSNM Nos. 51163, 51164); *ibidem*, Viale Monza, tra Via Erodoto e Via Fratelli Bressan, lato dei numeri dispari (WGS84: 45.509735°N, 9.223672°E), tra gli autobloccanti, 132 m, no exp., 1 July 2021, *G. Galasso* (FI, MSNM Nos. 51165, 51166); *ibidem*, Via Marco Bruto, spartitraffico lungo i binari del tram (WGS84: 45.459896°N, 9.238533°E), erboso lungo i binari del tram, 112 m, no exp., 8 September 2021, *G. Galasso* (MSNM No. 51179). – Naturalized regional alien species new for the flora of Lombardia.

D. Saiani

Euphorbia characias **L. (Euphorbiaceae)**

+ (CAS) **TAA**: Trento (Trento), giardini lungo il Torr. Fersina (WGS84: 46.055585°N, 11.12346°E), inselvatichita su muro, 203 m, 23 May 2021, *F. Prosser* (FI). – Casual regional alien species new for the flora of Trentino-Alto Adige.

This species was also observed in Arco at the archducal garden and in Varone.

F. Prosser, M. Merli

Geranium lucidum **L. (Geraniaceae)**

+ (CAS) **TAA**: Tret (Trento), presso l'orto botanico (WSG84: 46.450094°N, 11.140336°E), terreno smosso, 1050 m, 5 June 2000, *F. Festi* (ROV No. 35784); Gardolo (Trento), cimitero (WSG84: 46.106670°N, 11.105074°E), 196 m, 22 April 2021, *F. Festi, G. Tomasi* (FI, ROV No. 80122). – Casual regional alien species confirmed for the flora of Trentino-Alto Adige.

This species was indicated as doubtfully occurring in Trentino-Alto Adige by Prosser et al. (2019).

F. Festi, G. Tomasi

Hydrocotyle vulgaris **L. (Araliaceae)**

+ (CAS) **TAA**: Rovereto (Trento), Corso Rosmini (WSG84: 45.890889°N, 11.037143°E), in un'aiuola, 192 m, 5 October 2021, *F. Prosser* (FI, ROV No. 80121). – Casual regional alien species new for the flora of Trentino-Alto Adige.

F. Prosser

Moricandia arvensis **(L.) DC. (Brassicaceae)**

+ (CAS) **TAA**: Mezzano (Trento), zona artigianale in loc. Le Ghiaie (WSG84: 46.151046°N, 11.808401°E), zona erbosa disturbata, 635 m, 23 September 2011, leg. *A. Bertolli, F. Prosser*, det. *F. Prosser* (FI). – Casual regional alien species new for the flora of Trentino-Alto Adige.

A. Bertolli, F. Prosser

Petrosedum sediforme **(Jacq.) Grulich subsp.** ***sediforme*** **(Crassulaceae)**

+ (NAT) **VEN**: Verona (Verona), stazione di Porta Nuova (WSG84: 45.425787°N, 10.9793°E), scalo ferroviario, 64 m, 2 July 2021, leg. et det. *A. Bertolli, F. Prosser* (FI, ROV No. 80118). – Casual regional alien species new for the flora of Veneto.

A. Bertolli, F. Prosser

Quercus trojana **Webb subsp.** ***trojana*** **(Fagaceae)**

+ (CAS) **MAR**: Sirolo (Ancona), Parco Regionale del Conero (WSG84: 43.545558°N, 13.602775°E), rinnovazione gamica esemplari fertili nei pressi di una radura al margine di

un rimboschimento misto a dominanza di *Quercus ilex* L., 439 m, 11 September 2021, *T. Spilli, A. Pica, J. Lupoletti* (FI). – Casual regional alien species new for the flora of Marche.

Ciacci (1965) introduced *Quercus trojana* subsp. *trojana* in the Conero area. Later, this species was mentioned by Biondi et al. (2012) as cultivated for reforestation. In the recorded site, a stable renewal of *Q. trojana* is observed.

T. Spilli, A. Pica, J. Lupoletti

***Rubus radula* Weihe (Rosaceae)**

+ (NAT) **VEN**: Verona (Verona), stazione di Verona Porta Nuova (WSG84: 45.42425°N, 10.979136°E), scalo ferroviario abbandonato, 64 m, 9 June 2021, leg. *F. Prosser, G. Tomasi*, det. *K. Pagitz, G. Király* (ROV No. 80124). – Casual regional alien species confirmed for the flora of Veneto.

While *Rubus* ser. *Radula* (Focke) Focke is certainly recorded for Veneto (Argenti et al. 2019), *R. radula* is indicated as doubtfully occurring in the region by Bartolucci et al. (2018).

G. Király, K. Pagitz, F. Prosser, G. Tomasi

***Soleirolia soleirolii* (Req.) Dandy (Urticaceae)**

+ (CAS) **MAR**: Fermo (Fermo) (WGS84: 43.161562°N, 13.718048°E), mura basali subumide del palazzo situato dietro la biblioteca comunale e aree di calpestio limitrofe, 300 m, 18 April 2021, *A. Crisanti* (CAME, FI). – Casual regional alien species new for the flora of Marche.

S. Ballelli, A. Crisanti, R. Pennesi

Nomenclatural and distribution updates from other literature sources, and corrigenda

Nomenclatural and distribution updates, and corrigenda to Bartolucci et al. (2018) are provided in Suppl. material 1.

F. Bartolucci, G. Galasso

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References

Anzalone B, Iberite M, Lattanzi E (2010) La flora vascolare del Lazio. Informatore Botanico Italiano 42(1): 187–317.

Argenti C, Masin R, Pellegrini B, Perazza G, Prosser F, Scortegagna S, Tasinazzo S (2019) Flora del Veneto. Cierre Ed., Sommacampagna, Verona.

Badino B, Peruzzi L (2009) Notula: 1558. In: Nepi C, Peccenini S, Peruzzi L (Eds) Notulae alla checklist della flora vascolare italiana: 7 (1530–1567). Informatore Botanico Italiano 41(1): 138.

Barberis G, Domina G (2010) Notula: 1635. In: Nepi C, Peccenini S, Peruzzi L (Eds) Notulae alla checklist della flora vascolare italiana 9 (1623–1681). Informatore Botanico Italiano 42(1): 372–373.

Barsali E (1932) Prodromo della Flora Umbra (continuazione). Nuovo Giornale Botanico Italiano 39(2): 346–415. https://doi.org/10.1080/11263503209440423

Bartolucci F, Peruzzi L, Galasso G, Albano A, Alessandrini A, Ardenghi NMG, Astuti G, Bacchetta G, Ballelli S, Banfi E, Barberis G, Bernardo L, Bouvet D, Bovio M, Cecchi L, Di Pietro R, Domina G, Fascetti S, Fenu G, Festi F, Foggi B, Gallo L, Gottschlich G, Gubellini L, Iamonico D, Iberite M, Jiménez-Mejías P, Lattanzi E, Marchetti D, Martinetto E, Masin RR, Medagli P, Passalacqua NG, Peccenini S, Pennesi R, Pierini B, Poldini L, Prosser F, Raimondo FM, Roma-Marzio F, Rosati L, Santangelo A, Scoppola A, Scortegagna S, Selvaggi A, Selvi F, Soldano A, Stinca A, Wagensommer RP, Wilhalm T, Conti F (2018) An updated checklist of the vascular flora native to Italy. Plant Biosystems 152(2): 179–303. https://doi.org/10.1080/11263504.2017.1419996

Bartolucci F, Domina G, Ardenghi NMG, Bacaro G, Bacchetta G, Ballarin F, Banfi E, Barberis G, Beccarisi L, Bernardo L, Bonari G, Bonini F, Brullo S, Buono S, Buono V, Calbi M, Caldararo F, Calvia G, Cancellieri L, Cannavò S, Dagnino D, Esposito A, Fascetti S, Filibeck G, Fiorini G, Forte L, Galasso G, Gestri G, Gigante D, Gottschlich G, Gubellini L, Hofmann N, Lastrucci L, Lonati M, Lorenz R, Lunardi L, Magrini S, Mainetti A, Maiorca G, Mereu G, Messa Ballarin RT, Minuto L, Mossini S, Musarella CM, Nimis PL, Passalacqua NG, Peccenini S, Petriglia B, Podda L, Potenza G, Ravetto Enri S, Roma-Marzio F, Rosati L, Ruggero A, Spampinato G, Stinca A, Tiburtini M, Tietto C, Tomaselli V, Turcato C, Viciani D, Wagensommer RP, Nepi C (2019a) Notulae to the Italian native vascular flora: 8. Italian Botanist 8: 95–116. https://doi.org/10.3897/italianbotanist.8.48626

Bartolucci F, Cancellieri L, Conti F, Banfi E, Bouvet D, Celestini M, Ciaschetti G, Di Pietro R, Falcinelli F, Fascetti S, Galasso G, Lattanzi E, Masin RR, Pennesi R, Rosati L, Stinca A, Tilia A, Forte TGW, Scoppola A (2019b) Contribution to the floristic knowledge of Velino and Aterno valleys (Lazio-Abruzzo, central Italy). Italian Botanist 7: 93–100. https://doi.org/10.3897/italianbotanist.7.34697

Batelli A (1887) Seconda contribuzione alla Flora Umbra. Annali dell'Università libera di Perugia, Anno II (1886–1887), Vol. I: 136–248.

Biondi E, Gubellini L, Pinzi M, Casavecchia S (2012) The vascular flora of Conero Regional Nature Park (Marche, Central Italy). Flora Mediterranea 22: 67–167. https://doi.org/10.7320/FlMedit22.067

Bisogni C (1896) Contributo alla flora d'Hipponium. Rivista Italiana Scienze Naturale 6: 73–100.

Buffa G, Carpenè B, Casarotto N, Da Pozzo M, Filesi L, Lasen C, Marcucci R, Masin R, Prosser F, Tasinazzo S, Villani M, Zanatta K (2016) Lista rossa regionale delle piante vascolari. Regione del Veneto. Regione Veneto, Europrint, Treviso, 105 pp.

Caruel T (1884) Flora Italiana, Vol. 6. Le Monnier, Firenze.

Ciacci A (1965) Il rimboschimento del Monte Conero ad opera del Consorzio Provinciale fra lo Stato e la Provincia di Ancona (1931–1955). Isp. Rip. Foreste, Ancona, 18 pp.

Conti F, Abbate G, Alessandrini A, Blasi C [Eds] (2005) An annotated checklist of the Italian vascular flora. Palombi & Partner, Roma, 424 pp.

De Visiani R, Saccardo PA (1869) Catalogo delle piante vascolari del Veneto. Atti del Reale Istituto Veneto di Scienze, Lettere ed Arti, ser. II, 14: 71–111.

Di Gaeta E, Garbari F (2009) Aspetti floristici e ambientali del parco di Villa Carmignani (Collesalvetti, Livorno). Atti della Società Toscana di Scienze Naturali, Memorie, serie B 116: 1–15.

Fiori A (1924) Nuova flora analitica d'Italia, Vol. 1(5). Tipografia M. Ricci, Firenze.

Fiori A (1926) Nuova flora analitica d'Italia, Vol. 2(3). Tipografia M. Ricci, Firenze.

Fiori A, Béguinot G [Eds] (1900–1902) Flora analitica d'Italia, Vol. 2. Tipografia del Seminario, Padova [Padua].

Gentile S, Di Benedetto G (1962) Su alcune praterie a *Lygeum spartum* L. e su alcuni aspetti di vegetazione di terreni argillosi della Sicilia orientale e Calabria meridionale. Delpinoa n.s. 3(1961): 67–151.

Giardina G, Raimondo FM, Spadaro V (2007) A catalogue of plants growing in Sicily. Bocconea 20: 5–582.

Goiran A (1897–1904) Le piante fanerogame dell'Agro Veronese. Censimento. "Flora veronensis, Phanerogamae". Franchini, Verona.

Kurtto A, Weber HE, Lampinen R, Sennikov AN (2010) Atlas Florae Europaeae. Distribution of Vascular Plants in Europe. 15. Rosaceae (Rubus). The Committe for Mapping the Flora of Europe & Societas Biologica Fennica Vanamo, Helsinki, 362 pp.

Longo B (1905) Nuova contribuzione alla flora calabrese. Annali di Botanica (Roma) 2: 169–183.

Lorenzetti R, Iamonico D (2009) Notula: 1550. In: Nepi C, Peruzzi L, Scoppola A (Eds) Notulae alla Checklist della flora italiana: 7 (1530–1567). Informatore Botanico Italiano 41(1): 135.

Macchiati L (1884) Catalogo delle piante raccolte nei dintorni di Reggio Calabria dal Settembre 1881 al Febbraio 1883. Nuovo Giornale Botanico Italiano 16: 59–100.

Marhold K (2011+) Apocynaceae. In: Euro+Med Plantbase – the information resource for Euro-Mediterranean plant diversity. http://ww2.bgbm.org/EuroPlusMed/ [accessed: 27.01.2022]

Mazzerioli M, Papini A, Venanzoni R (1996) L'erbario di Mons. Giulio Cicioni: prime osservazioni. Giornale Botanico Italiano 130(1): 463–463. https://doi.org/10.1080/11263509609439686

Negri G (1905) La vegetazione della collina di Torino. Memorie della Reale Accademia delle Scienze di Torino, ser. 2, 55(1): 113–188.

Parlatore F (1848) Flora Italiana, Vol. 1. Le Monnier, Firenze.

Petagna V, Terrone G, Tenore M (1827) Viaggio in alcuni luoghi della Basilicata e della Calabria Citeriore effettuato nel 1826. Tip. Francese, 8, Napoli.

Pignatti S (1982) Flora d'Italia, 1–3. Edagricole, Bologna.

Pignatti S, Guarino R, La Rosa M [Eds] (2017) Flora d'Italia, Ed. 2, Vol. 2. Edagricole, Milano.

Pignatti S, Guarino R, La Rosa M [Eds] (2018) Flora d'Italia, Ed. 2, Vol. 3. Edagricole, Milano.
Pollini C (1822–1824) Flora Veronensis, quam in prodromum florae Italiae septentrionalis exhibet, 3 Vols. Società Tipografica, Verona.
Porta P (1879) Viaggio botanico intrapreso da Huter, Porta e Rigo in Calabria nel 1877. Nuovo Giornale Botanico Italiano 11: 224–290.
Prosser F, Bertolli A, Festi F, Perazza G (2019) Flora del Trentino. Ed. Osiride-Fondazione Museo Civico, Rovereto, 1211 pp.
Roma-Marzio F, Bedini G, Müller J, Peruzzi L (2016) A critical checklist of the woody flora of Tuscany (Italy). Phytotaxa 287(1): 1–135. https://doi.org/10.11646/phytotaxa.287.1.1
Tenore M (1824–1829) Flora Napolitana, Vol. 3. Stamperia Francese, Napoli.
Tenore M (1830) Flora Napolitana, Vol. 4. Stamperia Francese, Napoli.
Tenore M (1831) Sylloge plantarum vascularium florae neapolitanae hucusque detectarum. Tipografia del Fibreno, Neapoli [Naples], 580 pp.
Tenore M (1835) Ad Florae Neapolitanae Syllogem. Appendix quarta. Typ. Fibreni, Napoli.
Tenore M, Gussone G (1842) Memorie sulle peregrinazioni eseguite dai soci ordinari Signori M. Tenore e G. Gussone lette alla Reale Accademia delle Scienze nel 1834–1838. Stamperia Reale, Napoli.
Vasolin E (1900) Flora dei monti Toraro e Campomolon e dei loro contrafforti, Tip. Cooperativa, Firenze.

Supplementary material 1

Supplementary data

Authors: [Edited by] Fabrizio Bartolucci, Gabriele Galasso

Data type: Species data (PDF file)

Explanation note: 1. Nomenclatural updates; 2. Note updates; 3. Distribution updates; 4. Synonyms, misapplied or included names.

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RESEARCH ARTICLE

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Global and Regional IUCN Red List Assessments: 13

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Abstract

In this contribution, the conservation status assessment of two vascular plants according to IUCN categories and criteria are presented. It includes the global assessment of *Isoëtes todaroana* Troìa & Raimondo and *Moluccella bucharica* (B.Fedtsch.) Ryding.

Keywords

conservation, extinction risk, IUCN protocol, threats

How to contribute

The text of the global and regional assessments should be submitted electronically to Simone Orsenigo (simone.orsenigo@unipv.it) or to Giuseppe Fenu (gfenu@unica.it); the text, up to 8000 characters in length (spaces included), must include a distribution map and a picture of the assessed species.

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Red List Assessments

Isoëtes todaroana Troìa & Raimondo

Global assessment
Taxonomy and nomenclature
Order: Isoëtales *Family*: Isoëtaceae

Isoëtes todaroana Troìa & Raimondo, Amer. Fern J. 99(4): 238 (2010) = *Isoëtes iapygia* Ernandes, Beccarisi & Zuccarello, Pl. Biosystems 144(4): 807 (2010).

Common name: Calamaria di Todaro (It), Sicilian Quillwort (En).

Geographic distribution range: *Isoëtes todaroana* (Fig. 1) is a perennial amphibious plant described from Sicily (Troìa and Raimondo 2010) and later reported for other localities of Italy and Greece (Fig. 2). This species was found near Mazara del Vallo (Trapani) and its current distribution range in the island is circumscribed to a restricted area in western Sicily. In the Italian Peninsula, *I. todaroana* occurs in Calabria, between Capo Colonna and Isola Capo Rizzuto near Crotone (Bernardo and Peruzzi

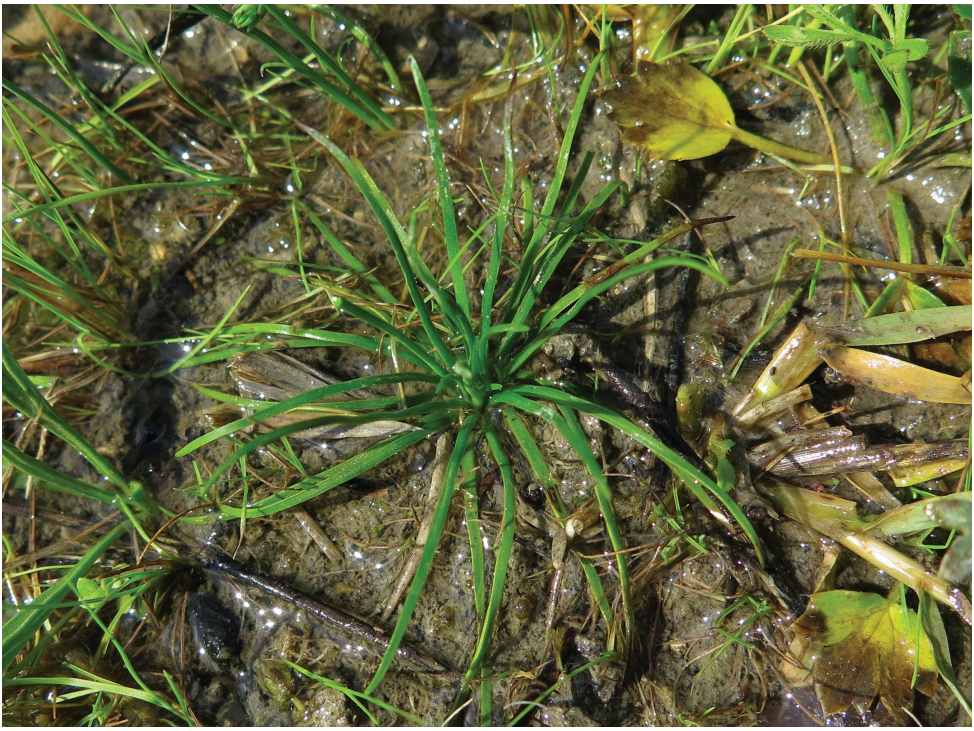

Figure 1. *Isoëtes todaroana* Troìa & Raimondo from *locus classicus* (Mazara del Vallo, Sicily). Photograph by S. Cambria.

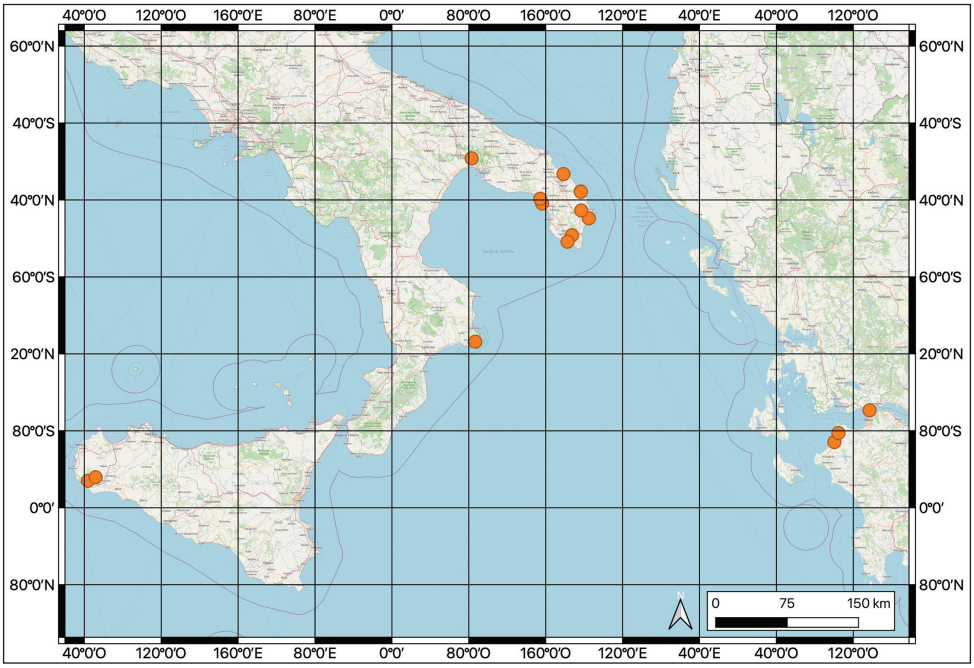

Figure 2. Geographic range and distribution map of *Isoëtes todaroana* Troìa & Raimondo.

2011), and in several localities of Apulia, between Massafra and the province of Lecce (Ernandes et al. 2010). According to Troìa and Greuter (2015), on the basis of verified herbarium specimens (formerly stored under different names), *I. todaroana* has to be added to the Greek flora.

Distribution: *Countries of occurrence*: Italy and Greece.

Biology: *Plant growth form*: perennial (geophyte).

Chromosome number: $2n = 22$ (Troìa et al. 2011).

Phenology: The spores begin to mature throughout March to May.

Reproduction: There is no available detailed information**.**

Habitat and ecology: *Isoëtes todaroana* grows on calcareous sandstone in seasonal wetlands that dry out in summer. It occurs up to 150 m a.s.l.; the community in which it grows is characterized by several hygrophilous plant species, such as *Eleocharis palustris* (L.) Roem. & Schult., *Isolepis cernua* (Vahl) Roem. & Schult., *Mentha pulegium* L., and *Lythrum tribracteatum* Salzm. ex Spreng., *Romulea ramiflora* Ten. From a phytosociological viewpoint, it falls within the *Isoëto-Nanojuncetea* class. It should be noted that the plant communities with *I. todaroana*, which is the characteristic species of the *Isoëtetum todaroanae* association (Brullo et al. 2022), are listed in Annex I of the Habitats Directive as priority habitat type (3170* Mediterranean temporary ponds).

Population information: This species shows a central-Mediterranean range with a narrow distribution in few stands. The Italian distribution is limited to 13 sites in southern Italy and Sicily, while only three sites are reported on mainland Greece (Troìa

and Greuter 2015). Usually, for each site, there is a small number of mature individuals, due to the limited extension of seasonal wetlands. Detailed information on the number of existing individuals is lacking.

Threats: *2.3 Livestock farming and ranching (nomadic grazing)*: Agricultural activities (farming and grazing) are the most relevant threat to this species. In particular, trampling by livestock and their droppings modify the natural habitats.

6.3 Work and other activities: Human pressure causes the disappearance of temporary wetlands, especially when these areas are reclaimed and converted to farmland, as can be seen in the type locality of *I. todaroana.*

11.2 Drought: the conservation of *I. todaroana* depends on the presence of temporary pools and, therefore, their drying up due to high temperature causes the rapid disappearance of the species.

CRITERIA APPLIED

Criterion B: **AOO**: 64 Km^2 calculated with GeoCAT (Geospatial Conservation Assessment Tool) programme (Bachman et al. 2011).

a) Number of locations: 10. The species is distributed in several localities of the Mediterranean basin, but its habitat is often fragmented and circumscribed to small areas of a few square meters. Although the most important threat is represented by agricultural activities (farming and grazing), as well as the conversion of the wetlands to farmland, drought could also threaten *I. todaroana*, causing the disappearance of suitable habitats.
b) According to field observations and literature data, habitat quality (iii) is in continuous decline, and a reduction of AOO (ii) is likely to have affected the species.

Red List category and Criteria (Global Assessment)

VU	**Vulnerable**	**B2ab(ii,iii)**

Rationale for the assessment: The populations are scattered in the Mediterranean area and are linked to humid habitats. Because of the presence of few individuals per stands and the significant reduction of the wetlands size, a future decline of this species is likely. Based on recent research and field investigations and according to its AOO of 64 km^2 and the number of locations (10) this species can be assessed as Vulnerable (VU).

Previous assessment: This taxon has been previously evaluated as critically endangered (CR) at a global level (Christenhusz et al. 2017a; Garcia Criado et al. 2017), but taking into account only the Sicilian populations, and considering *Isoëtes iapygia* as a distinct taxon (evaluated as vulnerable, VU, by Christenhusz et al. 2017b). At a regional level (Italy), this species (including *I. iapygia*) has been assessed as Endangered (Orsenigo et al. 2018).

Conservation actions: *Isoëtes todaroana* is not protected by international, national, or regional laws. Some of the currently known populations of this species fall within protected areas. In Italy, it grows in the following SACs (Special Areas of

Conservation, according to Habitats Directive 92/43/EEC): "Sciare di Marsala" (Trapani, code ITA010014), "Area delle Gravine" (Taranto, code IT9130007), "Palude del Capitano" (Lecce, code IT9150013) and "Rauccio" (Lecce, code IT9150006), while in Greece only one locality is included in the SAC named "Limnothalassa kalogrias, dasos strofylias kai elos lamias, araxos" (code GR2320001). Note that the *locus classicus* was not included in a protected site when the species was described, its inclusion was regarded as being desirable by Troìa and Raimondo (2010) who described the species, and formally proposed two years later, becoming recently effective .

Conservation actions needed: The restoration of degraded ecosystems is recommended in order to preserve the plant communities where *I. todaroana* grows. To maintain the natural habitats, the conversion of wetlands into farmland has to be forbidden. Furthermore, *in situ* and *ex sit*u conservation strategies are needed for possible plant translocation activities, with the objective of increasing population sizes.

Notes: The actual distribution range of the species was unclear, especially in Italy, since shortly after the publication of *I. todaroana*, another quillwort was described from Puglia as *I. iapygia* (Ernandes et al. 2010), which is currently considered as a heterotypic synonym (Troìa and Greuter 2015). This species is apparently similar to the well-known Mediterranean terrestrial species *I. histrix* Bory and *I. durieui* Bory, but actually belongs to another lineage, including the western Mediterranean *I. delilei* Rothm. and the eastern Mediterranean *I. phrygia* (Boiss.) Hausskn. (Troìa et al. 2019).

G. Tavilla, S. Cambria, A. Troìa

Moluccella bucharica (B.Fedtsch.) Ryding

Global assessment
Taxonomy and nomenclature
Order: Lamiales *Family*: Lamiaceae

Moluccella bucharica (B.Fedtsch.) Ryding, Taxon 60: 48 (2011) ≡ *Otostegia bucharica* B.Fedtsch., Izv. Imp. Bot. Sada Petra Velikago 15: 2 (1915)

Common name: Otostegia Bukhara (En).

Geographic distribution range: *Moluccella bucharica* (Fig. 3) is endemic to gypsum areas of the south-western Pamir-Alay (Uzbekistan). It is restricted to the foothill areas of the western Hissar ridge, with a narrow altitudinal range between 1,150 and 1,450 m a.s.l. Currently, this species has only two subpopulations 7 km away from each other: the largest is located in the gypsum foothill area near the villages of Derbend-Shurob, and the smallest around the village of Gurkhozhi (Fig. 4).

Distribution: *Countries of occurrence*: Uzbekistan.

Biology: *Plant growth form*: Shrub (nanophanerophyte).

Flowering and fruiting time: flowering from May to July, fruiting from July to August.

Figure 3. *Moluccella bucharica* in south-western Pamir-Alay (Surkhandarya). Photograph by B. Khabibullaev.

Reproduction: no information on pollination and dispersal strategy is available. The number of seeds per individual is variable, but overall, 85% of seeds produced are damaged by pests (Khabibullaev et al. 2022); germination rate of seeds in the laboratory is 0.001% (1/1000).

Habitat and ecology: *Moluccella bucharica* is a rare shrub (up to 120–150 cm) that grows on gypsum-rich areas, at an optimum elevation range from 1,100 to 1,500 m a.s.l., in the driest and hottest southern region of Uzbekistan (Surkhandarya region). In the foothills where it grows, the average annual temperature is in the range of 11.7–13.9 °C, with an average annual rainfall of 205 mm (1980–2020). In the hottest summer months, the average maximum temperature is 21.1 °C and the soil temperature rises to 65 °C, while in the coldest winter months, the average minimum temperature is 6.21 °C and the soil temperature can drop to -20 °C (Sparks 2022). The habitat of *Moluccella bucharica* is restricted exclusively to gypsum soils (Khabibullaev 2020), colonized by plant communities mainly dominated by *Prunus spinosissima* (Bunge) Franch., *Zygophyllum atriplicoides* Fisch. & C.A.Mey. and *Artemisia sogdiana* Bunge.

Population information: The existing subpopulations of *M. bucharica* grow in very small, isolated areas on chalk foothills. The number of adult plants in 1977 was 2,860 in three subpopulations (Belolipov 1980); in 2005 a total number of 1,974 individuals was counted, while in 2006, 2007, 2008, and 2018 the subpopulations were monitored but the individuals were not counted (Tojibaev et al. 2019). Currently,

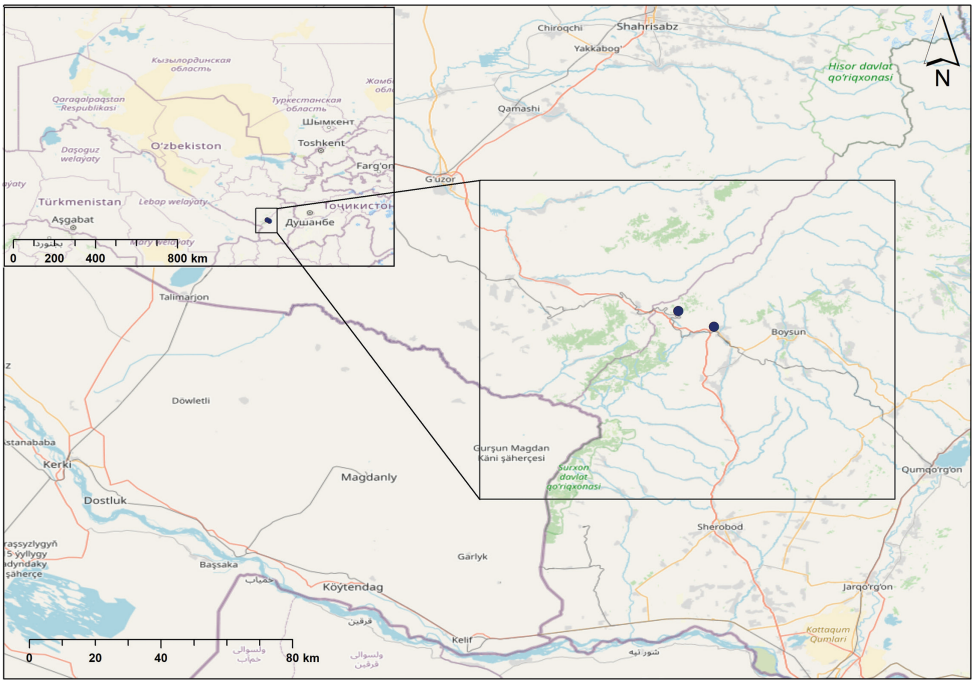

Figure 4. Geographic range and distribution map of *Moluccella bucharica*.

only two subpopulations are preserved, with a total of *c*. 600 plants, 570 of which are mature individuals (95% of the total); in the subpopulation in Derbend-Shurab, there are about 400 individuals (of these 380 are mature), and in the subpopulation in Gurkhozhi 200 individuals (of these 190 are mature). During the last 20 years, these subpopulations have been subject to large changes in population size, cover, and density. Belolipov (1980) did not observe any renewal from seeds during the previous 15 years. From unpublished work carried out at Levichev's Botanical Institute in 1987 on the seed renewal of a population growing along a pedestrian route 5 km in length, not a single seedling was observed. However, 3- to 4-year-old individuals were detected, obviously being of seminal origin (Tojibaev 2009). The overall trend of the population size and the number of mature individuals is decreasing due to the numerous threats affecting the species.

Threats: 1.1 *Housing & urban areas*: Due to the increase in the rural population, houses under construction have approached the plant populations by 20 meters, resulting in a potential negative impact.

2.3 Livestock farming & ranching (2.3.1 Nomadic grazing): the mountainous areas where the species grows are used by the local population throughout the year as pastures for livestock. Livestock grazing leads to severe damage to *M. bucharica* branches and the destruction of young individuals. In addition, there is non-irrigated agricultural land around the population of Shurob.

4.1 Roads & railroads: Large-scale road construction and geological prospecting also have a negative impact on the populations of this species. In 2005, part of the *M. bucharica* subpopulation was translocated as a result of a rail transfer from the area where the species grows (Tojibaev et al. 2019).

5.2 Gathering terrestrial plants (5.2.2 Unintentional effects [species is not the target]): Like many fuel plants, *M. bucharica* is harvested by locals for firewood.

7.3 Other ecosystem modifications: The number of pests in the ecosystem has increased dramatically. As a result, the percentage of damage to *M. bucharica* seeds has also increased. The proportion of ruderal species in the plant community has increased due to grazing (Shomurodov and Khabibullaev 2022).

11.2 Droughts: Based on the last 39 years of meteorological data (Khabibullaev et al. 2022), the trend towards a more arid climate in the locality of *M. bucharica* continues; air temperature rises by 0.27 °C every 10 years and moisture deficit increased up to 28% in the warm half of the year (e.g., in 2001 there was 87.5 mm of precipitation as compared with 299.46 mm in 1997).

11.3 Temperature extremes: The amplitude of the change in the average, maximum and minimum air temperature in the territory is high (Khabibullaev et al. 2022).

CRITERIA APPLIED

Criterion A: a continuous decline of the population of *c*. 80% was observed over the past 45 years.

Criterion B: **EOO**: 8 km^2 calculated with GeoCAT (Geospatial Conservation Assessment Tool) software (Bachman et al. 2011).

AOO: 8 km^2 calculated with GeoCAT software (Bachman et al. 2011).

a) Only a single location (unsystematic grazing and its use as fuel by the local population).
b) Continuing decline in extent of occurrence, area of occupancy, extent and quality of habitat, number of locations and subpopulations, and number of mature individuals.
c) No extreme fluctuation observed.

Criterion C: the global population, in continuous decline, is currently composed of 570 mature individuals and no subpopulation has more than 1,000 mature plants.

Criterion D: the global population comprises fewer than 1,000 mature plants.

Red List category and Criteria (Global Assessment)

CR	**Critically Endangered**	**B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v) + A2(a,c)**

Rationale for the assessment: *Moluccella bucharica* is endemic to a small area, with an EOO and AOO of 8 km^2, only one location could be identified according to major threats, and a decline in habitat quality, AOO, EOO number of location and subpopulations of this species was observed. The global population consists of 570 mature plants, and a continuous decline of the population of *c*. 80% was observed over the past 45 years. Climate change is projected to further reduce the available habitat of this high-elevation restricted

species. Although criteria C and D allow to assess the species as vulnerable (VU), *M. bucharica* should be assessed as Critically Endangered (CR) according to criteria A and B.

Previous assessment: This taxon is evaluated as Critically Endangered (CR) at the global level (Khabibullaev et al. 2021).

Conservation actions: *Moluccella bucharica* is included in the Red Book of the Republic of Uzbekistan with category 1 (on the brink of extinction) (Kuchkarov et al. 2019). However, the area where it is distributed is not part of a reserve. To protect this species from further decline by reducing habitat loss and fragmentation, the protection of sites and the limitation of overgrazing and logging are recommended. To restore the population of *M. bucharica*, it is necessary to create a protected area that includes its growing sites, raise awareness of the local population, and conduct regular monitoring. Currently, experiments are being conducted in the Tashkent Botanical Garden on the reproduction biology of the species. Measures should be taken to control pests that damage the seeds.

Conservation actions needed: Research and monitoring programmes are recommended in order to better understand the reproductive biology and population trends of this species. In addition, *in situ* and *ex situ* conservation measures are suggested for potential plant translocation programmes, with the goal to increase the low number of individuals in the population.

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References

Bachman S, Moat J, Hill AW, Torre J de la, Scott B (2011) Supporting Red List threat assessments with GeoCAT: geospatial conservation assessment tool. In: Smith V, Penev L (Eds) E-Infrastructures for data publishing in biodiversity science. ZooKeys 150: 117–126. https://doi.org/10.3897/zookeys.150.2109 [Version BETA]

Belolipov IV (1980) The modern state of rare species of Central Asian flora - *Otostegia bucharica*. Introduction and Acclimatization of Plants 9: 90–100.

Bernardo L, Peruzzi L (2011) Notulae alla checklist della Flora vascolare Italiana 12 (1823–1883). Informatore Botanico Italiano 43(2): 365.

Brullo S, Brullo C, Sciandrello S, Tavilla G, Cambria S, Tomaselli V, Ilardi V, Giusso del Galdo G, Minissale P (2022) The Plant Communities of the Class *Isoëto-Nanojuncetea* in Sicily. Plants 11(9): e1214. [73 pp.] https://doi.org/10.3390/plants11091214

Christenhusz M, Bento Elias R, Dyer R, Ivanenko Y, Rouhan G, Rumsey F, Väre H (2017a) *Isoetes todaroana*. The IUCN Red List of Threatened Species 2017: e.T83570762A83570898. https://doi.org/10.2305/IUCN.UK.2017-2.RLTS.T83570762A83570898.en

Christenhusz M, Bento Elias R, Dyer R, Ivanenko Y, Rouhan G, Rumsey F, Väre H (2017b) *Isoetes iapygia*. The IUCN Red List of Threatened Species 2017: e.T83515051A83515105. https://doi.org/10.2305/IUCN.UK.2017-2.RLTS.T83515051A83515105.en

Ernandes P, Beccarisi L, Zuccarello V (2010) A new species of *Isoëtes* (Isoëtaceae, Pteridophyta) for the Mediterranean. Plant Biosystems 144: 805–813. https://doi.org/10.1080/11263504.2010.518414

García Criado M, Väre H, Nieto A, Bento Elias R, Dyer R, Ivanenko Y, Ivanova D, Lansdown R, Molina JA, Rouhan G, Rumsey F, Troìa A, Vrba J, Christenhusz MJM (2017) European Red List of Lycopods and Ferns. Brussels, Belgium: IUCN, [iv +] 59 pp.

Khabibullaev B (2020) History of the study of the genus *Otostegia* Benth. (Lamiaceae Lindl.) in Central Asia. International scientific-theoretical conference - Actual problems of natural sciences, 247–249.

Khabibullaev B, Shomurodov K, Omar K (2021) *Moluccella bucharica*. The IUCN Red List of Threatened Species 2021: e.T198563178A198563231. https://doi.org/10.2305/IUCN.UK.2021-3.RLTS.T198563178A198563231.en [Accessed on 14 May 2022]

Khabibullaev BS, Shomurodov KF, Adilov BA (2022) Impact of long-term climate change on *Moluccella bucharica* population decline in Uzbekistan. Plant Science Today 9(2): 357–363. https://doi.org/10.14719/pst.1464

Kuchkarov BT, Khasanov FO, Tozhibaev KS, Pratov UP, Belolipov IV, Shomurodov HF, Beshko NY, Mukhtoraliev SG (2019) The Red Data Book of The Republic of Uzbekistan. Chinor ENK, Tashkent.

Orsenigo S, Montagnani C, Fenu G, Gargano D, Peruzzi L, Abeli T, Alessandrini A, Bacchetta G, Bartolucci F, Bovio M, Brullo C, Brullo S, Carta A, Castello M, Cogoni D, Conti F, Domina G, Foggi B, Gennai M, Gigante D, Iberite M, Lasen C, Magrini S, Perrino EV, Prosser F, Santangelo A, Selvaggi A, Stinca A, Vagge I, Villani M, Wagensommer RP, Wilhalm T, Tartaglini N, Duprè E, Blasi C, Rossi G (2018) Red Listing plants under full national responsibility: extinction risk and threats in the vascular flora endemic to Italy. Biological Conservation 224: 213–222. https://doi.org/10.1016/j.biocon.2018.05.030

Sparks A (2022) nasapower: NASA-POWER Data from R. https://doi.org/10.5281/zenodo.1040727, R package version 4.0.7. https://CRAN.R-project.org/package=nasapower

Shomurodov KF, Khabibullaev BS (2022) Investigation of changes in the species composition of the plant community containing relict species of *Moluccella bucharica* for half a century. Malayan Nature Journal 74(1).

Tojibaev K (2009) Monitoring of the relic endemics of Uzbekistan's flora. Czech Journal of Genetic and Plant Breeding (CJGPB) 46: 45–46. https://doi.org/10.17221/698-CJGPB

Tojibaev K, Beshko N, Volis S (2019) Translocation of *Otostegia bucharica*, a highly threatened narrowly distributed relict shrub. Plant Diversity 41(2): 105–108. https://doi.org/10.1016/j.pld.2019.01.005

Troìa A, Greuter W (2015) A conspectus of and key to Greek *Isoetes* (Isoetaceae), based on a reassessment of Haussknecht's gatherings of 1885. Willdenowia 45: 391–403. https://doi.org/10.3372/wi.45.45303

Troìa A, Raimondo FM (2010) *Isoëtes todaroana* (Isoëtaceae, Lycopodiophyta), a new species from Sicily (Italy). American Fern Journal 99(4): 238–243. [2009] https://doi.org/10.1640/0002-8444-99.4.238

Troìa A, Marino P, Orlando AM (2011) Report 1751. In: Kamari G, Blanché C, Siljak-Yakovlev S (Eds) Mediterranean chromosome number reports – 21. Flora Mediterranea 21: 355–376.

Troìa A, Johnson G, Taylor WC (2019) A contribution to the phylogeny and biogeography of the genus *Isoetes* (Isoetaceae, Lycopodiidae) in the Mediterranean region. Phytotaxa 395(3): 168–178. https://doi.org/10.11646/phytotaxa.395.3.2