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RESEARCH ARTICLE

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Anatomical characteristics of fossil wood collected from the Manchar Formation (Miocene), Thano Bula Khan, Sindh, Pakistan

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Abstract

The characterization of petrified wood provides valuable information about paleoclimatology and geological history and helps to reconstruct the past forest flora of different parts of the earth. The present study was undertaken to evaluate the anatomical characteristics of fossil wood of the Miocene age collected from the Manchar Formation exposed at Thano Bula Khan, Sindh, Pakistan. In order to carry out a detailed anatomical investigation, three-dimensional sections were prepared using a petrotome. The microscopic analysis allowed us to study vessel size and arrangement, wood parenchyma, fibers, and xylem rays. Based on the comparison between recent and fossil wood, we concluded that the investigated characters are comparable with those of the genus *Atalantia* Corrêa of the Rutaceae family. Therefore, it was named as *Atalantioxylon thanobolensis* sp. nov. with reference to the location of Thano Bula Khan from which the fossil wood was collected.

Keywords

Atalantioxylon thanobolensis sp. nov. Rutaceae, fossil wood, Manchar Formation, Pakistan

Introduction

The anatomical study of fossil wood has long been proven as an effective instrument for determining the flora of the paleo-forest. The anatomical study of fossil wood provides useful features for the taxonomy of fossil plant and represents an important tool in determining the flora of paleo-forests. Moreover, xylotomical data can also be useful for paleo-ecological reconstruction. As suggested by Visscher and Jagels (2003), the identification of fossil wood gives valuable information on paleo-ecosystems and paleo-environments in the absence of reproductive or vegetative plant organs. Recently, Acarca et al. (2018) evaluated and identified the silicified wood belonging to Miocene forests. Based on paleobotanical studies, a variety of dicot wood flora was described by Akkemik et al. (2018) from the Miocene age in Ankara Turkey, confirming the paleoclimatic conditions (a xeric-low mountainous forest prevailing under a semi-dry climate). Anatomical studies of dicotyledonous fossil wood species from Sindh region of Pakistan were reported by various authors, such as Khan and Rehmatullah (1968), Rehmatullah (1971), Khan and Rajput (1976), Bhutto et al. (1993), Ahmed et al. (2007), Shar et al. (2010), Soomro et al. (2016) and Mangi et al. (2020). Rajput and Khan (1984) identified gymnosperm and monocot wood from the Sindh province. De Franceschi et al. (2008) also found some dicotyledonous fossil wood in the lower portions of the Chitarwal Formation, Sulaiman Range, eastern Baluchistan, while fossil woods from the province of Punjab (Pakistan) have also been documented by Soomro et al. (2016a, b; 2017). The current work aims to characterize the fossil wood obtained from the Manchar Formation of the Miocene Age at Thano Bula Khan, Sindh (Pakistan).

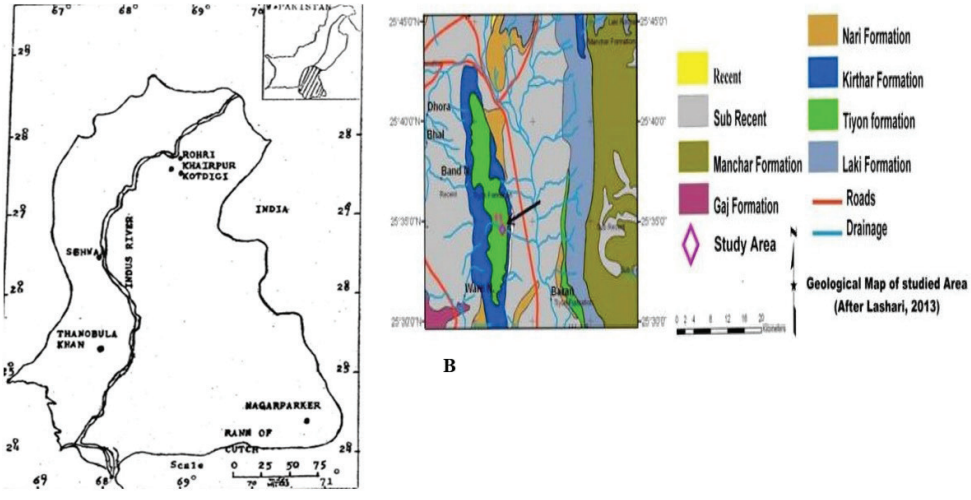

Figure 1. A map of Sindh (Pakistan), showing the area of Thano Bula Khan from where the fossil wood was collected **B** geological map showing the Manchar Formation exposed in the study area.

Material and methods

The fossil wood sample of the Manchar Formation (TB35) was taken from Thano Bula Khan (25°24'35"N, 67°46'27"E, district of Jamshoro, Sindh, Pakistan). The size of the sample was 20 cm in length and 4.5 cm in width. The colour of the fossil wood was noted to determine the depositional material. Using the ground thin-section method described by Opała-Owczarek et al. (2020), nine thin sections were prepared (cross, tangential and radial planes). All the samples were carefully observed under the microscope and all their anatomical features were noted. Photography was carried out with a digital microscope available at the Paleobotany Laboratory, Institute of Plant Sciences, University of Sindh, Jamshoro.

Results

Family: Rutaceae

Genus: *Atalantia* Corrêa

***Atalantioxylon thanobolensis* sp. nov.**

Diagnosis. Wood diffuse porous, growth ring present, demarcated by a line of terminal parenchyma, vessels small to medium in size, tangential diameter 45–134 μm, radial diameter 67–180 μm, solitary and in radial multiples of 2–5 evenly distributed over 24–30 mm^2. Vessel members 150–400 μm long with simple oblique perforation. Intervessel pit pairs about 3–5μm in diameter, bordered alternate, circular to oval in shape. Parenchyma terminal, paratracheal parenchyma sparse. Xylem rays 1–3 (mostly 2) seriate 8–34 cells, 80–550 μm in height, distributed over 5–7 mm^2. Ray tissue homogeneous, with only procumbent cells. Fibers moderately thick-walled with lumen 15–20 μm in diameter, polygonal in cross-section, non-septate, 450–660 μm long.

***Holotype*.** The specimen was given the name "TB 35" (holotype shown in Fig. 2). It consists of silicified wood collected 10 km south-west of Thano Bula Khan, by the first author.

Horizon. Manchar Formation. Age: Pliocene to Upper Miocene.

Morphological description. The present fossil was anatomically identified from a well-preserved secondary wood sample measuring 20 cm in length and 4.5 cm in width. The color of the fossilized wood is light brown with shine indicating deposition of silicates.

Anatomical analysis. Cross section. Wood diffuse porous, growth ring present, demarcated by a line of terminal parenchyma vessels small to medium in size, solitary and mostly in radial multiples of 2–5, mostly evenly distributed but in some places showing crowding at the beginning of the growth ring, circular to oval when

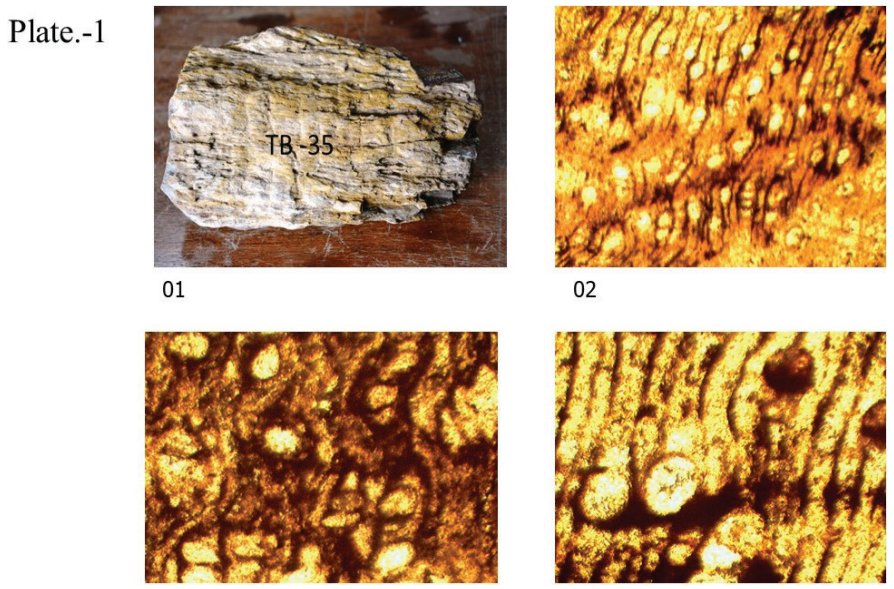

Figure 2. *Atalantioxylon thanobolensis* sp. nov. Plate 1-01: Macrograph of the fossil wood TB 35. Plate 1-02: Cross section showing general distribution of vessels and parenchyma (×40). Plate 1-03: Cross section showing general distribution of vessels and parenchyma. (×100). Plate 1-04: Cross section showing details of vessels and parenchyma. (×200).

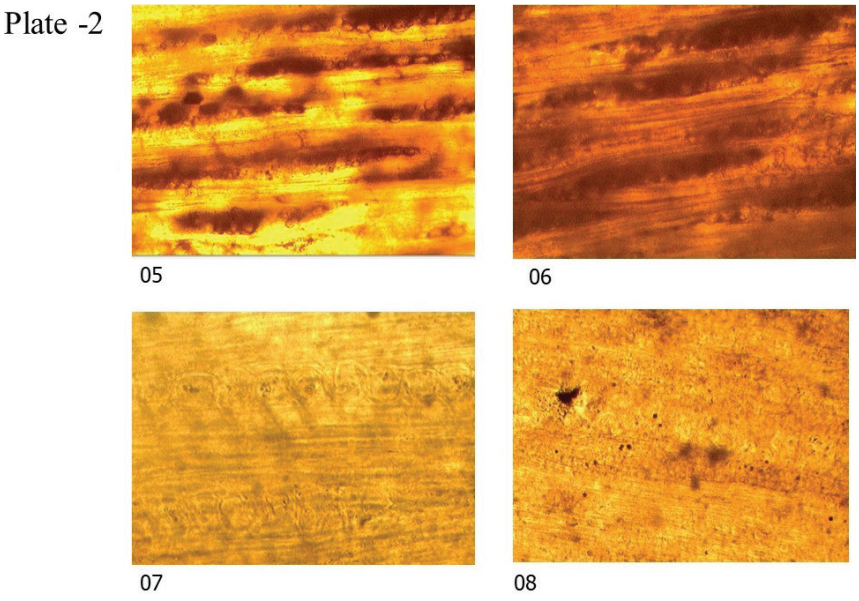

Figure 3. *Atalantioxylon thanobolensis* sp. nov. Plate 2-05 Tangential section showing general distribution of xylem rays and fibers (×40). Plate 2-06 Tangential section showing general distribution of xylem rays and fibers (×100). Plate 2-07 Tangential section showing details of xylem rays (×400). Plate 2-08 Tangential section showing general distribution of xylem rays and fibers (×200).

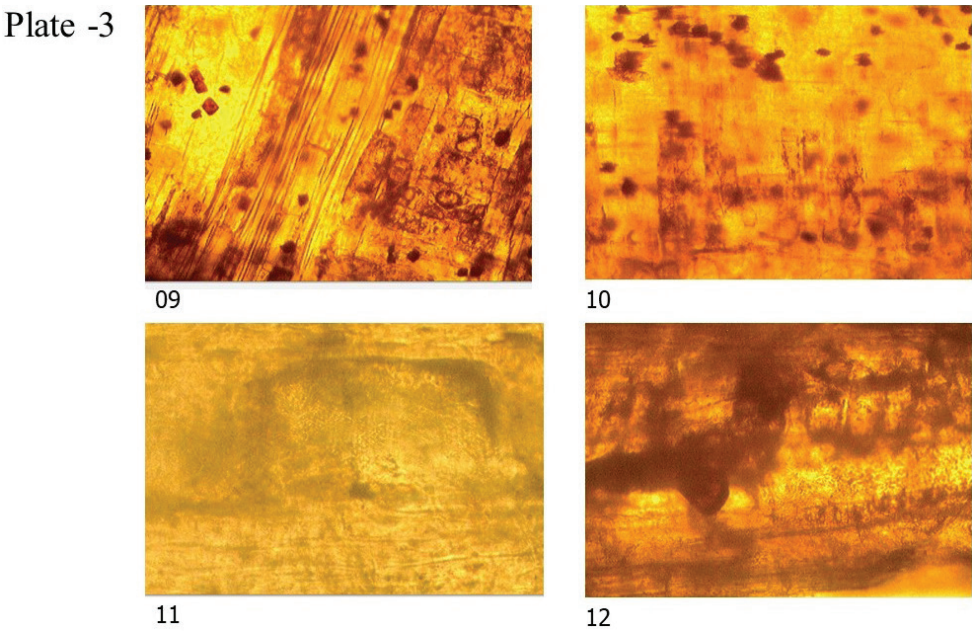

Figure 4. *Atalantioxylon thanobolensis* sp. nov. Plate 3-09 Radial longitudinal section showing arrangement of fibers (×40). Plate 3-10 Radial longitudinal section showing arrangement of fibers (×40). Plate 3-11 Radial longitudinal section showing vessel end-walls and pits (×200). Plate 3-12 Radial longitudinal section showing pits on wall of vessels (×100).

solitary, sometimes elliptical due to pressure during fossilization. Tylosis present, parenchyma paratracheal, terminal, and apotracheal; the latter diffuse, while paratracheal parenchyma is sparse, present as few cells around some of the vessels; terminal parenchyma forms 2–3 seriate continuous lines demarcating the growth rings; diffuse parenchyma very sparse, difficult to locate in cross section, fibers thick-walled and non-septate (Fig. 2).

Tangential longitudinal section. Vessels evenly distributed, 170–390 μm long with oblique ends and 73–273 μm wide. Perforation simple intervessel pit pairs about 3–6 μm diameter, bordered alternate circular to oval in shape. Xylem rays small to medium 1–3 (mostly 2) seriate 5–7 mm^2, 8–34 cells, 80 -550 μm in height, separated by rows of fibers. Ray cells polygonal in tangential section often with dark content ray tissue, homogenous made up of procumbent cells; fibers elongated, non-septate, 15–20 μm in diameter, 450–630 μm in length (Fig. 3).

Radial longitudinal section. Vessel segments elongated with oblique end, length of the vessel members, 175–395 μm, width 84–275 μm, vessel walls 10–12 μm thick. Intervessel pit pairs about 4–6 μm in diameter, bordered alternate, circular to oval in shape. Parenchyma cells attached to the vessels 20–25 μm in diameter and 45–60 μm in length. Xylem ray cells 8–34, 80–556 μm long (Fig. 4).

Discussion

Comparison with modern wood

The principal anatomical characters of the petrified wood samples are: small to medium sized vessels, thin bands of terminal parenchyma along with scanty and diffuse paratracheal parenchyma; 1–3 (mostly 2) seriate, homogeneous xylem rays and moderately thick-wall, non-septate fibers strongly indicate the affinity of this fossil wood with the Rutaceae (Metcalfe and Chalk 1950; Stoel and Borman 2008). A detailed anatomical study of various genera of this family revealed a close resemblance of the studied fossil wood with the modern woods of *Atalantia* Corrêa. A comparison was made with the wood of *Atalantia monophylla* DC., *Atalantia. missionis* Oliv., and *Limonia acidissima* L. The fossil wood under consideration resembles very closely the woods of both these species in all the anatomical characters, such as distribution of vessels, vessel shape and size, parenchyma arrangement, 1–3 seriate, homogeneous xylem rays, and non-septate fibers. The only difference observed between the fossil wood and the modern wood of the fore-mentioned species is the presence of crystalliferous apotracheal parenchyma in the modern wood while it is absent in the fossil wood. Given the resemblance of the fossil wood with the wood of both *Atalantia* and *Limonia*, we proposed a new genus *Atalantioxylon*.

The genus *Atalantia* is limited to the Indian subcontinent where it is present with four species and two varieties. The infra-generic classification and the species limits of the genus are, however, not well established due to the presence of intermediate forms. Two species, *A. monophylla* (L.) DC. and *A. racemosa* Wight & Arn. are extensively distributed, while the third species, *A. wightii* Yu.Tanaka is endemic to Pakistan (Rameshkumar et al. 2020).

Comparison with fossil wood

Chitaley and Shallon (1962) described a fossil wood from the Deccan near Nagpur; they placed their fossil wood in the family Rutaceae but from its photographs and text figures it does not appear to belong to this family. It also differs markedly from the fos-

Table 1. Comparison of the new species with *Atalantioxylon indicum* Lakhanpal.

Species	Wood	Vessels	Wood Parenchyma	Xylem	Fibres
Atalantioxylon indicum Lakhanpal	Diffuse porous	Vessels medium to large in size, up to 350 µm	Axial parenchyma absent or extremely rare, paratracheal parenchyma scanty, forming few cells around the vessel	Ray width 1 to 3 cells; all ray cells procumbent, 4–12 mm	Non-septate
Atalantioxylon thanobolensis sp. nov.	Diffuse porous	Vessels small to medium in size; tangential diameter 45–134 µm; radial diameter 67–180 µm; solitary and in radial multiples of 2–5, evenly distributed over 24–30 mm^2	Parenchyma paratracheal, terminal and apotracheal; apotracheal diffuse; paratracheal sparse, present as few cells around some of the vessels; terminal parenchyma forms 2–3 seriate continuous lines demarcating the growth ring	Xylem rays fine to medium 1–3 (mostly 2) seriate, over 5–7 mm^2; 8–34 cells 80 -550 µm long separated by rows of fibers. Rays cells polygonal in tangential section often with dark content; ray tissue homogeneous made up of procumbent cells	Non-septate

Table 2. Geographical and stratigraphical data of fossils related to the genus *Atalantioxylon*.

Species	Reference	Locality	Geological age
Atalantioxylon indicum Lakhanpal, Prakash & Bande	Lakhanpal et al. (1978)	Mandla, District, Madhya Pradesh, India	Paleocene
Atalantioxylon thanobolensis sp. nov.	This paper	Thano Bula Khan, Pakistan	Miocene

sil wood under investigation in the absence of terminal parenchyma and in having two types of xylem rays, short and long, made up of both heterogeneous procumbent cells and erect cell. The fossil wood of *Atalantioxylon indicum* from Madhya Pradesh in India was the first authentic record of a member of the Rutaceae in fossil state (Lakhanpal et al. 1978). The differences observed between the fossil wood under investigation and the previously reported fossil wood from India regard the size of vessels and slightly dissimilar parenchyma cells (Table 1). Hence, the studied fossil wood is assigned a new species name, viz. *Atalantioxylon thanobolensis* sp. nov.

Conclusion

A new species, *Atalantioxylon thanobolensis* is described from Sindh, Pakistan. The presence of other Rutaceae fossil species of *Atalantioxylon* in the subcontinent and their resemblance with the actual genus *Atalantia* suggest that a tropical climate existed in the past in the sub-continent.

References

Acarca Bayam NN, Akkemik Ü, Poole, I, Akarsu F (2018) Further contributions to the early Miocene forest vegetation of the Galatian Volcanic Province, Turkey. Palaeontologia Electronica 21.3.40A: 1–42. https://doi.org/10.26879/816

Ahmed B, Rajput M, Soomro N (2007) *Anogeissoxylon rehmanense* sp. nov., a new fossil species of the family Combretaceae from Rehman Dhoro, District Jamshoro, Sindh, Pakistan. Pakistan Journal of Botany 39(7): 2337–2344.

Akkemik Ü, Atıcı G, Poole I, Çobankaya M (2018) Three new silicified woods from a newly discovered earliest Miocene forest site in the Haymana Basin (Ankara, Turkey). Review of Palaeobotany and Palynology 254: 49–64. https://doi.org/10.1016/j.revpalbo.2018.04.012

Bhutto I, Ahmed B, Arain C, Khan K (1993) *Lagarstromiaxylon ranikotensis* sp. nov. A new species of Lythraceae from the Tertiary sequences of Sindh, Pakistan. Sindh University Research Journal (Science Series) 22: 25–32.

Chitaley SD, Shallom LJ (1962) A fossil wood of Rutaceae from the Deccan Intertrappean beds of India. Proceedings of Rajasthan Academic Science 9(2): 31–35.

De Franceschi D, Hoorn C, Antoine P-O, Cheema IU, Flynn LJ, Lindsay EH, Marivaux L, Métais G, Rajpar AR, Welcomme J-L (2008) Floral data from the mid-Cenozoic of central Pakistan. Review of Palaeobotany and Palynology 150(1–4): 115–129. https://doi.org/10.1016/j.revpalbo.2008.01.011

Khan K, Rajput M (1976) *Laurinoxylon rehmanense* sp. nov. A new species of fossil dicot. Wood from Tertiary rocks of Sindh, Pakistan. Sindh University Research Journal (Science Series) 9: 5–13.

Khan K, Rehmatullah C (1968) *Sapindoxylon petaroensis* sp. nov. A new species of dicot wood from the late Tertiary deposits of Sindh. Sindh University Research Journal (Science Series) 3: 137–142.

Lakhanpal RN, Prakash U, Bande MB (1978) Fossil dicotyledonous woods from the Deccan Intertrappean beds of Mandla District in Madhya Pradesh. The Palaeobotanist 25: 190–204.

Metcalfe C, Chalk L (1950) Anatomy of the dicotyledons (Vol. II). Clarendon Press, Oxford, 20 pp.

Mangi J, Khan SA, Soomro N, Naz H, Panhwer M (2020) Wood of *Burseroxylon* fossil from Bara formation of Rani Kot Fort area, district Jamshoro Sindh, Pakistan. Pakistan Journal of Agriculture, Agricultural Engineering and Veterinary Sciences 36(1): 1–7. https://doi.org/10.47432/2020.36.1.1

Opała-Owczarek M, Owczarek P, Łupikasza E, Boudreau S, Migała K (2020) Influence of climatic conditions on growth rings of *Salix uva-ursi* Pursh from the shore of Hudson Bay, Subarctic Canada. Arctic, Antarctic, and Alpine Research 52(1): 87–102. https://doi.org/10.1080/15230430.2020.1722397

Rajput MTM, Khan KM (1984) *Araucarioxylon* sp. A silicified Gymnosperm wood from Manchhar Formation. Pakistan Journal of Botany 16(1): 53–60.

Rameshkumar K, Menon LN, Rani MP, Anchu E, Kumar B, Prakashkumar R (2020) Threatened medicinal plants in the Western Ghats–phytochemical perspective. Conservation and Utilization of Threatened Medicinal Plants. Springer, 277–316. https://doi.org/10.1007/978-3-030-39793-7_10

Rehmatullah C (1971) Studies of the silicified wood from the Tertiary rocks of Sindh. M. Phil. thesis, University of Sindh.

Shar M, Trimizi SAS, Ahmed B (2010) *Shoreoxylon ranikotensis* sp. nov., a new species of fossil wood Dipterocarpiaceae from Ranikot Fort area, district Jamshoro, Sindh, Pakistan Journal of Botany 12(4): 527–531.

Soomro N, Arain BA, Rajput MTM (2016a) *Albizzioxylon chinjiensis* sp. nov., a new fossil species of the family Leguminosae from Chinji formation salt range, Punjab Pakistan. International Journal of Geomate 11(28): 2838–2843.

Soomro N, Jillani N, Quereshi S, Mangi J, Arain B, Rajput M (2017) Discovery of Miocene Wood from Manchar Formation, *Lagerstroemioxylon thanobolensis* sp. nov. of Family Lythraceae, Thano BulaKhan District Jamshoro, Sindh, Pakistan. Sindh University Research Journal-SURJ (Science Series) 49(3): 557–562. https://doi.org/10.26692/surj/2017.09.16

Soomro N, Mangi J, Jamali A, Jillani N, Arain B, Rajput M (2016b) *Dichrostachyoxylon chinjiensis* sp. nov., a new fossil species of the family Fabaceae from Chinji Formation, Salt Range, Punjab, Pakistan. Sindh University Research Journal-SURJ (Science Series) 48(4): 803–808.

Stoel BC, Borman TM (2008) A comparison of wood density between classical Cremonese and modern violins. PLoS ONE 3(7): e2554. https://doi.org/10.1371/journal.pone.0002554

Visscher GE, Jagels R (2003) Separation of *Metasequoia* and *Glyptostrobus* (Cupressaceae) based on wood anatomy. IAWA Journal 24(4): 439–450. https://doi.org/10.1163/22941932-90000348

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Remnants of naturalness in a reclaimed land of central Italy

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Abstract

Wetlands are among the most fragile habitats on Earth and have often undergone major environmental changes. As a study case in this context, the present work aims at increasing the floristic knowledge of a reclaimed land now turned into an agricultural lowland with scarce patches of natural habitats. The study area is named Piana di Rosia, and it is located in southern Tuscany (Italy). The compiled checklist consists of 451 specific and subspecific taxa of vascular plants. The life-form spectrum shows a predominance of hemicryptophytes, followed by therophytes. The chorological spectrum highlights a co-dominance of Euri-Mediterranean and Eurasian species along with many widely distributed species. The checklist includes seven species of conservation concern, three Italian endemics (*Crocus etruscus* Parl., *Polygala vulgaris* L. subsp. *valdarnensis* (Fiori) Arrigoni, and *Scabiosa uniseta* Savi), 41 alien species, 21 segetal species, and 11 aquatic macrophytes of which five helophytes and six hydrophytes. This study suggests that irreversible land-use changes in wetlands can lead towards a simplification of the flora. However, despite the deep transformations that the former wetland has undergone, the presence of some aquatic and protected taxa is interesting. From a conservation point of view, the natural value of this agricultural area could be enhanced and its current management partly reconsidered, thus preserving the remnants of naturalness present.

Keywords

Agroecosystem, biodiversity, botany, checklist, inventory, phytogeography, SAR, survey, wetland

Introduction

Wetlands are acknowledged to be among the most biologically productive ecosystems (Ramsar Convention on Wetlands 2018). They play a major role in the water cycle by receiving, storing and releasing water, regulating flows, and supporting life. River channels, floodplains and connected wetlands play a significant role in hydrology. Wetlands work as natural sponges that trap and slowly release surface water, rain, snowmelt, groundwater, and floodwaters. Besides, their holding capacity helps to control floods and prevents water logging of crops (Environmental Protection Agency 2020). Moreover, wetlands contribute to the regulation of microclimate, while wetland vegetation slows the speed of floodwaters and helps in distributing them over the floodplain.

In the Mediterranean Basin, natural wetland habitats decreased in extension by 10% between 1975 and 2005 (Mediterranean Wetlands Observatory 2014). This loss is mainly due to land conversion to agricultural land-use and urbanization (Gardner et al. 2015). Land-use changes and the implementation of artificial water systems have reduced the connectivity in many river systems and floodplain wetlands (Ramsar Convention on Wetlands 2018). The environmental changes that wetlands underwent during the last century significantly depleted their unique biodiversity. Furthermore, human activities often simplified geomorphology, eliminating important environments such as transitional ones that connect wetlands and dryer areas, whose flora and fauna are among the most threatened (Alessandrini 2000).

In Europe, the loss of wetland biodiversity is a consequence of the declining extent and quality of wetland habitats (Janssen et al. 2016). However, in Italy, freshwaters host many threatened species and habitats (Gigante et al. 2016, 2018; Orsenigo et al. 2020). Consistently with the general trends at larger scales, also many wetlands of southern Tuscany have suffered a decrease in extent. Such reduction has generally caused an overall decline in plant diversity, with the disappearance of native species and an increase of non-native ones (Viciani et al. 2014; Lazzaro et al. 2020; Viciani et al. 2020).

This study concerns a lowland known as Piana di Rosia, located a few kilometers southwest of Siena (Tuscany, central Italy). This former wetland turned into an intensive agricultural area in the 19th century. Though, land-use change and human impact led to a substantial loss of the humid habitats, relict elements of naturalness, related to more or less humid environments, are present.

In Tuscany, information at the species level is usually easily available as it is embedded in floristic online databases (i.e., Wikiplantbase #Toscana – Peruzzi and Bedini 2015 onwards; Peruzzi et al. 2017a), where data arising from studies on a different scale (Arrigoni 2016–2018; Bonari et al. 2016–2019; Cannucci et al. 2019), as well as herbarium specimens and field observations, are stored. This data availability has also facilitated the study of the patterns of Tuscan floristic richness (D'Antraccoli et al. 2019). However, unlike many well-studied neighbouring areas (Mariotti et al. 1986; Chiarucci et al. 1993; Landi et al. 2002, 2009, 2016), floristic knowledge of the Piana di Rosia is very scarce (Angiolini et al. 2005), except for some recent floristic findings

(Peruzzi et al. 2017b, 2017c, 2018). Also, only a few herbarium samples and a few literature sources can testify for the diversity of aquatic plants once present (Caruel 1860; Baroni 1908). Therefore, we aim at increasing the floristic knowledge of southern Tuscany in the context of a transformed landscape by providing an inventory of the vascular plants of the Piana di Rosia.

Materials and methods

Study area

The Piana di Rosia is a lowland plain of central Italy that covers 23.23 km^2 and is located about 10 km southwest of Siena (southern Tuscany, 43°14'38"N, 11°15'35"E). The average elevation is 190 m a.s.l., ranging between 180 and 250 m a.s.l. The area lies within the municipality of Sovicille, in the administrative province of Siena, and is surrounded by small villages (Fig. 1).

The study area borders the Special Area of Conservation (SAC) "Montagnola Senese" (IT5190003) along its western side, and the SAC "Alta Val di Merse" (IT519006) along its southwestern side. The Nature Reserve "Alto Merse" is also nearby present (in Suppl. material 1: Fig. S1).

The study area is dominated by alluvial and lake deposits. The alluvial deposits occur in the central and southern part and have a mainly gravelly and/or sandy texture. Lake sediments occur along the borders of the study area, at slightly higher elevations. In the eastern part, eluvian-colluvial deposits occur. In the northeastern part, where superficial deposits are missing, marine Pliocene deposits emerge (mudstones and sandstones). An outcrop of Miocene continental breccia (limestone) is present near the village of Malignano (Martini 2011; Iacoviello and Martini 2012, 2013). The study area is part of a wide aquifer (Luco aquifer), which extends northwards between the Montagnola Senese area, Pian del Lago area, and the village of Monteriggioni. The aquifer mainly develops within the Breccia di Grotti Formation (Barazzuoli et al. 2020).

The bioclimate of the study area can be classified as Oceanic sub-Mediterranean (Temperate sub-Mediterranean macrobioclimate). The thermotype is lower mesotemperate and the ombrotype is upper sub-humid. Regarding the continentality, the climate is weakly semi-continental (Pesaresi et al. 2014, 2017). The position of the plain surrounded by hills enhances temperature excursions, both daily and seasonal. According to the nearby weather station of San Rocco a Pilli, in the period 2008–2018 the mean annual temperature was 14.3 °C. January was the coldest month (mean temperature 5.3 °C) and July the hottest month (24.2 °C). Freezing temperatures are common in winter, due to thermal inversion. The recorded temperature extremes are about -10 °C and 40 °C. According to the nearby weather station of Rosia, in the period 1951–1997 the mean annual rainfall was 962 mm. Summer was the driest season (125 mm) and winter the wettest one (252 mm).

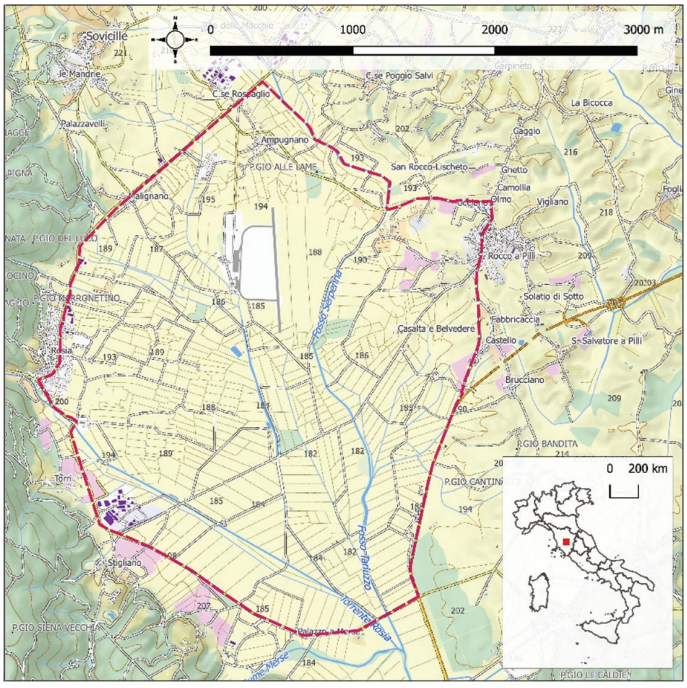

Figure 1. Borders of the study area (red dashed line) and, in the box, the location of the Piana di Rosia (Sovicille, Siena) in Italy.

Landscape transformation

The Piana di Rosia was formerly an ancient wetland reclaimed in the 19th century for agricultural purposes. The plain was neither included in the existing inventory of the marshy areas of Tuscany (Arrigoni 1981), nor in the review on the status of geobotanical knowledge of the Tuscan wetlands (Tomei 1982). This testifies that the landscape has been heavily modified and cannot be considered a wetland anymore. The wetland extended along the middle course of the Merse River and some of its tributaries (Favilli et al. 2017). Like elsewhere in Italy, in the 1950s traditional agro-pastoral practices began to be gradually replaced by intensive agriculture. This led to the disappearance of the traditional agricultural landscape, highly diversified and hosting frequent patches of natural and semi-natural vegetation, with a shift towards a simplified agro-ecosystem represented by large arable fields and artificial water channels (Suppl. material 1: Fig. S2). Unlike other lowlands of the Siena territory, Piana di Rosia was cultivated already in the first half of the nineteenth century (Greppi 2014). In the last decades, this territory is experiencing a phase of 'attrition', a stage in the process of fragmentation when only very small and isolated patches of natural vegetation remain (Hunter and Gibbs 2007). Elements such as riparian woods, swampy areas, shrublands, and grasslands, are present (Fig. 2).

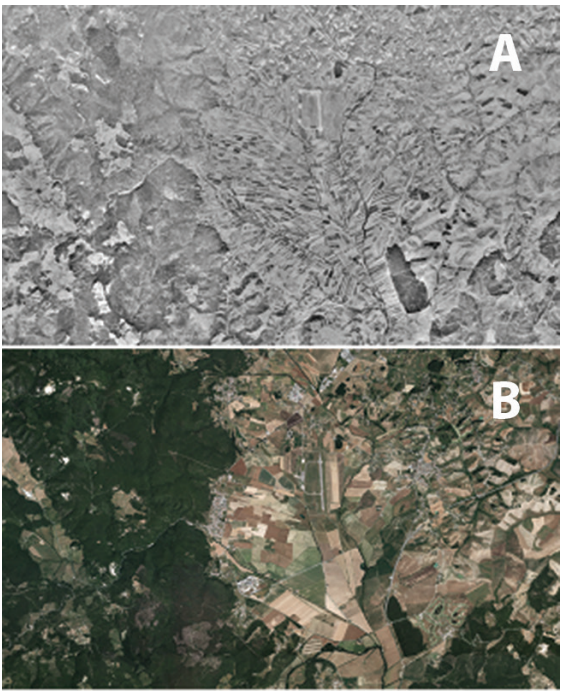

Figure 2. Aerial photos of the study area in 1954 (**A**) and 2019 (**B**), showing the intensification of the agricultural practices, thus resulting in larger and more homogeneous patches (Regione Toscana 2020).

Current land-use types

The main land-use types in the study area derive from thematic maps of Regione Toscana (2020) (Suppl. material 1: Fig. S3). About 90% of the study area is devoted to agricultural land use. Arable crops are the main ones, including winter cereals (mainly *Triticum* sp. pl.), corn (*Zea mays* L.), sunflower (*Helianthus annuus* L.), and sorghum (*Sorghum bicolor* (L.) Moench). Woody crops are much less common and include olive groves (*Olea europaea* L.), walnut groves (*Juglans regia* L.) and vineyards (*Vitis vinifera* L.). The rest is occupied by urban and industrial areas (6.0%), broad-leaved forests (1.6%), an airport (1.0%), transitional forest-shrub formations (0.9%), and inland waters (0.04%). The latter include small lakes and main streams, but not artificial channels, which are mapped as deciduous or transitional shrubs.

Field surveys and data analysis

We carried out floristic surveys from 2017 to 2019 in all the land-use types, but excluding urban and industrial areas, with the exception of the airport area, that are limited in extension and out of our aim. The investigations were performed in all seasons. The collected specimens are stored in the herbarium SIENA (acronym follows Thiers 2020 onwards). Species were mainly identified according to Pignatti (1982), Pignatti et al.

(2017–2019), and occasionally by using Fiori (1923–1929). We used other floras or specific publications for critical groups including Tutin et al. (1964–1980), Castroviejo et al. (1984–2005), Rameau et al. (1989, 2008), Tison and De Foucault (2014), Arrigoni (2014–2018), Di Natale et al. (2020). Taxonomic nomenclature follows the updated Italian checklists of the native (Bartolucci et al. 2018a) and alien (Galasso et al. 2018a) vascular flora and subsequent updates summarised in the Portal to the Flora of Italy (2020 onwards; see also Martellos et al. 2020). The order of families follows Bartolucci et al. (2018a) and Galasso et al. (2018a), whereas species are arranged in alphabetical order.

To highlight chorological novelties, we checked species distribution at the administrative province, region and national levels (Peruzzi and Bedini 2015 onwards; Portal to the Flora of Italy 2020). To verify the conservation concern of each taxon, we checked the Tuscan attention list, the Italian and European Red Lists of vascular plants, the list of rare or threatened European arable plants, and the IUCN Red List of threatened species (Sposimo and Castelli 2005; Bilz et al. 2011; Castelli 2012; Rossi et al. 2013; Storkey et al. 2012; Orsenigo et al. 2020; IUCN 2021). We detected Italian endemic taxa according to Bartolucci et al. (2018a, b, c). Alien species, their introduction time in Italy, and naturalization status categories in the study area follow Galasso et al. (2018a, b, c). With regard to the alien status, we distinguished three categories, i.e., casual (unable to form self-maintaining populations), naturalized (occurring with self-maintaining populations), and invasive (occurring with self-maintaining populations and being able to spread over a large area) (Galasso et al. 2018a). Concerning the introduction time, we distinguished between archaeophytes, introduced before 1492, and neophytes, introduced after 1492 (Galasso et al. 2018a). Since Piana di Rosia is an agricultural area, we checked segetal species, i.e., typical "weeds" of wheat and similar crops, following Fanfarillo et al. (2020a). Within segetal species, we checked the presence of strictly segetal species, i.e., those species strictly dependent on such crops. Life forms and chorotypes follow Pignatti (1982), with the exception of alien species (Galasso et al. 2018a, b, c).

Finally, we calculated a Species-Area Relationship (SAR) strictly based on the extension of the study area according to the formula proposed by D'Antraccoli et al. (2019). This formula provides constants for Tuscany that allow to calculate the expected species in an area. We calculated the expected number of species for all taxa, native taxa and alien taxa.

Graphs were drawn using R Studio v. 3.6.0 (R Core Team 2020).

Results

Floristic inventory

The floristic checklist includes 451 specific and subspecific taxa for the study area (Suppl. material 1: Floristic inventory). The taxa belong to 283 genera and 75 families. We recorded 442 Angiosperms, eight fern and fern allies, and one gymnosperm (*Juniperus communis* L.).

According to the SAR formula, we obtained -31.4% of taxa compared to the expected value of 654 and -36.5% for native taxa compared to the expected value of 644. On the contrary, concerning alien species, we obtained +45.2% of taxa compared to the expected value of 29. The most represented families are Poaceae (63 taxa), Asteraceae (53), and Fabaceae (40) (Fig. 3). The most represented genera are *Euphorbia* and *Lathyrus* (8 taxa), *Trifolium* (7), *Galium* (6), *Carex*, *Festuca*, *Geranium*, *Veronica*, and *Vicia* (5).

Overall, we found seven species of conservation concern. One species (*Crocus etruscus* Parl.) is included in the IUCN Red List of threatened species and in the European Red List of vascular plants, as Near Threatened, in the Tuscan attention list, and in Annex IV of the Habitat Directive (Bilz et al. 2011; Carta and Peruzzi 2011; Ercole et al. 2016). The species included in the Red Lists of threatened vascular plants of Italy are six, five of which are classified as Least Concern (*Allium pendulinum* Ten., *Bellevalia romana* (L.) Sweet, *Brachypodium phoenicoides* (L.) Roem. & Schult., *Ruscus aculeatus* L., and *Thinopyrum acutum* (DC.) Banfi), and one as Data Deficient (*Cirsium vulgare* (Savi) Ten. subsp. *vulgare*).

We found 10 native taxa that are new or confirmed for the administrative province of Siena: *Allium rotundum* L., *Brachypodium phoenicoides* (L.) Roem. & Schult., *Bromus racemosus* L., *Dasypyrum villosum* (L.) P.Candargy, *Eragrostis pilosa* (L.) P.Beauv. subsp. *pilosa*, *Fragaria viridis* Weston subsp. *viridis*, *Medicago praecox* DC., *Persicaria decipiens* (R.Br.) K.L.Wilson, *Populus canescens* (Aiton) Sm., and *Spergularia rubra* (L.) J.Presl & C. Presl. We found three native taxa with no records in the last century for the administrative province of Siena. These are *Allium longispathum* Redouté, *Bromus commutatus* Schrad. subsp. *commutatus*, and *Persicaria maculosa* Gray. Eight alien taxa are new to the administrative province of Siena: *Amaranthus hybridus* subsp. *cruentus* (L.) Thell., *A. powellii* S.Watson, *Beta vulgaris* L. subsp. *vulgaris*, *Oxalis articulata* Savigny, *Panicum miliaceum* L. subsp. *miliaceum*, *Parthenocissus quinquefolia* (L.) Planch., *Sporobolus indicus* (L.) R.Br., and *Vitis* × *koberi* Ardenghi, Galasso, Banfi & Lastrucci. With regard to *Amaranthus hybridus* subsp. *cruentus* (L.) Thell., several historical specimens are present in SIENA, but many of these specimens were collected at the Botanical Garden of Siena with no clear indication as to whether they were cultivated plants or not, whereas others have no locality.

We found 16 rare native taxa that represent the second or third recent record in the administrative province of Siena. They are *Brassica nigra* (L.) W.D.J.Koch, *Conium maculatum* L. subsp. *maculatum*, *Glyceria fluitans* (L.) R.Br., *Hordeum geniculatum* All., *H. marinum* Huds., *Lythrum tribracteatum* Salzm. ex Spreng., *Orobanche caryophyllacea* Sm., *O. crenata* Forssk., *Polygonum arenastrum* Boreau, *Raphanus raphanistrum* subsp. *landra* (Moretti ex DC.) Bonnier & Layens, *Stachys annua* (L.) L. subsp. *annua*, *S. palustris* L., *Thalictrum minus* L. subsp. *minus*, *Tordylium maximum* L., *Veronica cymbalaria* Bodard subsp. *cymbalaria*, and *Visnaga daucoides* Gaertn.

Of the 41 alien species, 30 are neophytes and 11 are archaeophytes. Neophytes are *Actinidia deliciosa* (A.Chev.) C.F.Liang & A.R.Ferguson, *Ailanthus altissima* (Mill.) Swingle, *Amaranthus deflexus* L., *A. hybridus* subsp. *cruentus*, (L.) Thell. *A. powellii* S.Watson, *A. retroflexus* L., *Artemisia verlotiorum* Lamotte, *Bidens frondosa* L., *Crepis*

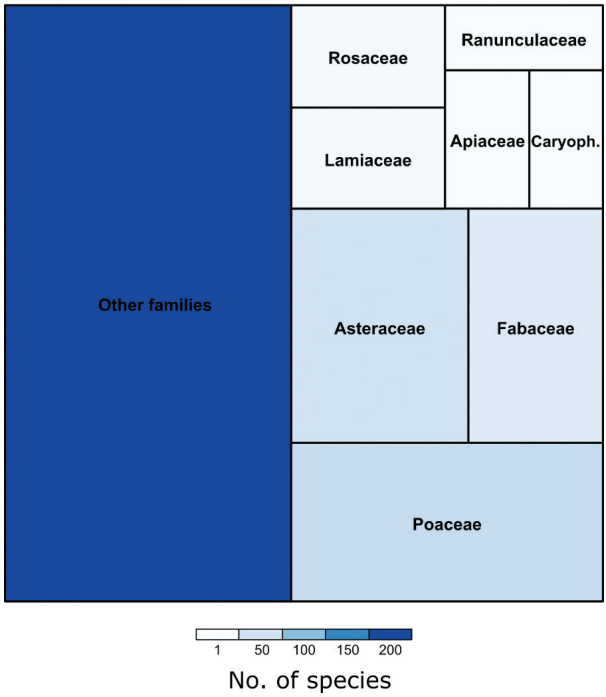

Figure 3. Representation of the families across the inventoried flora. Each rectangle represents a family. The area of each polygon is proportional to the number of taxa present in the given category. Other families = families with less than 12 species; Caryoph. = Caryophyllaceae.

sancta (L.) Bornm. subsp. *nemausensis* (P.Fourn.) Babc., *Cuscuta campestris* Yunck., *Datura stramonium* L., *Erigeron annuus* (L.) Desf., *E. bonariensis* L., *E. canadensis* L., *E. sumatrensis* Retz., *Euphorbia maculata* L., *E. prostrata* Aiton, *Fagopyrum esculentum* Moench, *Helianthus tuberosus* L., *Mirabilis jalapa* L., *Oxalis articulata* Savigny, *Parthenocissus quinquefolia* (L.) Planch., *Paspalum distichum* L., *Robinia pseudoacacia* L., *Setaria italica* (L.) P.Beauv., *Sporobolus indicus* (L.) R.Br., *Veronica persica* Poir., *Vitis riparia* Michx., *Vitis* × *koberi* Ardenghi, Galasso, Banfi & Lastrucci, and *Xanthium italicum* Moretti. Archaeophytes are *Abutilon theophrasti* Medik., *Arundo donax* L., *Avena fatua* L. subsp. *fatua*, *Beta vulgaris* L. subsp. *vulgaris*, *Galega officinalis* L., *Hordeum vulgare* L. subsp. *vulgare*, *Isatis tinctoria* L. subsp. *tinctoria*, *Medicago sativa* L., *Mespilus germanica* L., *Panicum miliaceum* L. subsp. *miliaceum*, and *Sorghum halepense* (L.) Pers. In the study area, the naturalization status for alien species is thus distributed: six taxa are casual, 20 are invasive, and 15 are naturalized.

We found 21 segetal taxa in the study area. Among the segetal species, four are strictly segetal, i.e., strictly related to wheat fields and similar habitats, and they are *Alopecurus myosuroides* Huds. subsp. *myosuroides*, *Bunium bulbocastanum* L., *Delphinium consolida* L. subsp. *consolida*, and *Legousia speculum-veneris* (L.) *Chaix* subsp. *speculum-veneris*, the latter being the only segetal species of conservation concern in

Europe. The other species are typical for segetal habitats, but commonly occur also in other open and more or less disturbed habitats: *Anisantha diandra* (Roth) Tutin ex Tzvelev, *Avena fatua* L. subsp. *fatua*, *Brassica nigra* (L.) W.D.J.Koch, *Euphorbia exigua* L. subsp. *exigua*, *E. falcata* L. subsp. *falcata*, *Gladiolus italicus* Mill., *Lathyrus annuus* L., *Lysimachia arvensis* (L.) U.Manns & Anderb. subsp. *arvensis*, *Matricaria chamomilla* L., *Muscari comosum* (L.) Mill., *Myosotis arvensis* (L.) Hill subsp. *arvensis*, *Orobanche crenata* Forssk., *Papaver rhoeas* L. subsp. *rhoeas*, *Rapistrum rugosum* (L.) All., *Sinapis arvensis* L. subsp. *arvensis*, *Veronica arvensis* L., and *Vicia angustifolia* L.

Eleven aquatic vascular plant species were recorded, including five helophytes and six hydrophytes. The helophytes are *Carex pendula* Huds., *Cyperus longus* L., *Lythrum salicaria* L., *Phragmites australis* (Cav.) Trin. ex Steud., and *Schoenoplectus lacustris* (L.) Palla, while the hydrophytes are *Alisma plantago-aquatica* L., *Callitriche stagnalis* Scop., *Glyceria fluitans* (L.) R.Br., *Lemna minor* L., *Potamogeton polygonifolius* Pourr., and *Sparganium neglectum* Beeby.

Life-form spectrum

The life-form spectrum shows a predominance of herbaceous taxa, mostly hemicryptophytes (35.9%) and therophytes (30.8%) (Fig. 4).

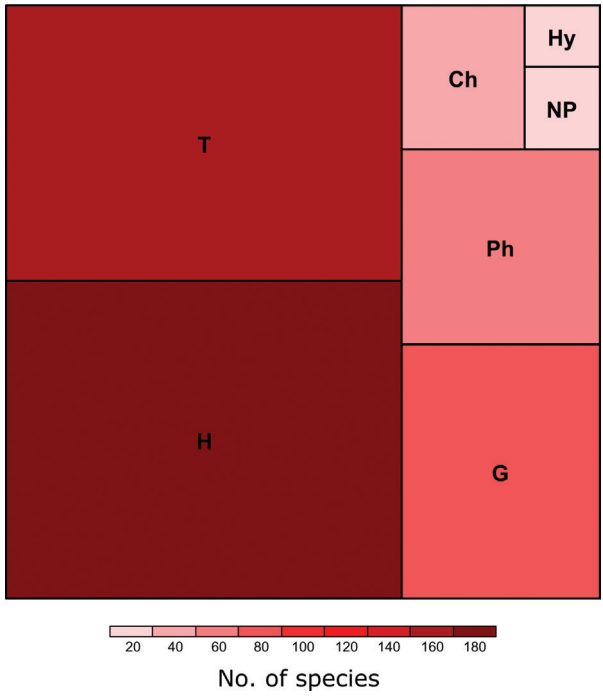

Figure 4. Life-form spectrum of the inventoried flora. Ch = chamaephytes; G = geophytes; H = hemicryptophytes; Hy = hydrophytes; NP = nanophanerophytes; Ph = phanerophytes; T = therophytes. The area of each polygon is proportional to the number of taxa present in the given category.

Chorological spectrum

The chorological spectrum shows a co-dominance Mediterranean (27.1%) and Eurasian (23.5%) elements (Fig. 5).

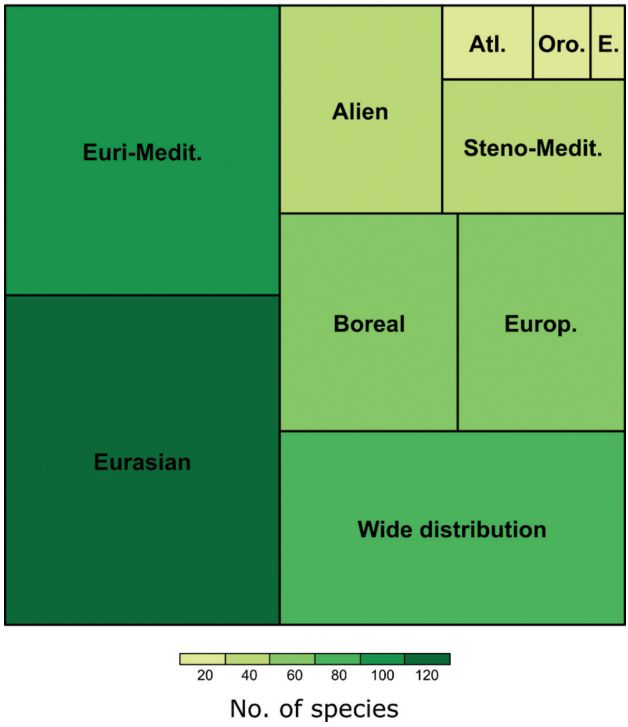

Figure 5. Chorological spectrum of the inventoried flora. Atl. = Atlantic; E. = Italian endemics; Euri-Medit. = Euri-Mediterranean; Europ. = European; Oro. = Orophilous; Steno-Medit. = Steno-Mediterranean. The area of each polygon is proportional to the number of taxa present in the given category.

Discussion

We studied a reclaimed land of central Italy that is currently an agricultural area. Our floristic surveys revealed the presence of a relatively rich vascular flora in the study area, thanks to the diversity of the habitats present, although most of them occur as small patches. In particular, wetlands and relict woods represent the most relevant elements. Therefore, our results suggest that, despite the conversion to agricultural land, former wetlands host particular species, especially in particular remnant habitats.

The abundance of Poaceae, Asteraceae, and Fabaceae is similar but not consistent with the pattern known for the Italian flora, as the abundance of the first two families in the Italian flora is reversed. The families with fewer species largely follow the trend of the Italian flora (Bartolucci et al. 2018a; Galasso et al. 2018a).

The high proportion of annual species, mostly linked to non-hygrophilous communities as found by Angiolini et al. (2011), is related to the large surfaces used as agricultural areas, especially as arable land. The repeated tillage and the disturbance of the sites promotes therophytes in arable crop fields (Fanfarillo et al. 2020a). Though forests and shrublands are generally rare in the area, we found a relatively high diversity of phanerophytes and nanophanerophytes. The abundance of geophytes is partly related to residual natural and semi-natural habitats (e.g., *Anemonoides nemorosa* (L.) Holub, *Petasites hybridus* (L.) G.Gaertn., B.Mey. & Scherb. subsp. *hybridus*), but also promoted by tillage practices as reflected by species as *Cirsium arvense* (L.) Scop., *Gladiolus italicus* Mill., and *Sorghum halepense* (L.) Pers.). On the contrary, we recorded only few aquatic species due to the limited surfaces of wetlands, nowadays corresponding to artificial water bodies and channels, which, especially these latter, tend to dry out in summer. However, species related to wet or partially wet environments are present, such as *Althaea cannabina* L., *Lysimachia nummularia* L., *Lythrum tribracteatum* Salzm. ex Spreng., and *Sparganium neglectum* Beeby. This is in accordance with other Tuscan wetlands under a strong anthropogenic pressure (Lastrucci et al. 2010, 2014). Palustrine and lacustrine plants and plant communities might respond differently to different environmental factors (Angiolini et al. 2019).

The chorological spectrum is in line with the life-form spectrum, highlighting a transition between the Mediterranean and Temperate climate. Both, European and Mediterranean species are abundant, with a slight predominance of the former. The high number of widely distributed species is largely due to the occurrence of synanthropic plants (e.g., *Alopecurus myosuroides* Huds. subsp. *myosuroides*, *Chenopodium album* L. subsp. *album*, and *Poa annua* L.) and only partially to aquatic plants (e.g., *Alisma plantago-aquatica* L., *Glyceria fluitans* (L.) R.Br., and *Schoenoplectus lacustris* (L.) Palla). Alien species (e.g., *Artemisia verlotiorum* Lamotte, *Amaranthus retroflexus* L., and *Datura stramonium* L.) are abundant due to the high anthropogenic influence. By contrast, the Italian endemics are scarce. Among them, *Crocus etruscus* Parl. is included in several lists of threatened plant species. This species is a geophyte endemic to Tuscany, Umbria, and Emilia-Romagna. It grows in forests and at forest edges or, less frequently, on grasslands, from 200 to 800 m a.s.l. It flowers between February and April. In our study area, the species was found in deciduous woods with *Castanea sativa* Mill., *Quercus cerris* L., *Q. pubescens* Willd. subsp. *pubescens*, and *Q. robur* L. subsp. *robur*. The populations are not subjected to particular threats, except for a pressure exerted by wild ungulates or human foraging (Ercole et al. 2016).

The presence of endemics and species of conservation concern, both nationally and locally, is useful to assess the status and quality of a flora and of the environment. As mentioned, in our study area such species are very few. This is predominantly linked to the high human impact but might also be due to the lack of specific substrates, morphology or any other particular environmental features. For example, the Piana di Rosia lacks areas with outcropping rocks. This deficiency is partially compensated by the presence of dry-stone walls, boulders, dirt roads, and road edges. Here, we found characteristic species of outcrops or habitats with low soil formation, such as *Cerastium*

sp. pl., *Cymbalaria muralis* G.Gaertn., B.Mey. & Scherb., *Sedum* sp. pl., and *Veronica cymbalaria* Bodard. Even though such areas are limited and small in size, they host numerous species.

The alien species we found are mostly neophytes and their amount is considerable, with every tenth species being an alien one. The local naturalization status of such taxa mostly matches their status on a regional level, except for a few species that are considered casual or naturalized in the study area, but that are naturalized or invasive in Tuscany, respectively, such as *Abutilon theophrasti* Medik., *Fagopyrum esculentum* Moench, *Helianthus tuberosus* L., *Mirabilis jalapa* L., and *Oxalis articulata* Savigny. Despite the relatively high presence of alien species in the Piana di Rosia, not many species behave as invasive when compared with the whole Italian flora (Galasso et al. 2018a). The most invasive herbaceous species are *Amaranthus* sp. pl., *Erigeron* sp. pl., and *Paspalum distichum* L., while the most invasive woody aliens are *Ailanthus altissima* (Mill.) Swingle, *Parthenocissus quinquefolia* (L.) Planch., and *Robinia pseudoacacia* L. Some of them, namely *A. altissima*, *Amaranthus* sp. pl., *Erigeron* sp. pl., and *R. pseudoacacia*, are very frequent and well-established aliens in Italy, and very common in different plant communities (Viciani et al. 2020). Moreover, *R. pseudoacacia* and *A. altissima* have a heavy impact on natural habitats in the study area, mirroring what is reported at the national scale (Radtke et al. 2013; Lazzaro et al. 2020).

In the study area, we found new alien species for the administrative province of Siena. Among the most invasive ones, there are *Amaranthus hybridus* subsp. *cruentus* (L.) Thell. and *A. powellii* S.Watson. This is consistent with the invasive character of many species of the genus *Amaranthus* and with their relevance as agricultural weeds (Iamonico 2015). We also found scarcely observed aliens for the administrative province of Siena, such as *Abutilon theophrasti* Medik., *Datura stramonium* L., and *Erigeron annuus* (L.) Desf., and interesting floristic records such as *Populus canescens* (Aiton) Sm. This species grows in riparian woods and humid environments (Pignatti et al. 2017–2019). The discovery of this new phanerophyte for the province of Siena is relevant in the context of the woody flora of Tuscany (Roma-Marzio et al. 2016). The rediscovery of *Allium longispathum* Redouté, *Bromus commutatus* Schrad. subsp. *commutatus*, and *Persicaria maculosa* Gray confirms the importance of complete floristic surveys, since these taxa are likely commonly distributed, but scarcely observed. The record of *Lythrum tribracteatum* Salzm. ex Spreng. is the third record for the province of Siena. Its occurrence was previously known at Chiusi and Montepulciano Lakes (Arrigoni and Ricceri 1981). Similarly, *Conium maculatum* L. subsp. *maculatum* was reported in recent times at only a few sites in the south of the Siena province (Selvi 1996). We found other relatively rare species such as *Isatis tinctoria* L. subsp. *tinctoria*, rare in Tuscany (Peruzzi et al. 2017c). Some species new to the province of Siena, such as *Fragaria viridis* Weston subsp. *viridis* and *Spergularia rubra* (L.) J.Presl & C.Presl, are common in Tuscany, but not in the province of Siena, where they are, however, likely to be scarcely observed.

The analysis of segetal species revealed that most of the taxa are not of conservation concern in Europe, since all are common and widespread. This is consistent with the

fact that agriculture in the area is mostly intensive, and thus there is a lack of the typical species-rich fields common in many traditional agricultural areas of Italy (Fanfarillo et al. 2019b; Fanfarillo et al. 2020b). Practices such as chemical weeding and fertilization, that feature the intensively managed arable fields of Piana di Rosia, cause a reduction of segetal biodiversity (Richner et al. 2015; Fanfarillo et al. 2019a). The only exception is represented by *Legousia speculum-veneris* (L.) Chaix subsp. *speculum-veneris*, which is considered of conservation concern at the European level. This species is in fast regression under the pressure of intensive agriculture, like other segetal species (Storkey et al. 2012; Richner et al. 2015). However, *L. speculum-veneris* (L.) Chaix subsp. *speculum-veneris* is relatively common in the Italian peninsula.

Conclusions and implications for conservation

This work contributes to the knowledge of the vascular flora of a poorly studied area of southern Tuscany, a former wetland of the previous century. Our results suggest that the land-use changes that occurred in the Piana di Rosia have modified the typical wetland flora and caused a general simplification of the plant species present. Further, the overall number of species and the number of native species present is lower than expected, while the opposite is true for alien species. Despite this, remnants of natural or semi-natural vegetation, like residual woods and shrubs, together with the presence of natural and artificial small water bodies, allow the presence of interesting plant species occurring in relatively undisturbed habitats, such as endemics, relatively rare species, protected species, and hydrophytes. We also found some species that have not been reported in the administrative province of Siena for over a century. These features are typical of "type 2" of the High Nature Value farmlands, i.e., "farmlands with a mosaic of low intensity agriculture and natural and structural elements, such as field margins, hedgerows, stone walls, patches of woodland or scrub, small rivers etc." (Keenleyside et al. 2014). However, the Piana di Rosia is currently not qualifiable as a High Nature Value farmland due to the intensive land use. In this context, the most biologically valuable areas are ecological corridors bordering channels, streams, ditches, residual groves, highlighting the problem of the reduced surface of these elements and a generalized habitat fragmentation. Residual wetlands within agroecosystems should be maintained, as they offer fundamental niches for numerous hygrophilous species, suggesting that many relevant species might be commonly overlooked, also in areas with a currently scarce natural importance.

Although this study fills a gap in the floristic knowledge of southern Tuscany, our data also suggest that the knowledge of southern Tuscany is far from complete and further botanical and ecological investigations are generally needed, also in areas with an alleged scarce environmental value. Accordingly, surveying and inventorying plant biodiversity in current agroecosystems is fundamental for what they have represented in the past, but also for a better application of sustainable management in the future, in the perspective of preserving valuable elements and restore ecosystem functioning and services (Zerbe 2019). Our findings suggest that an ecological intensification of

the agroecosystem would be feasible in the area thanks to the remnants of naturalness present. Also, native plant material could be used to increase the extent and quality of natural and semi-natural elements in the agricultural mosaic. This would help to make such remnants more valuable, also considering that restoration of these agroecosystems becomes much more difficult once they have disappeared (Strohbach et al. 2015). From a conservation point of view, the natural value of this agricultural area could be enhanced, and its current management partly reconsidered, in order to maintain the remnants of floristic naturalness present, bearing also in mind that almost half of the Piana di Rosia borders on protected areas. Lastly, we recall that floristic surveys should become a basic tool for policymakers to calibrate their environment-related decisions.

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References

Alessandrini A (2000) La flora delle zone umide d'acqua dolce: importanza e problemi di conservazione. In: Bernardoni A, Casale F (Eds) Proceedings of the conference "Zone umide d'acqua dolce – Tecniche e strategie di gestione della vegetazione palustre". Quaderni della Riserva Naturale Paludi di Ostiglia 1: 11–19.

Angiolini C, Arrigoni PV, Selvi F (2005) Stato attuale e progressi delle conoscenze floristiche in Toscana dal 1978 ad oggi. In: Scoppola A, Blasi C (Eds) Stato attuale delle conoscenze sulla flora vascolare d'Italia. Palombi, Roma, 141–145.

Angiolini C, Nucci A, Frignani F, Landi M (2011) Using multivariate analyses to assess effects of fluvial type on plant species distribution in a Mediterranean river. Wetlands 31(1): 167–177. https://doi.org/10.1007/s13157-010-0118-7

Angiolini C, Viciani D, Bonari G, Zoccola A, Bottacci A, Ciampelli P, Gonnelli V, Lastrucci L (2019) Environmental drivers of plant assemblages: are there differences between palustrine and lacustrine wetlands? A case study from the northern Apennines (Italy). Knowledge and Management of Aquatic Ecosystems 420(34): 1–11. https://doi.org/10.1051/kmae/2019026

Arrigoni PV (1981) Introduzione al convegno sulle zone umide della Toscana tenutosi in Pisa il 20 Ottobre 1980. Atti della Società Toscana di Scienze Naturali. Memorie Serie B 88: 279–284.

Arrigoni PV (2014) Revisione tassonomica e corologica del genere *Polygala* in Italia. Informatore Botanico Italiano 46(2): 235–263.

Arrigoni PV (2016) Flora analitica della Toscana (Vol. 1). Polistampa, Firenze, 408 pp.
Arrigoni PV (2017) Flora analitica della Toscana (Vol. 2). Polistampa, Firenze, 336 pp.
Arrigoni PV (2018) Flora analitica della Toscana (Vol. 3). Polistampa, Firenze, 536 pp.
Arrigoni PV, Ricceri C (1981) La vegetazione dei laghi di Chiusi e di Montepulciano (Siena). Atti della Società Toscana di Scienze Naturali – Memorie Serie B 88: 285–299.
Barazzuoli P, Migliorini J, Capacci F (2020) Water resources and main groundwater bodies in the Province of Siena in the framework of the land management plan. Italian Journal of Groundwater 9(1): 51–61. https://doi.org/10.7343/as-2020-433
Baroni E (1908) Supplemento Generale al Prodromo della Flora Toscana di T. Caruel. Società Botanica Italiana, Firenze, 638 pp.
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 R, 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 (2018a) 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, Banfi E, Bernardo L, Bonari G, Buccomino G, Calvia G, Carruggio F, Cavallaro V, Chianese G, Conti F, Facioni L, Del Vico E, Di Gristina E, Falcinelli F, Forte L, Gargano D, Mantino F, Martino M, Mei G, Mereu G, Olivieri N, Passalacqua NG, Pazienza G, Peruzzi L, Roma-Marzio F, Scafidi F, Scoppola A, Stinca A, Nepi C (2018b) Notulae to the Italian native vascular flora: 5. Italian Botanist 5: 71–81. https://doi.org/10.3897/italianbotanist.5.25892
Bartolucci F, Domina G, Ardenghi NMG, Bacchetta G, Bernardo L, Buccomino G, Buono S, Caldararo F, Calvia G, Carruggio F, Cavagna A, D'Amico FS, Di Carlo F, Festi F, Forte L, Galasso G, Gargano D, Gottschlich G, Lazzaro L, Magrini S, Maiorca G, Medagli P, Mei G, Mennini F, Mereu G, Miserocchi D, Olivieri N, Passalacqua NG, Pazienza G, Peruzzi L, Prosser F, Rempicci M, Roma-Marzio F, Ruggero A, Sani A, Saulle D, Steffanini C, Stinca A, Terzi M, Tondi G, Trenchi M, Viciani D, Wagensommer RP, Nepi C (2018c) Notulae to the Italian native vascular flora: 6. Italian Botanist 6: 45–64. https://doi.org/10.3897/italianbotanist.6.30575
Bilz M, Kell SP, Maxted N, Lansdown RV [Eds] (2011) European Red List of vascular plants. Publications Office of the European Union, Luxembourg.
Bonari G, Cantini D, Angiolini C, Selvi F, Scoppola A, Viciani D, Ferretti G, Gabellini A, Perini C, De Dominicis V, Ardenghi NMG, Lastrucci L (2016) Contribution to the vascular flora of Pietraporciana Nature Reserve (Southern Tuscany, Italy). Atti della Società Toscana di Scienze Naturali – Memorie Serie B 123: 9–28. http://dx.doi.org/10.2424/ASTSN.M.2016.02
Bonari G, Selvi F, Minniti F, Frignani F, Angiolini C (2018) Contribution to the vascular flora of Castelvecchio Nature Reserve (central Tuscany, Italy). Atti della Società Toscana di Scienze Naturali – Memorie Serie B 125: 77–86. https://doi.org/10.3897/italianbotanist.7.33763

Bonari G, Fiaschi T, Chytrý K, Biagioli M, Angiolini C (2019) *Coriaria myrtifolia*-dominated vegetation: Syntaxonomic considerations on a newly found community type in Tuscany (Italy). Plant Sociology 56(2): 99–112. https://doi.org/10.7338/pls2019562/07

Cannucci S, Angiolini C, Anselmi B, Banfi E, Biagioli E, Castagnini P, Centi C, Fiaschi T, Foggi B, Gabellini A, Lastrucci L, Lattanzi E, Scoppola A, Selvi F, Viciani D, Bonari G (2019) Contribution to the knowledge of the vascular flora of Miniere di Murlo area (southern Tuscany, Italy). Italian Botanist 7: 51–67. https://doi.org/10.3897/italianbotanist.7.33763

Carta A, Peruzzi L (2011) *Crocus etruscus*. The IUCN Red List of Threatened Species 2011: e.T161939A5516365. [accessed 11.01.2021]

Caruel T (1860) Prodromo della flora toscana. Le Monnier, Firenze, 767 pp.

Castelli C [Ed.] (2012) RENATO – Repertorio Naturalistico Toscano. Aggiornamento dei dati per il periodo 2005–2010. Technical Report for the Tuscany Region.

Castroviejo S, Aedo C, Ciruiano S, Lainz M, Montserrat P, Morales R, Muñoz Garmendia F, Navarro C, Paiva J, Soriano C [Eds] (1984–2005) Flora Iberica. Real Jardìn Botanico, CSIC, Madrid.

Chiarucci A, Mariotti MG, De Dominicis V (1993) Ricerche geobotaniche in Val di Merse (Toscana meridionale). 4. Contributo alla conoscenza della Flora della Val di Farma. Webbia 47(2): 277–311. https://doi.org/10.1080/00837792.1993.10670546

Di Natale S, Lastrucci L, Hroudová Z, Viciani D (2020) A review of *Bolboschoenus* species (Cyperaceae) in Italy based on herbarium data. Plant Biosystems. https://doi.org/10.1080/11263504.2020.1852330

D'Antraccoli M, Roma-Marzio F, Carta A, Landi S, Bedini G, Chiarucci A, Peruzzi L (2019) Drivers of floristic richness in the Mediterranean: a case study from Tuscany. Biodiversity and Conservation 28: 1411–1429. https://doi.org/10.1007/s10531-019-01730-x

Environmental Protection Agency (2020) Wetlands Protection and Restoration. [accessed 11.01.2021]

Ercole S, Giacanelli V, Bacchetta G, Fenu G, Genovesi P [Eds] (2016) Manuali per il monitoraggio di specie e habitat di interesse comunitario (Direttiva 92/43/CEE) in Italia: specie vegetali. ISPRA, Serie Manuali e linee guida, 140/2016.

Fanfarillo E, Kasperski A, Giuliani A, Abbate G (2019a) Shifts of arable plant communities after agricultural intensification: A floristic and ecological diachronic analysis in maize fields of Latium (central Italy). Botany Letters 166(3): 356–365. https://doi.org/10.1080/23818107.2019.1638829

Fanfarillo E, Scoppola A, Lososová Z, Abbate G (2019b) Segetal plant communities of traditional agroecosystems: a phytosociological survey in central Italy. Phytocoenologia 49(2): 165–183. https://doi.org/10.1127/phyto/2019/0282

Fanfarillo E, Latini M, Iberite M, Bonari G, Nicolella G, Rosati L, Salerno G, Abbate G (2020a) The segetal flora of winter cereals and allied crops in Italy: species inventory with chorological, structural and ecological features. Plant Biosystems 154(6): 935–946. https://doi.org/10.1080/11263504.2020.1739164

Fanfarillo E, Petit S, Dessaint F, Rosati L, Abbate G (2020b) Species composition, richness, and diversity of weed communities of winter arable land in relation to geo-environmen-

tal factors: A gradient analysis in mainland Italy. Botany 98(7): 381–392. https://doi.org/10.1139/cjb-2019-0178

Favilli L, Benocci A, Piazzini S, Manganelli G (2017) Il Padule di Rosia: un ambiente da ripristinare. EtruriaNatura XII: 108–116.

Fiori A (1923–1929) Nuova Flora Analitica d'Italia (Vols. 1–3). Tipografia M. Ricci, Firenze.

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 (2018a) An updated checklist of the vascular flora alien to Italy. Plant Biosystems 152(3): 556–592. https://doi.org/10.1080/11263504.2018.1441197

Galasso G, Domina G, Adorni M, Ardenghi NMG, Bonari G, Buono S, Cancellieri L, Chianese G, Ferretti G, Fiaschi T, Forte L, Guarino R, Labadessa R, Lastrucci L, Lazzaro L, Magrini S, Minuto L, Mossini S, Olivieri N, Scoppola A, Stinca A, Turcato C, Nepi C (2018b) Notulae to the Italian alien vascular flora: 5. Italian Botanist 5: 45–56. https://doi.org/10.3897/ib.5.25910

Galasso G, Domina G, Alessandrini A, Ardenghi NMG, Bacchetta G, Ballelli S, Bartolucci F, Brundu G, Buono S, Busnardo G, Calvia G, Capece P, D'Antraccoli M, Di Nuzzo L, Fanfarillo E, Ferretti G, Guarino R, Iamonico D, Iberite M, Latini M, Lazzaro L, Lonati M, Lozano V, Magrini S, Mei G, Mereu G, Moro A, Mugnai M, Nicolella G, Nimis PL, Olivieri H, Pennesi R, Peruzzi L, Podda L, Probo M, Prosser F, Ravetto Enri S, Roma-Marzio F, Ruggero A, Scafidi F, Stinca A, Nepi C (2018c) Notulae to the Italian alien vascular flora: 6. Italian Botanist 6: 65–90. https://doi.org/10.3897/italianbotanist.6.30560

Gardner RC, Barchiesi S, Beltrame C, Finlayson CM, Galewski T, Harrison I, Paganini M, Perennou C, Pritchard DE, Rosenqvist A, Walpole M (2015) State of the World's wetlands and their services to people: a compilation of recent analyses. Ramsar Convention Secretariat, Gland. Ramsar Briefing Note no. 7: 1–21. https://doi.org/10.2139/ssrn.2589447

Gigante D, Attorre F, Venanzoni R, Acosta ATR, Agrillo E, Aleffi M, Alessi N, Allegrezza M, Angelini P, Angiolini C, Assini S, Azzella MM, Bagella S, Biondi E, Bolpagni R, Bonari G, Bracco F, Brullo S, Buffa G, Carli E, Caruso G, Casavecchia S, Casella L, Cerabolini BEL, Ciaschetti G, Copiz R, Cutini M, Del Vecchio S, Del Vico E, Di Martino L, Facioni L, Fanelli G, Foggi B, Frattaroli AR, Galdenzi D, Gangale C, Gasparri R, Genovesi P, Gianguzzi L, Gironi F, Giusso Del Galdo G, Gualmini M, Guarino R, Lasen C, Lastrucci L, Maneli F, Pasta S, Paura B, Perrino EV, Petraglia A, Pirone G, Poponessi S, Prisco I, Puglisi M, Ravera S, Sburlino G, Sciandrello S, Selvaggi A, Spada F, Spampinato G, Strumia S, Tomaselli M, Tomaselli V, Uzunov D, Viciani D, Villani M, Wagensommer RP, Zitti S (2016) A methodological protocol for Annex I Habitats monitoring: the contribution of Vegetation science. Plant Sociology 53(2): 77–87. https://doi.org/10.7338/pls2016532/06

Gigante D, Acosta ATR, Agrillo E, Armiraglio S, Assini S, Attorre F, Bagella S, Buffa G, Casella L, Giancola C, Giusso Del Galdo GP, Marcenò C, Pezzi G, Prisco I, Venanzoni R, Viciani

D (2018) Habitat conservation in Italy: the state of the art in the light of the first European Red List of Terrestrial and Freshwater Habitats. Rendiconti Lincei. Scienze Fisiche e Naturali 29(2): 251–265. https://doi.org/10.1007/s12210-018-0688-5

Greppi C (2014) La Piana di Rosia dalla fine del governo granducale alla crisi della mezzadria. La Piana di Rosia (Sovicille): storia di un paesaggio culturale di pianura. Miscellanea storica della Valdelsa 326(1): 115–131.

Hunter ML, Gibbs JP (2007) Fundamentals of conservation biology (3rd ed.). Blackwell Publishing, Oxford.

Iacoviello F, Martini I (2012) Provenance and geological significance of red mud and other clastic sediments of the Mugnano cave (Montagnola Senese, Italy). International Journal of Speleology 41(2): 317–328. https://doi.org/10.5038/1827-806X.41.2.17

Iacoviello F, Martini I (2013) Clay minerals in cave sediments and terra rossa soils in the Montagnola Senese karst massif (Italy). Geological Quarterly 57(3): 527–536. https://doi.org/10.7306/gq.1111

Iamonico D (2015) Taxonomic revision of the genus *Amaranthus* (Amaranthaceae) in Italy. Phytotaxa 199(1): 1–84. https://doi.org/10.11646/phytotaxa.199.1.1

IUCN (2021) The IUCN Red List of Threatened Species. Version 2020-3. [accessed 11.01.2021]

Janssen J, Rodwell J, García Criado M, Gubbay S, Haynes T, Nieto A, Sanders N, Landucci F, Loidi J, Ssymank A, Tahvanainen T, Valderrabano M, Acosta A, Aronsson M, Arts G, Attorre F, Bergmeier E, Bijlsma R-J, Bioret F, Gubbay S (2016) European Red List of Habitats – Part 2. Terrestrial and freshwater habitats.

Keenleyside C, Beaufoy G, Tucker G, Jones G (2014) High Nature Value farming throughout EU-27 and its financial support under the CAP. Institute for European Environmental Policy, London.

Landi M, Angiolini C, De Dominicis V (2002) Florula del tratto medio-basso del fiume Merse (Toscana meridionale). Micologia e Vegetazione Mediterranea 17(2): 175–192.

Landi M, Bonari G, Frignani F, Landi S, Angiolini C (2016) La flora della Riserva Naturale Biogenetica di Tocchi. In: Saveri C (Ed.) La Riserva Naturale Biogenetica di Tocchi. Il Leccio, Monteriggioni, 135–160.

Landi M, Frignani F, Bonini I, Casini F, Saveri C, De Dominicis V, Angiolini C (2009) Flora and vegetation in the catchment area of the stream "La Bolza" in the Merse valley (Siena, southern Tuscany). Webbia 64(2): 187–212. https://doi.org/10.1080/00837792.2009.10670859

Lastrucci L, Bonari G, Angiolini C, Landi M, Casini F, Giallonardo T, Landucci F, Gigante D, Venanzoni R, Viciani D (2014) Vegetation of Lakes Chiusi and Montepulciano (Tuscany, Central Italy): updated knowledge and new discoveries. Plant Sociology 51(2): 29–55. https://doi.org/10.7338/pls2014512/03

Lastrucci L, Landi M, Angiolini C (2010) Vegetation analysis on wetlands in a Tuscan agricultural landscape (central Italy). Biologia 65(1): 54–68. https://doi.org/10.2478/s11756-009-0213-5

Lazzaro L, Bolpagni R, Buffa G, Gentili R, Lonati M, Stinca A, Acosta ATR, Adorni M, Aleffi M, Allegrezza M, Angiolini C, Assini S, Bagella S, Bonari G, Bovio M, Bracco F, Brundu G, Caccianiga M, Carnevali L, Di Cecco V, Ceschin S, Ciaschetti G, Cogoni A, Foggi B, Frattaroli AR, Genovesi P, Gigante D, Lucchese F, Mainetti A, Mariotti M, Minissale P, Paura B, Pellizzari M, Perrino EV, Pirone G, Poggio L, Poldini L, Poponessi S, Prisco I,

Prosser F, Puglisi M, Rosati L, Selvaggi A, Sottovia L, Spampinato G, Stanisci A, Venanzoni R, Viciani D, Vidali M, Villani M, Lastrucci L (2020) Impact of invasive alien plants on native plant communities and Nature Natura 2000 habitats: state of the art, gap analysis and perspectives in Italy. Journal of Environmental Management 274: e111140. https://doi.org/10.1016/j.jenvman.2020.111140

Mariotti M, Persiano T, Regni E, De Dominicis V (1986) Ricerche geobotaniche in Val di Merse (Toscana meridionale). I. Contributo alla conoscenza della flora di Pian di Feccia e Pian Ferrale. Webbia 39(2): 233–258. https://doi.org/10.1080/00837792.1986.10670372

Martellos S, Bartolucci F, Conti F, Galasso G, Moro A, Pennesi R, Peruzzi L, Pittao E, Nimis PL (2020) FlorItaly – the portal to the Flora of Italy. PhytoKeys 156: 55–71. https://doi.org/10.3897/phytokeys.156.54023

Martini I (2011) Cave clastic sediments and implications for speleogenesis: new insights from the Mugnano Cave (Montagnola Senese, Northern Apennines, Italy). Geomorphology 134(3–4): 452–460. https://doi.org/10.1016/j.geomorph.2011.07.024

Mediterranean Wetlands Observatory (2014) Land cover – Spatial dynamics in Mediterranean coastal wetlands from 1975 to 2005. Thematic collection, issue #2. Tour du Valat.

Orsenigo S, Fenu G, Gargano D, Montagnani C, Abeli T, 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 M, Rossi G (2020) Red list of threatened vascular plants in Italy. Plant Biosystems. https://doi.org/10.1080/11263504.2020.1739165

Peruzzi L, Bedini G [Eds] (2015 onwards) Wikiplantbase #Toscana v. 2.1. [accessed 11.01.2021]

Peruzzi L, Bagella S, Filigheddu S, Pierini B, Sini M, Roma-Marzio F, Caparelli KF, Bonari G, Gestri G, Dolci D, Consagra A, Sassu P, Caria MC, Rivieccio G, Marrosu M, D'Antraccoli M, Pacifico G, Piu V, Bedini G (2017a) The Wikiplantbase project: the role of amateur botanists in building up large online floristic databases. Flora Mediterranea 27: 117–129. https://doi.org/10.7320/FlMedit27.117

Peruzzi L, Viciani D, Agostini N, Angiolini C, Ardenghi NMG, Astuti G, Bardaro MR, Bertacchi A, Bonari G, Boni S, Chytrý M, Ciampolini F, D'Antraccoli M, Domina G, Ferretti G, Guiggi A, Iamonico D, Laghi P, Lastrucci L, Lazzaro L, Lazzeri V, Liguori P, Mannocci M, Marsiaj G, Novák P, Nucci A, Pierini B, Roma-Marzio F, Romiti B, Sani A, Zoccola A, Zukal D, Bedini G (2017b) Contributi per una flora vascolare di Toscana. VIII (440–506). Atti della Società Toscana di Scienze Naturali – Memorie Serie B 123: 71–82. https://doi.org/10.2424/ASTSN.M.2016.06

Peruzzi L, Viciani D, Angiolini C, Astuti G, Banfi E, Benocci A, Bonari G, Bruni G, Caramante P, Caré M, Carta A, Castagnini P, Cheli A, Ciampolini F, D'Antraccoli M, Ferretti G, Ferruzzi S, Fiaschi T, Foggi B, Fontana D, Galasso G, Gallo L, Galvani D, Gestri G, Grazzini A, Lastrucci L, Lazzaro L, Loppi S, Manganelli G, Mugnai M, Piazzini S, Pierini B, Roma-Marzio F, Sani A, Selvi F, Soldano A, Stinca A, Bedini G (2017c) Contributi per una flora vascolare di Toscana. IX (507–605). Atti della Società Toscana di Scienze Naturali – Memorie Serie B 124: 73–86. https://doi.org/10.2424/ASTSN.M.2017.07

Peruzzi L, Viciani D, Angiolini C, Astuti G, Banfi E, Bardaro MR, Bianchetto E, Bonari G, Cannucci S, Cantini D, Castagnini P, D'Antraccoli M, Esposito A, Ferretti G, Fiaschi T, Foggi B, Franceschi G, Galasso G, Gottschlich G, Lastrucci L, Lazzaro L, Maneli F, Mar-

chetti D, Marsiaj G, Mugnai M, Roma-Marzio F, Ruocco M, Salvai G, Stinca A, Bedini G (2018) Contributi per una flora vascolare di Toscana. X (606–663). Atti della Società Toscana di Scienze Naturali – Memorie Serie B 125: 67–76. https://doi.org/10.2424/ASTSN.M.2018.12

Pesaresi S, Galdenzi D, Biondi E, Casavecchia S (2014) Bioclimate of Italy: application of the worldwide bioclimatic classification system. Journal of Maps 10(4): 538–553. https://doi.org/10.1080/17445647.2014.891472

Pesaresi S, Biondi E, Casavecchia S (2017) Bioclimates of Italy. Journal of Maps 13(2): 955–960. https://doi.org/10.1080/17445647.2017.1413017

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

Pignatti S, Guarino R, La Rosa M (2017–2019) Flora d'Italia (Ed. 2, Vols. 1–4). Edagricole di New Business Media, Milano.

Portal to the Flora of Italy (2020 onwards) Portale della Flora d'Italia/Portal to the Flora of Italy. 2020.1. [accessed 11.01.2021]

Radtke A, Ambraß S, Zerbe S, Tonon G, Fontana V, Ammer C. (2013) Traditional coppice forest management drives the invasion of *Ailanthus altissima* and *Robinia pseudoacacia* into deciduous forests. Forest Ecology and Management 291: 308–317. https://doi.org/10.1016/j.foreco.2012.11.022

R Core Team (2020) R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna. [accessed 11.01.2021]

Regione Toscana (2020) GEOscopio. [accessed 11.01.2021]

Rameau JC, Mansion D, Dumé G, Timbal J, Lecointe A, Dupont P, Keller R (1989) Flore Forestière Francaise. Guide Ecologique Illustré. Institut pour le Développement Forestier & Ministère de l'Agricolture et de la Foret.

Rameau JC, Mansion D, Dumé G, Gauberville C, Bardat J, Bruno E, Keller R (2008) Flore Forestière Francaise. Guide Ecologique Illustré. Institut pour le Développement Forestier-CNPPF & Ministère de l'Agricolture et de la Péche-DGFAR.

Ramsar Convention on Wetlands (2018) Global Wetland Outlook: State of the World's wetlands and their services to people. Ramsar Convention Secretariat, Gland.

Richner N, Holderegger R, Linder HP, Walter T (2015) Reviewing change in the arable flora of Europe: a meta-analysis. Weed Research 55: 1–13. https://doi.org/10.1111/wre.12123

Roma-Marzio F, Bedini G, Müller JV, 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

Rossi G, Montagnani C, Gargano D, Peruzzi L, Abeli T, Ravera S, Cogoni A, Fenu G, Magrini S, Gennai M, Foggi B, Wagensommer RP, Venturella G, Blasi C, Raimondo FM, Orsenigo S [Eds] (2013) Lista Rossa della Flora Italiana. 1. Policy Species e altre specie minacciate. Comitato Italiano IUCN e Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Roma.

Selvi F (1996) Flora and phytogeography of the volcanic dome of Monte Amiata (central Italy). Webbia 50(2): 265–310. https://doi.org/10.1080/00837792.1996.10670606

Sposimo P, Castelli C (2005) La biodiversità in Toscana. Specie e habitat in pericolo. Archivio del Repertorio Naturalistico Toscano (RENATO). Regione Toscana-Direzione Generale Politiche Territoriali e Ambientali, Firenze.

Storkey J, Meyer S, Still KS, Leuschner C (2012) The impact of agricultural intensification and land-use change on the European arable flora. Proceedings of the Royal Society B 279: 1421–1429. https://doi.org/10.1098/rspb.2011.1686

Strohbach MW, Kohler ML, Dauber J, Klimek S (2015) High Nature Value farming: From indication to conservation. Ecological Indicators 57: 557–563. https://doi.org/10.1016/j.ecolind.2015.05.021

Tison J-M, De Foucault B (2014) Flora Gallica: Flore de France. Biotope éditions, Mèze.

Thiers B (2020 onwards) Index Herbariorum: A Global Directory of Public Herbaria and Associated Staff. New York Botanical Garden's Virtual Herbarium. [accessed 11.01.2021]

Tomei PE (1982) Le zone umide della Toscana: stato attuale delle conoscenze geobotaniche e prospettive di salvaguardia. Atti della Società Toscana di Scienze Naturali – Memorie Serie B 89: 345–361.

Tutin TG, Heywood VH, Burgers NA, Moore DM, Valentine DH, Walters SM, Webb DA [Eds] (1964–1980) Flora Europaea (Vols. 1–5). University Press, Cambridge.

Viciani D, Lastrucci L, Dell'Olmo L, Ferretti G, Foggi B (2014) Natura 2000 habitats in Tuscany (central Italy): synthesis of main conservation features based on a comprehensive database. Biodiversity and Conservation 23: 1551–1576. https://doi.org/10.1007/s10531-014-0686-6

Viciani D, Vidali M, Gigante D, Bolpagni R, Villani M, Acosta ATR, Adorni M, Aleffi M, Allegrezza M, Angiolini C, Assini S, Bagella S, Bonari G, Bovio M, Bracco F, Brundu G, Buffa G, Caccianiga M, Carnevali L, Ceschin S, Ciaschetti G, Cogoni A, Di Cecco V, Foggi B, Frattaroli AR, Genovesi P, Gentili R, Lazzaro L, Lonati M, Lucchese F, Mainetti A, Mariotti M, Minissale P, Paura B, Pellizzari M, Perrino E, Pirone G, Poggio L, Poldini L, Poponessi S, Prisco I, Prosser F, Puglisi M, Rosati L, Selvaggi A, Sottovia L, Spampinato G, Stanisci A, Stinca A, Venanzoni R, Lastrucci L (2020) A preliminary checklist of the alien-dominated vegetation in Italy. Plant Sociology 57(1): 29–54. https://doi.org/10.3897/pls2020571/04

Zerbe S (2019) Renaturierung von Ökosystemen im Spannungsfeld von Mensch und Umwelt. Ein interdisziplinäres Fachbuch. Springer, Heidelberg. https://doi.org/10.1007/978-3-662-58650-1

Supplementary material 1

Figures S1–S3 and floristic inventory

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RESEARCH ARTICLE

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Non-indigenous macroalgal species in coralligenous habitats of the Marine Protected Area Isole Ciclopi (Sicily, Italy)

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Abstract

Biological invasions are considered one of the main threats for biodiversity. In the last decades, more than 60 macroalgae have been introduced in the Mediterranean Sea, causing serious problems in coastal areas. Nevertheless, the impacts of alien macroalgae in deep subtidal systems have been poorly studied, especially in the coralligenous habitats of the eastern coast of Sicily (Italy). Therefore, within the framework of the programme "Progetto Operativo di Monitoraggio (P.O.M.)" of the EU Marine Strategy Framework Directive (MSFD), the aim of the present study was to gain knowledge on the alien macroalgae present in coralligenous habitats of the Marine Protected Area (MPA) Isole Ciclopi, along the Ionian coast of Sicily. By Remotely Operated Vehicle (ROV) videos and destructive samples analysed in the laboratory, five alien species were identified: *Caulerpa cylindracea*, *Antithamnion amphigeneum*, *Asparagopsis armata*, *Bonnemaisonia hamifera*, and *Lophocladia lallemandii*. Since *A. amphigeneum* was previously reported only in the western Mediterranean and Adriatic Sea, the present report represents the first record of this species in the eastern Mediterranean. The ROV surveys showed that the alien species do not have a high coverage and do not appear to be invasive in the coralligenous area of the MPA. Since ocean temperatures are predicted to increase as climate change continues and alien species are favoured by warming of the Mediterranean Sea, the risk of biotic homogenisation caused by the spread of alien species is realistic. Therefore, further studies are needed to assess the incidence and invasiveness of alien species in phytobenthic assemblages of coralligenous in the MPA.

Keywords

Coralligenous, Macroalgae, Mediterranean Sea, Marine Strategy Framework Directive, Non-indigenous species

Introduction

In the Mediterranean Sea, deep rocky bottoms are characterized by assemblages dominated by calcareous organisms, defined as coralligenous biocenosis (Pérès and Picard 1964), mainly built by Rhodophyta belonging to the orders Corallinales, Hapalidiales, and Peyssonneliales (Ballesteros 2006). In this system, the heterogeneity of the rocky bottom is increased by a complex microtopography related to the presence of a secondary substrate provided by building organisms, particularly calcareous encrusting algae (Piazzi et al. 2007). This high heterogeneity in the substrate favours the presence of a high number of species per unit area (Cocito 2004; Ballesteros 2006). However, coralligenous habitats are sensitive to several impacts, especially if caused by human activities (Hong 1983). Among these stressors, biological invasions caused by Non-Indigenous Species (NIS) have been recognized as an important threat in marine habitats (Walker and Kendrick 1998; Seebens et al. 2017). NIS are defined as organisms introduced intentionally or unintentionally outside their natural range by human activities (Olenin et al. 2010). Marine NIS are mainly introduced unintentionally by discharges of ballast waters and accumulated ballast sediments (David et al. 2012), attached to the hulls of vessels (Buschbaum et al. 2012), by the mariculture industry (Naylor et al. 2001), and by passage through canals (e.g., Suez Channel, Strait of Gibraltar, and Dardanelles Strait) (Galil 2012). In particular, port areas have been considered to be hotspots for the introduction of NIS (Tempesti et al. 2020). Introduction, spread, and establishment of NIS pose significant threats to biodiversity, at different scales and extent, and to economies worldwide (Streftaris and Zenetos 2006; Galil 2007; Saebi et al. 2020). For this reason, many environmental programmes, initiatives, policies and strategies have focused their attention on the protection against alien species. In particular, the Bern Convention on the Conservation of European Wildlife and Natural Habitats has developed the European Strategy on Invasive Alien Species, which offers specific advice to countries and international organisations on measures to limit this threat. The Convention on Biological Biodiversity (CBD) has highlighted the need to assemble and disseminate information on alien species that threaten ecosystems, habitats, and species in order to prevent any further introduction. Moreover, more studies on the impact of alien invasive species on biological diversity are strongly encouraged (CBD 2000). The EU Marine Strategy Framework Directive (MSFD 2008) includes measures to limit the spread of alien species in European Seas (Streftaris and Zenetos 2006). In fact, alien species are one of the eleven qualitative descriptors for the assessment of the environmental status of the water bodies, according to the MSFD (García et al. 2015). In particular, the descriptor D2 requires that the alien species remain at levels that do not adversely alter the ecosystem, in order to reach the Good Environmental Status (GES) of the marine environment. Therefore, data on the presence/absence, abundance, and impacts of the alien species on marine habitats have to be available (García et al. 2015).

In the last decades, more than 60 macroalgae have been introduced in the Mediterranean Sea (Verlaque 1994; Galil 2000; Boudouresque and Verlaque 2002) and in several coastal areas they have become dominant in the benthic assemblages (Verlaque and Fritayre 1994; Piazzi and Cinelli 2003). The introduction of marine macroalgae represents a major threat for marine systems (Ribera and Boudouresque 1995; Scheibling and Gagnon 2006). Indeed, the spread of introduced benthic algae may lead to a complete cover of substrata, affecting native assemblages and reducing biodiversity (Viejo 1997; Britton-Simmons 2004; Casas et al. 2004; Buschbaum et al. 2006). The replacement of native benthic algae by alien macroalgae modifies environmental conditions and the functioning of ecosystems, causing an impoverishment of littoral systems (Rueness 1989; Staehr et al. 2000; Wikstrom and Kautsky 2004; Sanchez et al. 2005). In particular, the spread of species of the genus *Caulerpa* and turf-forming Rhodophyta have been considered among the most serious biological invasions in the Mediterranean (Meinesz et al. 2001; Boudouresque and Verlaque 2002). Nevertheless, the ecological impact of the majority of NIS in the Mediterranean is still unknown, since the few available studies were conducted at limited temporal and spatial scales, and the synergistic relations with other stressors affecting the marine environment are largely unknown (Raitsos et al. 2010; Galil et al. 2018). Furthermore, although all habitats are considered vulnerable to invasions (Lodge 1993), some are thought to be more sensitive than others (Wasson et al. 2005). In particular, the effects of introduced species in deep subtidal systems, such as coralligenous habitats, are still little-known (Piazzi et al. 2007). Therefore, the aim of the present study was to acquire knowledge on alien macroalgae in the coralligenous habitats of the Marine Protected Area (MPA) Isole Ciclopi, along the Ionian coast of Sicily (Italy) (Fig. 1A).

Materials and methods

Study area

The MPA, established in 1998 and with a total extension of 6.23 km^2, is located in the municipality of Aci Castello, along the central-eastern coast of Sicily (Italy). The MPA hosts three harbours, one of which, the largest in size, with a total extension of 0.028 km^2. In this port, in summer, about 380 boats used for all authorized activities in the MPA (diving, professional fishing, recreational fishing, artisanal fishing, buoy field, recreational boat, touristic boat) are present. Indeed, especially in summer, daily input and output flows are more frequent. From a geological point of view, this area comprises a complex of subvolcanic rocks, mainly consisting of columnar basalts, and effusive submarine products forming extensive fields of pillow lavas (Cristofolini 1975; Corsaro and Cristofolini 1997). The underwater topography, from the coastline down to 25–40 m depth, is steeply sloping and consists largely of *in situ* basaltic bedrocks and large volcanic blocks (Sciuto et al. 2015).

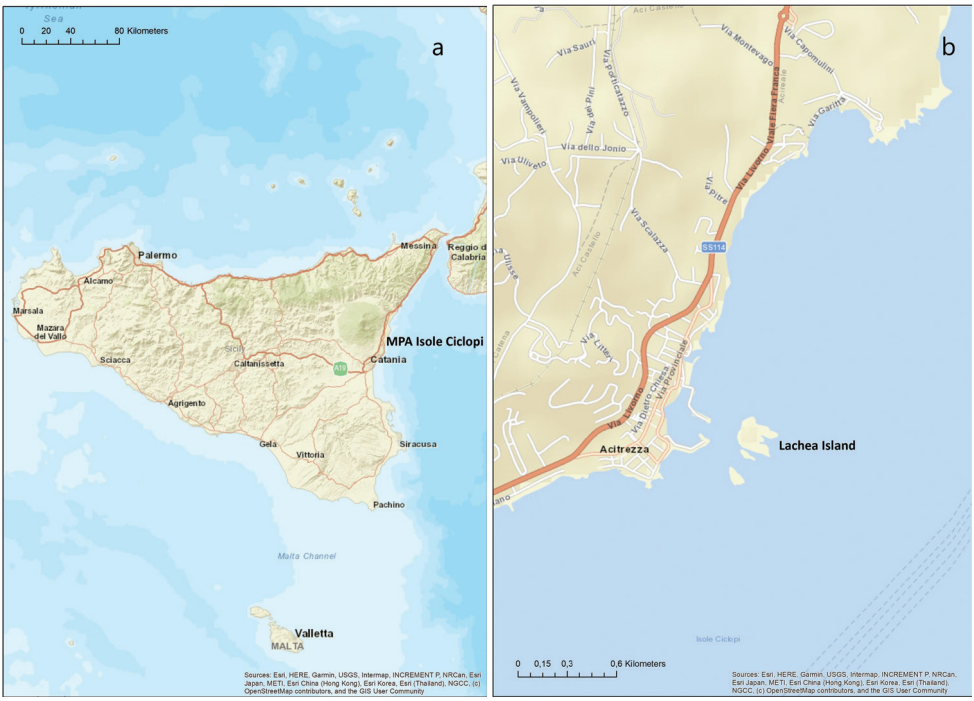

Figure 1. Map of the study area **a** geographical location of the MPA Isole Ciclopi along the Ionian coast of Sicily **b** detail of the Lachea Island, the sampling site.

Methods

The present study was conducted in October 2018 along the border of zone A of the MPA Isole Ciclopi. A visual census of the coralligenous habitats was carried out by a ROV in three transects (each with an extension of ca. 200 m and at depth of 32–39 m) located along the northeastern side of the island of Lachea (37°33'40.51"N, 15°09'05.43"E), the largest outcrop of the Isole Ciclopi (Fig. 1B). The type of ROV used for this study was a Marine Scope, FO II model, equipped with a high-definition video camera (GoPro 5), a digital camera with depth sensor and an integrated compass, two laser beams placed 10 cm apart and used as a metric scale for the images and the visual field, and two led strobes of 13,000 lumen. Subsequently, an average of 20 frames for each transect were extrapolated from the ROV videos to allow the identification of the main macroalgal taxa.

Moreover, samplings in scuba diving were performed in the same area as the ROV surveys in two different seasons (spring and autumn) at a depth of 36 m. Two samples, one for each season, were collected by removing with a hatchet all sessile organisms from 20 × 20 cm quadrats. We preferred to use the hatchet rather than the traditional hammer and chisel since it was easier to use on organogenic substrates. The samples collected in scuba diving were stored in a solution of seawater and 90% ethyl alcohol and carried to the Laboratory of Algology of the University of Catania for the identification of the flora.

Results

Through the observation of frames extrapolated by the ROV videos and the analysis of the samples in the laboratory, a total of 92 taxa were found (Costanzo et al. 2020). Among them, five NIS were observed, including one Chlorophyta (*Caulerpa cylindracea* Sonder) and four Rhodophyta [*Antithamnion amphigeneum* A.Millar, *Asparagopsis armata* Harvey, *Bonnemaisonia hamifera* Hariot and *Lophocladia lallemandii* (Montagne) F.Schmitz].Comments on morphology, distribution, and likely way of introduction for each species are reported below.

Ceramiales
Ceramiaceae

Antithamnion amphigeneum A.Millar

Description. The collected specimens match with the descriptions of Verlaque and Seridi (1991), Cormaci et al. (2004), Rodríguez-Prieto et al. (2013) and Verlaque et al. (2015). The thalli are pink-reddish, filamentous and uniseriate, consisting of creeping and erect axes, bearing distichous opposite whorl branches. The whorl branches have an isodiametric basal cell and bear opposite distichous simple or branched branchlets with only abaxial branchlets near the distal portion. As reported by Secilla et al. (1997), we noticed in our samples that the apical cells are blunt and sometimes provided with a single hyaline hair (Fig. 2A). The lateral indeterminate branches arise replacing a branchlet and with the suppression of the opposite branchlet (Fig. 2B). Moreover, in the collected specimens there were abundant gland cells located on the adaxial side of both normal and special branchlets, touching 2–3 cells. We found only sterile specimens.

Chorology. Indo-Pacific.

Presumed introduction vector. Fouling.

Remarks. Hitherto in the Mediterranean, this species has only been reported in the western basin (Verlaque et al. 2015) and in the Adriatic Sea (Mačić and Ballesteros 2016). Therefore, the present report represents the first record of *A. amphigeneum* in the eastern Mediterranean.

Bonnemaisoniales
Bonnemaisoniaceae

Asparagopsis armata Harvey

Description. In our samples, only the tetrasporophytic phase (known as *Falkenbergia rufolanosa*) was found. The tetrasporophytes are filamentous and usually form small tufts. The tetrasporophytic thalli consist of an axis with apical growth, with 3 periaxial cells around each axial cell. In the collected specimens the gland cells, which are cut off

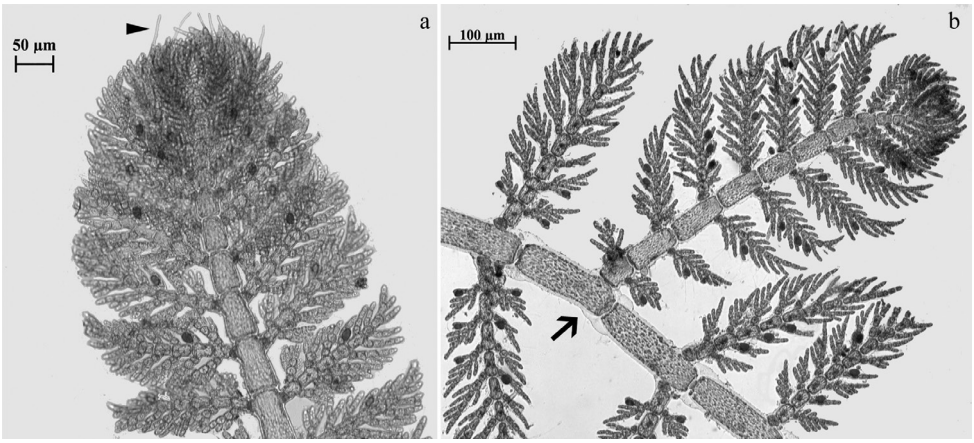

Figure 2. *Antithamnion amphigeneum* **a** apical portion of an indefinite axes: the arrowhead shows a terminal hyaline hair **b** detail of lateral indeterminate branches, which arise by replacing a branchlet and with the suppression of the opposite branchlet (arrow).

by each periaxial cell, were well-identifiable. Previously, in the MPA Isole Ciclopi the gamethophytes were also reported (Giaccone and Pizzuto 2001). Gametophytic thalli are pale pink, with a pyramidal outline and fixed to the substrate by cylindrical stolons. The frond consists of a cylindrical main axis, irregularly and radially branched, bearing plumose branches on all sides. Furthermore, the branches are scattered and with a harpoon shape for the presence of several retroverted spines.

Chorology. Cosmopolitan.

Presumed introduction vector. Fouling.

Remarks. This species has been widely reported in almost all the Mediterranean. Hitherto, in the coralligenous of the MPA only the tetrasporophytes have been found (Furnari and Scammacca 1970; Furnari et al. 1977). In fact, usually, the gametophytes occur in the upper infralittoral (Cormaci et al. 2020).

Bonnemaisonia hamifera Hariot

Description. In the collected samples, only the tetrasporophytic stage (known as *Trailliella intricata*) was observed. The specimens found match with the descriptions of Cormaci et al. (2014), Verlaque et al. (2015) and Cormaci et al. (2020). The tetrasporophytic thalli are pinkish-red or pinkish-brown and consist of uniseriate and irregularly branched filaments. One or rarely two small refractive gland cells are formed at the upper end of each cell. The gamethophytic thalli are dark red and consist of a main axis, which bears opposite branches, lacking in lower portions. Primary axes are arranged on several levels forming a 3/8 spiral. Few branches are modified to form reflexed crozier-shaped hooks, which are present particularly in the middle-upper parts of the thallus and serve for anchoring and vegetative propagation.

Chorology. Circumboreal.

Presumed introduction vector. Fouling and/or spontaneously through the Strait of Gibraltar.

Remarks. Hitherto, in the Mediterranean Sea, *B. hamifera* gametophytes have only been reported in Spain: in the Strait of Gibraltar and along the coasts of Catalonia (Cormaci et al. 2020). Previously, in the MPA the tetrasporophytes were only found in 1978 at a depth of 45 m (Cormaci and Furnari 1979).

Bryopsidales
Caulerpaceae

Caulerpa cylindracea Sonder

Description. The found specimens clearly show the features described by Rodríguez-Prieto et al. (2013), Cormaci et al. (2014), and Verlaque et al. (2015). The thalli of this species consist of stolons attached by numerous short slender rhizoids and bearing erect photosynthetic cylindrical axes. The erect fronds, with a simple axis, are rarely branched and slightly swollen at the base, bearing loose to moderately dense ramules, distichous or radial, inclined towards the apex. The ramules are sub-cylindrical to claviform, rounded at the apex and slightly attenuated downwards, without constraint at the point of attachment to the axis.

Chorology. Pantropical.

Presumed introduction vector. Ballast waters.

Remarks. In the Mediterranean, *C. cylindracea* is widely distributed from the lower eulittoral to the upper circalittoral (Cormaci et al. 2014). Most of the previous reports of this species were referred to as *Caulerpa racemosa* var. *cylindracea* (Sonder) Verlaque, Huisman & Boudouresque. In 2014, molecular studies assessed the identity of Mediterranean specimens as *C. cylindracea* (Belton et al. 2014). In the MPA this species has been previously reported as *C. racemosa* by Giaccone and Pizzuto (2001).

Ceramiales
Rhodomelaceae

Lophocladia lallemandii (Montagne) F.Schmitz

Description. The collected specimens correspond to the description of Cormaci et al. (2004), Rodríguez-Prieto et al. (2013) and Verlaque et al. (2015). The thalli of this species are dark red, filamentous and are attached to the substrate by rhizoids with multicellular discs. The axes are cylindrical and dichotomously branched, with a monopodial structure. Each axial cell develops four pericentral cells. Trichoblasts are pigmented and are formed radially, one per segment, in a regular spiral. Branches are mainly exogenous and replace a trichoblast. In our samples, only gamethophytes were found.

Chorology. Indo-Pacific.

Presumed introduction vector. Spontaneously through the Suez Canal.

Remarks. This species has spread throughout the Mediterranean Sea, colonising subtidal communities from shallow waters to deep environments (Verlaque et al. 2015). According to Bedini et al. (2011), the percentage cover of *L. lallemandii* increase with depth. In the coralligenous habitats of the MPA, this species has been recorded since the 1970s (Furnari and Scammacca 1970; Furnari et al. 1977).

Discussion

Through the observation of ROV frames, we saw that in the investigated area the encrusting layer is well developed and formed by a high coverage of calcareous Rhodophyta. In both samples and frames analysis, it was observed that alien species do not show a high coverage or an invasive attitude in the coralligenous of the MPA. Indeed, in ROV frames only few thalli of *C. cylindracea* and *L. lallemandii* (corresponding to a coverage of 5–25% of the Braun-Blanquet's Scale), were observed (Fig. 3A, B). Instead, the other alien species, due to their microscopic sizes, were observed only by analysis of the destructive samples in the laboratory. In particular, we found specimens of *A. amphigeneum*, previously reported only in the western Mediterranean (Verlque et al. 2015) and more recently in the Adriatic Sea (Mačić and Ballesteros 2016). Therefore, the present record constitutes a further eastward step of this species in the Mediterranean Sea. Moreover, in the present study only the tetrasporophytic stages of *A. armata* and *B. hamifera* have been observed. This could depend on the daylength and temperature requirements of these species. In fact, in culture experiments, it has been observed that the tetrasporophytes of both species reproduce under short-day conditions [less than 9 h of light for *Falkenbergia* (Guiry and Dawes 1992) and less than 12 h of light for *Trailliella* (Breeman et al. 1988)] and within a narrow temperature range of about 15 °C (Breeman et al. 1988; Oza 1989). Conditions of low irradiance and relatively constant temperature are typical of coralligenous habitats (Garrabou and Ballesteros 2000) and, thus, this might explain the presence of the only tetrasporophytes in the coralligenous habitat of the study area.

Almost all NIS found in this study, except *B. hamifera*, are warm-water species, whose origin is from Australasia or from the Red Sea. Generally, the presence of warm-water alien species has been related to warming of the Mediterranean Sea. In fact, this warming not only stresses the native species, but also facilitates the arrival of other NIS, adding extra pressure on the ecosystem (Harris and Tyrell 2001). The survival, reproduction, and establishment of warm alien species in a new environment depends on the thermal regime, which has to match the thermal physiological requirement of the species (Raitsos et al. 2010). The concurrent increase in seawater temperature and abundance of warm alien species is a phenomenon called 'tropicalization' of the Mediterranean Sea, which has especially affected the south-eastern sectors of the basin (Bianchi et al. 2018).

Most marine introductions take place by dispersal operated by cargo ships; thus, ports are considered one of the principal dispersal hotspots for alien species (Hulme

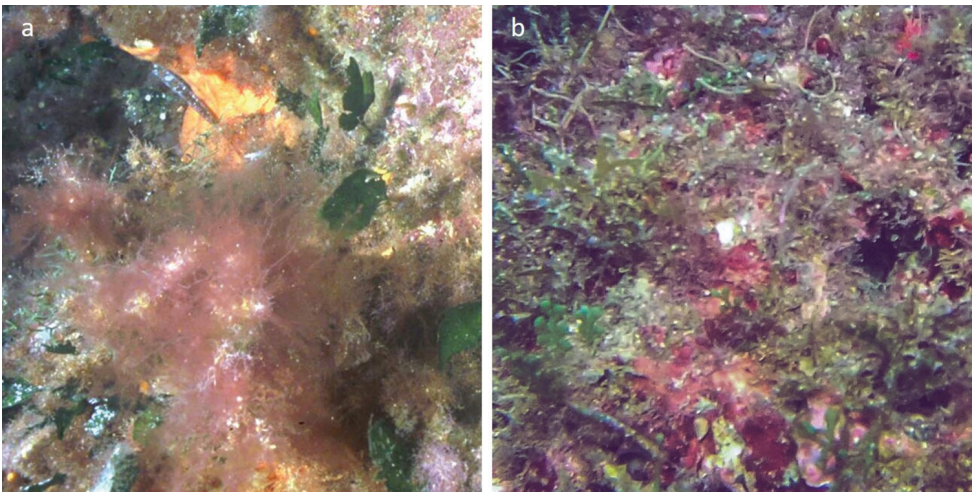

Figure 3. Examples of frames extrapolated from ROV videos **a** a frame showing *Lophocladia lallemandii* **b** a frame showing *Caulerpa cylindracea*.

2009). Moreover, ports also provide several artificial structures that create favourable habitats for NIS (Mineur et al. 2012), particularly sessile benthic invertebrates (Cangussu et al. 2010), and macroalgae (Petrocelli et al. 2019). Due to the presence of three harbours within the MPA, it is likely that the main way of access of the NIS in this area is related to shipping. In fact, particularly during summer, there is a considerable flux of authorized vessels in the MPA. Moreover, most of the found NIS could have easily been transported by fouling. In fact, the recent ban of Tributyltin based antifouling paints, applied to limit metal pollution (Campbell and Hewitt 2011), and the long periods spent by ships in port (Floerl and Coutts 2009) are factors which further enhance hull fouling transport. Therefore, surveillance, eradication, and monitoring programmes should be suggested and established (Rohde et al. 2017).

In conclusion, in the present study, we observed that the occurrence of alien species contributes to an increase of the percentage incidence of Rhodophyta in the flora of the coralligenous habitats of the MPA. Nevertheless, the presence of NIS does not currently compromise this Mediterranean biodiversity hotspot. Since ocean temperatures are predicted to increase as climate change continues (IPCC 2007) and alien species are favoured by warming of Mediterranean waters, the risk of biotic homogenisation is possible. Therefore, further studies are needed to fully assess the incidence and invasiveness of alien species in the coralligenous phytobenthic assemblages of this MPA.

References

Ballesteros E (2006) Mediterranean coralligenous assemblages: a synthesis of present knowledge. Oceanography and Marine Biology: An Annual Review 44: 123–195. https://doi.org/10.1201/9781420006391.ch4

Bedini R, Bonechi L, Piazzi L (2011) Spread of the red alga *Lophocladia lallemandii* in the Tuscan Archipelago (NW Mediterranean Sea). Cryptogamie, Algologie 32(4): 383–391. https://doi.org/10.7872/crya.v32.iss4.2011.383

Belton GS, Prud'homme van Reine WF, Huisman JM, Draisma SGA, Gurgel CFD (2014) Resolving phenotypic plasticity and species designation in the morphology challenging *Caulerpa racemosa-peltata* complex (Caulerpaceae, Chlorophyta). Journal of Phycology 50(1): 32–54. https://doi.org/10.1111/jpy.12132

Bianchi C, Caroli F, Guidetti P, Morri C (2018) Seawater warming at the northern reach for southern species: Gulf of Genoa, NW Mediterranean. Journal of the Marine Biological Association of the United Kingdom 98(1): 1–12. https://doi.org/10.1017/S0025315417000819

Boudouresque CF, Verlaque M (2002) Biological pollution in the Mediterranean Sea: invasive versus introduced macrophytes. Marine Pollution Bulletin 44: 32–38. https://doi.org/10.1016/S0025-326X(01)00150-3

Breeman AM, Meulenhoff EJS, Guiry MD (1988) Life history regulation and phenology of the red alga *Bonnemaisonia hamifera*. Helgoländer Meeresuntersuchungen 42: 535–551. https://doi.org/10.1007/BF02365625

Britton-Simmons KH (2004) Direct and indirect effects of the introduced alga *Sargassum muticum* on benthic, subtidal communities of Washington State, USA. Marine Ecology Progress Series 277: 61–78. https://doi.org/10.3354/meps277061

Buschbaum C, Chapman AS, Saier B (2006) How an introduced seaweed can affect epibiota diversity in different coastal systems. Marine Biology 148: 743–754. https://doi.org/10.1007/s00227-005-0128-9

Buschbaum C, Lackschewitz D, Reise K (2012) Nonnative macrobenthos in the Wadden Sea ecosystem. Ocean & Coastal Management 68: 89–101. https://doi.org/10.1016/j.ocecoaman.2011.12.011

Campbell ML, Hewitt CL (2011) Assessing the port to port risk of vessel movements vectoring non-indigenous marine species within and across domestic Australian borders. Biofouling 27: 631–644. https://doi.org/10.1080/08927014.2011.593715

Cangussu LC, Altvater L, Haddad MA, Cabral AC, Heyse HL, Rocha R (2010) Substrate type as a selective tool against colonization by non-native sessile invertebrates. Brazilian Journal of Oceanography 58(3): 219–231. https://doi.org/10.1590/S1679-87592010000300005

Casas G, Scrosati R, Piriz ML (2004) The invasive kelp *Undaria pinnatifida* (Phaeophyceae, Laminariales) reduces native seaweed diversity in Nuevo Gulf (Patagonia, Argentina). Biological Invasions 6: 411–416. https://doi.org/10.1023/B:BINV.0000041555.29305.41

CBD [Convention on Biological Diversity] (2000) Interim Guiding Principles. Conference of the Parties Decision V/8 Alien species that threaten ecosystems, habitats or species. http://www.cbd.int/decision/cop/default.shtml?id=7150

Cocito S (2004) Bioconstruction and biodiversity: their mutual influence. Scientia Marina 68: 137–144. https://doi.org/10.3989/scimar.2004.68s1137

Cormaci M, Furnari G (1979) Flora algale marina della Sicilia orientale: Rhodophyceae, Phaeophyceae, Chlorophyceae. Informatore Botanico Italiano 11: 221–250.

Cormaci M, Furnari G, Giaccone G, Serio D (2004) Alien macrophytes in the Mediterranean Sea: a review. Recent Research Developments in Environmental Biology 1: 153–202.

Cormaci M, Furnari G, Alongi G (2014) Flora marina bentonica del Mediterraneo: Chlorophyta. Bollettino dell'Accademia Gioenia di Scienze Naturali di Catania 47(377): 11–436.

Cormaci M, Furnari G, Alongi G (2020) Flora marina bentonica del Mediterraneo: Rhodophyta – Rhodymeniophycidae I. Bollettino dell'Accademia Gioenia di Scienze Naturali di Catania 53(383): 11–346. https://doi.org/10.35352/gioenia.v53i383.87

Corsaro RA, Cristofolini R (1997) Geology, geochemistry and mineral chemistry of tholeiitic to transitional Etnean magmas. Acta Vulcanologica 9: 55–66.

Costanzo LG, Marletta G, Alongi G (2020) Assessment of marine litter in the coralligenous habitat of a Marine Protected Area along the Ionian coast of Sicily (Central Mediterranean). Journal of Marine Science and Engineering 8(9): e656. https://doi.org/10.3390/jmse8090656

Cristofolini R (1975) La massa subvulcanica di Aci Trezza (Etna). Rendiconti della Società Italiana di Mineralogia e Petrografa 30: 741–770.

David M, Perkovič M, Suban V, Gollasch S (2012) A generic ballast water discharge assessment model as a decision supporting tool in ballast water management. Decision Support Systems 53: 175–185. https://doi.org/10.1016/j.dss.2012.01.002

Floerl O, Coutts A (2009) Potential ramifications of the global economic crisis on human-mediated dispersal of marine non-indigenous species. Marine Pollution Bulletin 58: 1595–1598. https://doi.org/10.1016/j.marpolbul.2009.08.003

Furnari G, Scammacca B (1970) Flora algale dell'Isola Lachea (Golfo di Catania). Primo Contributo. Giornale Botanico Italiano 104(3): 137–164. https://doi.org/10.1080/11263507009426713

Furnari G, Scammacca B, Cormaci M, Battiato A (1977) Zonazione della vegetazione sommersa dell'Isola Lachea (Catania). In: Cinelli F, Fresi E, Mazzella L (Eds) Atti del IX Congresso della Società Italiana di Biologia Marina, 245–257.

Galil BS (2000) A sea under siege – alien species in the Mediterranean. Biological Invasions 2: 177–186. https://doi.org/10.1023/A:1010057010476

Galil BS (2007) Loss or gain? Invasive aliens and biodiversity in the Mediterranean Sea. Marine Pollution Bulletin 55: 314–322. https://doi.org/10.1016/j.marpolbul.2006.11.008

Galil BS (2012) Truth and consequences: the bioinvasion of the Mediterranean Sea. Integrative Zoology 7: 299–311. https://doi.org/10.1111/j.1749-4877.2012.00307.x

Galil BS, Marchini A, Occhipinti-Ambrogi A (2018) East is east and West is west? Management of marine bioinvasions in the Mediterranean Sea. Estuarine, Coastal and Shelf Science 201: 7–16. https://doi.org/10.1016/j.ecss.2015.12.021

García M, Weitzmann B, Pinedo S, Cebrian E, Ballesteros E (2015) First report on the distribution and impact of marine alien species in coastal benthic assemblages along the Catalan coast. Handbook of Environmental Chemistry 43: 249–270. https://doi.org/10.1007/698_2015_411

Garrabou J, Ballesteros E (2000) Growth of *Mesophyllum alternans* and *Lithophyllum frondosum* (Corallinales, Rhodophyta) in the northwestern Mediterranean. European Journal of Phycology 35(1): 1–10. https://doi.org/10.1080/09670260010001735571

Giaccone G, Pizzuto F (2001) Stato delle conoscenze sulla biodiversità algale marina delle Isole dei Ciclopi (Catania, Sicilia orientale). Bollettino dell'Accademia Gioenia di Scienze Naturali di Catania 34(360): 5–22.

Guiry MD, Dawes CJ (1992) Daylength, temperature and nutrient control of tetrasporogenesis in *Asparagopsis armata* (Rhodophyta). Journal of Experimental Marine Biology and Ecology 158: 197–217. https://doi.org/10.1016/0022-0981(92)90227-2

Harris LG, Tyrrell MC (2001) Changing community states in the Gulf of Maine: Synergism between invaders, overfishing and climate change. Biological Invasions 3: 9–21. https://doi.org/10.1023/A:1011487219735

Hong JS (1983) Impact of the pollution on the benthic community. Environmental impact of the pollution on the benthic coralligenous community in the Gulf of Fos, northwestern Mediterranean. Bulletin of the Korean Fishery Society 16(3): 273–290.

Hulme PE (2009) Trade, transport and trouble: managing invasive species pathways in an era of globalization. Journal of Applied Ecology 46: 10–18. https://doi.org/10.1111/j.1365-2664.2008.01600.x

IPCC [Intergovernmental Panel on Climate Change] (2007) Climate change 2007: Impacts, adaptation and vulnerability. Cambridge University Press, 986 pp. https://doi.org/10.1017/CBO9780511546013

Lodge DM (1993) Biological invasions: lesson for ecology. Trends in Ecology and Evolution 8: 133–137. https://doi.org/10.1016/0169-5347(93)90025-K

Mačić V, Ballesteros E (2016) First record of the alien alga *Antithamnion amphigeneum* (Rhodophyta) in the Adriatic Sea. Acta Adriatica 57(2): 315–320.

Meinesz A, Belsher T, Thibaut T, Antolić B, Ben Mustapha K, Boudouresque CF, Chiaverini D, Cinelli F, Cottalorda JM, Djellouli A, El Abed A, Orestano C, Grau AM, Iveša L, Jallin A, Langar H, Massuti-Pascual E, Peiraino A, Tunesi L, De Vaugelas J, Zavodnik N, Žuljević A (2001) The introduced green alga *Caulerpa taxifolia* continues to spread in the Mediterranean. Biological Invasions 3: 201–210. https://doi.org/10.1023/A:1014549500678

Mineur F, Cook EJ, Minchin D, Bohn K, MacLeod A, Maggs CA (2012) Changing coasts: marine aliens and artificial structures. In: Gibson RN, Atkinson RJA, Gordon JDM, Hughes RN (Eds) Oceanography and Marine Biology: An Annual Review (Vol. 50). CRC Press, Abingdon, 189–233. https://doi.org/10.1201/b12157-5

MSFD [Marine Strategy Framework Directive] (2008) Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy. Official Journal of the European Union L 164: 19–40.

Naylor RL, Williams SL, Strong DR (2001) Aquaculture – a gateway for exotic species. Science 294(5547): 1655–1656. https://doi.org/10.1126/science.1064875

Olenin S, Alemany F, Cardoso AC, Gollasch S, Goulletquer P, Lehtiniemi M, McCollin T, Minchin D, Miossec L, Occhipinti Ambrogi A, Ojaveer H, Jensen KR, Stankiewicz M, Wallentinus I, Aleksandrov B (2010) Marine Strategy Framework Directive – Task Group 2 Report. Non-indigenous Species. Office for Official Publications of the European Communities, Luxembourg, 44 pp. https://doi.org/10.2788/87092

Oza RM (1989) Growth of red alga *Falkenbergia rufolanosa* (Harvey) Schmitz in response to temperature, irradiance and photoperiod. Indian Journal of Marine Sciences 18: 210–211.

Pérès JM, Picard J (1964) Nouveau manuel de bionomie benthique de la Méditerranée. Recueil des travaux de la station marine d'Endoume 3: 1–137.

Petrocelli A, Antolić B, Bolognini L, Cecere E, Cvitković I, Despalatović M, Falace A, Finotto S, Iveša L, Mačić V, Marini M, Orlando-Bonaca M, Rubino F, Trabucco B, Žuljević A (2019) Port baseline biological surveys and seaweed bioinvasions in port areas: what's the matter in the Adriatic Sea? Marine Pollution Bulletin 147: 98–116. https://doi.org/10.1016/j.marpolbul.2018.04.004

Piazzi L, Cinelli F (2003) Evaluation of benthic macroalgal invasion in a harbour area of the western Mediterranean Sea. European Journal of Phycology 38: 223–231. https://doi.org/10.1080/1364253031000136358

Piazzi L, Balata D, Cinelli F (2007) Invasions of alien macroalgae in Mediterranean coralligenous assemblages. Cryptogamie, Algologie 28(3): 289–301.

Raitsos DE, Beaugrand G, Georgopoulos D, Zenetos A, Pancucci-Papadopoulou AM, Theocharis A, Papathanassiou E (2010) Global climate change amplifies the entry of tropical species into the Eastern Mediterranean Sea. Limnology and Oceanography 55: 1478–1484. https://doi.org/10.4319/lo.2010.55.4.1478

Ribera MA, Boudouresque CF (1995) Introduced marine plants, with special reference to macroalgae: mechanisms and impact. Progress in Phycological Research 11: 187–268.

Rodríguez-Prieto C, Ballesteros E, Boisset F, Afonso-Carrillo J (2013) Guía de las Macroalgas y Fanerógamas Marinas del Mediterráneo Occidental. Ediciones Omega, Barcelona, 656 pp.

Rohde S, Schupp PJ, Markert A, Wehrmann A (2017) Only half of the truth: managing invasive alien species by rapid assessment. Ocean & Coastal Management 146: 26–35. https://doi.org/10.1016/j.ocecoaman.2017.05.013

Rueness J (1989) *Sargassum muticum* and other introduced Japanese macroalgae: biological pollution of European coasts. Marine Pollution Bulletin 20: 173–176. https://doi.org/10.1016/0025-326X(89)90488-8

Saebi M, Xu J, Grey EK, Lodge DM, Corbett JJ, Chawla N (2020) Higher-order patterns of aquatic species spread through the global shipping network. PLoS ONE 15: e0220353. https://doi.org/10.1371/journal.pone.0220353

Sanchez I, Fernandez C, Arrontes J (2005) Long-term changes in the structure of intertidal assemblages after invasion by *Sargassum muticum* (Phaeophyta). Journal of Phycology 41: 942–949. https://doi.org/10.1111/j.1529-8817.2005.00122.x

Scheibling RE, Gagnon P (2006) Competitive interactions between the invasive green alga *Codium fragile* ssp. *tomentosoides* and native canopy-forming seaweeds in Nova Scotia (Canada). Marine Ecology Progress Series 325: 1–14. https://doi.org/10.3354/meps325001

Sciuto F, Rosso A, Sanfilippo R, Di Martino E (2015) Ostracods from mid-outer shelf bottoms of the Ciclopi Islands Marine Protected Area (Ionian Sea, Eastern Sicily). Bollettino della Società Paleontologica Italiana 54: 131–145.

Secilla A, Gorostiaga JM, Diez I, Santolaria A (1997) *Antithamnion amphigeneum* (Ceramiales, Rhodophyta) from the European Atlantic coast. Botanica Marina 40: 329–332. https://doi.org/10.1515/botm.1997.40.1-6.329

Seebens H, Blackburn TM, Dyer EE, Genovesi P, Hulme PE, Jeschke JM, Pagad S, Pyšek P, Winter M, Arianoutsou M, Bacher S, Blasius B, Brundu G, Capinha C, Celesti-Grapow L, Dawson W, Dullinger S, Fuentes N, Jäger H, Kartesz J, Kenis M, Kreft H, Kühn I, Lenzner B, Liebhold A, Mosena A, Moser D, Nishino M, Pearman D, Pergl J, Rabitsch W, Rojas-Sandoval J, Roques A, Rorke A, Rossinelli S, Roy HE, Scalera R, Schindler S, Štajerová K,

TokarskaGuzik B, van Kleunen M, Walker K, Weigelt P, Yamanaka T, Essl F (2017) No saturation in the accumulation of alien species worldwide. Nature Communications 8: e14435. https://doi.org/10.1038/ncomms14435

Staehr PA, Pedersen MF, Thomsen MS, Wernberg T, Krause Jensen D (2000) Invasion of *Sargassum muticum* in Limfjorden (Denmark) and its possible impact on the indigenous macroalgal community. Marine Ecology Progress Series 207: 79–88. https://doi.org/10.3354/meps207079

Streftaris N, Zenetos A (2006) Alien marine species in the Mediterranean – the 100 'worst invasives' and their impact. Mediterranean Marine Science 7: 87–118. https://doi.org/10.12681/mms.180

Tempesti J, Mangano MC, Langeneck J, Lardicci C, Maltagliati F, Castelli A (2020) Non-indigenous species in Mediterranean ports: a knowledge baseline. Marine Environmental Research 161: e105056. https://doi.org/10.1016/j.marenvres.2020.105056

Verlaque M (1994) Inventaire des plantes introduites en Méditerranée: origines et répercussions sur l'environnement et les activités humaines. Oceanologica Acta 17: 1–23.

Verlaque M, Seridi H (1991) *Antithamnion algeriensis* nov. sp. (Ceramiaceae, Rhodophyta) from Algeria (Mediterranean Sea). Botanica Marina 34: 153–160. https://doi.org/10.1515/botm.1991.34.2.153

Verlaque M, Fritayre P (1994) Modifications des communautés algales méditerranéennes en présence de l'algue envahissante *Caulerpa taxifolia* (Vahl) C.Agardh. Oceanologica Acta 17: 659–672.

Verlaque M, Ruitton S, Mineur F, Boudouresque CF (2015) CIESM Atlas of Exotic Species in the Mediterranean, Vol. 4 Macrophytes. CIESM Publishers, Monaco, 364 pp.

Viejo RM (1997) The effects of colonization by *Sargassum muticum* on tidepool macroalgal assemblages. Journal of the Marine Biological Association of the United Kingdom 77: 325–340. https://doi.org/10.1017/S0025315400071708

Walker DI, Kendrick GA (1998) Threats to macroalgal diversity: marine habitat destruction and fragmentation, pollution and introduced species. Botanica Marina 41: 105–112. https://doi.org/10.1515/botm.1998.41.1-6.105

Wasson K, Fenn K, Pearse JS (2005) Habitat differences in marine invasions of central California. Biological Invasions 7: 935–948. https://doi.org/10.1007/s10530-004-2995-2

Wikstrom SA, Kautsky L (2004) Invasion of a habitat-forming seaweed: effects on associated biota. Biological Invasions 6: 141–150. https://doi.org/10.1023/B:BINV.0000022132.00398.14

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RESEARCH ARTICLE

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Notulae to the Italian flora of algae, bryophytes, fungi and lichens: 11

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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 *Aneura*, *Aulacomnium*, *Dumortiera*, *Fossombronia*, *Hennediella*, *Hygrohypnella*, *Pohlia*, *Porella*, *Riccardia*, *Tortella*, and *Tortula*, the fungal genera *Cortinarius*, *Mycena*, *Naucoria*, *Trichoglossum*, and *Tubaria* and the lichen genera *Agonimia*, *Blastenia*, *Chaenotheca*, *Cladonia*, *Endocarpon*, *Gyalecta*, *Lecanographa*, *Parmeliella*, *Porpidia*, *Stenhammarella*, and *Thelidium*.

Keywords

Ascomycota, Basidiomycota, Bryidae, Jungermanniopsida, Marchantiidae

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

***Aneura pinguis* (L.) Dumort. (Aneuraceae)**

+ **CAM**: Savone delle Ferriere, Teano (Caserta), on tuffs (UTM WGS84 33T 420170.4568975), 220 m, 4 August 2019, leg. *A. Croce*, det. *V. Plášek* (Herbarium A. Croce). – Species new for the flora of Campania.

Aneura pinguis is a cosmopolitan species, ranging from Europe, Asia, Australia, and New Zealand to North America and Mexico (Paton 1999). It represents a complex of cryptic species (Myszczyński et al. 2017). *Aneura pinguis* produces flat, green to dark green creeping thalli, which grow single or usually together with other bryophytes in moist habitats. It is common from lowlands up to the high mountain zone and grows on various habitats, such as on damp and wet peaty soil, flushed rocks, banks, lake and steam margins, base-rich fens. According to Aleffi et al. (2020) this frondose liverwort is distributed in all the Italian regions with the exception of Puglia and Campania.

A. Croce, V. Plášek, M. Aleffi

***Aulacomnium androgynum* (Hedw.) Schwägr. (Aulacomniaceae)**

+ **TAA**: Cascata del Lupo, Bedollo (Trento), on a rotting wood (UTM WGS84: 32T 676998.5114915), 906 m, 20 October 2020, leg. *G. Bergamo Decarli,* det. *F. Sguazzin* (Bryophytorum Herbarium F. Sguazzin); near the Redebus bog, Bedollo (Trento), along the bank of the Regnana stream, on a rotting wood (UTM WGS84: 32T 677074.5115017), 1428 m, 17 April 2018, leg. *G. Bergamo Decarli, det. F. Sguazzin* (Bryophytorum Herbarium F. Sguazzin); not far from the Combricol "Malga", Bedollo (Trento), under a dripping rock on a rotting wood (UTM WGS84: 32T 678705.5111581), 1630 m, 29 May 2015, leg. *G. Bergamo Decarli*, det. *F. Sguazzin* (Bryophytorum Herbarium F. Sguazzin). – Species new for the flora of Trentino-Alto Adige.

Aulacomnium androgynum is a temperate species widespread in northern Europe, up to 63° N, in Cyprus, Turkey, North Africa, Central Asia, Japan, Korea, Canary Islands, North America, and Patagonia (Smith 2004). In northern Italy the species was recently reported for Val d'Aosta, Piemonte, and Lombardia (Aleffi et al. 2020). According to Dierßen (2001), *A. androgynum* is a highly acidophytic to subneutrophytic species, moderately hygrophytic to mesophytic, considerably sciophytic, and saprolignic, usually occurring on decaying organic matter.

F. Sguazzin, G. Bergamo Decarli

***Dumortiera hirsuta* (Sw.) Nees subsp. *hirsuta* (Dumortieraceae)**

+ **CAM**: Savone delle Ferriere, Teano (Caserta), on acid rocks and humus at the bottom of the shady gorge, in a site rich in ferns dominated by *Woodwardia radicans* (L.) Sm. (UTM WGS84 33T 420670.4568811), 180 m, 21 August 2019, leg. *A. Croce*, det. *V. Plášek* (Herbarium A. Croce). – Subpecies new for the flora of Campania.

Dumortiera hirsuta (Sw.) Nees subsp. *hirsuta* is an euoceanic- w. mediterranean-macaronesian species, widely distributed in tropical regions. This frondose liverwort is listed as Endangered by Rossi et al. (2013) and Near Threatened (NT) by Hodgetts et al. (2019). In Italy, it was recorded only for Friuli Venezia Giulia (doubtfully), Liguria, Toscana, and Calabria (Aleffi et al. 2020). Robust forms of *Pellia* are sometimes mistaken for *Dumortiera*, but the latter is clearly distinguished by typical male and female receptacles with conspicuous marginal hairs.

A. Croce, V. Plášek, M. Aleffi

***Fossombronia caespitiformis* De Not. ex Rabenh. subsp. *multispira* (Schiffn.) J.R.Bray & Cargill (Fossombroniaceae)**

+ **PUG**: Lama di Lupo, Sant'Eramo in Colle (Bari), on thin soil (UTM WGS84: 33T 644122.4514233), 460 m, 9 March 2019, leg. *V. Tomaselli*, det. M. *Puglisi* (CAT). – Subpecies new for the flora of Puglia.

Fossombronia caespitiformis subsp. *multispira* is a Mediterranean-Atlantic taxon, usually growing on thin soil over rocky cliffs and along the side of paths, in microsites which are moist in winter but dry in summer. The diagnostic character of this subspecies is that the elaters are consistently 3–5- spiralled, whereas in *F. caespitiformis* subsp. *caespitiformis* they are regularly bispiralled (Sotiaux et al. 2009). This subspecies is widespread in Italy (Aleffi et al. 2020). In the new site, *F. caespitiformis* subsp. *multispira* was found within the Natura 2000 site "Murgia Alta" (SCI IT9120007). Here, it grew in disturbed habitats, generally in transition between pastures and grasslands, on thin soil accumulated in small corrosion pools.

M. Puglisi, V. Tomaselli

***Hennediella heimii* (Hedw.) R.H.Zander (Pottiaceae)**

+ **ITALIA** (**TAA**): Fassa Valley, Catinaccio Group, Pale Rabbiose above Vigo di Fassa, sheltered base of south facing dolomitic rock with *Hornungia pauciflora* (Koch) Soldano & al. (UTM WGS84: 32T 702944.5145248), 2312 m, 28 June 2020, *F. Prosser* (Herb. Prosser No. 05072). – Species confirmed for the flora of Italy (Trentino-Alto Adige).

This species is reported for Italy by Aleffi et al. (2020) as not confirmed after 1968 in Piemonte, Lombardia, Trentino-Alto Adige, Lazio, and Campania. In particular, for Trentino-Alto Adige there are two old records for Sexten (Dalla Torre and Sarnthein 1914) and for Ratzes (Milde 1864). *Hennediella heimii* is a species occurring in Europe in saline habitats mainly along coasts (Frey et al. 2006), but it is reported in Switzerland up to 2,400 m elevation (Swissbryophytes 2004–2020). The sheltered habitat, where *H. heimii* was found at Pale Rabbiose, offers refuge to chamois that, with their urine, probably create the saline conditions necessary for this moss.

F. Prosser

***Hygrohypnella ochracea* (Turner ex Wilson) Ignatov & Ignatova (Campyliaceae)**

+ **LIG**: "IT1331721 Val Noci - Torrente Geirato - Alpesisa", Rio Val Noci, Montoggio (Genova), rock in torrent (UTM WGS84: 32 T 502634.4918701), 500 m, 6 August 2020, *I. Briozzo, D. Dagnino, C. Turcato* (GE B236). – Species new for the flora of Liguria.

Hygrohypnella ochracea occurs in several countries of the Mediterranean basin (Ros et al. 2013) and in a few administrative regions of northern Italy (Aleffi et al. 2020). In the new site, *H. ochracea* was found on rocks in flowing water with typical herbaceous vegetation (*Agrostis stolonifera* L., *Typha latifolia* L., *Veronica beccabunga* L., *Juncus articulatus* L.,

Juncus inflexus L.). In the same site other moss species were found, such as *Rhynchostegium riparioides* (Hedw.) Cardot and *Eurhynchium striatum* (Hedw.) Schimp.

I. Briozzo, D. Dagnino, C. Turcato

***Pohlia bulbifera* (Warnst.) Warnst. (Mniaceae)**

+ **SAR**: Isola Serpentara, Villasimius (Sud Sardegna), on soil (UTM WGS84: 32S 552371.4332380), ca. 20 m, 9 February 2001, *S. Poponessi, A. Cogoni* (CAG No. SA2.6.2.1.). – Species new for the flora of Sardegna.

Pohlia bulbifera is a circumpolar boreo-temperate species, widespread in Europe and in the whole Boreal hemisphere, but rare in the Mediterranean area (Ros et al. 2013). According to Aleffi et al. (2020), the presence in Italy of *P. bulbifera* is currently restricted to Piemonte and Marche, while in Lombardia and Sardegna it has not been confirmed over the last 50 years. In particular, it was reported in Sardegna, without specifying the altitude, only for Gennargentu (Herzog 1926). This species is characterized by axillary gemmae with four or five laminate leaf primordia which are concave and form a dome over the gemma apex.

S. Poponessi, A. De Agostini, A. Cogoni

***Porella arboris-vitae* (With.) Grolle subsp. *arboris-vitae* (Porellaceae)**

+ **LIG**: Ponte dei Passi, Rezzo (Imperia), Tilio-Acerion mixed forest in a creek ravine (UTM WGS84: 32T 406909.4874820), 770 m, 10 June 2020, *D. Dagnino, M. Mariotti* (GE B251). – Species confirmed for the flora of Liguria.

Porella arboris subsp. *arboris-vitae* was no longer recorded for Liguria (before 1968), despite it's presence in most of the surrounding Italian regions (Aleffi et al. 2020). We found this species within a Tilio-Acerion mixed forest referring to the Directive 92/43/CEE Habitat of priority interest code 9180*. The site of discovery is close to the border of the SAC "IT1314609 M. Monega – M. Prearba", thus the species probably also occurs within the protected area. It is a basiphytic, sciophytic, meso-xerophytic, saxicolous and occasionally epiphytic taxon normally found on shaded basic rocks in woods (Dierßen 2001). *Porella arboris-vitae* subsp. *arboris-vitae* is a Mediterranean-Atlantic species, considered as NT in the new European Red List of bryophytes (Hodgetts et al. 2019).

D. Dagnino, M. Mariotti

***Riccardia palmata* (Hedw.) Carruth. (Aneuraceae)**

+ **CAL**: Vallone delle Sette Acque, Sila Grande (Cosenza), on rotting logs (UTM WGS 84: 33S 624656.4354888), 1322 m, 20 August 2020, *D. Puntillo, M. Puntillo* (CLU No. 4190); Vallone Fossiata, Sila Grande (Cosenza), on rotting logs (UTM WGS 84: 33S 636772.4363141), 1336 m, 25 August 2020, *D. Puntillo, M. Puntillo* (CLU No. 4191). – Species new for the flora of Calabria.

Riccardia palmata is recognizable in the field for its dark, erect green palmately branched thallus. This is the only species of *Riccardia* that usually grows on rotting wood. In the collection sites, *R. palmata* forms dense green patches of flat fronds and grows in the most humid and shady part of the forest, especially along the stream, on decaying wood, together with *Nowellia curvifolia* (Dicks.) Mitt., *Lophocolea heterophylla* (Schrad.) Dumort. subsp. *heterophylla*, and *Buxbaumia viridis* (Moug. ex Lam. & DC.) Brid. ex Moug. & Nestl. This species in Italy is known from the Alps to Toscana with an outpost in Sicilia (Aleffi et al. 2020).

D. Puntillo, M. Puntillo

***Tortella flavovirens* (Bruch) Broth. var. *flavovirens* (Pottiaceae)**

+ **LIG**: Final section of the trail to Punta Manara, Sestri Levante (Genova), on sandstone in xerothermophilous pioneer herbaceous vegetation (UTM WGS84: 32T 532293.4900019), 50 m, 24 May 2020, *C. Turcato, D. Dagnino* (GE B235). – Variety confirmed for the flora of Liguria.

Tortella flavovirens var. *flavovirens* occurs in most of the Italian administrative regions (Aleffi et al. 2020) and in several Mediterranean countries (Ros et al. 2013), growing in rock crevices or sand dunes in the basal zone, mainly along the coast (Cortini Pedrotti 2001). An old record of this species is available for Rapallo (Genova) (Fleischer 1893), but it was no longer recorded for Liguria (Aleffi et al. 2020). In the new site, this species was found within a mosaic of garigues and therophytic grasslands above the rocky coast of the Promontory of Punta Manara, on sandy soil subjected to marine aerosols. *Tortella flavovirens* var. *flavovirens* is an heliophlous, halotolerant, xero-thermophytic plant (Dierßen 2001), occurring in several coastal Mediterranean habitats (Aleffi et al. 2005; Esposito and Filesi 2007; Privitera et al. 2008; Puglisi et al. 2019).

D. Dagnino, C. Turcato, G. Berta

***Tortella inclinata* (R.Hedw.) Limpr. (Pottiaceae)**

+ **MOL**: Campomarino (Campobasso), retrodunal garrigue of Cisto-Lavanduletalia (UTM WGS84: 33T 510306.4641807), 4 m, 5 November 2020, *M. Tiburtini* (PI040612). – Species new for the flora of Molise.

Tortella inclinata is a temperate species, that thrives in harsh conditions. It is a tuft-forming moss, that grows often in basiphytic and xerophytic conditions. It can be found either in foredune and retrodunal environments (Murru et al. 2018). Indeed, I found this species growing on sand in a garigue of the habitat 2260 "Cisto-Lavanduletalia dune sclerophyllous scrubs". The combination of foliar characters, i.e., absence of papillae on the costa, ascending hyaline cells, acute and cucullate apex, make it easily distinguishable from related species, such as *T. densa* (Lorentz & Molendo) Crundw. & Nyholm, *T. flavovirens* (Bruch) Broth. var. *flavovirens*, and *Trichostomum brachydontium* Bruch.

M. Tiburtini

***Tortula caucasica* Broth. (Pottiaceae)**

+ **LIG**: Monte Croce dei Tozzi, Casarza Ligure (Genova), on serpentine in arborescent matorral with *Juniperus* sp. pl. (UTM WGS84: 32T 537512.4901829), 130 m, 24 May 2020, *C. Turcato, D. Dagnino* (GE B233); final section of the trail to Punta Manara, Sestri Levante (Genova), on sandstone in xero-thermophilous pioneer herbaceous vegetation (UTM WGS84: 32T 532293.4900019), 50 m, 24 May 2020, *C. Turcato, D. Dagnino* (GE B234). – Species confirmed for the flora of Liguria.

Tortula caucasica occurs in most of the Italian administrative regions (Aleffi et al. 2020) and it is found in many Mediterranean countries (Ros et al. 2013), growing in exposed and disturbed environments, in the basal zone (Cortini Pedrotti 2001; Dierßen 2001). A record of this species in Liguria was made by Piccone (1863) but it is no longer recorded for Liguria (Aleffi et al. 2020). This species can be distinguished from other closely related taxa for the rudimental peristome, the upper leaf cells smooth or weakly papillose, and the recurved leafy margins (Ros and Werner 2007). We found this species in xero-thermic Mediterranean environments, dominated by discontinuous shrubby and herbaceous vegetation, referring to several Directive 92/43/CEE Habitats (cod. 6220* and 5210).

D. Dagnino, C. Turcato, G. Berta

Fungi

***Cortinarius ochraceopallescens* Moënne-Locc. & Reumaux (Cortinariaceae)**

+ **LIG**: Palo, Sassello (Savona) under *Fagus sylvatica* L. (UTM WGS84: 32T 464099.4925732), 660 m, 22 October 2016, *F. Boccardo* (Herb. GDOR 3948); Dolcina, Rapallo (Genova) under *Quercus pubescens* Willd. (UTM WGS84: 32T 514013.4909289), 377 m, 19 November 2011, *M. Clericuzio, F. Boccardo* (Herb. GDOR 2435). – Species new for the flora of Liguria.

Cortinarius ochraceopallescens belongs to *Cortinarius* sect. *Calochroi* M.M.Moser & Horak, and it is characterized by a relatively large size, pale ochraceous-yellowish colours on pileus, often with velar patches, tending to stain in age owing to scattered brownish spots; tender violet lamellae, negative reactions on pileus and bulbipellis with KOH, spores (9.5)10–12.5(14) × 6–7(7.5) µm, amygdaliform, strongly verrucose (Bidaud et al. 2001).

F. Boccardo, M. Clericuzio, F. Dovana

***Mycena stylobates* (Pers.) P.Kumm. (Mycenaceae)**

+ **CAL**: Botanical Garden of the University of Calabria, Rende (Cosenza), on leaf litter under the crown of a holm oak tree (*Quercus ilex* L.) (UTM WGS84: 33S 605942.4357155), 216 m, 13 November 2020, *A.B. De Giuseppe, N.G. Passalacqua, G. Sicoli* (CLU No. F312). – Species new for the flora of Calabria.

Mycena stylobates is an agaricoid fungus colonising the leaf litter of deciduous trees from where its stipitate and bright-white small pileate basidiomata emerge, easily recognisable for a distinct basal disc at the point of attachment of the stipe to the leaf. A dozen of such basidiomata were detected showing glabrous and at most 10 mm diameter max sized pilei, 5 mm long and 1 mm thick stipes, and maximum 2.5 mm max wide basal discs surrounded by a hairy edge easily detectable under a lens (Elborne et al. 1992, Walther et al. 2001). Although occurring in almost all administrative regions in central and northern Italy, *M. stylobates* has not, so far, apparently been reported from southern Italy, except from Puglia (Onofri et al. 2013).

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

***Naucoria bohemica* Velen. (Hymenogastraceae)**

+ **CAL**: Botanical Garden of the University of Calabria, Rende (Cosenza), on the ground in a deciduous coppice stand (*Quercus* spp. as prevailing tree species) (UTM WGS84: 33S 605950.4357342), 200 m, 23 October 2020, *G. Sicoli, A.B. De Giuseppe, N.G. Passalacqua* (CLU No. F310). – Species new for the flora of Calabria.

A group of small agaricaceous basidiomata belonging to *Naucoria bohemica* was detected on the ground along a path surrounded by *Quercus cerris* L. and *Q. pubescens* Willd. in a mixed broadleaved coppice stand where this fungus is an ectomycorrhizal agent to tree species. The chestnut-brown and 2–3 mm diameter campanulate pilei of basidiomata were easily recognisable for being radially weakly striate close to the edge. The stipe showed a dense silvery white coating disappearing at maturity and by handling. The ochre, verrucose and amygdaliform spores exceeding 10 µm in length were produced mostly at the top of 2-spored basidia, and cheilocystidia were apically obtuse and subcylindric (Døssing 1992; Courtecuisse and Duhem 1995; Moreau and Borovička 2010). This species was already reported in northern and central Italy (Onofri et al. 2013).

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

***Trichoglossum tetrasporum* Sinden & Fitzp. (Geoglossaceae)**

+ **CAL**: Botanical Garden of the University of Calabria, Rende (Cosenza), on the ground among mosses in a deciduous coppice oak stand (UTM WGS84: 33S 605941.4357277), 205 m, 13 January 2021, *G. Sicoli, S. Rovito, D. Puntillo* (CLU No. F313). – Species new for the flora of Calabria.

Trichoglossum tetrasporum is an ascomycete living on the ground in meadows, forests and bogs, and producing a 10-mm high blackish club-shaped hymenophore borne by a non well defined, same height, longer or shorter, narrow stipe. The hymenial and stem surfaces are covered with fine erect setae as in *Trichoglossum hirsutum* (Pers.) Boud.; *T. tetrasporum* differs from this species by forming 105–140 µm long and 15-septate (when mature) ascospores in four-spored asci instead of eight-spored ones (Courtecuisse and Duhem 1995; Ohenoja 2000). In Italy *T. tetrasporum* has so far been detected only in Sicily (Lantieri 2011).

G. Sicoli, S. Rovito, D. Puntillo

***Tubaria furfuracea* (Pers.) Gillet (Tubariaceae)**

+ **CAL**: Botanical Garden of the University of Calabria, Rende (Cosenza), on the ground at the edge of a riparian wood (*Populus* ×*canescens* and *Salix* sp. pl. as prevailing species) (UTM WGS84: 33S 605955.4357351), 200 m, 23 October 2020, *N.G. Passalacqua, A.B. De Giuseppe, G. Sicoli* (CLU No. F311). – Species new for the flora of Calabria.

Small agaricaceous basidiomata belonging to *Tubaria fufuracea* were observed and identified on the ground close to *Populus* and *Salix* trees, where this fungus is a plant-remnants degrading agent. The reddish-brown and 2-3 mm-diameter basidiomata were easily recognisable due to the typical small, white veil remnants close to the edge of the campanulate, hygrophanous and striate pilei. The smooth and ellipsoid spores were light ochre and cheilocystidia were typically subcapitate (Jacobsson 1992; Courtecuisse and Duhem 1995; Matheny et al. 2007).

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

Lichens

***Agonimia globulifera* M.Brand & Diederich (Verrucariaceae)**

+ **PIE**: Vernante (Cuneo), 3 km NNW of Limone Piemonte (Cuneo), growing on soil on a limestone outcrop in deciduous forest (UTM WGS84: 32T 384862.4898399), 920 m, 27 April 2012, *J. Malíček* (Herb. Malíček no. 7068). – Species new for the flora of Piemonte.

Agonimia globulifera is a crustose lichen, well characterized by the presence of black, glossy sterile globules (aggregated goniocysts) on a minutely granulose greenish thallus. In Europe, this species generally occurs on moss, plant debris, humus, and rarely on rocks in open calcareous areas at mainly low and middle elevations (Olsen et al. 2019, Malíček et al 2020); nonetheless, its overall distribution is poorly known. This is the third report for the flora of Italy (Nimis 2016) concerning this species, which is scatteredly reported in the Alps (Nimis et al. 2018).

J. Malíček, S. Ravera

***Blastenia monticola* Arup & Vondrák (Teloschistaceae)**

+ **LOM**: Boschi del Giovetto di Palìne Natural Reserve, Roccolo del Gatì, Borno (Brescia), on bark of *Picea abies* (L.) H.Karst. (UTM WGS84: 32T 587850.5090486), 1710 m, 25 October 2020, leg. *G. Gheza*, det. *G. Gheza, P.L. Nimis* (Herb. Nascimbene JN7012, Herb. Gheza). – Species new for the flora of Lombardia.

+ **VEN**: Dolomiti d'Ampezzo Natural Park, Socroda, Cortina d'Ampezzo (Belluno), on bark of *Rhododendron ferrugineum* L. (UTM WGS84: 33T 277742.5169622), 2150 m, 17 June 1998, leg. *J. Nascimbene*, det. *J. Nascimbene, P.L. Nimis* (Herb. Nascimbene JN265). – Species new for the flora of Veneto.

+ **TAA**: Zirmboden, Obereggen (Bolzano), on bark of *Picea abies* (L.) H.Karst. (UTM WGS84: 32T 695717.5139877), 1950 m, 11 May 2012, leg. *J. Nascimbene*,

det. *J. Nascimbene, P.L. Nimis* (Herb. Nascimbene JN2694). – Species new for the flora of Trentino-Alto Adige.

This is a recently-described species (Vondrák et al. 2020) of subalpine environments, colonizing acid bark of conifers or twigs of shrubs. Most earlier records of *Blastenia herbidella* (Hue) Servít from the Alps may refer to this species. This is the case for the two records reported here, both collected in subalpine environments, that were previously published under that name (Nascimbene and Caniglia 2003; Nascimbene 2013). The distinction between the two species on a morphological basis is not easy, being mainly based on the shape of blastidia. However, the two species seem to be well differentiated ecologically (Vondrák et al. 2020).

J. Nascimbene, G. Gheza, P.L. Nimis

***Chaenotheca brachypoda* (Ach.) Tibell (Coniocybaceae)**

+ **VEN**: Casera Razzo,Vigo di Cadore (Belluno), on wood of *Abies alba* Mill. (UTM WGS84: 33T 316446-5150323), ca. 1700 m, 12 September 1987, *D. Puntillo* (CLU No. 4223). – Species new for the flora of Veneto.

During a review of some specimens of Caliciod lichens stored in the CLU herbarium, several apothecia of *Chaenotheca brachypoda* were found mixed together with *Chaenotheca trichialis* (Ach.) Hellb. and its parasite *Microcalicium disseminatum* (Ach.) Vainio. *Chaenotheca brachypoda* has an endosubstratic thallus, and it is recognizable for its densely yellowish green-pruinose stalk, the spherical capitulum with yellow-green pruina with poorly developed excipulum and the evanescent cylindrical asci characteristically formed in chains. This specimen was collected on lignum of *Abies alba* Mill., on the face protected from rain. It is a rare species, classified in the Italian Red List of epiphytic lichens as "Endangered" (Nascimbene et al. 2013).

D. Puntillo

***Cladonia subturgida* Samp. (Cladoniaceae)**

+ **TOS**: Montecristo, Portoferraio (Livorno), on soil in the shrubland along the trail to Monte della Fortezza (UTM WGS84: 32T 607034.4688072), 195 m, 10 May 2016, leg. *E. Bianchi, R. Benesperi, L. Di Nuzzo*, det. *T. Athi* (Herb. Benesperi RB14). – Species new for the flora of Toscana.

Cladonia subturgida is a fruticose lichen with composite thallus. The primary thallus is persistent while the secondary thallus, which bears dark brown apothecia, is often absent. Despite being previously reported only for the Iberian Peninsula and Canary Islands (Pino-Bodas et al. 2012), a recent study showed that it is quite common in the Mediterranean region and that it was probably often misidentified with other *Cladonia* species (Pino-Bodas et al. 2020). It can be distinguished from similar species by the absence of scyphi and the presence of large pycnidia on the squamules, which are fragile with a pale-green upper side and a grey-brownish lower side (Burgaz et al. 2020). This species was previously reported for Italy only for Calabria and Sardegna (Pino-Bodas et al. 2020; Burgaz et al. 2020).

E. Bianchi E., R. Benesperi R., L. Di Nuzzo

***Endocarpon psorodeum* (Nyl.) Blomb. & Forssell (Verrucariaceae)**

+ **LOM**: Dossi di Santicolo, Corteno Golgi (Brescia), along the road between Edolo and Santicolo, on a schist outcrop (Scisti di Edolo formation) (UTM WGS84: 32T 599618.5113738), 807 m, 19 August 2019, leg. *G. Gheza*, det. *L. Di Nuzzo* (Herb. Gheza); trail between Saviore dell'Adamello and Fabrezza (Brescia), on a schist outcrop (Scisti di Edolo formation) (UTM WGS84: 32T 608473.5104057), 1272 m, 3 January 2020, *G. Gheza* (Herb. Gheza). – Species new for the flora of Lombardia.

Endocarpon psorodeum is a squamulose chlorolichen with distinctly flattened and ascending squamules and black globose perithecia with hymenial algae (Nimis 2020). It is similar to *Endocarpon adscendens* (Anzi) Müll. Arg., whose squamules have dark rhizohyphae, lacking in *E. psorodeum*. Another similar species is *Endocarpon latzelianum* Servít, which grows on calcareous substrates, whereas *E. psorodeum* grows on basic siliceous substrates (Nimis and Nascimbene 2021). This species has been scatteredly reported in the Alps (Nimis et al. 2018) and only in Piemonte in Italy (Nimis 2016).

G. Gheza, C. Vallese, L. Di Nuzzo

***Gyalecta derivata* (Nyl.) H. Olivier (Gyalectaceae)**

+ **CAM**: Santuario S.S. Annunziata, Licusati frazione di Camerota (Salerno), on *Olea europaea* L. (UTM WGS84: 33T 530453.4434790), 410 m, 4 April 2010, *S. Ravera* (Herb. Ravera); Omignano (Salerno), on *Castanea sativa* Mill. (UTM WGS 84: 33T 506305.4454875), 750 m, 14 July 2010, *S. Ravera* (Herb. Ravera); Centola (Salerno), on *Olea europaea* L. (UTM WGS 84: 33T 527122.4436156), 340 m, 25 February 2011, leg. *G. Brunialti, V. Genovesi, S. Ravera*, det. *S. Ravera* (Herb. Ravera). – Species new for the flora of Campania.

Gyalecta derivata is a crustose trentepohlioid lichen with a thin or inconspicuous grey thallus and urceolate apothecia, characterized by orange-brown disc. It can be easily differentiated from other species of the genus by oblong-fusiform ascospores (5–)7–13–septate, rarely with 1–2 longitudinal septa. This species is widespread in Europe and also known from North Africa (Werner 1972), and in Italy it is usually found in natural or semi-natural habitats with a humid-warm climate on bark on broad-leaved trees (Nimis 2016). *Gyalecta derivata* is included in the Italian Red List of epiphytic lichens, under the "Near-threatened" category (Nascimbene et al. 2013).

S. Ravera

***Lecanographa amylacea* (Ehrh. ex Pers.) Egea & Torrente (Lecanographaceae)**

+ **CAM**: S. Severino di Centola (Salerno), on wood (UTM WGS84: 33T 529671.4437415), 130 m, 21 February leg. *G. Brunialti, V. Genovesi, S. Ravera*, det. *S. Ravera*; Pisciotta (Salerno), on *Olea europaea* L. (UTM WGS84: 33T 519127.4440793), 230 m, 22 February 2011, leg. *G. Brunialti, V. Genovesi, S. Ravera*, det. *S. Ravera* (Herb. Ravera). – Species new for the flora of Campania.

Lecanographa amylacea is a crustose trentepohlioid lichen with a thick, chalky white to grey-white, farinose thallus and densely white-pruinose, round to irregular black apothecia, more or less immersed in the thallus. It is a mild-temperate, mainly western lichen, rare in Italy (Nimis 2006), usually found on dry bark of old trees not directely wetted by rain, in ancient woodlands or also historical urban parkland e.g. Botanical Garden in Rome (Ravera et al. 1999; Munzi et al 2007), Garden of Ninfa, in the territory of Cisterna di Latina (Herb. Ravera 3126). The specimen recorded in Pisciotta were collected on centenary trees in olive groves.

S. Ravera

***Parmeliella testacea* P.M.Jørg. (Pannariaceae)**

+ **ABR**: Vallone Grascito, south of Sulmona (L'Aquila), on the bark of *Quercus pubescens* Willd. (UTM WGS84: 33T 413890.4652618), 545 m, 7 July 2020, leg. *L. Paoli, Z. Fačkovcová, S. Loppi, A. Vannini*, det. *L. Paoli, Z. Fačkovcová, S. Loppi*. – Species new for the flora of Abruzzo.

This cyanolichen has a squamulose thallus, typically characterized by chestnut brown to grey-brown rosettes, loosely attached (Nimis 2016). The squamules are generally 2-3 mm wide: when the thallus is developed, the marginal ones are elongate and radiating. Soralia are mainly marginal and resembling isidia, breaking down into blue-grey, granular soredia. In the study site, few small thalli without apothecia have been observed, growing together with *Bacidia fraxinea* Lönnr., *Catillaria nigroclavata* (Nyl.) J.Steiner, *Collema subflaccidum* Degel. *Parmeliella testacea* is included in the Italian Red List of epiphytic lichens under the category "Least Concern" (Nascimbene et al. 2013).

L. Paoli, Z. Fačkovcová, S. Loppi

***Porpidia flavicunda* (Ach.) Gowan (Lecideaceae)**

+ **TAA**: Val Comasine, Pejo (Trento), on siliceous rocks (UTM WGS84: 32T 628432.5132684), 2070 m, 31 August 2020, leg. *T.L. Bacchilega*, det. *J. Nascimbene* (Herb. Nascimbene JN7050). – Species confirmed for the flora of Trentino-Alto Adige.

Porpidia flavicunda is a variable species (see Nimis 2016) with a circumpolar, arctic-alpine distribution, that was previously collected in Trentino-Alto Adige in the late 19th Century (see references in Nimis 1993). The record reported here was collected on a siliceous boulder in a very humid situation, in an open *Larix*-forest that is one of the lichen-richest habitats in the Alps (Nascimbene et al. 2006, 2012).

J. Nascimbene

***Stenhammarella turgida* (Ach.) Hertel (Lecideaceae)**

+ **VEN**: Dolomiti Bellunesi National Park, Vette Feltrine, Col dei Cavai, Sovramonte (Belluno), on selciferous calcareous rocks (UTM WGS84: 32T 719874.5106811), 1660 m, 28 June 2020, leg. *J. Nascimbene*, det. *P.L. Nimis* (Herb. Nascimbene JN7120);

Dolomiti Bellunesi National Park, Cimonega, Col dei Bechi, Cesiomaggiore (Belluno), on selciferous calcareous rocks (UTM WGS84: 32T 727065.5115734), 1975 m, 12 August 2020, leg. *J. Nascimbene*, det. *P.L. Nimis* (Herb. Nascimbene JN7121). – Species confirmed for the flora of Veneto.

This species, widespread throughout the Alps (Nimis et al. 2018), is typical of rocks containing a low percentage of calcium carbonate, mostly on steeply inclined, north-exposed and rather humid faces near or above treeline, as in the case of the records reported here, that were collected on flint layers included in a carbonatic, late Jurassic formation. The last, and only, record from Veneto dates back to the mid-19th century (Nimis 1993) and in the original source (Massalongo 1852) there is no detailed reference to collection locality.

J. Nascimbene, P.L. Nimis

***Thelidium auruntii* (A. Massal.) Kremp. (Verrucariaceae)**

+ **VEN**: Dolomiti d'Ampezzo Natural Park, Tofana di Rozes, Cortina d'Ampezzo (Belluno), on dolomite (UTM WGS84: 33T 273856.5158438), 2870 m, 5 August 2020, leg. *J. Nascimbene*, det. *P.L. Nimis, J. Nascimbene* (Herb. Nascimbene JN6884). – Species confirmed for the flora of Veneto.

Thelidium auruntii differs from the related *Thelidium pyrenophorum* (Ach.) Körb. in the well-developed, brown thallus and the smaller spores. Known form several scattered stations throughout the Alps (Nimis & al. 2018), it is also known from Scandinavia and grows on limestone, dolomite and calciferous schists in upland areas. The material reported here was collected on a humid dolomitic wall along the path to the top of Tofana di Rozes. The last records from Veneto date back to the 19th century (see Nimis 1993).

J. Nascimbene, P.L. Nimis

***Thelidium ungeri* Körb. (Verrucariaceae)**

+ **VEN**: Dolomiti d'Ampezzo Natural Park, Tofana di Rozes, Cortina d'Ampezzo (Belluno), on dolomite (UTM WGS84: 33T 273856.5158438), 2870 m, 5 August 2020, leg. *J. Nascimbene*, det. *P.L. Nimis, J. Nascimbene* (Herb. Nascimbene JN6884). – Species confirmed for the flora of Veneto.

Thelidium auruntii differs from the related *Thelidium pyrenophorum* (Ach.) Körb. in the well-developed brown thallus and the smaller spores. Known form several scattered stations throughout the Alps (Nimis et al. 2018), it is also known from Scandinavia and grows on limestone, dolomite and calciferous schists in upland areas. The material reported here was collected on a humid dolomitic wall along the path to the top of Tofana di Rozes. The last records from Veneto date back to the 19th century (see Nimis 1993).

J. Nascimbene, P.L. Nimis

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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

Aleffi M, Campisi P, Cogoni A, Cortini Pedrotti C, Flore F, Perego S, Sguazzin F, Tacchi R (2005) Contributo alla conoscenza della flora briologica delle Murge Tarantine (Taranto, Puglia): la Gravina di Petruscio ed il Bosco delle Pianelle. Informatore Botanico Italiano 37: 1137–1144.

Bidaud A, Moënne-Loccoz P, Reumaux P (2001) Atlas des Cortinaires 11: 527–626.

Burgaz AR, Ahti T, Pino-Bodas R (2020) Mediterranean Cladoniaceae. Sociedad Española de Liquenología (SEL), Madrid, 117 pp.

Coppins BJ (2008) *Micarea perparvula* in North America. Opuscula Philolichenum 5: 23–24.

Coppins BJ, Printzen C (1995) *Micarea perparvula* In: Printzen C (Ed.) Die Flechtengattung *Biatora* in Europa. Bibliotheca Lichenologica 60: e204.

Cortini Pedrotti C (2001) Flora dei muschi d'Italia, I parte. Antonio Delfino Editore, Sassari, 832 pp.

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.

Dierßen K (2001) Distribution, ecological amplitude and phytosociological characterization of European bryophytes. Bryophytorum Bibliotheca 56: 1–289.

Døssing L (1992) *Naucoria* (Fr.) Kumm. In: Hansen L, Knudsen H (Eds) Nordic Macromycetes, Vol. 2. Nordsvamp, Copenhagen.

Elborne SA, Læssøe T, Østmoe KH (1992) *Mycena* (Pers.: Fr.) Roussell. In: Hansen L, Knudsen H (Eds) Nordic Macromycetes (Vol. 2). Nordsvamp, Copenhagen.

Esposito A, Filesi L (2007) Caratterizzazione di comunità a *Crucianella maritima* e relazioni con la componente briofitica. Fitosociologia 44(2) suppl.1: 255–261.

Fleischer M (1893) Beitrag zur Laubmoosflora Liguriens. Atti del Congresso Internazionale di Genova 1892: 266–310.

Frey W, Frahm J-P, Fischer E, Lobin W (2006) The Liverworts, Mosses and Ferns of Europe. Harley Books, Colchester, 512 pp.

Herzog Th (1926) Die alpine Bryoflora des Monte Gennargentu auf Sardinien. Botanische Jahrbücher für Systematik 60: 570–579.

Hodgetts N, Calix M, Englefield E, Fettes N, Garcia Criado M, Patin L, Nieto A, Bergamini A, Bisang I, Baisheva E, Campisi P, Cogoni A, Hallingback T, Konstantinova N, Lockhart

N, Sabovljevic M, Schnyder N, Schrock C, Sergio C, Sim Sim M, Vrba J, Ferreira CC, Afonina O, Blockeel T, Blom H, Caspari S, Gabriel R, Garcia C, Garilleti R, Gonzalez Mancebo J, Goldberg I, Hedenas L, Holyoak D, Hugonnot V, Huttunen S, Ignatov M, Ignatova E, Infante M, Juutinen R, Kiebacher T, Kockinger H, Kučera J, Lonnell N, Luth M, Martins A, Maslovsky O, Papp B, Porley R, Rothero G, Soderstrom L, Ştefănuţ S, Syrjanen K, Untereiner A, Vaňa J, Vanderpoorten A, Vellak K, Aleffi M, Bates J, Bell N, Brugues M, Cronberg N, Denyer J, Duckett J, During HJ, Enroth J, Fedosov V, Flatberg K-I, Ganeva A, Gorski P, Gunnarsson U, Hassel K, Hespanhol H, Hill M, Hodd R, Hylander K, Ingerpuu N, Laaka-Lindberg S, Lara F, Mazimpaka V, Mežaka A, Muller F, Orgaz JD, Patino J, Pilkington S, Puche F, Ros RM, Rumsey F, Segarra-Moragues JG, Seneca A, Stebel A, Virtanen R, Weibull H, Wilbraham J, Żarnowiec J (2019) A miniature world in decline: European Red List of Mosses, Liverworts and Hornworts. IUCN, Brussels, 87 pp.

Jacobsson S (1992) *Tubaria* (W.G.Smith) Gill. In: Hansen L, Knudsen H (Eds) Nordic Macromycetes (Vol. 2). Nordsvamp, Copenhagen.

Lantieri A (2011) First record of *Trichoglossum tetrasporum* Sinden & Fitzp. (Helotiales, Geoglossaceae) from Italy. Plant Biosystems 145: 116–119. https://doi.org/10.1080/11263504.2010.543788

Malíček J, Palice Z, Šoun J, Vondrák J, Novotný P (2020) Atlas českých lišejníků. www.dalib.cz [accessed 15.2.2021]

Massalongo A (1852) Ricerche sull'autonomia dei licheni crostosi e materiali pella loro naturale ordinazione. Tip. Frizerio, Verona, 221 pp.

Matheny PB, Vellinga EC, Bougher NL, Ceska O, Moreau P-A (2007) Taxonomy of displaced species of *Tubaria*. Mycologia 99: 569–585. https://doi.org/10.1080/15572536.2007.11832551

Milde J (1864) Ein Sommer in Südtirol. Botanische Skizze. Bot. Zeitung 22 (17 suppl., 19 suppl.): 1–22.

Moreau P-A, Borovička J (2010) Epitypification of *Naucoria bohemica* (Agaricales, Hymenogastraceae). Czech Mycology 62: 33–42. https://doi.org/10.33585/cmy.62104

Munzi S, Ravera S, Caneva G (2007) Epiphytic lichens as indicators of environmental quality in Rome. Environmental Pollution 146: 350–358. https://doi.org/10.1016/j.envpol.2006.03.042

Murru V, Marignani M, Acosta ATR, Cogoni A (2018) Bryophytes in Mediterranean coastal dunes: ecological strategies and distribution along the vegetation zonation. Plant Biosystems 152: 1141–1148. https://doi.org/10.1080/11263504.2017.1418452

Myszczyński K, Bączkiewicz A, Buczkowska K, Ślipiko M, Szczecińska M, Sawicki J (2017) The extraordinary variation of the organellar genomes of the *Aneura pinguis* revealed advanced cryptic speciation of the early land plants. Scientific Reports 7: 1–12. https://doi.org/10.1038/s41598-017-10434-7

Nascimbene J (2013) The epiphytic lichen flora of the forest monitoring plot "Großer Zirmboden", Latemar, South Tyrol. Gredleriana 13: 5–14.

Nascimbene J, Caniglia G (2003) Materiale per una check-list dei licheni del Parco Naturale delle Dolomiti D'Ampezzo (Belluno – NE Italia). Lavori della Società Veneziana di Scienze Naturali 28: 65–69.

Nascimbene J, Martellos S, Nimis PL (2006) Epiphytic lichens of tree-line forests in the Central-Eastern Italian Alps and their importance for conservation. The Lichenologist 38: 373–382. https://doi.org/10.1017/S0024282906006220

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

Nascimbene J, Thor G, Nimis PL (2012) Habitat-types and lichen conservation in the Alps – Perspectives from a case study in the Stelvio National Park (Italy). Plant Biosystems 146: 428–442. https://doi.org/10.1080/11263504.2011.557099

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) ITALIC - The Information System on Italian Lichens. Version 5.0. University of Trieste, Dept. of Biology. www.italic.units.it [accessed 17.1.2021]

Nimis PL, Nascimbene J (2021) Keys to the lichens of Italy – 51) Endocarpon and Staurothele. http://italic.units.it/flora/index.php?procedure=ext_key_home&key_id=3044 [accessed 3.1.2021]

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

Ohenoja E (2000) *Trichoglossum* Boud. In: Hansen L, Knudsen H (Eds) Nordic Macromycetes (Vol. 1). Nordsvamp, Copenhagen.

Olsen O, Haug S, Nordén B (2019) *Agonimia globulifera* new to mainland Norway. Graphis Scripta 31: 1–4.

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 1.2.2021]

Paton JA (1999) The Liverwort Flora of the British Isles. Harley Books, Martins, 626 pp.

Pino-Bodas R, Martín MP, Burgaz AR (2012) *Cladonia subturgida* and *C. iberica* (Cladoniaceae) form a single, morphologically and chemically polymorphic species. Mycological Progress 11: 269–278. https://doi.org/10.1007/s11557-011-0746-1

Pino-Bodas R, Araujo E, Gutiérrez-Larruga B, Burgaz AR (2020). *Cladonia subturgida* (Cladoniaceae, Lecanoromycetes), an overlooked, but common species in the Mediterranean region. Symbiosis 82: 9–18. https://doi.org/10.1007/s13199-020-00688-7

Piccone A (1863) Elenco dei Muschi di Liguria. Commentario della Società Crittogamologica Italiana 1: 240–287.

Privitera M, Campisi A, Carratello A, Cogoni A, Flore F, Gueli L, Lo Giudice R, Provenzano F, Petraglia A, Sguazzin F, Zimbone A (2008) La flora briofitica dell'Isola di Lipari (Arcipelago delle Eolie, Sicilia). Informatore Botanico Italiano 40: 3–13.

Puglisi M, Sciandrello S, Musarella C, Spampinato G, Privitera M, Tomaselli V (2019) Bryosociological remarks on garrigue environments in Apulia Region (Southern Italy). Plant Sociology 56: 43–52.

Ravera S, Brezzi G, Massari G (1999) Contributo alla conoscenza dei licheni dell'area romana: la florula epifitica dell'Orto Botanico di Villa Corsini. Biologi Italiani 10: 37–43.

Ros RM, Werner O (2007) The circumscription of the genus *Pottiopsis* (Pottiaceae, Bryophyta) based on morphology and molecular sequence data. Nova Hedwigia 131: 65–79.

Ros RM, Mazimpaka V, Abou-Salama U, Aleffi M, Blockeel T L, Brugués M, Cros RM, Dia MG, Dirkse GM, Draper I, El-Saadawi W, Erdag A, Ganeva A, Gabriel R, Gonzales- Mancebo JM, Granger C, Herrnstadt A, Hugonnot V, Khalil K, Kürschner H, Losada-Lima A, Luís L, Mifsus S, Privitera M, Puglisi M, Sabovljević, Sèrgio C, Shabbara HM, Sim-Sim M, Sotiaux A, Tacchi R, Vanderpoorten A, Wernner O (2013) Mosses of the Mediterranean, an annotated checklist. Cryptogamie, Bryologie 34: 99–283. https://doi.org/10.7872/cryb.v34.iss2.2013.99

Rossi G, Montagnani C, Gargano D, Peruzzi L, Abeli T, Ravera S, Cogoni A, Fenu G, Magrini S, Gennai M, Foggi B, Wagensommer RP, Venturella G, Blasi C, Raimondo FM, Orsenigo S [Eds] (2013) Lista Rossa della Flora Italiana. 1. Policy Species e altre specie minacciate. Comitato Italiano IUCN e Ministero dell'Ambiente e della Tutela del Territorio e del Mare, 54 pp.

Smith AJE (2004) The moss flora of Britain and Ireland. 2nd edn. Cambridge University Press, Cambridge, 1012 pp. https://doi.org/10.1017/CBO9780511541858

Sotiaux A, Stieperaere H, Sotiaux O, Pohl H (2009) *Fossombronia caespitiformis* De Not. ex Rabenh. subsp. *multispira* (Schiffn.) J.R.Bray et Cargill in Belgium, a remarkable extension of its European range. Cryptogamie, Bryologie 30: 265–269.

Swissbryophytes (2004–2020) Online-Atlas der Schweizer Moose. www.swissbryophytes.ch [accessed 9.12.2020]

Vondrák J, Frolov I, Košnar J, Arup U, Veselská T, Halıcı G, Malíček J, Søchting U (2020) Substrate switches, phenotypic innovations and allopatric speciation formed taxonomic diversity within the lichen genus *Blastenia*. Journal of Systematics and Evolution 58: 295–330. https://doi.org/10.1111/jse.12503

Walther V, Rexer K-H, Kost G (2001) The ontogeny of the fruit bodies of *Mycena stylobates*. Mycological Research 105: 723–733. https://doi.org/10.1017/S0953756201004038

Werner RG (1972) Lichens et champignons de la plainc marocainc. Bulletin de l'Académie Lorraine des Sciences 10: 83–97.

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RESEARCH ARTICLE

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Poorly known names authored by Antonio Raimondi

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Abstract

Nine nomenclatural acts by Antonio Raimondi are assessed and commented. These include a new genus, six new species and two new combinations that are absent from or incorrectly cited in major databases. A new combination, *Jacaranda acutifolia* var. *punctata* is proposed for an endemic plant from central Peru. Lastly, *Jacaranda punctata* Raimondi and *Puya raimondii* Harms are neotypified and lectotypified, respectively.

Keywords

Andean flora, endemism, nomenclature, Peruvian flora, taxonomy

Introduction

Giovanni Antonio Raimondi dell'Acqua was born in Milan (currently in Italy) in 1824, the seventh child of a family of bakers (Cossia 2009). His affection for the natural sciences is well attested: writings on his personal notebooks reflect his interest in botany, chemistry, and other subjects. Little is known about his early life in Italy (Villacorta 2010a). He arrived in Peru on July 28th, 1850, during the National Holiday, fulfilling his dream of travelling to that country. Further remarks on the life of this outstanding naturalist, and his importance for the Italo-Peruvian community, can be found in the work of Bonfiglio (2004).

During his exploration, he put together a considerable collection of minerals, pressed plants, skinned animals, and archaeological findings. Nevertheless, he was first and foremost a botanist (Mariotti 2009). Some of his observations on plant life were

reported in his textbooks, intended to be read by his undergraduate students at the Medical School of the University of San Marcos in Lima (Raimondi 1857a, b). In the first tome of his magnum opus "El Perú" (Raimondi 1874), he published the description of a now famous plant: *Puya raimondii* Harms. However, most of his taxonomical work is known from indirect references by third parties.

Methods

A thorough bibliographic research was done on the published botanical work of Antonio Raimondi. Additionally, his herbarium preserved at USM (herbarium acronyms follow Thiers 2021+) was reviewed. For the Peruvian composites assessed here, the author also consulted the works of Cabrera (1954) and Cuatrecasas (1950).

Several short visits at former rural areas of Lima were made each summer to identify possible surviving individuals of *Jacaranda punctata* Raimondi, since it was the only plant that was not readily identified while reviewing the descriptions and herbarium material. A neotype is selected for the species, here considered a variety of *J. acutifolia* Bonpl.

No lectotypes were designated as no original material was found for most of the species listed below. Since every name by Raimondi, except *J. punctata*, is currently synonymised, no neotypes were selected for them.

Here, I present a full catalogue of the new plant species and combinations made by Antonio Raimondi in his scientific books published as a result of his expeditions in the Peruvian Andes: the two volumes of "Elementos de Botánica", the first subtitled "Anatomía, fisiología y patología vegetal" (Raimondi 1857a) and the second subtitled "Taxonomía, fitografía y geografía botánica" (1857b), and the first volume of "El Perú" (Raimondi 1874), with brief notes and referring to the types of his species, when available. The full transcriptions of his protologues in Spanish and Latin are provided in Suppl. material 1.

Results and discussion

In total, Raimondi published one new genus, six new species (one of which accepted here at the varietal rank, newly proposed as a new combination) and two new combinations.

Family Asteraceae Bercht. & J.Presl

Cryptochaete Raimondi, Elem. Bot. (Raimondi) 2: 187. 1857.
Type: *Cryptochaete andicola* Raimondi.
= *Senecio* L.

Cryptochaete andicola Raimondi, Elem. Bot. (Raimondi) 2: 187. 1857.
Type: not designated.

= *Senecio violifolius* Cabrera, Darwiniana 10: 577. 1954.
Type (holotype). Peru. Lima: prov. Yauyos, Huacracocha, 17 km de Tupe, 4400 m, 22 January 1952, *E. Cerrate & O. Tovar 1222* (LP barcode LP000707 [digital image!]).

Raimondi named the new genus and species within the main text. Then, in the same page, he included a generic-specific description in a footnote.

The name *Cryptochaete* Raimondi is an earlier homonym to *Cryptochaete* P.Karst., a peniophoraceous genus of fungi currently synonymised under *Peniophora* Cooke (Kirk et al. 2008). The description of *C. andicola* fits neatly with that of *Senecio violifolius* (Cabrera 1954), who described the new species unaware of Raimondi's work. Despite it is not the oldest, legitimate name of the species, the epithet *violifolius* is the earliest available when *C. andicola* is considered a species of *Senecio*, since its epithet *andicola* is preoccupied by *S. andicola* Turcz. No original material was traced in the Raimondi herbarium at USM.

Herrera (1921) cited *C. andicola* as a synonym of *Laccopetalum giganteum* (Wedd.) Ulbr. in a mistake, since *C. andicola* is clearly a composite, not a member of the Ranunculaceae (Coloma 2016). This confusion is probably due the common name that both *L. giganteum* and *S. violifolius* share in Peruvian Spanish, "huamanripa", and their ethnobotanical use as expectorant (Bussmann and Sharon 2015; Llacta and Quispe 2018).

Culcitium discolor Raimondi, Elem. Bot. (Raimondi) 2: 186. 1857 [as "*discclor*"].
Type: not designated.
≡ *Senecio discoloratus* Cuatrec., Fieldiana, Bot. 27(1): 43. 1950.
= *Senecio tephrosioides* Turcz. Bull. Soc. Imp. Naturalistes Moscou 24(2): 92. 1851.
Type (holotype). Ecuador. Pichincha: Quito, Antisana volcano, 3650 m, *W. Jameson 846* (KW barcode KW001001543 [digital image!]).

Raimondi gave a brief diagnosis of the species and provided a few ethnobotanical notes in the main text. In the footnote, he gave a formal description in Latin. The protologue is short, so any element present was taken into consideration to interpret the name, recently considered of dubious identity by Salomón et al. (2018).

Among the species of *Senecio* ser. *Culcitium* (Bonpl.) Cabrera, we searched for the following characteristics: plants villose, with discoloured leaves and campanulate involucrum, living in the central Peruvian Andes, with medicinal properties attributed. Taking all of these into consideration simultaneously narrowed the selection. While *S. tephrosioides* is sparsely hairy and does not always present discoloured leaves, specimens collected at high altitudes conform to Raimondi's description. Furthermore, the common names in Quechua, which are words including "ticlla", an adjective meaning "discolour" (Sánchez 1995) and "warmi ("woman"), or "wasa" ("back", referring to the abaxial side of the leaf, as reported by Raimondi 1874) are consistent with current ethnobotanical knowledge, as is the medicinal use originally attributed to the plant by Raimondi and Herrera (Valdivia 2013; Bussmann and Sharon 2015).

Cuatrecasas (1950) transferred this species to *Senecio* as *Senecio discoloratus*, a replacement name for *C. discolor*, due the pre-existence of *S. discolor* DC. He cited the replaced name as *C. discolor* Raimondi ex Herrera, using the entry of the *Index Kewensis* referring to the paper by Herrera (1921) as the original publication place. However, this is not true, because Herrera made a catalogue of species, using the original description as a source. A similar mistake has been made with regards to *Chloraea undulata*. However, since Herrera did not write the original place of publication and gives a full description in Spanish, it should be interpreted as an indirect reference to the original place of publication (Art. 41.3 of the ICN: Turland et al. 2018). No original material was traced in the Raimondi herbarium at USM.

Family Bignoniaceae Juss.

Jacaranda punctata Raimondi, Elem. Bot. (Raimondi) 2: 166. 1857.

Type (neotype, designated here). Peru. Lima: Santiago de Surco (WGS84: 12.1293783S, 76.9792395W), 68 m, 7 December 2020, *Molinari 712* (MOL!; isoneotype: USM!).

≡ *Jacaranda acutifolia* var. *punctata* (Raimondi) Molinari & Mayta, comb. et stat. nov.

Raimondi wrote about the plant's common name and ethnobotanical uses; he then gave the description in a footnote. Since no original material was traced, a neotype is here designated.

For comparison, living material was taken from a tree belonging to the author of this article, raised from seed in and bought from the Forestry Vivarium of La Molina National Agrarian University to ensure its correct taxonomical placement. Additionally, the types of *J. acutifolia* and *J. mimosifolia* D.Don. were consulted.

Gentry (1992) does not include this species in his treatment; it keys out with *J. acutifolia*, although it does not match the description completely. Raimondi was aware of the Bonpland species, which he listed after his novelty, even having a scientific watercolour painting of it made during his expeditions (Villacorta 2010b). While this is not a guarantee of taxonomical distinctiveness, it is worth noting that Raimondi found this ornamental tree distinct enough to not confuse it with the then common *J. acutifolia*.

To clarify the identity of this species, I surveyed the former rural areas of Lima, the place where Raimondi found this plant in cultivation. A healthy tree, fully corresponding the description, was found in an old garden at Santiago de Surco, a district which, in Raimondi's time, was outside the city, dotted with villas and manorial houses (Fig. 1).

The tree differs from *J. acutifolia* by its leaves with suborbicular-elliptical, strongly apiculate leaflets with non-revolute margins and a dusty appearance on both sides. Additionally, the vein impression is visible on the adaxial side, and small, cylindrical secretions of dry resin, *ca*. 1 mm wide, appear on the abaxial side (Fig. 2).

The impression on the leaves places the plant close to *J. mimosifolia*, the sister species of *J. acutifolia* (Ragsac et al. 2019), occurring in Peru exclusively as an introduced ornamental, currently extremely common in Lima. However, the smaller pinnae (Fig. 3) and

Figure 1. General habit of *Jacaranda acutifolia* var. *punctata*. Clockwise: general view of the tree, leaf (adaxial view), leaf (abaxial view), and inflorescence. Tree from which the neotype (*Molinari 712*) was collected.

the deeper blue colour of the flowers (Fig. 4) put our tree decisively within the variability of *J. acutifolia*. This was confirmed by comparing the specimen with the lectotype of *J. mimosifolia* and the lectotype of its heterotypic synonym *J. chelonia* Griseb.

After confirming the specific identity of the collection, it became apparent that it differs from the type of *J. acutifolia* by the smaller leaves with fewer pinnae; shorter, rounder, thicker leaflets with obtuse bases, resin secretions on the abaxial side and strong vein impressions on the adaxial side resembling those of *J. mimosifolia*; the colour of the corolla paler than the typical variety and not consistently purple but becoming greyish towards the base of the tube. For a comparison with the autonymic variety of *J. acutifolia* and the widely cultivated *J. mimosifolia*, see Table 1.

When treating the Bignoniaceae, leaf differences are essential to determine subspecific taxa: Wood (2008) created a key to the subspecies of *Tecoma fulva* (Cav.) D.Don with leaf characters as the first steps towards determination of the subspecies. This

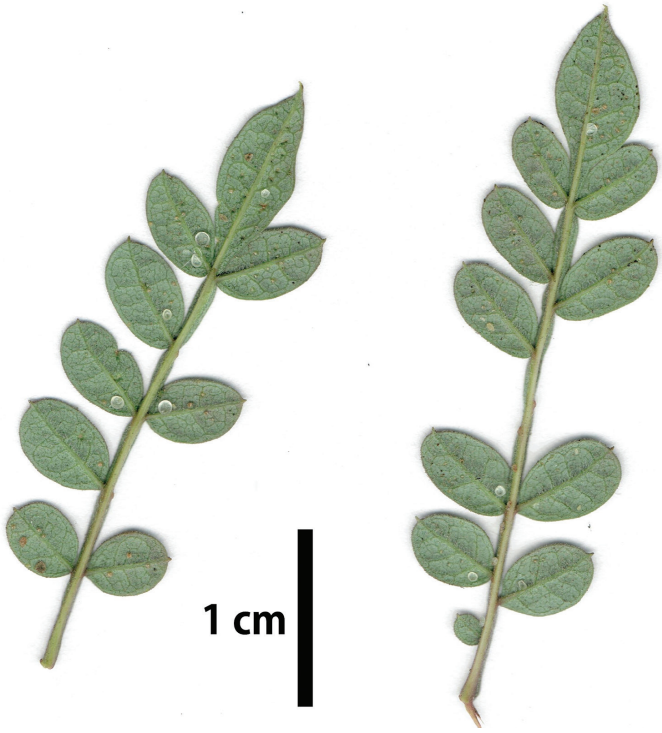

Figure 2. Resin dots on the abaxial side of the leaf of *Jacaranda acutifolia* var. *punctata*. The resin dots appear irregularly under the leaflets and are more common in younger leaves. From the tree from which the neotype was collected.

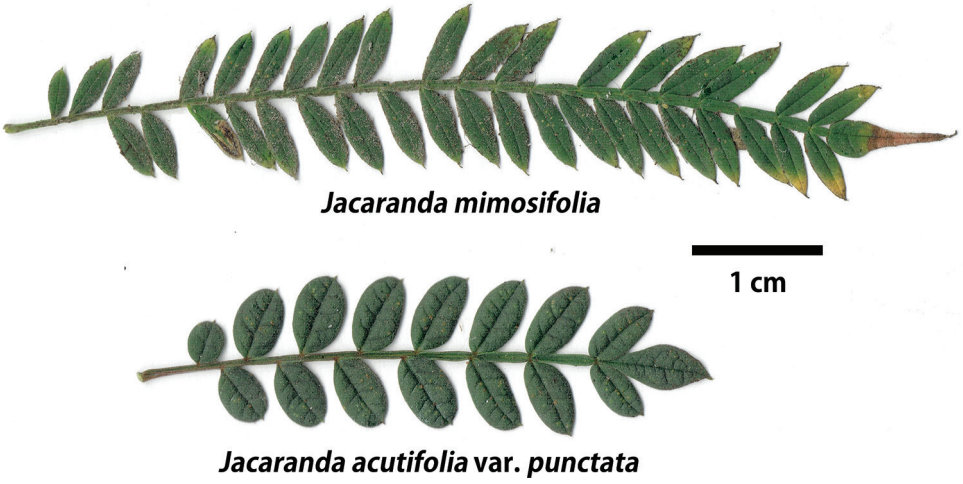

Figure 3. Comparison of pinnae from *Jacaranda mimosifolia* and *Jacaranda acutifolia* var. *punctata*. Note the difference in the length of the pinnae and the general form of the leaflets. The leaf of *J. mimosifolia* was taken from a cultivated tree in the author's garden, the leaf of *J. acutifolia* var. *punctata* was taken from the tree from which the neotype was collected.

Figure 4. Comparison of flowers from *Jacaranda mimosifolia* and *Jacaranda acutifolia* var. *punctata*. Note the difference in the colour of the corolla, the latter being slightly darker. The flower of *J. mimosifolia* was taken from a cultivated tree in the author's garden, the flower of *J. acutifolia* var. *punctata* was taken from the tree from which the neotype was collected.

Table 1. Diagnostic characters of *J. acutifolia* var. *punctata*. Compared with the autonymic variety and *J. mimosifolia*, a species of the genus common in Lima. Description based on the examined plants and Gentry (1992).

Morphological traits	*Jacaranda acutifolia* var. *acutifolia*	*Jacaranda acutifolia* var. *punctata*	*Jacaranda mimosifolia*
leaves	pinnae 2.0–3.0 cm apart	pinnae 1.0–2.0 cm apart	pinnae 1.3–2.1 cm apart
pinnae	11–33 leaflets	9–17 leaflets	13–41 leaflets
leaflets	5–16 mm long, 2–4 mm wide, narrowly elliptic, sharply acuminate, the base cuneate, chartaceous, the surface smooth above	2–5 mm long, 1–3 mm wide, suborbicular, apiculate, the base obtuse, coriaceous, with vein impressions above, resin dots below	3–12 mm long, 1–4 mm wide, narrowly elliptic, sharply acuminate, the base cuneate, chartaceous, with vein impressions above
corollas	deep purplish blue, consistently so through the length of the tube, or becoming slightly paler towards the base	somewhat paler than the typical variety, becoming greyish towards the base	pale purplish blue, becoming white towards the end, with the tube white inside

was a methodological approach made already by Gentry (1992), who used vegetative characters in numerous occasions to determine varieties and subspecies of this family, often accompanied by subtle reproductive traits. He even recognised new species on the grounds of foliar characteristics (Gentry 1985), as did Morawetz (1979), who, nevertheless, supported their taxonomical opinions with reproductive traits.

Specimina visa

***Jacaranda acutifolia* var. *acutifolia*. Peru. Cajamarca:** in calidis fluvii Guancambamba prope Sn. Phelipe, *A. Humboldt & A. Bonpland s.n.* (B [digital image!], type of *Jacaranda acutifolia*). **Huánuco:** Acomay, 3200 m, 11 November 1964, *Ferreyra 16116* (USM!). **Lambayeque:** 13 km E of Olmos on road to Pucara, 410 m, 10 Junuary 1978, *A. Gentry 22683* (USM!). **Lima:** Canta, Santa Rosa de Quives, 940 m, 2011, *P. Gonzales 1742* (USM!).

***Jacaranda mimosifolia*. Argentina. Tucumán:** raro prope La Cruz, 1872, *P. Lorentz s.n.* (GOET [digital image!], type of *Jacaranda chelonia*). **Brazil:** cultivated near Bayswater, England, Bot. Reg. 8: pl. 631, 1822 (type of *Jacaranda mimosifolia*). **Peru. Arequipa:** Provincia de Arequipa, distrito de Cayma, cultivada, 2400 m, 2019, *H. Carrillo s.n.* (HUSA!); Provincia de Arequipa, distrito de Uchumayo, cultivada, 1970 m, 2019, *H. Carrillo s.n.* (HUSA!). **Lima:** Jardín Botánico "Octavio Velarde Núñez", La Molina, August 2010, *A. Arista 9* (MOL!).

Family Bromeliaceae Juss.

Pourretia gigantea Raimondi, Perú 1: 295. 1874.
Type: not designated.
= *Puya raimondii* Harms, Notizbl. Bot. Gart. Berlin-Dahlem 10: 213. 1928.
Type (lectotype, designated here). Peru. Áncash: Cajamarquilla, auf der Cordillera negra bei Huaraz, 3800 m, 16 November 1903, *A. Weberbauer 3746* (MOL!; isolectotype: B barcode B-100247173 [digital image!]).

Probably the best-known plant described by Raimondi, the description starts on page 295 and continues with ecological and phenological data to end, on page 297, with the formal naming of the species. All the botanical description is interlayered with geographical information, personal impressions, travel anecdotes and reflections about the Andean landscape. More information on the description of the species can be found in Mariotti (2009).

Harms (1928) considered, erroneously, that the species was not validly published since it lacked a Latin description, which was not required before 1935 (Art. 39.1 of the ICN). However, he was aware of the fact that transferring *Pourretia gigantea* with its epithet to the genus *Puya* Molina would create a later homonym, since there was already a *Puya gigantea* Phil., so he opted to describe a new species based on Weberbauer's material sent from Peru (syntypes according to Art. 9.6 of the ICN), from which a lectotype is here selected.

The authority of the species is incorrectly listed in IPNI (2021+) as "*Pourretia gigantea* Raimondi ex Herrera". No original material was found in the Raimondi herbarium at USM.

Other specimens examined (syntypes). Peru. Áncash: Huaraz, Umgebung des Dorfes Aija, grasige, etwas steinige Abhainge, 4000 m, April 1903, *A. Weberbauer 2955* (B barcodes B-100247174 [digital image!], B-100247175 [digital image!], B-100247176 [digital image!].

Family Caricaceae Dumort.

Carica integrifolia Raimondi, Elem. Bot. (Raimondi) 2: 230. 1857.
Type: not designated.
= *Vasconcellea candicans* (A.Gray) A.DC., Prodr. [A. P. de Candolle] 15(1): 417. 1864.
Type (holotype). Peru, Lima: Amancaes Mts., in ravines between Lima and Obrajillo, *Wilkes Exploring Expedition s.n.* (US barcode US- 00115148 [digital image!]).

Raimondi provided a Spanish diagnosis of this species within the text, comparing it with the better-known *C. papaya* L., and pointed to a footnote where he proposed a formal description.

This species was previously described three years earlier by Gray (1854) as *C. candicans*, from the same Lomas ecosystems near Lima. It was later transferred to *Vasconcellea* by de Candolle (1864), a change upheld by Badillo (2000) and currently accepted. No original material was found in the Raimondi herbarium at USM.

Family Orchidaceae Juss.

Chloraea undulata Raimondi, Elem. Bot. (Raimondi) 1: 143. 1857.
Type (lectotype, designated by Trujillo and Paredes-Burneo 2020: 93): Peru, Lima, *A. Raimondi s.n.* (USM-Raimondi Herbarium No. 9904!).
= *Chloraea pavonii* Lindl., Gen. Sp. Orchid. Pl.: 404, 1840.
Type (holotype): "Chile" [Peru]: *Pavon s.n.* (BM barcode BM000095631 [digital image!]).

Raimondi provided his description after casually naming the species a page before, as an example of plant with gynostemia, and referred to a footnote with a Latin protologue, preceded by a brief introduction in Spanish.

This name is commonly attributed to Miguel Fernández de Colunga, specifically in the second volume of his "Lecciones de botánica" (Fernández de Colunga 1878). The author, a disciple and close friend of the Italian scientist (Raimondi 1991), only copied the original description on page 187 and should not be credited with the authorship, as has occurred recently (Lleellish 2015). A review of the nomenclatural history of this species, with the corresponding typification of Raimondi's name and other synonyms, was published while this article was in preparation (Trujillo and Paredes-Burneo 2020), where the priority of the name by Lindley (1840) was asserted.

Family Polypodiaceae J.Presl & C.Presl

Niphobolus ccallahuala (Ruiz) Raimondi, Elem. Bot. (Raimondi) 2: 57. 1857 [as "*calaguala*"].
≡ *Polypodium ccallahuala* Ruiz, Disert. Ratánhia Calaguala Canchalagua: 37. 1796, nom. rej. prop.
Type (lectotype, designated by León 2016: 1424): "Polypodium", inedit colour and ink drawing by Isidro Gálvez (MA No. MA-AJB04-D-1680 [digital image!]).

= *Campyloneurum densifolium* (Hieron.) Lellinger, Amer. Fern J. 78(1): 19. 1988, nom. cons. prop.
≡ *Polypodium angustifolium* f. *densifolium* Hieron., Bot. Jahrb. Syst. 34(4): 532. 1904.
Type (lectotype, designated by Lellinger 1988: 19): Ecuador, Azuay: ad arborum truncos et locis lapidosis (Porphyr-Schotter) prope Las Yerbas Buenas in declivibus occasum solis spectantibus montium Cordillera occidental de Cuenca, 2500–2900 m, *F.C. Lehmann 5723* (US No. 832728 [barcode 00065745, digital image!]; isotypes: B barcode B 20 0093585, F No. 771612 [barcode V0075791F, photo neg. 65683]).

The new combination was made effective by an indirect reference in the text, where Raimondi named both the basionym and its author, Ruiz (1796). Then, again in a footnote of the same page, he gave a brief description in Latin of the genus.

The basionym of this name has been proposed for rejection by León (2016), because a new combination under the genus *Campyloneurum* would replace the well-established *C. densifolium* (Lellinger 1988; Zuloaga et al. 2008). The proposal was recommended by the Nomenclature Committee for Vascular Plants (Applequist 2019). To the best of my knowledge, this is the only combination made with the original name by Ruiz (1796).

Family Pteridaceae E.D.M.Kirchn.

Notholaena flavens (Sw.) Raimondi, Elem. Bot. (Raimondi) 2: 59. 1857 [as "*Nothoclaena flava*"], probable isonym.
Notholaena flavens (Sw.) T.Moore, Index Fil. (T.Moore) 2: LXX. 1857 [April 1857] [as "*Nothoclaena*"].
≡ *Acrostichum flavens* Sw., Syn. Fil. (Swartz): 16 (204). 1806.
Type (holotype): "America Meridional." [Panama]: *Cavanilles s.n.* (S barcode S06-1742 [digital image!]).
= *Argyrochosma nivea* var. *tenera* (Gillies ex Hook.) Ponce, Hickenia 2(38): 177. 1996.
≡ *Notholaena tenera* Gillies ex Hook., Bot. Mag. 58: pl. 3055. 1831.
Type (holotype): Argentina, Mendoza: cultivated from spores collected near Villavicencio, February 1821, *Gillies s.n.* (K barcode K-000633290 [digital image!]).

The combination was made effective by an indirect reference to the basionym accompanied by a short description, complemented with a justification for the nomenclatural novelty in a footnote of the same page. Raimondi used the orthographic variant "*Nothoclaena*" by Kaulfuss (1824) and changed the epithet to "*flava*".

The same combination was made by Moore (1857) in April of the same year. According to Pamo (1994), Raimondi was at Tingo María the first months of the year, and his book appeared after he returned to Lima. Therefore, it is most probable that Moore's "Index Filicum" was published before "Elementos de Botánica", making Raimondi's combination an isonym with no nomenclatural standing (Art. 6 Note 2 of the ICN).

The referred name is currently considered a synonym for *Argyrochosma nivea* var. *tenera* in major floristic works (Ponce 1996; Zuloaga et al. 2008; Jørgensen et al. 2014). According to Tryon and Weatherby (1956), the original material of *Acrostichum flavens* was collected by Née in "South America", however no indication of this is found on the herbarium labels, which state "E Nova Granata" ("from [the Viceroyalty of] New Granada") and "Cavanilles misit" ("sent by Cavanilles [to Swartz]"). Considering the direction taken by the Malaspina Expedition, the most probable place of collection is Panama, then a part of the Viceroyalty of New Granada and the only place visited between the Viceroyalties of Peru and New Spain (Madulid 1989).

Conclusions

Raimondi was a notable botanist with an acute knowledge of the Peruvian flora, whose precision was hindered only by the lack of access to updated literature from Europe and the United States. In fact, he proposed new species that were total novelties at the time, but which were subsequently forgotten by later researchers. Despite all of this, Raimondi is mostly remembered as a geologist and geographer, and the reappraisal of his botanical skills came much later. May this work add to the knowledge of that aspect of this remarkable Italian explorer.

Acknowledgements

The author invested over five years in this little piece of research, to honour properly the memory of the great Raimondi. In his path, he was aided by some of the foremost scientists of Peru: Hamilton Beltrán (USM), who helped with the identification, taxonomy, and nomenclatural information of Asteraceae, Severo Baldeón and Mario Benavente, for granting access to the Raimondi Herbarium and the general collection at USM since 2014, Luis Mayta (HUSA), the co-author of the new combination based on *Jacaranda punctata*. Also, the staff of the Raimondi Museum is to be acknowledged, especially its director Luis Felipe Villacorta, who gave privileged access to their collections and bibliographic material. Finally, the author is grateful to the editor, Gabriele Galasso, Stefania Biondi and two anonymous reviewers for their comments, criticisms, and suggestions, which helped to greatly improve this work.

References

Applequist WL (2019) Report of the Nomenclature Committee for Vascular Plants: 70. Taxon 68(4): 847–854. https://doi.org/10.1002/tax.12113

Badillo VM (2000) *Carica* L. vs. *Vasconcella* St. Hil. (Caricaceae) con la rehabilitación de este último. Ernstia, s. 2 10(2): 74–79. https://doi.org/10.2307/3393173

Bonfiglio G (2004) Antonio Raimondi, el Mensaje Vigente. Universidad de Lima y Banco de Crédito del Perú, Lima, 294 pp.

Bussmann RW, Sharon D (2015) Plantas Medicinales de los Andes y la Amazonia. La Flora Mágica y Medicinal del Norte del Perú. Centro William L. Brown, Jardin Botánico de Missouri, Trujillo, 292 pp.

Cabrera AL (1954) Senecios sudamericanos nuevos o críticos. Darwiniana 10(4): 547–605. https://www.jstor.org/stable/23211771

Candolle A de (1864) Prodromus Systematis Naturalis Regni Vegetabilis (Vol. 15(1)). Sumptibus Victori Masson et filii, Parisiis, 522 pp. https://www.biodiversitylibrary.org/page/153953

Coloma C (2016) La medicina tradicional peruana en la obra de Ricardo Palma. Aula Palma 12: 47–64. https://doi.org/10.31381/test2.v0i12.18

Cossia G (2009) Antonio Raimondi uno sconosciuto a Milano. Quaderni di Casa America 3(5): 96–99.

Cuatrecasas J (1950) Contributions to the flora of South America: studies on Andean Compositae–I. Fieldiana. Botany 27(1): 1–54. https://www.biodiversitylibrary.org/page/393248

de Colunga MF (1878) Lecciones de Botánica (Vol. 2). Imprenta del Estado, Lima, 671 pp. https://archive.org/details/b21497850_0002

Gentry AH (1985) Studies in Bignoniaceae 48: new South American species of Bignoniaceae. Phytologia 57(3): 240–248. https://www.jstor.org/stable/i400045

Gentry AH (1992) Bignoniaceae. Part II (Tecomeae). Flora Neotropica Monographs 25(2): 1–370. https://www.jstor.org/stable/i400045

Gray A (1854) United States Exploring Expedition (Vol. 15 (Botany Part 1, text)). C. Sherman, Philadelphia, 777 pp. https://www.biodiversitylibrary.org/page/40382254

Harms H (1928) Bromeliaceae novae. Notizblatt des Königlichen Botanischen Gartens und Museums zu Berlin 10(93): 211–221. https://doi.org/10.2307/3994669

Herrera FL (1921) Contribución a la Flora del Departamento del Cuzco. (Segunda edicion.). Primera parte. El Trabajo, Cuzco, 242 pp. https://www.biodiversitylibrary.org/page/8415151

IPNI (2021+) International Plant Names Index. The Royal Botanic Gardens, Kew, Harvard University Herbaria & Libraries and Australian National Botanic Gardens. http://www.ipni.org [accessed 11.01.2021]

Jørgensen PM, Nee MH, Beck SG (2014) Catálogo de las plantas vasculares de Bolivia. Monographs in Systematic Botany from the Missouri Botanical Garden 127(1–2): 1–1744.

Kaulfuss GF (1824) Enumeratio Filicum. Sumtibus Caroli Cnobloch, Lipsiae, 300 pp.

Kirk PM, Cannon PF, Minter DW, Stalpers JA (2008) Ainsworth & Bisby's Dictionary of the Fungi. 10th edn. CAB International, Wallingford, 771 pp. https://doi.org/10.1079/9780851998268.0000

Lellinger DB (1988) Some new species of *Campyloneurum* and a provisional key to the genus. American Fern Journal 78(1): 14–34. https://doi.org/10.2307/1547598

León B (2016) (2480) Proposal to conserve *Campyloneurum densifolium* against *Polypodium ccallahualla* ("*P. calaguala*") (Polypodiaceae). Taxon 65(6): 1424–1425. https://doi.org/10.12705/656.16

Lindley J (1840) The genera and Species of Orchidaceous Plants. Ridgeways, London, 554 pp. https://www.biodiversitylibrary.org/page/393248

Llacta FL, Quispe WK (2018) Evaluación del Efecto Expectorante en Ratones Albinos y Efecto Hepatotóxico en Ratas Albinas del Extracto Seco Hidroalcohólico al 40% de *Senecio violifolius* Cabrera (huamanrripa). Universidad Nacional de San Antonio Abad del Cusco, Cusco, 105 pp.

Lleellish M (2015) Notas sobre *Chloraea undulata* "Orquídea de Lima" y su registro en las lomas de Asia, Cañete, Perú. Revista Peruana de Biología 22(3): 309–314. https://doi.org/10.15381/rpb.v22i3.11436

Madulid DA (1989) The life and work of Luis Née, botanist of the Malaspina expedition. Archives of Natural History 16(1): 33–48. https://doi.org/10.3366/anh.1989.16.1.33

Mariotti MG (2009) Antonio Raimondi, botanico poco noto. Quaderni di Casa America 3(5): 42–44.

Moore T (1857) Index Filicum: a Synopsis, with Characters, of the Genera, and an Enumeration of the Species of Ferns, with Synonymes, References. W. Pamplin, London, 396 pp. https://www.biodiversitylibrary.org/page/37681492

Morawetz W (1979) Vier neue Arten der Gattung *Jacaranda* (Bignoniaceae) aus dem Südosten Brasiliens. Plant Systematics and Evolution 132(4): 333–341. https://doi.org/10.1007/BF00982396

Pamo O (1994) Antonio Raimondi y la Facultad de Medicina de Lima (1850–1890). Revista Médica Herediana 5(1): 47–58. https://doi.org/10.20453/rmh.v5i1.435

Ponce MM (1996) Nuevas combinaciones en *Argyrochosma* (Pteridaceae). Hickenia 2(38): 177–178.

Ragsac AC, Farias-Singer R, Freitas LB, Lohmann LG, Olmstead RG (2019) Phylogeny of the Neotropical tribe Jacarandeae (Bignoniaceae). American Journal of Botany 106(12): 1589–1601. https://doi.org/10.1002/ajb2.1399

Raimondi A (1857a) Elementos de Botánica. Primera Parte: Anatomía, Fisiología y Patología Vegetal. Mariano Murga, Lima, 284 pp. https://doi.org/10.17192/eb2013.0019

Raimondi A (1857b) Elementos de Botánica. Segunda Parte: Taxonomía, Fitografía y Geografía Botánica. Mariano Murga, Lima, 342 pp. https://doi.org/10.17192/eb2013.0019

Raimondi A (1874) El Perú. Tomo I: Parte Preliminar. Imprenta del Estado, Lima, 464 pp. https://books.google.com.pe/books?id=uo9fAAAAcAAJ

Raimondi A (1991) Apreciaciones personales. Cartas a Miguel Colunga. Biblioteca Nacional del Perú, Lima, 196 pp.

Ruiz H (1796) Disertaciones Sobre la Raíz de la Ratánhia de la Calaguala y de la China y Acerca de la Yerba Llamada Canchalagua. Imprenta Real, Madrid, 72 pp. https://bibdigital.rjb.csic.es/idurl/1/12721

Salomón L, Sklenář P, Freire SE (2018) Synopsis of *Senecio* series *Culcitium* (Asteraceae: Senecioneae, Senecioninae) in the Andean region of South America. Phytotaxa 340(1): 1–47. https://doi.org/10.11646/phytotaxa.340.1.1

Sánchez R (1995) Espacio y estructuras religiosas en los mitos de Awsangate. Anthropologica del Departamento de Ciencias Sociales 13(13): 167–185.

Thiers B (2021+) Index herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's virtual herbarium. http://sweet-gum.nybg.org/science/ih/ [accessed 11.01.2021]

Trujillo D, Paredes-Burneo D (2020) The *Chloraea* from Lima, a little-known species but described several times. Lankesteriana 20(1): 91–106. https://doi.org/10.15517/lank.v20i1.41443

Tryon R, Weatherby UF (1956) A revision of the American species of *Notholaena*. Contributions from the Gray Herbarium of Harvard University 179: 1–106.

Turland NJ, Wiersema JH, Barrie FR, Greuter W, Hawksworth DL, Herendeen PS, Knapp S, Kusber W-H, Li D-Z, Marhold K, May TW, McNeill J, Monro AM, Prado J, Price MJ, Smith GF [Eds] (2018) International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code) adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017. Regnum Vegetabile 159: 1–254. https://doi.org/10.12705/Code.2018

Valdivia MM (2013) Plantas tóxicas. Hospital Arzobispo Loayza. https://es.slideshare.net/condeponce/exposicion-buena-de-hierbas-toxicas [accessed 30.11.2020]

Villacorta LF (2010a) Flora perpetua. Cronología de Antonio Raimondi. Estudios. Asociación Educacional Antonio Raimondi, Lima, 227 pp.

Villacorta LF (2010b) Flora Perpetua. Acuarelas Botánicas. Asociación Educacional Antonio Raimondi, Lima, 375 pp.

Wood JRI (2008) A revision of *Tecoma* Juss. (Bignoniaceae) in Bolivia. Botanical Journal of the Linnean Society 156(1): 143–172. https://doi.org/10.1111/j.1095-8339.2007.00731.x

Zuloaga FO, Morrone O, Belgrano MJ (2008) Catálogo de las plantas vasculares del Cono Sur (Argentina, Sur de Brasil, Chile, Paraguay y Uruguay). Monographs in Systematic Botany from the Missouri Botanical Garden 107(1–3): 1–3348.

Supplementary material 1

Protologues and combinations by Antonio Raimondi

Author: Eduardo Molinari-Novoa

Data type: Nomenclatural information

Explanation note: Here we present the full protologues by Antonio Raimondi. The orthography and punctuation have been updated, but we tried to respect both the archaic prosodic tone of the text as well as its format.

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RESEARCH ARTICLE

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Notulae to the Italian native vascular flora: 11

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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, exclusions, and status changes to the Italian administrative regions. A new combination in the genus *Pilosella* is proposed. 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

***Aconitum anthora* L. (Ranunculaceae)**

+ **TOS**: Villa Collemandina (Lucca), Pania di Corfino (WGS84: 44.197804N, 10.383953E), lungo la cresta rocciosa sopra la località "La Bandita", 1550 m s.l.m., 17 August 2020, *E. Cheli* (FI). – Species new for the flora of Toscana.

E. Cheli, G. Bedini

***Ajuga genevensis* L. (Lamiaceae)**

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

According to Bartolucci et al. (2018), this species has not been recently found in Campania and Abruzzo. For both these administrative regions, Tenore (1831) indicated *Ajuga reptans* L. var. *montana* Ten., and, on this basis, Casali (1901) reported *A. genevensis* for Montevergine (Pignatti et al. 2018). However, Tenore's combination is a synonym of *A. reptans* (Grande 1923).

E. Del Guacchio

***Arabis caerulea* All. (Brassicaceae)**

– **LIG**. – Species to be excluded from the flora of Liguria.

This species was reported for Liguria by Penzig (1897), but at the time the administrative region included part of the Maritime Alps, which are currently located in France or in Piemonte. Furthermore, in Liguria the suitable habitats for this species (wet gravels above 1,900 m a.s.l.; Pignatti et al. 2017) are extremely reduced. No herbarium specimens were found in FI, GE, GDOR, and TO.

G. Barberis, S. Peccenini

***Bolboschoenus glaucus* (Lam.) S.G. Sm. (Cyperaceae)**

+ **MAR**: Porto Recanati (Macerata), loc. Scossicci, stagni artificiali ad uso venatorio ("guazzi") presso la foce del Fiume Musone (WGS84: 43.467787N, 13.632456E), c. 3 m, 13 October 2020, *L. Gubellini, N. Hofmann, S. Tonelli* (FI, PESA); dintorni di Fano, luoghi acquitrinosi nell'alveo del Metauro presso la foce, suolo prevalentemente argilloso, 18 September 1963, leg. et det. A.*J.B. Brilli-Cattarini* (PESA, under

the name *Scirpus maritimus* L. β *macrostachys* W.). – Species confirmed for the flora of Marche.

According to Bartolucci et al. (2018) and Di Natale et al. (2020), *B. glaucus* was known so far for Marche only as historical record.

L. Gubellini, N. Hofmann, S. Tonelli

***Bolboschoenus maritimus* (L.) Palla (Cyperaceae)**

+ **UMB**: Tuoro sul Trasimeno (Perugia), Punta Navaccia, tra i massi dell'argine del lago nei pressi del Campo del Sole (WGS84: 43.194102N, 12.079322E), ca. 255 m, 5 October 2020, *N.Hofmann* (FI; PESA). – Species confirmed for the flora of Umbria.

This species was recorded by Bartolucci et al. (2018) as doubtfully occurring in Umbria, and has been recently reported for this administrative region by Di Natale et al. (2020) based on old herbarium specimens.

L. Gubellini, N. Hofmann

***Bupleurum stellatum* L. (Apiaceae)**

– **LIG**. – Species to be excluded from the flora of Liguria.

This species was reported for Liguria by Penzig (1897) and Gismondi (1950) and, based on these records, also by Bartolucci et al. (2018) and Pignatti et al. (2018). Burnat (1906) provided only a few localities for the Maritime Alps, which currently fall in France. The habitat of this species (rocks and siliceous stony ground) is very rare in the Ligurian Alps. We were unable to trace any herbarium specimens in FI, GE, GDOR, and TO.

G. Barberis, S. Peccenini

***Bromus arvensis* L. subsp. *arvensis* (Poaceae)**

+ **TOS**: Piazzano (Empoli), lungo il Rio Camerata in loc. Villa Somelli (WGS84: 43.69403N, 10.966135E), margine di campi coltivati, 45 m, 2 August 2020, F. Roma-Marzio, L. Peruzzi (FI). – Subspecies new for the flora of Toscana.

F. Roma-Marzio, L. Peruzzi

***Carex elata* All. subsp. *elata* (Cyperaceae)**

+ **LIG**: Luni (La Spezia), "IT1345101 Piana del Magra", campi abbandonati a N di Luni Mare (WGS84: 44.063945N, 10.009447E), magnocariceto, 0 m, 1 April 2019, *I. Briozzo, D. Dagnino, C. Turcato* (GE No. 450). – Species confirmed for the flora of Liguria.

According to Bartolucci et al. (2018), *C. elata* subsp. *elata* is no longer recorded in Liguria. Barberis et al. (2019) cited three old herbarium specimens housed in GDOR.

I. Briozzo, D. Dagnino, C. Turcato

***Centaurea arrigonii* Greuter (Asteraceae)**

+ **LAZ**: Accumoli (Rieti), Forca Canapine, towards Pantani di Accumoli (WGS84: 42.72319183N, 13.20861419E), 1550–1600 m, arid subalpine meadows, 10 July 1957, leg. *V. Marchesoni*, rev. *S. Ballelli, D. Lucarini* (CAME, FI). – Species new for the flora of Lazio.

This specimen was previously referred to *C. ambigua* Guss. s.l. (Ballelli et al. 2005).

S. Ballelli, R. Pennesi, D. Lucarini†

***Chenopodium betaceum* Andrz. (Amaranthaceae)**

+ **UMB**: Perugia, isola Polvese (lago Trasimeno), dintorni della Villa S. Giuliano, il Poggio, Punta del Macerone (WGS84: 43.122316N, 12.130543E), incolti erbosi, 262–295 m, 23 October 2007, leg. *S. Ballelli, D. Lucarini*, det. *S. Ballelli*, conf. *D. Iamonico* (CAME); Perugia, isola Polvese (lago Trasimeno), dal molo Canoa Club alla Punta del Macerone (rive del viale nord) (WGS84: 43.118573N, 12.144589E), battigia, incolti, limiti boschivi, 262–270 m, 23 October 2007, leg. *S. Ballelli, D. Lucarini*, det. *S. Ballelli*, conf. *D. Iamonico* (HFLA). – Species confirmed for the flora of Umbria.

Chenopodium betaceum has been reported in Italy for the northern administrative regions (except Liguria), Marche, Lazio (central Italy) and as doubtful in Umbria (Bartolucci et al. 2018). This species is represented on the Polvese Island by two populations, both consisting of few individuals.

D. Iamonico, R. Pennesi, S. Ballelli

***Chenopodium pedunculare* Bertol. (Amaranthaceae)**

+ **VEN**: San Martino Buon Albergo (Verona), loc. Cà dell'Aglio, margine di strada sterrata nei pressi di una stalla (WGS84: 45.405564N, 11.105253E), 37 m, 30 November 2019, *F. Menini, M. Trenchi* (FI); Erbè (Verona), loc. Oltre Tione, prato incolto con accumulo di stallatico (WGS84: 45.240611N, 10.964377E), 13 m, 7 October 2020, *S. Andreatta* (VER No. SA525) – Species confirmed for the flora of Veneto.

Chenopodium pedunculare was only recently re-established (Iamonico and Mosyakin 2018), and has been poorly known from Veneto: its presence was witnessed by Bertoloni, who found it in Brondolo (Chioggia, Verona) and mentioned it at "*Fossa Clodia ad viam della Madonna a Prof. Naccario*". Other than there, the author also described this species only in Sarzana (La Spezia; Bertoloni, 1837). Several specimens have been found in San Martino Buon Albergo (Verona), by the side of a country lane near a big barn, on nitrophilic soil.

F. Menini, M. Trenchi, S. Andreatta

***Crucianella angustifolia* L. (Rubiaceae)**

+ **PIE**: Bussoleno (Torino), Val di Susa, fraz. Case Trucco (WGS84: 43.149152N, 7.125142E), prateria xerica, 650 m, 16 June 2014, *G. Nota, A. Mainetti, S. Ravetto*

Enri (FI); Giaglione (Torino), Val di Susa, Borgata Clarea (WGS84: 45.134872N, 6.993274E), radura xerica all'interno di boschi misti di latifoglie e pino silvestre, 882 m, 26 August 2020, *M. Pittarello, D. Barberis, M. Lonati* (FI). – Species confirmed for the flora of Piemonte.

Crucianella angustifolia was reported for Piemonte by Braun-Blanquet (1961), for a site close to the first site here recorded. Since then, this species had never been observed again in Piemonte.

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

***Eleocharis caduca* (Delile) Schult. (Cyperaceae)**

0 **PUG**: Otranto (Lecce), Laghi Alimini ("*In paludosis ad lacum Alimini, prope Hydrantum*") (WGS84: 40.201063N, 18.445781E), August 1875, leg. et det. *H. Groves*, rev. *L. Lastrucci* (FI barcode FI054915, under the name *Heleocharis ovata* R. Br.). – Species not recently confirmed for the flora of Puglia.

In Italy, this species was reported as native only for Toscana, Sicilia, and Sardegna by Bartolucci et al. (2018).

L. Lastrucci, D. Viciani

***Gentiana lutea* L. subsp. *symphyandra* (Murb.) Hayek (Gentianaceae)**

+ **TOS**: Villa Collemandina (Lucca), Monte Vecchio (WGS84: 44.230882N, 10.414822E), lungo il versante roccioso che alterna ripidi canali ad ampi macereti terminanti al limite della faggeta, esposizione S, stazione compresa tra 1620 e 1750 m s.l.m., 5 August 2020, *E. Cheli* (FI). – Subspecies new for the flora of Toscana.

E. Cheli, G. Bedini

***Glebionis discolor* (d'Urv.) E.Cano, Musarella, Cano-Ortiz, Piñar Fuentes, Spamp. & Pinto Gomes (Asteraceae)**

+ **BAS**: Scanzano Jonico (Matera), SS 106, svincolo rotatoria di Scanzano Jonico (WGS84: 40.235278N, 16.692500E), bordo strada, 11 May 2018, leg. *C.M. Musarella*, det. *V.L.A. Laface, C.M. Musarella, G. Spampinato* (FI, REGGIO). – Species new for the flora of Basilicata.

This species was recently re-evaluated based on morphological and ecological features (Cano et al. 2017). *Glebionis discolor* was recently reported also for Puglia (Manni 2020).

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

***Helleborus viridis* L. subsp. *abruzzicus* (M.Thomsen, McLewin & B.Mathew) Bartolucci, F.Conti & Peruzzi (Ranunculaceae)**

+ MAR: Sefro (Macerata), Forca di Bara (WGS84: 43.12632052N, 12.87509678E), 1160 m, edge of beech forest, no exp., 3 July 1962, leg. *V. Marchesoni* rev. *D. Lucarini* (CAME); Sarnano (Macerata), Monti Sibillini National Park, Pizzo di Meta-Punta

di Ragnolo (WGS84: 43.02522031N, 13.20534272E), 1560 m, meadows, 12 July 1962, leg. *V. Marchesoni*, rev. *D. Lucarini* (CAME). – Subspecies confirmed for the flora of Marche.

These specimens were previously referred to *H. viridis* subsp. *bocconei*, and then (2007) revised as *H. viridis* L. subsp. *abruzzicus*.

R. Pennesi, D. Lucarini†, S. Ballelli

***Hieracium amplexicaule* L. subsp. *chenevardianum* Zahn (Asteraceae)**

+ **VDA**: Brusson (Aosta), Castello di Graines (WGS84: 45.73843N, 7.75398E), mura interne, 1362 m s.l.m., exp. Est, 16 June 2020, leg. *S. Orsenigo*, det. *G. Gottschlich* (PAV). – Subspecies confirmed for the flora of Valle d'Aosta.

According to Bovio (2014) and Bartolucci et al. (2018), this subspecies was known, only historically, for Valle d'Aosta. Vaccari (1904–1911) reported its presence for several localities: between Bard and Champorcher, Valsavarenche, Èntrèves, Valgrisenche, between Aosta and Valpelline, and between Bionaz and Prarayer).

S. Orsenigo, G. Gottschlich

***Hieracium cydoniifolium* Vill. subsp. *parcepilosum* (Arv.-Touv.) Zahn (Asteraceae)**

+ **VEN**: Rocca Pietore (Belluno) sopra Passo Fedaia verso il Rifugio Padon (WGS84: 46.456420N, 11.888447E) cespugli in pascolo, su silice, 2100 m, 25 July 2020, leg. *C. Argenti*, det. *G. Gottschlich* (FI, *Herb. Argenti*). – Subspecies new for the flora of Veneto.

G. Gottschlich, C. Argenti

***Hieracium gombense* Lagger ex Christener subsp. *weitfeldense* (Murr) Zahn**

+ **VEN**: Livinallongo del Col di Lana (Belluno), in loc. Spiz de Jou, Altopiano di Cherz (WGS84: 46.508808N, 11.891936E), pascolo, su silice, 2095 m, 15 August 2020, leg. *C. Argenti*, det. *G. Gottschlich* (FI, *Herb. Argenti*). – Species new for the flora of Veneto.

G. Gottschlich, C. Argenti

***Hieracium lachenalii* Suter subsp. *amaurochlorum* (Zahn ex Heimerl) Zahn**

+ **VEN**: Ponte nelle Alpi (Belluno), in loc. La Secca (WGS84: 46.129080N, 12.317921E), rupe calcarea, 390 m, 26 May 2020, leg. *C. Argenti*, det. *G. Gottschlich* (FI, *Herb. Argenti*). – Subspecies new for the flora of Veneto.

G. Gottschlich, C. Argenti

***Hieracium levicaule* Jord. subsp. *perscissiforme* Benz & Zahn**

+ **ITALIA** (**VEN**): Agordo (Belluno), in loc. La Campona (WGS84: 46.302955N, 12.053582E), margine bosco a *Picea abies*, 1200 m, 26 June 2020, leg. *C. Argenti*, det. *G. Gottschlich* (FI, Herb. Argenti). – Subspecies new for the flora of Italy (Veneto).

This subspecies was hitherto only known from Austria and Slovenia (Zahn 1922–38).

G. Gottschlich, C. Argenti

***Hordeum geniculatum* All. (Poaceae)**

+ **LOM**: Stagno Lombardo (Cremona), destra idrografica del Fiume Po, ca. 1 Km a SE di Cascina Isolone (WGS84: 45.070042N, 10.040859E), carrareccia tra un giovane pioppeto e una boscaglia ripariale con *Salix alba*, *Humulus japonicus*, *Sicyos angulatus* e *Artemisia verlotiorum*, 35 m, 24 June 2020, leg. *P. Marenzi*, det. *F. Bonali*, conf. *E. Banfi* (FI, MSNM, *Herb. F. Bonali*). – Species new for the flora of Lombardia.

The population here reported consists of about eighty individuals.

F. Bonali, P. Marenzi, E. Banfi, G. Galasso

***Hyparrhenia sinaica* (Delile) Llauradó ex G.López (Poaceae)**

+ **LAZ**: Alvito (Frosinone), Fossa Maiura (WGS84: 41.715940N, 13.721343E), garriga sul versante esposto a sud di una grande dolina, 771 m, 26 May 2020, *L. Cancellieri*, *L. Carotenuto* (FI). – Species new for the flora of Lazio.

Hyparrhenia sinaica is a SW-Steno-Mediterranean species, reported in peninsular Italy for Toscana, Puglia, Calabria, and for Sicilia and Sardegna (Bartolucci et al. 2018); it was also recently reported also for Umbria (Bartolucci et al. 2019). A population of about 1 m^2 was found on the steep, south-facing slope of the Maiura doline on a loose and coarse substrate, apparently poor in organic matter.

L. Cancellieri, L. Carotenuto

***Laburnum alpinum* (Mill.) Bercht. & J.Presl (Fabaceae)**

+ **LAZ**: Settefrati (Frosinone), Val Canneto tra Rifugio Acquanera e Casone Bartolomucci (WGS84: 41.713656N, 13.901975E ± 100 m), margine di faggeta, 1330 m, 4 September 2020, *L. Cancellieri*, *G. Filibeck* (UTV). – Species confirmed for the flora of Lazio.

This species was reported as doubtful for Lazio by Bartolucci et al. (2018) and as an "almost certainly wrong record" by Anzalone et al. (2010); however, Conti (1995), following Grande (1924), referred to this taxon in an old record by Tenore and Gussone (1842) (sub *Cytisus laburnum*) from Val Canneto, where we have rediscovered it.

L. Cancellieri, G. Filibeck

***Laurus nobilis* L. (Lauraceae)**

+ **SAR**: Status change from naturalized alien to native for the flora of Sardegna.

Laurus nobilis is reported by Bartolucci et al. (2018) as casual or naturalized alien in five Italian administrative regions, including Sardegna, whereas in all other regions it is considered as a native species. However, several previous works (Desole 1947, 1949; Arrigoni 2006; Filibeck 2006) highlighted the native status of this species in Sardegna.

Indeed, Mediterranean Italy is probably an area of glacial refugia for this frost-sensitive species (Alessi et al. 2019 and references therein). In Sardegna, old individuals grow in gorges and along streams (Filibeck 2006; Bacchetta et al. 2007).

E. Farris, L. Rosati, G. Filibeck

***Leucopoa spectabilis* (Bertol.) H.Scholz & Foggi subsp. *spectabilis* (Poaceae)**

+ TOS: Zeri (Massa-Carrara), tra Bergugliara e Patigno, lungo la SP 37 (WGS84: 44.34857N, 9.75561E), macereti lungo la strada, su serpentino, 655 m s.l.m. 28 August 2020, *B. Foggi, A. Gabellini* (FI). – Subspecies confirmed for the flora of Toscana.

The first record for Toscana can be found in Caruel (1866) in the Monte Pisano area, where the subspecies has never been found again (Del Prete et al. 1990; Pierini et al. 2009; Pierini and Peruzzi 2014). A large population was found in an area between Bergugliara and Patigno in a serpentine outcrop.

B. Foggi, A. Gabellini, G. Ferretti

***Narcissus tazetta* L. subsp. *italicus* (Ker Gawl.) Baker (Amaryllidaceae)**

+ **CAL**: Reggio Calabria (Reggio Calabria), Podargoni (WGS84: 38.165488N, 15.780366E), noceto incolto, 542 m, 18 January 2020, leg. *V.L.A. Laface*, det. *V.L.A. Laface, C.M. Musarella, G. Spampinato* (FI, REGGIO). – Subspecies new for the flora of Calabria.

First observed in 2007 in an uncultivated field with *Juglans regia* L., nowadays the subspecies is much more widespread in the nearby areas.

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

***Phelipanche nana* (Reut.) Soják (Orobanchaceae)**

+ **MAR**: Cagli (Pesaro e Urbino) (WGS84: 43.541627N, 12.652022E), vegetazione di recupero di coltivi abbandonati 280 m, 16 May2020, leg. *G. Mei*, det. *G. Mei, A. Stinca, G. Domina (FI, Herb. Mei*). – Species new for the flora of Marche.

This species, whose range is restricted to the Mediterranean area (Domina et al. 2011), is an annual parasite of the root systems mainly of *Urtica dioica* L., *Oxalis pes-caprae* L., *Asteraceae* and *Fabaceae*, both spontaneous and cultivated (Domina 2018).

G. Mei, A. Stinca, G. Domina

***Phlomis fruticosa* L. (Lamiaceae)**

+ SAR: Status change from doubtful alien to native for the flora of Sardegna.

Phlomis fruticosa is a northern Mediterranean calcicolous species typical of cliffs and garrigues, whose original areal extent is difficult to establish (Pignatti et al. 2018). In Sardegna, this taxon was first reported by Moris (1827, 1859). Later it was reported as native by Pignatti (1982) and Corrias and Diana-Corrias (1983). It was then

reported as doubtful casual alien by Arrigoni (2013), Bartolucci et al. (2018) and as native of doubtful occurrence by Pignatti et al. (2018). The population found in Taccu (WSG84: 39.513194N, 09.325653E) near S. Nicolò Gerrei (Sud Sardegna) confirms its presence in Sardegna, and certainly it has to be considered native, due to its presence in natural, inaccessible, and rocky contexts.

G. Bacchetta, G. Campus, L. Podda

***Pilosella cymosa* (L.) F.W.Schultz & Sch.Bip. subsp. *vaillantii* (Tausch) S.Bräut. & Greuter**

+ **VEN**: Canale d'Agordo (Belluno), nell'abitato di Gares (WGS84: 46.312934N, 11.882061E), prato, 1375 m, 28 June 2020, leg. *C. Argenti*, det. *G. Gottschlich* (FI). – Subspecies new for the flora of Veneto.

G. Gottschlich, C. Argenti

***Pilosella paragogiformis* (Zahn & Besse ex Käser) Soják (Asteraceae)**

+ **ITALIA** (**VDA**): Champorcher (Aosta), Valle di Champorcher, scendendo dal Creton, sopra il Ponte delle Maddalene (WGS84: 45.614538N, 7.578559E), bordo strada, 1820 m s.l.m., 9 July 2013, leg. *M. Bovio et al.*, det. *G. Gottschlich* (AO, *Herb. Gottschlich 60034*); *ibidem*, 1814 m s.l.m., 4 July 2020, *C. Ganz, M. Broglio, M. Bovio* (FI, *Herb. Gottschlich 75989, Herb. Ganz*). – Species new for the flora of Italy (Valle d'Aosta).

Pilosella paragogiformis was published as *Hieracium paragogiforme* by Käser (1903), who cited a handwritten description sent to him by Zahn. Our collection from 2013 was first identified as *P. arida* (Freyn) Soják, however the second collection from 2020 shows that the broad white margins of the phyllaries do not fit with this species.

G. Gottschlich, M. Bovio

***Quercus coccifera* L. (Fagaceae)**

+ (CAS) **ABR**: Pineto (Teramo), Area Marina Protetta Torre del Cerrano (WSG84: 42.58842N, 14.08589E), in pineta retrodunale a dominanza di *Pinus pinea* L. con *Pinus halepensis* Mill. subsp. *halepensis*, 0 m, 14 November 2020, *J. Lupoletti, A. Pica* (FI). – Casual regional alien species new for the flora of Abruzzo.

It is very likely these plants derive from three adult and fertile planted specimens of *Q. coccifera* growing into the Mediterranean garden of the Marine Protected Area, 300 m from the discovery site.

J. Lupoletti, A. Pica

***Ranunculus rionii* Lagger (Ranunculaceae)**

+ SIC: Godrano (Palermo), Gorgo Lungo (WGS84: 37.900907N, 13.408385E), 1 June 2018, *L. Lastrucci, R. Bolpagni, L. Gianguzzi, O. Caldarella* (FI barcode

FI055169); Castronovo di Sicilia (Palermo), Gorgo di Carcaci (WGS84: 37.700990N, 13.540453E), 2 June 2018, *L. Lastrucci, R. Bolpagni, L. Gianguzzi* (FI barcode FI055170). – Species new for the flora of Sicilia.

Ranunculus rionii Lagger is a species distributed in Europe, North Africa, and central-western Asia (Wiegleb et al. 2017). In Italy, it is considered very rare (Pignatti et al. 2017), and is, so far, known with certainty only for Trentino-Alto Adige (Bartolucci et al. 2018), Lombardia, and Toscana (Bartolucci et al. 2019).

L. Lastrucci, R. Bolpagni, L. Gianguzzi, O. Caldarella

***Salix repens* L. subsp. *repens* (Salicaceae)**

– **ITALIA** (**LOM**, **VEN**). Species to be excluded from the flora of Italy (Lombardia, Veneto).

Many old records of *S. repens* for Lombardia and Veneto are unreliable, lacking habitats suitable for this species. No herbarium specimens attest to its presence in these administrative regions. Furthermore, the recent report (Frattini 1997) for Lombardia (Piana del Gaver, Tonale) is not confirmed. Most records of *S. repens* are to be referred to *Salix rosmarinifolia* L. or *S. helvetica* Vill., so that the species is to be excluded from Italy.

M. Merli, E. Banfi, G. Galasso

***Senecio doronicum* (L.) L. subsp. *orientalis* J.Calvo (Asteraceae)**

+ **TOS**: Val Serenaia (Lucca), Sentiero CAI 180, sopra il Rif. Donegani (WGS84: 44.130927N, 10.199348E), 1200 m, 7 July 2020, leg. *L. Pinzani*, det. L. Peruzzi, L. Pinzani (FI); Monte Orsaro (Massa-Carrara), (44.408214N, 9.990470E), 1800 m, 25 July 2020, leg. *L. Pinzani* det *L. Peruzzi, L. Pinzani* (PI); Monte Gomito (Pistoia), versante SE (44.123341N, 10.642118E), 1800 m, 21 July 2020, leg. *L. Pinzani*, det *L. Peruzzi*, *L. Pinzani* (PI). – Subspecies new for the flora of Toscana.

+ **LIG**: Pratorotondo (Genova) (WGS84: 44.427253N, 8.589218E), 1100 m, 26 June 2020, leg. *L. Pinzani*, det. *L. Peruzzi, L. Pinzani* (FI). – Subspecies new for the flora of Liguria.

In Toscana, *Senecio doronicum* subsp. *doronicum* has been reported by several authors along the northern Apennines (Raffaelli and Rizzotto 1991; Tomaselli et al. 2019; Marchetti 2020). According to Calvo et al. (2015), *S. doronicum* subsp. *doronicum* shows scattered arachnoid trichomes above the leaves and involucre weakly arachnoid to floccose. Our specimens, on the contrary, are glabrescent on both leaves and involucres, in agreement with the morphological features typical of *S. doronicum* subsp. *orientalis*. In Italy, *S. doronicum* subsp. *orientalis* occurs in many regions of the peninsula and on the eastern Alps (Bartolucci et al. 2018). In some localities, *S. doronicum* subsp. *orientalis* overlaps with *S. doronicum* subsp. *doronicum*, e.g., as in Monte Baldo (Veneto, Italy) (Calvo et al. 2015).

L. Pinzani, L. Peruzzi

***Senecio doronicum* (L.) L. subsp. *doronicum* (Asteraceae)**

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

L. Pinzani, L. Peruzzi

***Stellaria ruderalis* M.Lepší, P.Lepší, Z.Kaplan & P.Koutecký (Caryophyllaceae)**

+ **LOM**: Milano (Milano), Monte Stella (WGS84: 45.490153N, 9.134815E ± 300 m), margine erboso, 130–180 m, 6 May 2020, leg. *M. Martignoni*, det. *G. Galasso* (FI, MSNM Nos 50831, 50832, 50833). – Species new for the flora of Lombardia.

This recently described species has been already reported for Italy (Lepší et al. 2019). The presence in Italy of this species is presumably much greater than currently documented, given its high morphological similarity with *Stellaria media* (L.) Vill.

M. Martignoni, E. Banfi, G. Galasso

***Ulmus laevis* Pall. (Ulmaceae)**

+ C **CAL**: Corigliano-Rossano (Cosenza), Foce del Fiume Crati (WGS84: 39.717472N, 16.524165E), bosco planiziale igrofilo, 5 m, 22 August 2019, *A. Brusco, R. Marchianò*, *G. Piovesan* (FI). – Cryptogenic species new for the flora of Calabria.

This species is cultivated in Italy as an ornamental tree (Mittempergher et al. 1993), and it has been regarded as non-native for the whole country (Banfi and Galasso 2010). However, genetic data (Pepori et al. 2013) suggest a native status for some populations in NW Italy. Bartolucci et al. (2018) consider the species as cryptogenic in Piemonte; it was not recorded for Calabria. We found two large individuals in an area of well-preserved riparian vegetation. We think that *U. laevis* in Calabria should provisionally have the status of cryptogenic.

G. Filibeck, A. Brusco, R. Marchianò, G. Piovesan

Nomenclatural novelties

***Pilosella piloselloides* (Vill.) Soják subsp. *litoralis* (Nägeli & Peter) Gottschl., comb. nov.**

urn:lsid:ipni.org:names:77217192-1

≡ *Hieracium florentinum* subsp. *litorale* Nägeli & Peter, Hierac. Mitt.-Eur., 540 (1885)
≡ *Hieracium piloselloides* subsp. *litorale* (Nägeli & Peter) Zahn, Syn. Mitteleur. Fl. [Ascherson & Graebner] 12/1: 315 (1929).

The combination *Pilosella piloselloides* subsp. *litorale* (Nägeli & Peter) Zahn reported by Bartolucci et al. (2018) was never published.

G. Gottschlich

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

Alessi N, Těšitel J, Zerbe S, Spada F, Agrillo E, Wellstein C (2019) Ancient refugia and present-day habitat suitability of native laurophylls in Italy. Journal of Vegetation Science 30(3): 564–574. https://doi.org/10.1111/jvs.12743

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

Arrigoni PV (2006) Flora dell'Isola di Sardegna, Vol. 1. Carlo Delfino Editore, Sassari, 448 pp.

Arrigoni PV (2013) Flora dell'Isola di Sardegna, Vol. 4. Carlo Delfino Editore, Sassari, 584 pp.

Bacchetta G, Farris E, Fenu G, Filigheddu R, Mattana E, Mulè P (2007) Contributo alla conoscenza dei boschi a *Laurus nobilis* L. della Sardegna, Habitat prioritario ai sensi della Direttiva 92/43/CEE. Fitosociologia, 44(2) suppl. 1: 239–244.

Ballelli S, Lucarini D, Pedrotti F (2005) Catalogo dell'erbario dei Monti Sibillini di Vittorio Marchesoni. Braun-Blanquetia 38: 3–259.

Banfi E, Galasso G (2010) La flora esotica lombarda. Museo di Storia Naturale di Milano, Milano.

Barberis G, Dagnino D, Longo D, Peruzzi L, Bedini G, Peccenini S [Eds] (2019) Wikiplantbase #Liguria v3.0. http://bot.biologia.unipi.it/wpb/liguria/index.html

Bartolucci F, Domina G, Alessandrini A, Angiolini C, Ardenghi NMG, Bacchetta G, Banfi E, Bolpagni R, Bonari G, Bräuchler C, Calvia G, Cancellieri L, Cannucci S, Carruggio F, Conti F, Cavallaro V, Fanfarillo E, Ferretti G, Festi F, Fiaschi T, Foggi B, Forte L, Fröhner SE, Galasso G, Gestri G, Gottschlich G, Labadessa R, Lastrucci L, Lazzaro L, Mereu G, Morabito A, Mugnai M, Musarella CM, Orsenigo S, Pazienza G, Pennesi R, Peruzzi L, Pierini B, Podda L, Prosser F, Rossi G, Scoppola A, Spampinato G, Stinca A, Tomaselli V, Zangari G, Nepi C (2019) Notulae to the Italian native vascular flora: 7. Italian Botanist 7: 125–148. https://doi.org/10.3897/italianbotanist.7.36148

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, Marti-

netto 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

Bertoloni A (1837) Flora Italica, Vol. 3. Ex Typographaeo Haeredum Richardi Masii, Bononiae [Bologna], 660 pp.

Bovio M (2014) Flora vascolare della Valle d'Aosta. Repertorio commentato e stato delle conoscenze. Sarre: Testolin Editore, 662 pp.

Braun-Blanquet J (1961) Die Inneralpine Trockenvegetation. Fischer, Stuttgart.

Burnat E (1906) Flore des Alpes Maritimes; ou, Catalogue raisonné des plantes qui croissent spontanément dans la chaine des Alpes maritimes y compris le département francais de ce nom et une partie de la Ligurie occidentale, Vol. 4. H. Georg, Genève, 304 pp.

Calvo J, Álvarez I, Aedo C (2015) Systematics of *Senecio* sect. *Crociseris* (Compositae, Senecioneae). Phytotaxa 211(1): 1–105. https://doi.org/10.11646/phytotaxa.211.1.1

Cano E, Musarella CM, Cano-Ortiz A, Piñar Fuentes JC, Spampinato G, Pinto Gomes CJ (2017) Morphometric analysis and bioclimatic distribution of *Glebionis coronaria* s.l. (Asteraceae) in the Mediterranean area. PhytoKeys 81: 103–126. https://doi.org/10.3897/phytokeys.81.11995

Caruel T (1866) Supplemento al Prodromo della Flora Toscana di T. Caruel. Atti della Società Toscana di Scienze Naturali – Memorie serie B 8: 1–52.

Casali C (1901) Flora irpina. Tipo-litografia Edoardo Pergola, Avellino, 148 pp.

Conti F (1995) Prodromo della flora del Parco Nazionale d'Abruzzo. Ente Autonomo Parco Nazionale d'Abruzzo, Roma.

Corrias B, Diana-Corrias S (1983) Piante rare in Sardegna. Considerazioni fitogeografiche e problemi connessi con la loro salvaguardia. Lavori della Società Italiana di Biogeografia, nuova serie 8: 199–211. https://doi.org/10.21426/B68110153

Del Prete C, Balderi F, Garbari F (1990) Geobotanical research on Mount Pisano (Tuscany, Italy), VIII. A preliminary checklist of the vascular flora. Atti della Società Toscana di Scienze Naturali – Memorie serie B 97: 121–192.

Desole L (1947) Diffusione e localizzazione della macchia-foresta a base di *Laurus nobilis* L. nella Sardegna settentrionale. Studi Sassaresi Sez. 2, 25(3): 3–17.

Desole L (1949) Diffusione e localizzazione della macchia-foresta a base di *Laurus nobilis* L. nella Sardegna settentrionale (Continuazione). Studi Sassaresi Sez. 2, 27(2): 3–24.

Di Natale S, Lastrucci L, Hroudová Z, Viciani D (2020) A review of *Bolboschoenus* species (Cyperaceae) in Italy based on herbarium data. Plant Biosystems [Published online: 29 Dec 2020]. https://doi.org/10.1080/11263504.2020.1852330

Domina G, Marino P, Castellano G (2011) The genus *Orobanche* (Orobanchaceae) in Sicily. Flora Mediterranea 21: 205.

Domina G (2018) *Orobanche nana* In: Pignatti S, Guarino R, La Rosa M (Eds) Flora d'Italia. Ed. 2, Vol. 3. Edagricole, Bologna, 376–389.

Filibeck G (2006) Notes on the distribution of *Laurus nobilis* L. (Lauraceae) in Italy. Webbia 61(1): 45–56. https://doi.org/10.1080/00837792.2006.10670794

Frattini S (1997) Natura in Lombardia. 9. Torbiere e altre zone umide nel Parco dell'Adamello e nelle Orobie bresciane. Regione Lombardia, Milano.

Gismondi A (1950) Prospetto della flora ligustica. Guida botanica della Liguria. SCIA, Genova.

Grande L (1923) Note di floristica. Nuovo Giornale Botanico Italiano n.s. 29 (1922): 142–161.

Grande L (1924) Note di floristica. Nuovo Giornale Botanico Italiano n.s. 31: 105–160.

Iamonico D (2010) Confirmation of the occurrence of *Chenopodium strictum* subsp. *strictum* (Amaranthaceae s. l.) in Italy. Phyton (Horn, Austria) 49(2): 235–240.

Iamonico D, Mosyakin SL (2018) Studies on *Chenopodium album* s.l. (Chenopodiaceae/Amaranthaceae s.l.): *Chenopodium pedunculare*. Annali di Botanica (Roma) 8: 67–74. https://doi.org/10.12705/674.17

Käser F (1903) Beiträge zur Kenntnis der Hieracienflora der Schweiz. Berichte der Schweizerischen Botanischen Gesellschaft 13: 134–150.

Lepší M, Lepší P, Koutecký P, Lučanová M, Koutecká E, Kaplan Z (2019) *Stellaria ruderalis*, a new species in the *Stellaria media* group from central Europe. Preslia 91(4): 391–420. https://doi.org/10.23855/preslia.2019.391

Manni QG (2020) Noterella 0308. In: Alessandrini A, Buono V, Longo D, Magni C, Manni QG, Nicolella G (Eds) Noterelle: 0239–0340. Acta Plantarum Notes 7, 292–292.

Marchetti D (2020) Note floristiche tosco-liguri-emiliane. XIV. Fanerogame osservate o raccolte in Lunigiana (MS, Toscana). Parte seconda (Apiaceae). Annali del Museo Civico di Rovereto, Sezione Architettura, Storia, Scienze Naturali 35(2019): 63–106.

Mittempergher L, Fagnani A, Ferrini F (1993) L'olmo ciliato (*Ulmus laevis* Pallas), un olmo europeo interessante e poco conosciuto. Monti e Boschi 44(4): 13–17.

Moris GG (1827) Stirpium Sardoarum Elenchus, 1. Ex Typis Regiis, Cagliari.

Moris GG (1858–1859) Flora Sardoa, Vol. 3. Ex Regio Typographeo, Taurini.

Penzig O (1897) Florae Ligusticae Synopsis. Annali del Museo Civico di Storia Naturale di Genova s. 2, 18: 423–531.

Pepori AL, Selvaggi A, Varese P, Ghelardini L, Santini A (2013) About *Ulmus laevis* Pall. in Italy. Third International Elm Conference 2013: 39.

Pierini B, Garbari F, Peruzzi L (2009) Flora vascolare del Monte Pisano (Toscana nord-occidentale). Informatore Botanico Italiano 41(2): 147–213.

Pierini B, Peruzzi L (2014) Prodromo della flora vascolare della Provincia di Lucca (Toscana nord-occidentale). Informatore Botanico Italiano 46(1): 3–16. [electronic appendix, 500 pp.]

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

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

Pignatti S, Guarino R, La Rosa M (2018) Flora d'Italia. Ed. 2, Vol. 3. Edagricole, Bologna.

Raffaelli M, Rizzotto M (1991) Contributo alla conoscenza della flora dell'Alpe della Luna (Appennino Aretino, Toscana). Webbia 46(1): 19–79. https://doi.org/10.1080/00837792.1991.10670508

Tenore M (1831) Sylloge plantarum vascularium florae neapolitanae hucusque detectarum. Tipografia del Fibreno, Neapoli [Naples], 580 pp.

Tenore M, Gussone G (1842) Memorie sulle peregrinazioni eseguite dai soci ordinari Signori M. Tenore e G. Gussone. Stamperia Reale, Napoli, 171 pp.

Tomaselli M, Carbognani M, Foggi B, Petraglia A, Rossi G, Lombardi L, Gennai M (2019) The primary grasslands of the northern Apennine summits (N-Italy): a phytosociological and ecological survey. Tuexenia 39: 181–213.

Vaccari L (1904–1911) Catalogue raisonné des plantes vasculaires de la Vallée d'Aoste. Volume I. Thalamiflores et Calyciflores. Aoste: Impr. Catholique. VIII, 635 pp.

Wiegleb G, Bobrov AA, Zalewska-Gałosz J (2017) A taxonomic account of *Ranunculus* section *Batrachium* (Ranunculaceae). Phytotaxa 391(1): 1–55. https://doi.org/10.11646/phytotaxa.319.1.1

Zahn KH (1922–1938) *Hieracium*. In: Ascherson PFA, Graebner KOPP (Eds) Synopsis der mitteleuropäischen Flora 12(1): 1–80 (1922), 81–160 (1924), 161–400 (1929), 401–492 (1930); 12(2): 1–160 (1930), 161–480 (1931), 481–640 (1934), 641–790 (1935); 12(3): 1–320 (1936), 321–480 (1937), 481–708 (1938). Borntraeger, Leipzig, Berlin.

Supplementary material 1

Supplementary data

Authors: Fabrizio Bartolucci, Gabriele Galasso

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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Notulae to the Italian alien vascular flora: 11

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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

Acacia dealbata Link (Fabaceae)

+ (NAT) **SIC**: Castelbuono (Palermo), c.da Vicaretto (WGS84: 37.901537°N, 14.125820°E), pascolo abbandonato, 7 July 2018, *G. Domina* (SAF); Cefalù (Palermo), c.da Carbonara (WGS84: 38.005208°N, 14.027224°E), vicinanze di oliveto e frutteti, 580 m, 8 August 2020, *G. Domina* (FI, SAF). – Naturalized alien species new for the flora of Sicilia.

Several individuals originating from seeds produced by nearby trees were observed at different growth stages.

F. Scafidi, G. Barone, E. Di Gristina

***Acalypha australis* L. (Euphorbiaceae)**

+ (NAT) **VEN**: Sommacampagna (Verona), a SW di Sommacampagna, loc. Balconi Rossi (WGS84: 45.395550°N, 10.807802°E), campo di mais, 107 m, 22 October 2020, *F. Prosser*, *G. Tomasi*, *M. Gecchelin* (ROV); Valeggio sul Mincio (Verona), a NW di Valeggio sul Mincio presso Ca' Forneletti (WGS84: 45.373276°N, 10.711337°E), campi di mais e zucchine, 65 m, 23 October 2020, *A. Bertolli*, *F. Festi* (ROV); Castel d'Azzano (Verona) (WGS84: 45.355930°N, 10.942225°E), aiuola incolta, 46 m, 27 October 2020, *F. Prosser*, *G. Tomasi*, *M. Gecchelin* (FI, ROV); Sona (Verona), fraz. San Giorgio in Salici (WGS84: 45.42800998°N, 10.79159430°E), margine vigneto, 30 October 2020, *A. Bertolli*, *F. Festi*, *M. Gecchelin* (ROV). – Naturalized alien species new for the flora of Veneto.

In Veneto, this species was found in the western part close to the border with Lombardia (Ca' Forneletti); in this site, the species' occurrence is widespread, thereby becoming a dangerous weed.

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

***Acer saccharinum* L. subsp. *saccharinum* (Sapindaceae)**

+ (CAS) **LIG**: Carasco (Genova), ZSC "IT1332717 Foce e medio corso del Fiume Entella", loc. San Quirico, riva sinistra (WGS84: 44.35271°N, 9.35779°E), bosco ripario di salici e pioppi (Habitat Natura 2000 cod. 92A0), 19 m, 23 July 2020, leg. *D. Dagnino*, *C. Turcato*, det. *E. Banfi*, *D. Dagnino*, *C. Turcato* (FI, GE No. 2693). – Casual alien species new for the flora of Liguria.

D. Dagnino, C. Turcato, E. Banfi

***Actinidia deliciosa* (A.Chev.) C.F.Liang & A.R.Ferguson (Actinidiaceae)**

+ (CAS) **PIE**: Vistrorio (Torino), loc. Ciapies, bosco ripariale in sinistra orografica del Torrente Chiusella (WGS84: 45.442472°N, 7.759771°E), bosco ripariale, 465 m, 12 June 2020, *S. Ravetto Enri*, *A. Mainetti*, *D. Barberis* (FI); Rueglio (Torino), scarpata a monte della Strada per Bossola (WGS84: 45.477199°N, 7.763217°E), castagneto ceduo, 650 m, 26 September 2020, *S. Ravetto Enri* (FI). – Casual alien species new for the flora of Piemonte.

Two individuals were found in the above-mentioned sites: a well-developed fruiting female individual climbing along a 5 m tall *Salix alba* L. and a young male individual *ca.* 1 m tall.

S. Ravetto Enri, A. Mainetti, D. Barberis

***Ajuga dictyocarpa* Hayata (Lamiaceae)**

+ (CAS) **ITALIA** (**LOM**): Milano (Milano), Via C. Valvassori Peroni (WGS84: ca. 45.480805°N, 9.236509°E), casuale in un vaso di ligustro, 116 m, W, 15 May 2020, *E. Banfi* (FI, MSNM No. 50727). – Casual alien species new for the flora of Italy (Lombardia).

This species, native to East Asia, was identified with Flora of China (Li and Hedge 1994).

E. Banfi, G. Galasso

***Alcea biennis* Winterl subsp. *biennis* (Malvaceae)**

+ (CAS) **CAL**: Reggio Calabria (Reggio Calabria), Piani di San Nicola, fraz. Ortì (WGS84: 38.152106°N, 15.695742°E), bordo strada, 559 m, 29 June 2020, leg. *V.L.A. Laface*, det. *V.L.A. Laface*, *C.M. Musarella*, *G. Spampinato* (FI). – Casual alien species new for the flora of Calabria.

The recorded individuals originated from seeds of plants cultivated in a nearby monastery for medicinal purposes.

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

***Allium tuberosum* Rottler ex Spreng. (Amaryllidaceae)**

+ (NAT) **TOS**: Anghiari (Arezzo), lungo la strada SS73 Senese-Aretina (E78) al km 172 (WGS84: 43.511004°N, 12.084579°E), erbosi ai margini della strada, 313 m, 22 September 2020, *F. Selvi*, *L. Lazzaro*, *A. Coppi* (FI). – Naturalized alien species new for the flora of Toscana.

Allium tuberosum is native to Asia, but is nowadays widely cultivated for ornamental and culinary purposes (Blattner and Friesen 2006). We observed several flowering individuals forming a well-established population at the edge of the road SS73 (from km 170 to 172). We also observed a few other individuals along the same road between Le Lastre and Arezzo at km 147 (WGS84: 43.424812°N, 11.920076°E).

F. Selvi, L. Lazzaro, A. Coppi

***Amaranthus muricatus* (Moq.) Gillies ex Hieron. (Amaranthaceae)**

+ (NAT) **LAZ**: Roma (Roma), Via Monte Ruggero (WGS84: 41.948146°N, 12.529498°E), marciapiede, 30 m, 28 November 2017, *G. Nicolella* (RO); *ibidem*, 15 July 2020, *D. Iamonico*, *G. Nicolella* (HFLA, RO); *ibidem*, Via Sarandi (WGS84: 41.948286°N, 12.529817°E), marciapiede, 39 m, 15 July 2020, *D. Iamonico*, *G. Nicolella* (HFLA, RO); *ibidem*, Via Monte Cardoneto (WGS84: 41.947950°N, 12.529648°E), terrapieno, 28 September 2020, *G. Nicolella* (HFLA, RO). – Status change from casual to naturalized alien for the flora of Lazio.

Amaranthus muricatus was observed for the first time in Roma in 2017 as a casual alien (Nicolella 2018). In recent years, we noticed that this species regularly produces abundant fruits. Despite recurrent cuts, it still occurs in the place of first discovery and has also spread to some nearby streets.

D. Iamonico, G. Nicolella, A. Noor Hussain

***Amaranthus palmeri* S.Watson (Amaranthaceae)**

+ (NAT) **MAR**: Fano (Pesaro e Urbino), sponda destra del Fiume Metauro, poco a monte del ponte autostradale (WGS84: 43.8108333°N, 13.0391666°E), greto fluviale ghiaioso, ca. 5 m, 8 October 2020, *L. Gubellini* (FI, PESA). – Naturalized alien species new for the flora of Marche.

A few individuals were observed growing in the stony riverbed of the Metauro river about 4 km from its mouth.

L. Gubellini, N. Hofmann

***Asparagus aethiopicus* L. (Asparagaceae)**

+ (CAS) **CAL**: Reggio Calabria (Reggio Calabria), Via G. De Nava (WGS84: 38.119775°N, 15.653339°E), marciapiedi, 18 m, 22 September 2020, *V.L.A. Laface*, *C.M. Musarella*, *G. Spampinato* (FI, REGGIO). – Casual alien species new for the flora of Calabria.

Only two individuals were found growing in a crack in the sidewalk, probably escaped from the balconies of nearby houses.

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

***Begonia grandis* Dryand. subsp. *grandis* (Begoniaceae)**

+ (CAS) **SIC**: Palermo (Palermo), Via G. Malvica, nei pressi del civico 24 (WGS84: 38.1292592°N, 13.3504172°E), negli interstizi dei marciapiedi, 15 July 2020, *E. Di Gristina* (FI). – Casual alien species new for the flora of Sicilia.

Some mature individuals of this cultivated perennial native to Japan were found in the interstices of the sidewalks, probably coming from nearby adult fruiting plants.

E. Di Gristina, F. Scafidi, G. Barone

***Bidens subalternans* DC. (Asteraceae)**

+ (NAT) **TAA**: Rovereto (Trento), riva sinistra del Fiume Adige a monte del ponte di Villa Lagarina (WGS84: 45.918331°N, 11.046048°E), un esemplare, 174 m, 19 September 2019, leg. *C. Raffaelli*, det. *F. Prosser* (ROV); Ala (Trento), sponda destra del Fiume Adige presso Chizzola (WGS84: 45.80800950°N, 11.01131898°E), una decina di esemplari, 146 m, 20 July 2020, leg. *A. Bertolli*, *G. Tomasi*, det. *F. Prosser* (ROV); Trento (Trento), riva destra del Fiume Adige di fronte alla loc. Acquaviva (WGS84:

45.98892636°N, 11.11568431°E), un migliaio di esemplari per un tratto di ca. 1 km, 186–187 m, 6 October 2020, *C. Raffaelli* (FI, ROV). – Naturalized alien species new for the flora of Trentino-Alto Adige.

In Trentino, this species is spreading along the Adige river, probably starting from the vast settlement near Acquaviva, thanks to the transport of sheep. This is confirmed by a further observation, again along the Adige, just south of Avio (WGS84: 45.720804°N, 10.936019°E).

C. Raffaelli, A. Bertolli, G. Tomasi, F. Prosser

***Bidens vulgata* Greene (Asteraceae)**

+ (NAT) **VEN**: Verona (Verona), Porto San Pancrazio (WGS84: 45.431196°N, 11.020334°E), diversi esemplari in fiore sulla sponda di un fossato, 42 m, 6 October 2020, *S. Andreatta* (FI, VER No. SA459). – Naturalized alien species new for the flora of Veneto.

Until recently, this species has been misidentified with *Bidens frondosa* L. (Veerlove and Ardenghi 2015; Galasso et al. 2016). During field surveys in 2020, we also observed consistent populations of this taxon in other localities, such as San Bonifacio (Verona, WGS84: 45.40250°N, 11.25814°E), Cerea (Verona, WGS84: 45.199084°N, 11.203187°E), San Martino Buon Albergo (Verona).

F. Menini, M. Trenchi, S. Andreatta

***Bothriochloa saccharoides* (Sw.) Rydb. subsp. *saccharoides* (Poaceae)**

+ (NAT) **ITALIA** (**VEN**): Thiene (Vicenza), Via del Terziario SP349, nelle aree contermini all'ipermercato (WGS84: 45.6933378°N, 11.4826360°E), migliaia di esemplari distribuiti sul bordo strada, nelle scarpate stradali, negli incolti erbosi, 124 m, no exp., 21 September 2019, leg. *D. Tomasi*, det. *A.S. Vega* (FI, MSNM Nos. 50878, 50879, *Herb. D. Tomasi*). – Naturalized alien species new for the flora of Italy (Veneto).

Bothriochloa saccharoides is a grass native to the American continent (Vega 2000). The systematics of the *B. saccharoides* complex is quite complex. Indeed, this species had already been previously reported in Italy for western Liguria by Barberis and Orsino (1984), but later the record was attributed to *B. laguroides* (DC.) Herter subsp. *laguroides* (Verloove and Lambonon 2008; Galasso et al. 2018). A similar report for France was, instead, attributed to *B. barbinoidis* (Lag.) Herter (Lambinon 1995), so this record is the first for Europe. The discovery site consists of a large area of *ca.* 100 m in radius characterized by a herbaceous cenosis, in which *B. saccharoides* is dominant.

D. Tomasi

***Bougainvillea glabra* Choisy (Nyctaginaceae)**

+ (CAS) **ITALIA** (**TOS**): Vecchiano (Pisa), Tenuta di Migliarino, vicino al confine con Torre del Lago, all'interno della ZSC "IT5170001 Dune litoranee di Torre del Lago",

nella parte litoranea della Tenuta (WGS84: 43.8124°N, 10.2626°E), zone retrodunali con aree aperte, alberi e arbusti sparsi, 20 June 2018, *D. Viciani*, *S. Sarmati* (FI). – Casual alien species new for the flora of Italy (Toscana).

Bougainvillea glabra is an ornamental vine, very similar to *B. spectabilis* Willd. from which it differs for leaves glabrous to sparsely pubescent, generally elliptical with acute to attenuate base (*vs* usually densely pubescent, ovate with obtuse to rounded base), and for branches with generally straight (*vs* recurve) spines (Lu and Gilbert 2003; Udulutsch et al. 2020). We observed a wild individual in a seemingly little disturbed dune environment.

D. Viciani, S. Sarmati, G. Ferretti

***Bulbine asphodeloides* (L.) Spreng. (Asphodelaceae)**

+ (CAS) **TOS**: Massarosa (Lucca), Via Padule in Quiesa (WGS84: 43.838382°N, 10.355687°E), scarpata su muro a bordo strada, in espansione, 20 m, 16 January 2021, *L. Pinzani* (FI, *Herb. L. Pinzani*). – Casual alien species new for the flora of Toscana.

L. Pinzani

***Carex tribuloides* Wahlenb. (Cyperaceae)**

+ (NAT) **ITALIA** (**LOM**): Arsago Seprio (Varese), ZSC "IT2010011 Paludi di Arsago", Palude Pollini (WGS84: 45.69967°N, 8.72270°E), sponde di stagno periodicamente inondate, 293 m, no exp., 31 May 2020, leg. *M. Martignoni*, *N. Pilon*, det. *P. Jiménez-Mejías*, conf. *A. Hipp*, *A.A. Reznicek* (FI, MSNM No. 50819, UPOS); *ibidem*, 20 June 2020, leg. *M. Martignoni*, *N. Pilon*, det. *P. Jiménez-Mejías*, conf. *A. Hipp*, *A.A. Reznicek* (MSNM No. 50820, UPOS). – Naturalized alien species new for the flora of Italy (Lombardia).

Carex tribuloides is native to eastern North America, where it inhabits wet to moist open habitats. It belongs to the species-rich section *Cyperoideae* G.Don, including 3 species in Europe and *ca.* 90 species in North America. It can be confused with two other North American relatives that are also introduced in Europe, *C. bebbii* (L.H.Bailey) Fernald and *C. scoparia* Willd., from which it can be easily distinguished (Mastrogiuseppe et al. 2002) by the leaf sheaths (apex expanded upwards beyond the insertion of the blade *vs* truncate) and the utricles (wingless or very narrowly winged towards the base *vs* conspicuously winged towards the base). *C. tribuloides* was previously reported from Sweden, from where it seems to have disappeared (Wallnöfer and Essl 2016). Two large tufts of about 1 m^2 were observed.

M. Martignoni, N. Pilon, G. Galasso, P. Jiménez-Mejías

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

+ (CAS) **ABR**: Campli (Teramo), loc. Battaglia, zona Pianevie, nella vallata del Torrente Fosso Grande (WGS84: 42.704166°N, 13.618888°E), orlo di vegetazione

boschiva, ca. 720 m, N, 4 October 2020, *N. Olivieri* (FI). – Casual alien species new for the flora of Abruzzo.

Some young individuals of the species grow in a cool and shady area located at the bottom of a narrow valley subjected to thermal inversion, where the soil is a calcareous rendzina. The plants originated from seeds produced by a nearby artificial reforestation area.

N. Olivieri

***Chasmanthe aethiopica* (L.) N.E.Br. (Iridaceae)**

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

According to literature data, the presence of this species in Toscana has been reported for the Tuscan Archipelago and for Monte Argentario (Baldini 1995). In the Tuscan Archipelago, it was first reported by Sommier (1900), based on specimens collected on the islands of Capraia (FI!) and Elba (FI!). Subsequently, it was confirmed for both islands (Lastrucci et al. 2012a; Lazzaro et al. 2014). A further report for the island of Gorgona (Arrigoni 2017) lacks herbarium documentation in FI. A review, based on de Vos (1985), Grandis (2016), and Lazzeri (2016), of all herbarium material preserved in FI for Toscana and linked to the records cited above, has allowed us to attribute all the specimens to *Chasmanthe floribunda* (Salisb.) N.E.Br. (Tuscan Archipelago) or to *C. bicolor* (Gasp.) N.E.Br. (Monte Argentario).

G. Ferretti, L. Lazzaro

***Chasmanthe floribunda* (Salisb.) N.E.Br. (Iridaceae)**

+ (NAT) **TOS**. – Alien status indication for the flora of Toscana.

On the basis of the previous records wrongly referred as to *Casmanthe aethiopica* (L.) N.E.Br., *C. floribunda* should be considered as naturalized in Toscana.

G. Ferretti, L. Lazzaro

+ (INV) **ITALIA** (**SAR**). – Status change from casual to invasive alien for the flora of Italy (Sardegna).

In recent years, this species has become invasive in several semi-natural habitats, such as fallows, abandoned vineyards, reforested areas, rivers banks, and road margins. It is particularly invasive on the island of San Pietro (Carloforte, Sud Sardegna). It remains to be ascertained if the majority of the former records of *Chasmanthe aethiopica* (L.) N.E.Br., presently considered invasive in Sardegna, should be referred to *C. floribunda*.

G. Sotgiu Cocco, M. Marignani, S. Bardi, L. Rosati

***Cistus* ×*purpureus* Lam. nothosusbp. *purpureus* (Cistaceae)**

+ (CAS) **ITALIA** (**PUG**): Brindisi (Brindisi), loc. Punta Penne (WGS84: 40.683468°N, 17.935878°E), su suoli sabbiosi, 5 m, 12 May 2018, *V. Tomaselli* (FI, *Herb. V. Tomaselli*). – Casual alien nothospecies new for the flora of Italy (Puglia).

This widely cultivated taxon was identified according to Sweet (1825–1830) and was found in garrigues with *Thymbra capitata* (L.) Cav. and *Poterium spinosum* L., on sandy soils, in Habitat of Community Interest code 5420 "S*arcopoterium spinosum* phryganas".

V. Tomaselli, R.P. Wagensommer

***Colocasia esculenta* (L.) Schott (Araceae)**

+ (CAS) **SIC**: Messina (Messina), fraz. Santo Stefano Medio (WGS84: 38.106583°N, 15.488588°E), lungo un canale ai margini di coltivi, 95 m, 27 February 2020, *F. Luchino* (FI). – Casual alien species confirmed for the flora of Sicilia.

Giardina et al. (2007), on the basis of historical records, indicated this species for several localities in Sicilia. Many individuals were found along a canal used for irrigation and for conveying rainwater, on the edge of several cultivated fields. The plants are distributed in small groups of 1–10 individuals, over a distance of 200 m, in a partially shaded environment. A second small population was observed a decade ago in western Sicilia, along the Frattina stream near Corleone (Palermo), several hundred kilometres away from the above locality, in similar environments.

F. Luchino, O. Caldarella, A. La Rosa

***Cotoneaster bullatus* Bois (Rosaceae)**

+ (NAT) **ITALIA** (**LOM**): Rovetta (Bergamo), Val Bielone, bosco presso Via del Lò (WGS84: 45.893956°N, 9.977416°E), bosco di latifoglie, 674 m, SSW, 1 September 2019, *G. Galasso* (MSNM No. 50690); *ibidem* (WGS84: 45.893214°N, 9.976903°E), bosco di latifoglie, 663 m, SSW, 1 September 2019, *G. Galasso* (FI, MSNM No. 50693); *ibidem* (WGS84: 45.893214°N, 9.976903°E), bosco di latifoglie, 663 m, SSW, 28 June 2020, *G. Galasso* (FI, MSNM Nos. 50694, 50695). – Naturalized alien species new for the flora of Italy (Lombardia).

This species was identified according to Fryer and Hylmö (2009), Dickoré and Kasperek (2010), and Stace (2010). Native to China, it presents bullate leaves, 3.5–9.0 cm long, with 6–9 very deeply impressed veins. Several dozen individuals fruit abundantly and occupy about 13,000 m^2.

G. Galasso, E. Banfi

***Cotoneaster divaricatus* Rehder & E.H.Wilson (Rosaceae)**

+ (CAS) **ITALIA** (**LOM**): Rovetta (Bergamo), Val Bielone, Via del Lò, verso il fondo, sulla sinistra (WGS84: 45.897723°N, 9.978366°E), margine stradale, 726 m, E, 22 July 2019, leg. et det. *G. Galasso*, conf. *A.N. Sennikov* (FI, MSNM No. 50672); *ibidem*, Val Bielone, bosco presso Via del Lò (WGS84: 45.894927°N, 9.978532°E), bosco di latifoglie, 668 m, SSW, 14 October 2020, leg. *G. Galasso*, det. *A.N. Sennikov* (FI, MSNM No. 50846). – Casual alien species new for the flora of Italy (Lombardia).

This species was identified according to Fryer and Hylmö (2009), Dickoré and Kasperek (2010), and Stace (2010). Native to China, it differs from

Cotoneaster horizontalis Decne. in leaves 1.0–3.0 cm long and 0.7–1.9 cm wide (*vs* 0.5–1.2×0.5–0.9 cm), and branches never forming regular herring-bone pattern, and from *C. simonsii* Baker in leaves to 2.5 cm long (*vs* 3.5 cm), ± lanceolate-ovate to ovate-rhombic (*vs* ovate to oblong) with 3–4 veins lightly impressed (*vs* 4–5 not impressed). Two plants were observed, one of which fruits regularly.

G. Galasso, E. Banfi, A.N. Sennikov

***Cotoneaster franchetii* Bois (Rosaceae)**

+ (INV) **ITALIA** (**LOM**): Rovetta (Bergamo), Val Bielone, bosco presso Via del Lò (WGS84: 45.893850°N, 9.976254°E), bosco di latifoglie, 660 m, SSW, 22 July 2019, leg. et det. *G. Galasso*, conf. *A.N. Sennikov* (FI, MSNM Nos. 50670, 50671); *ibidem* (WGS84: 45.895240°N, 9.978740°E), bosco di latifoglie, 695 m, SSW, 1 September 2019, leg. et det. *G. Galasso*, conf. *A.N. Sennikov* (MSNM Nos. 50683, 50684); *ibidem* (WGS84: 45.895171°N, 9.978434°E), bosco di latifoglie, 695 m, SSW, 1 September 2019, leg. et det. *G. Galasso*, conf. *A.N. Sennikov* (FI, MSNM No. 50686); *ibidem* (WGS84: 45.894274°N, 9.977392°E), bosco di latifoglie, 678 m, SSW, 1 September 2019, leg. et det. *G. Galasso*, conf. *A.N. Sennikov* (FI, MSNM Nos. 50688, 50689); *ibidem* (WGS84: 45.893569°N, 9.976769°E), bosco di latifoglie, 666 m, SSW, 1 September 2019, leg. et det. *G. Galasso*, conf. *A.N. Sennikov* (FI, MSNM No. 50692); *ibidem* (WGS84: 45.893463°N, 9.976788°E), bosco di latifoglie, 665 m, SSW, 28 June 2020, leg. et det. *G. Galasso*, conf. *A.N. Sennikov* (FI, MSNM Nos. 50696, 50697, 50698); *ibidem* (WGS84: 45.895701°N, 9.978775°E), bosco di latifoglie, 700 m, W, 28 June 2020, leg. et det. *G. Galasso*, conf. *A.N. Sennikov* (FI, APP, MSNM Nos. 50706, 50707, 50708); *ibidem* (WGS84: 45.893887°N, 9.976804°E), bosco di latifoglie, 668 m, SSW, 14 October 2020, leg. et det. *G. Galasso*, conf. *A.N. Sennikov* (FI, MSNM Nos. 50842, 50843). – Status change from casual to invasive alien for the flora of Italy (Lombardia).

The species was recently recorded as casual alien in Lombardia by Mauri (2020). It presents (Fryer and Hylmö 2009; Dickoré and Kasperek 2010; Stace 2010) ovate to elliptic leaves, to 4 cm long, with 3–5 impressed veins, silevery tomentose underside. It can be mistaken for *Cotoneaster pannosus* Franch., with patent instead of erect petals. According to Dickoré and Kasperek (2010), and Tison and de Foucault (2014), we consider *C. mairei* H.Lév. as a synonym of *C. franchetii*. Several hundred individuals fruit abundantly and occupy the entire undergrowth of about 33,000 m^2, and also grow up along the mountainside.

G. Galasso, E. Banfi, A.N. Sennikov

***Cotoneaster horizontalis* Decne. (Rosaceae)**

+ (CAS) **PIE**: Giaglione (Torino), bassa Val Clarea, in prossimità del cavalcavia dell'autostrada A32 del Frejus (WGS84: 45.130574°N, 6.990841°E), radura in bosco di latifoglie, 680 m, 29 May 2020, *M. Lonati*, *D. Barberis*, *M. Pittarello* (FI). – Casual alien species new for the flora of Piemonte.

Some young individuals were found growing near the Clarea creek, in the understory of a young broadleaf forest.

M. Lonati, D. Barberis, M. Pittarello

+ (INV) **ITALIA** (**LOM**): Rovetta (Bergamo), Val Bielone, bosco presso Via del Lò (WGS84: 45.893850°N, 9.976254°E), bosco di latifoglie, 660 m, SSW, 22 July 2019, *G. Galasso* (MSNM No. 50669); *ibidem* (WGS84: 45.895171°N, 9.978434°E), bosco di latifoglie, 695 m, SSW, 1 September 2019, *G. Galasso* (FI, MSNM No. 50687); Fino del Monte (Bergamo), Val di Bi, sentiero tra Masù e la Cappelletta degli Alpini (WGS84: 45.898205°N, 9.998142°E), bosco di latifoglie, 768 m, SE, 5 September 2020, *G. Galasso* (FI, MSNM No. 50811); *ibidem*, Val di Bi, strada forestale poco oltre la Cappelletta degli Alpini (WGS84: 45.903189°N, 9.997746°E), bosco di latifoglie, 910 m, W, 5 September 2020, *G. Galasso* (FI, MSNM No. 50816). – Status change from naturalized to invasive alien for the flora of Italy (Lombardia).

In Rovetta, several hundred individuals fruit abundantly and occupy the entire undergrowth of an area of about 33,000 m^2; they also grow up along the mountainside.

G. Galasso, E. Banfi

***Cotoneaster simonsii* Baker (Rosaceae)**

+ (NAT) **LOM**: Sirtori (Lecco), loc. Cascina Giuditta, presso Via G. Besana (WGS84: 45.737215°N, 9.342631°E), margine di sentiero boschivo, 520 m, NE, 7 September 2016, leg. *M. Villa*, det. *A.N. Sennikov* (FI); *ibidem*, 7 November 2016 (MSNM No. 48298); *ibidem*, 29 May 2017 (MSNM No. 48299); Rovetta (Bergamo), Val Bielone, bosco presso Via del Lò (WGS84: 45.895171°N, 9.978434°E), bosco di latifoglie, 695 m, SSW, 1 September 2019, leg. *G. Galasso*, det. *G. Galasso*, *E. Banfi* (FI, MSNM No. 50685); *ibidem* (WGS84: 45.895167°N, 9.978475°E), bosco di latifoglie, 695 m, SSW, 28 June 2020, leg. *G. Galasso*, det. *G. Galasso*, *E. Banfi* (MSNM No. 50699); *ibidem* (WGS84: 45.895455°N, 9.978239°E), bosco di latifoglie, 712 m, SSW, 28 June 2020, leg. *G. Galasso*, det. *G. Galasso*, *E. Banfi* (FI, MSNM No. 50705); *ibidem*, 14 October 2020, leg. *G. Galasso*, det. *G. Galasso*, *E. Banfi* (FI, MSNM No. 50836). – Status change from casual to naturalized alien for the flora of Lombardia.

This species was recently recorded as casual alien in Lombardia by Villa (2020). It presents ovate to broadly elliptic leaves, deciduous or semi-evergreen, 1.9–3.3 cm long, with 4–5 not impressed veins, sparsely strigose, with flat margins (Fryer and Hylmö 2009; Dickoré and Kasperek 2010; Stace 2010; Fryer and Zika 2014). In Sirtori, only one individual occours, while in Rovetta there are a few plants scattered over about 20,000 m^2 of woodland, some regularly fruiting.

M. Villa, E. Banfi, G. Galasso, A.N. Sennikov

+ (CAS) **TAA**: Stenico (Trento), c/o fraz. Seo, loc. Fratte (WGS84: 46.056010°N, 10.866876°E), scarpata presso alcune villlette, 850 m, S, 2 December 2017, leg. *M. Merli*, det. *G. Galasso*, conf. *A.N. Sennikov* (*Herb. M. Merli*); *ibidem*, 22 November

2018 (*Herb. M. Merli*); *ibidem*, 23 November 2018 (FI, MSNM No. 50847); *ibidem*, 8 June 2020 (*Herb. M. Merli*); *ibidem*, 10 June 2020 (FI, MSNM No. 50848, ROV). – Casual alien species new for the flora of Trentino-Alto Adige.

Only one individual was observed.

M. Merli, E. Banfi, G. Galasso, A.N.Sennikov

***Cotula australis* (Sieber ex Spreng.) Hook.f. (Asteraceae)**

+ (NAT) **LAZ**: Roma (Roma), Via del Mascherino 30 (WGS84: 41.903479°N, 12.458651°E), selciato a blocchetti di leucitite (sanpietrini), ca. 19 m, 10 April 2021, *R. Guarino* (FI, MSNM Nos. 50880, 50881). – Status change from casual to naturalized alien for the flora of Lazio.

The first record for Lazio of this species (Lucchese 2017) was for a casual presence on the lakeshore of Trevignano Romano (Roma), at about 33 km NW from the current finding. This new population grows on cobblestones paving the streets near the Vatican City (Borgo Pio). Considering that it consists of several hundred individuals scattered in multiple meta-populations, it is proposed to consider the species as naturalized in Lazio.

R. Guarino

***Cotula coronopifolia* L. (Asteraceae)**

+ (NAT) **MAR**: Porto Recanati (Macerata), loc. Scossicci, stagni artificiali ad uso venatorio ("guazzi") presso la foce del Fiume Musone (WGS84: 43.4567660°N, 13.6442480°E), stagni, ca. 3 m, 29 September 2020, *N. Hofmann*, *S. Orlandini* (FI, PESA). – Naturalized alien species new for the flora of Marche.

This species grows at the edge of artificial ponds used for hunting, where it has probably been carried by birds from neighbouring areas.

L. Gubellini, N. Hofmann, S. Orlandini

***Cuscuta campestris* Yunck. (Convolvulaceae)**

+ (NAT) **CAL**: Tarsia (Cosenza), a N della diga sul Lago di Tarsia, lungo il Fiume Crati (WGS84: 39.6142582°N, 16.3064010°E), su *Xanthium italicum*, 75 m, 28 August 2020, *L. Peruzzi* (FI). – Naturalized alien species new for the flora of Calabria.

L. Peruzzi

***Cyclospermum leptophyllum* (Pers.) Sprague ex Britton & P.Wilson (Apiaceae)**

+ (CAS) **SAR**: Oristano (Oristano), presso il Vivaio Produttivo di Campulongu (WGS84: 39.961387°N, 8.600895°E), incolto, ruderale, infestante nella coltivazione, 6 m, 30 July 2020, leg. *G. Brundu*, *V. Lozano*, det. *G. Brundu* (FI, *Herb. Uniss Agraria*). – Casual alien species new for the flora of Sardegna.

This species was likely introduced accidentally to Sardegna through nursery growing substrates.

G. Brundu, V. Lozano

***Cyperus alternifolius* L. subsp. *flabelliformis* Kük. (Cyperaceae)**

+ (NAT) **CAM**: Pellezzano (Salerno), riva destra dell'Irno, sotto via F. Wenner (WGS84: 40.695469°N, 14.775396°E), sponde cementificate ed inerbite, 34 m, 24 October 2020, *E. Del Guacchio* (NAP, *Herb. E. Del Guacchio*). – Status change from casual to naturalized alien for the flora of Campania.

In Campania this taxon is widespread and propagates both vegetatively and by seed dispersal, as already noted by Del Guacchio and La Valva (2017). The new, small population regularly produces seeds and is well established.

E. Del Guacchio

***Cyperus esculentus* L. (Cyperaceae)**

+ (NAT) **UMB**: Perugia (Perugia), fraz. Ponte San Giovanni, lungo le rive del Fiume Tevere (WGS84: 43.010449°N, 12.428761°E), 166 m, 5 August 2008, leg. *L. Lastrucci*, *R. Barocco*, *R. Venanzoni*, det. *L. Lastrucci* (FI barcode FI060282); Deruta (Perugia), area agricola nei pressi di Fanciullata, a margine di campo coltivato a tabacco vicino alla sponda destra del Fiume Tevere (WGS84: 42.982128°N, 12.399031°E), margine di coltivo, 164 m, 23 October 2020, *F. Bonini*, *D. Gigante* (FI, PERU-DSA3). – Naturalized alien species confirmed for the flora of Umbria.

In Umbria, a plant community dominated by *Cyperus esculentus* was previously mentioned by Lastrucci et al. (2012b), but the status of this species has never been specified. Both new stands consist of many individuals of different generations, probably originated by vegetative reproduction given the conspicuous presence of tubers, and covering in one case an area of *ca.* 1,500 m^2.

F. Bonini, D. Gigante, L. Lastrucci

***Cyperus schweinitzii* Torr. (Cyperaceae)**

+ (NAT) **VEN**: Verona (Verona), stazione ferroviaria di Verona Porta Nuova, sulla massicciata (WGS84: 45.42530201°N, 10.96320326°E), massicciata ferroviaria, 67 m, 17 September 2020, *A. Bertolli*, *F. Prosser* (FI, ROV No. 74209); *ibidem*, stazione ferroviaria di Verona Porta Vescovo, sulla massicciata (WGS84: 45.43345724°N, 11.01062515°E), massicciata ferroviaria, 58 m, 17 September 2020, *A. Bertolli*, *F. Prosser* (ROV No. 74210). – Naturalized alien species new for the flora of Veneto.

This species grows and settles on stabilized pebbly embankments, often naked due to weeding. In the Porta Nuova railway station, there are *ca.* 100 plants distributed in three groups growing in the train maintenance sector over a stretch of *ca.* 150 m. In the Porta Vescovo station, there are about 100 plants in several groups in the freight yard

over a stretch of *ca*. 700 m. A subsequent survey carried out in all the other railway stations in the province of Verona gave negative results.

A. Bertolli, F. Prosser

***Dimorphotheca ecklonis* DC. (Asteraceae)**

+ (CAS) **SAR**: Selargius (Cagliari), loc. San Lussorio, lungo il sentiero che percorre la zona umida (WGS84: 39.261238°N, 9.155397°E), 9 m, 12 May 2020, *G. Bacchetta*, *M. Fois* (FI, CAG); Santa Giusta (Oristano), loc. Pauli sa Figu, presso la strada SS131 (WGS84: 39.860250°N, 8.612755°E), 2 m, 27 June 2020, *G. Bacchetta*, *M. Fois* (CAG); Villasimius (Sud Sardegna), loc. Simius, lungo la spiaggia (WGS84: 39.124728°N, 9.526095°E), 2 m, 15 September 2020, *G. Bacchetta*, *A. Lallai*, *L. Podda* (CAG). – Casual alien species new for the flora of Sardegna.

The observed individuals of this species probably originated from plants cultivated as ornamentals in nearby gardens or established from dumped garden cuttings.

G. Bacchetta, M. Fois, A. Lallai, L. Podda

***Dysphania pumilio* (R.Br.) Mosyakin & Clemants (Amaranthaceae)**

+ (NAT) **LIG**: Pietra Ligure (Savona), Via Don G. Bado, lungomare, presso il deposito delle barche (WGS84: 44.148011°N, 8.283063°E), pavimentazione stradale con mattonelle, 3 m, no exp., 23 August 2020, *G. Galasso* (FI, MSNM No. 50834); *ibidem*, Via Don G. Bado, lungomare, presso il locale "Blue Bay" (WGS84: 44.148344°N, 8.283942°E), pavimentazione stradale con mattonelle, 5 m, no exp., 23 August 2020, *G. Galasso* (FI, MSNM No. 50835); *ibidem*, Via Don G. Bado, lungomare (WGS84: 44.148627°N, 8.284586°E), pavimentazione stradale con mattonelle, 5 m, no exp., 24 August 2020, *G. Galasso* (FI). – Naturalized alien species new for the flora of Liguria.

G. Galasso

***Elsholtzia stauntonii* Benth. (Lamiaceae)**

+ (CAS) **ITALIA** (**TAA**): Trento (Trento), argine sinistro del Torrente Fersina in loc. Ghiaie (WGS84: 46.047903°N, 11.119232°E), scarpata cespugliata, 195 m, 19 September 2020, leg. *M. Merli*, det. *F. Verloove* (FI, MSNM No. 50849, ROV, *Herb. M. Merli*). – Casual alien species new for the flora of Italy (Trentino-Alto Adige).

We observed two flowering bushes of this ornamental Chinese species, identified according to Whiteley (2000).

M. Merli, F. Prosser, F. Verloove

***Eragrostis frankii* (Fisch., C.A.Mey. & Avé-Lall.) Steud. (Poaceae)**

+ (CAS) **SIC**: Catania (Catania) (WGS84: 37.509255N, 15.088711E), lungo il bordo strada, 13 m, 31 December 2018, leg. *S. Brullo*, det. *E. Banfi*, *G. Galasso* (FI, CAT). – Casual alien species new for the flora of Sicilia.

Several individuals grow in a small area of the city centre of Catania along roadsides.
G. Tavilla, S. Cambria

***Erigeron annuus* (L.) Desf. subsp. *lilacinus* Sennikov & Kurtto (Asteraceae)**

+ (NAT) **ITALIA** (**PIE**): Verrua Savoia (Torino), ruderi della Rocca, lungo il sentiero alla base delle mura (WGS84: 45.17433°N, 8.10005°E ± 70 m), incolto arido, 280 m, 3 July 1988, leg. *A. Pistarino*, det. *A. Sennikov* December 2018 (H barcode C.411491, MRSN); Azeglio (Torino), Lago di Viverone (WGS84: 45.41175°N, 8.01931°E ± 1 km), margine di sentiero, 230 m, 15 June 1992, leg. *A. Pistarino*, det. *A. Sennikov* December 2018 (H barcode C.411496, MRSN). – Naturalized alien subspecies new for the flora of Italy (Piemonte).

This taxon is very easy to recognise because of its broader, coarsely dentate leaves, long pubescence and noticeably lilac ray flowers (the ray flower colour may be rather indistinctly pale in some plants, whereas flowers in other plants in the same area may be intensely coloured). Sennikov and Kurtto (2019) observed that this taxon tends to occur close to houses and gardens, probably due to its dispersal with garden soil or other material.

A.N. Sennikov, G. Galasso

***Erigeron annuus* (L.) Desf. subsp. *strigosus* (Muhl. ex Willd.) Wagenitz (Asteraceae)**

+ (NAT) **ITALIA** (**VEN**): Orgiano (Vicenza), 8 km SE of Lonigo on minor road from Este (WGS84: 45.35°N, 11.45°E), rough ground by pool, 60 m, 1 August 1983, leg. *J.R. Akeroyd*, *S.L. Jury*, *C.J. Miles*, *F.J. Rumsey 4272*, det. *A. Sennikov* December 2018 (H barcode C.411011). – Naturalized alien subspecies new for the flora of Italy (Veneto).

The circumscription of this taxon in Sennikov and Kurtto (2019) corresponds exactly to the traditional definition given by Wagenitz (1965) in central Europe and by Tzvelev (1994) in eastern Europe. According to Frey et al. (2003), the previous records from Lombardia (Arietti and Crescini 1980; Aeschimann et al. 2004) are considered erroneous (Galasso et al. 2018) as are those from Piemonte and Veneto (Aeschimann et al. 2004). In light of these new observations, it is more appropriate to consider the presence in Lombardia and Piemonte as doubtful.

A.N. Sennikov, G. Galasso

***Euphorbia hypericifolia* L. (Euphorbiaceae)**

+ (NAT) **SAR**: Quartu Sant'Elena (Cagliari), giardino privato (WGS84: 39.234936°N, 9.176933°E), 5 m, 10 July 2020, *G. Campus*, *G. Bacchetta* (FI, CAG); Decimomannu (Cagliari), loc. Bagantinus, lungo le stradine del vivaio (WGS84: 39.300743°N, 8.970782°E), stradine, 5 m, 20 July 2020, *G. Bacchetta*, *M. Fois*, *L. Podda* (FI, CAG); Oristano (Oristano), presso il Vivaio Produttivo di Campulongu (WGS84: 39.961387°N, 8.600895°E), incolto, ruderale, infestante nella coltivazione, 6 m, 30

July 2020, leg. *G. Brundu*, *V. Lozano*, det. *G. Brundu* (FI, *Herb. Uniss Agraria*); Cagliari (Cagliari), Pirri, aiuole in Via Barracca Manna (WGS84: 39.253179°N, 9.119715°E), aiuole, 48 m, 21 November 2020, G. Bacchetta, M. Fois (CAG). – Status change from casual to naturalized alien for the flora of Sardegna.

This species was reported as a casual alien for Sardegna (Mugnai et al. 2021).

G. Bacchetta, G. Brundu, G. Campus, M. Fois, V. Lozano, L. Podda

***Freesia leichtlinii* Klatt subsp. *alba* (G.L.Mey.) J.C.Manning & Goldblatt (Iridaceae)**

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

A well-established, currently expanding, population was found in Stintino (Sassari, WGS84: 40.938422°N, 8.221278°E). It grows within Mediterranean shrubland and along roadsides, occupying more than 9 ha, thus behaving as a spontaneous geophyte.

G. Rivieccio, C.M. Caria, S. Bagella

***Glandularia tenera* (Spreng.) Cabrera (Verbenaceae)**

+ (CAS) **SIC**: Marsala (Trapani), c.da Conca (WGS84: 37.844405°N, 12.520455°E), ai margini di un prato artificiale, ca. 100 m, 7 June 2020, leg. *G. Domina*, det. *G. Domina*, *G. Barone* (FI, PAL). – Casual alien species new for the flora of Sicilia.

This species was identified according to O'Leary and Thode (2016).

G. Barone, E. Di Gristina, F. Scafidi

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

+ (NAT) **MAR**: Pesaro (Pesaro e Urbino), nei pressi del parcheggio di San Decenzio (WGS84: 43.904490°N, 12.914932°E), scarpata stradale e massicciata della ferrovia, ca. 7 m, 12 November 2020, *L. Gubellini* (FI, PESA); *ibidem*, lungo la Strada dell'Angelo Custode (WGS84: 43.868528°N, 12.922919°E), siepi, ca. 190 m, 25 February 2021, *L. Gubellini* (PESA). – Naturalized alien species new for the flora of Marche.

This species is cultivated as ornamental and often escapes from cultivation (McAllister and Rutherford 1990). As for other alien species of *Hedera*, it was hitherto rather neglected.

L. Gubellini, N. Hofmann

***Hedera* ×*sepulcralis* R.H.Marshall & McAll. (Araliaceae)**

+ (NAT) **MAR**: Falconara Marittima (Ancona), ai margini di un parcheggio lungo Via G. Marconi, al confine con il comune di Castelferretti (WGS84: 43.6129920°N, 13.3759990°E), incolto erboso, ca. 18 m, 10 December 2020, *N. Hofmann* (FI, PESA). – Naturalized alien nothospecies new for the flora of Marche.

A large population of the hybrid *Hedera algeriensis* Hibberd × *H. hibernica* (G.Kirchn.) Bean (Marshall et al. 2017) grows at the edge of an uncultivated field.

L. Gubellini, N. Hofmann

***Hesperocyparis macrocarpa* (Hartw. ex Gordon) Bartel (Cupressaceae)**

+ (CAS) **ABR**: Vasto (Chieti), loc. Vasto Marina, presso la strada SS16 Adriatica (WGS84: 42.083055°N, 14.741388°E), margine di incolto, ca. 4 m, S, 12 August 2020, *N. Olivieri* (FI). – Casual alien species new for the flora of Abruzzo.

A young individual of this species grows on the edge of an uncultivated area, on a slight slope quite close to the Adriatic Sea, on sandy soil.

N. Olivieri

***Hibiscus syriacus* L. (Malvaceae)**

+ (CAS) **CAL**: Cutro (Crotone), fraz. Steccato di Cutro, strada E90 (WGS84: 38.946331°N, 16.935111°E), canale di scolo delle acque piovane a bordo strada, 19 m, 25 September 2020, *V.L.A. Laface*, *C.M. Musarella*, *G. Spampinato* (FI, REGGIO). – Casual alien species new for the flora of Calabria.

A small group of scattered individuals was found, along with other alien species.

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

***Hydrangea macrophylla* (Thunb.) Ser. (Hydrangeaceae)**

+ (CAS) **PIE**: Cellio con Breia (Vercelli), fraz. Breia, scarpata che dalla strada SP102 scende verso il Rio Galletto (WGS84: 45.781481°N, 8.297819°E), bosco misto di latifoglie, due individui, 765 m, 28 July 2019, *M. Lonati*, *M. Probo* (FI); *ibidem*, scarpata a valle della strada SP102 (WGS84: 45.775540°N, 8.294707°E), castagneto con latifoglie miste, numerosi individui, 780 m, 28 July 2019, *M. Lonati*, *M. Probo* (FI). – Casual alien species new for the flora of Piemonte.

Both the above-mentioned populations form small stands in the undergrowth of the road slopes, both located in illegal landfills of plant material derived from private gardens. This species is frequently cultivated as ornamental in the surrounding villages and the young plants have probably originated from rooting of pruning residuals.

M. Lonati, M. Probo

***Lobelia erinus* L. (Campanulaceae)**

+ (CAS) **MAR**: Amandola (Fermo), Via Roma, centro storico (WGS84: 42.9807230°N, 13.3591715°E), tra gli interstizi del selciato, 500 m, 18 October 2020, *A. Pica*, *J. Lupoletti* (FI). – Casual alien species new for the flora of Marche.

Several mature individuals were found, probably escaped from nearby pots or flowerbeds.

A. Pica, J. Lupoletti

***Lonicera ligustrina* Wall. subsp. *yunnanensis* (Franch.) P.S.Hsu & H.J.Wang (Caprifoliaceae)**

+ (NAT) **ITALIA** (**LOM**): Rovetta (Bergamo), Val Bielone, bosco presso Via del Lò (WGS84: 45.894740°N, 9.978517°E), bosco di latifoglie, 688 m, SSW, 28 June 2020, *G. Galasso* (FI, MSNM Nos. 50700, 50701, 50702, 50703, 50704); *ibidem*, 14 October 2020, *G. Galasso* (FI, MSNM No. 50841). – Status change from casual to naturalized alien for the flora of Italy (Lombardia).

This species covers several square metres, leaning against other shrubs and forming offshoots.

G. Galasso, E. Banfi

***Ludwigia hexapetala* (Hook. & Arn.) Zardini, H.Y.Gu & P.H.Raven (Onagraceae)**

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

Recent investigations along the edges of Lake Bracciano revealed that, since the last report by Galasso et al. (2019), this species has colonised also the western shore, between Vicarello and Bracciano (Roma), as well as other areas (Arrone river, Anguillara Sabazia, Roma province) for a total of *ca.* 12 km, showing high invasiveness both in aquatic habitats and on the beaches.

S. Magrini, E. Argenti, S. Buono

***Lychnis chalcedonica* L. (Caryophyllaceae)**

+ (CAS) **ITALIA** (**TAA**): Santa Cristina Valgardena (Bolzano), Strada Cisles (WGS84: 46.559133°N, 11.728848°E), sponde del rio a lato della strada, 1420 m, 18 July 2019, *F. Bonali* (FI, *Herb. F. Bonali*). – Casual alien species confirmed for the flora of Italy; casual alien species new for the flora of Trentino-Alto Adige.

Lychnis chalcedonica was reported in Italy only in the Marche as no longer recorded (Galasso et al. 2018). Some flowering individuals were observed.

F. Bonali

***Nassella tenuissima* (Trin.) Barkworth (Poaceae)**

+ (CAS) **ABR**: Lanciano (Chieti), presso la strada SP82 per Treglio (WGS84: 42.224444°N, 14.401666°E), area ghiaiosa, ca. 260 m, 14 August 2020, *N. Olivieri* (FI). – Casual alien species new for the flora of Abruzzo.

Some individuals of different ages grow in a calcareous gravelly area with a sparse ruderal vegetation. The plants developed from seeds dispersed by the wind from individuals cultivated in flowerbeds located a few dozen metres away.

N. Olivieri

***Nephrolepis cordifolia* (L.) C.Presl (Nephrolepidaceae)**

+ (NAT) **LIG**: Pietra Ligure (Savona), Via Aurelia, presso una scalinata, sul lato del muro che guarda verso il paese (WGS84: 44.149920°N, 8.283200°E), muro, 14 m, SSE, 20 August 2019, *G. Galasso* (FI, MSNM Nos. 50663, 50664). – Status change from casual to naturalized alien for the flora of Liguria.

A well established, numerous population was observed.

G. Galasso

***Oenothera lindheimeri* (Engelm. & A.Gray) W.L.Wagner & Hoch (Onagraceae)**

+ (CAS) **MAR**: Civitanova Marche (Macerata), Piazza Don E. Scorolli (Via G. Matteotti) (WGS84: 43.310663°N, 13.728768°E), aiuola ai margini del parcheggio, 2 m, 7 November 2020, *A. Pica*, *J. Lupoletti* (FI). – Casual alien species new for the flora of Marche.

Some individuals were found in a flowerbed near the parking area.

A. Pica, J. Lupoletti

***Oxalis latifolia* Kunth (Oxalidaceae)**

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

This species is widespread in the province of La Spezia and in the eastern part of the province of Genova, sometimes with quite large populations (e.g., in the Magra and Entella valleys).

D. Marchetti, D. Dagnino

***Phyllostachys viridiglaucescens* (Carrière) Rivière & C.Rivière (Poaceae)**

+ (NAT) **MAR**: Cagli (Pesaro e Urbino) (WGS84: 43.540092°N, 12.648702°E), vegetazione ripariale, 240 m, 5 August 2016, *G. Mei* (*Herb. G. Mei*); *ibidem* (WGS84: 43.541887°N, 12.652201°E), area periodicamente allagata di coltivi abbandonati, 290 m, 19 May 2020, *G. Mei* (FI, *Herb. G. Mei*). – Naturalized alien species new for the flora of Marche.

G. Mei

***Plumbago auriculata* Lam. (Plumbaginaceae)**

+ (CAS) **MOL**: Termoli (Campobasso), mura del borgo antico (WGS84: 42.003611°N, 14.996944°E), ca. 18 m, SW, 29 August 2020, *N. Olivieri* (FI). – Casual alien species new for the flora of Molise.

Some individuals of this species have settled on the upper part of the walls surrounding the old town, on a sub-vertical substrate formed by limestone and sandstone blocks, colonized mainly by *Capparis spinosa* L.

N. Olivieri

***Rhaphiolepis bibas* (Lour.) Galasso & Banfi (Rosaceae)**

+ (NAT) **PUG**: Vico del Gargano (Foggia), loc. San Nicola (WGS84: 41.916107°N, 15.948185°E), incolto, 80 m, 28 August 2020, *N. Biscotti*, *D. Bonsanto* (FI); Rodi Garganico (Foggia), loc. Canneto (WGS84: 41.919412°N, 15.920386°E), agrumeto incolto, 40 m, 1 September 2020, *N. Biscotti*, *D. Bonsanto* (FI). – Naturalized alien species new for the flora of Puglia.

N. Biscotti, D. Bonsanto

***Rudbeckia laciniata* L. (Asteraceae)**

+ (CAS) **TOS**: Abetone Cutigliano (Pistoia), fraz. Pian degli Ontani, appena oltre l'abitato in direzione di Pian di Novello (WGS84: 44.105877°N, 10.717935°E), spontaneizzata al margine stradale, 930 m, 20 August 2020, *G. Ferretti*, *R. Ferretti* (FI). – Casual alien species new for the flora of Toscana.

A single nucleus of *ca.* 10 flowering individuals was observed on the road edge, near a small mountain village. This species reproduces very efficiently by rhizome fragmentation and produces copious amounts of achenes (EPPO 2009), so careful monitoring of the population is recommended.

G. Ferretti, L. Lazzaro, M. Mugnai

***Rudbeckia triloba* L. (Asteraceae)**

+ (CAS) **LIG**: Varese Ligure (La Spezia), Val di Vara, nei pressi di Cavizzano, sotto Chinela, loc. Carmelo (WGS84: 44.403376°N, 9.553931°E), margine stradale, 525 m, 26 August 2020, *D. Marchetti* (FI); Maissana (La Spezia), strada SP523R, presso San Pietro Vara verso Varese Ligure (WGS84: 44.343645°N, 9.590019°E), siepi al margine della strada, 310 m, 16 September 2020, *D. Marchetti* (FI, GE No. 4431). – Casual alien species new for the flora of Liguria.

This species was found in disturbed environments near the road edge.

D. Marchetti, D. Dagnino

***Salvia hispanica* L. (Lamiaceae)**

+ (CAS) **LIG**: *Molineri* [Imperia (Imperia), Oneglia (WGS84: ca. 43.88905°N, 8.05034°E), oliveti, s.d., *I. Molineri*)] (BOLO-Hortus Siccus Florae Italicae barcode BOLOHSFI102871). – Casual alien species new for the flora of Liguria.

The locality, cited by Bertoloni (1833) as "Nascitur in olivetis di *Oneglia* in Liguria occidua. Habui a Molinerio", is the same of a previous record by Allioni (1785). These are the first records of its occurrence as a casual alien in Italy, *ca.* 200 years earlier than the report from the Marche (Ballelli et al. 2015).

S. Peccenini, G. Galasso

***Setaria parviflora* (Poir.) Kerguélen (Poaceae)**

+ (CAS) **ABR**: Montesilvano (Pescara), Riserva Naturale Pineta di Santa Filomena, presso il lungomare (WGS84: 42.505879°N, 14.172151°E), bordo strada, 2 m, 16 August 2020, *A. Stinca*, *F. Conti* (FI, APP, PORUN-Stinca). – Casual alien species new for the flora of Abruzzo.

A. Stinca, F. Conti

***Tetragonia tetragonoides* (Pall.) Kuntze (Aizoaceae)**

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

The first records reported in the literature for *Tetragonia tetragonoides* in Sardegna were in the "Sassarese" and in Siddi (Viegi 1993). We observed this species as naturalized along the coastal strip of Siniscola (Nuoro), in the locality of "S'Ena e sa Chitta" (ItIsWet 2019). Like other invasive alien species, this established population is outcompeting the native coastal flora.

G. Bacchetta, M. Fois, L. Podda

***Tradescantia pallida* (Rose) D.R.Hunt (Commelinaceae)**

+ (CAS) **PUG**: Castrignano del Capo (Lecce), loc. Santa Maria di Leuca, presso la strada SP358 "Delle terme salentine" (WGS84: 39.797222°N, 18.369722°E), incolto, ca. 60 m, S, 20 August 2020, *N. Olivieri* (FI). – Casual alien species new for the flora of Puglia.

In this site, the species grows in an uncultivated area located along the roadside, on a substrate consisting of Mediterranean red soil and limestone fragments.

N. Olivieri

***Vachellia karroo* (Hayne) Banfi & Galasso (Fabaceae)**

+ (INV) **ITALIA** (**SAR**). – Status change from naturalized to invasive alien for the flora of Italy (Sardegna).

This species is common throughout Sardegna, but in recent years it was recorded as spreading in the southern coastal areas (Campidano, Sarrabus-Gerrei, and Sulcis-Iglesiente), especially at Villasimius (Sud Sardegna), near the "Stagno Santa Gilla" (Cagliari province), and at Santa Margherita di Pula (Pula, Cagliari), where it exhibits a clearly invasive behaviour, thereby threatening natural habitats.

G. Bacchetta, G. Brundu, G. Calvia, M. Fois, L. Podda

***Verbena brasiliensis* Vell. (Verbenaceae)**

+ (CAS) **MAR**: Montelabbate (Pesaro e Urbino), lungo l'argine destro del Fiume Foglia (WGS84: 43.8552960°N, 12.8048870°E), incolti erbosi, ca. 35 m, 28 October 2020, *F. Furlani*, *L. Gubellini* (FI, PESA). – Casual alien species new for the flora of Marche.

A few individuals of this species grow in an uncultivated grassland along the banks of the Foglia river.

F. Furlani, L. Gubellini

***Yucca gigantea* Lem. (Asparagaceae)**

+ (CAS) **PUG**: Otranto (Lecce), strada SP87, Borgo Minerva (WGS84: 40.138597°N, 18.494417°E), pineta, 22 m, 23 August 2019, leg. *C.M. Musarella*, det. *V.L.A. Laface*, *C.M. Musarella* (REGGIO); *ibidem*, Porto Badisco (WGS84: 40.079231°N, 18.482242°E), bordo strada, 16 m, 23 August 2019, leg. *C.M. Musarella*, det. *V.L.A. Laface*, *C.M. Musarella* (FI, REGGIO); Salve (Lecce), strada SP91 Strada Litoranea (WGS84: 39.838917°N, 18.231917°E), bordo strada, 12 m, 17 August 2020, leg. *V.L.A. Laface*, det. *V.L.A. Laface*, *C.M. Musarella* (REGGIO); Porto Cesareo (Lecce), Spunnulate di Torre Castiglione (WGS84: 40.287500N, 17.825278E), bordo strada, 3 m, 17 August 2020, leg. *V.L.A. Laface*, det. *V.L.A. Laface*, *C.M. Musarella* (REGGIO); Spongano (Lecce), strada SP166 Spongano-Andrano (WGS84: 40.002800°N, 18.372314°E), bordo strada, 112 m, 18 August 2020, leg. *V.L.A. Laface*, det. *V.L.A. Laface*, *C.M. Musarella* (REGGIO); Otranto (Lecce), strada SP151, Alìmini Grande (WGS84: 40.201194°N, 18.433508°E), bordo strada, 23 m, 18 August 2020, leg. *V.L.A. Laface*, det. *V.L.A. Laface*, *C.M. Musarella* (REGGIO). – Casual alien species new for the flora of Puglia.

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

***Zantedeschia aethiopica* (L.) Spreng. (Araceae)**

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

We detected several populations of *Zantedeschia aethiopica* colonizing wetlands and humid habitats. In particular, it is widespread along the Rio Posada (Torpè, Nuoro) with numerous lush individuals in full bloom within reed beds (28 February 2021), on the island of La Maddalena (Sassari) in the artificial lake of Puzzoni within wet meadows (10 June 2020), and in an artificial canal for facilitating freshwater runoff in the vicinity of the town of Alghero (Sassari) in the locality named Caragol (4 March 2021).

M. Marignani, E. Farris, L. Rosati

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

Aeschimann D, Lauber K, Moser DM, Theurillat J-P (2004) Flora Alpina. Haupt Verlag, Bern.

Allioni C (1785) Flora Pedemontana sive enumeratio methodica stirpium indigenarum Pedemontii (Vol. 1). Excudebat Ioannes Michael Briolus R. Scientiarum Academiae impressor et bibliopola, Augustae Taurinorum.

Arietti N, Crescini A (1980) Recenti avventizie della flora bresciana. Seconda contribuzione. Natura Bresciana 16(1979): 24–51.

Arrigoni PV (2017) Flora analitica della Toscana (Vol. 2). Edizioni Polistampa, Firenze.

Baldini RM (1995) Flora vascolare del Monte Argentario (Arcipelago Toscano). Webbia 50(1): 67–191. https://doi.org/10.1080/00837792.1995.10670598

Ballelli S, Crisanti A, Lucarini D (2015) Notula: 286. In: Galasso G, Nepi C, Domina G, Peruzzi L (Eds) Notulae alla flora esotica d'Italia: 12 (244–287). Informatore Botanico Italiano 47(1): 77–90.

Barberis G, Orsino F (1984) *Bothriochloa saccharoides* (Sw.) Rydb. subsp. *saccharoides* (Graminaee), nuova per l'Italia. Webbia 37(2): 277–282. https://doi.org/10.1080/00837792.1984.10670280

Bertoloni G (1883) Flora italica sistens plantas in Italia et in insulis circumstantibus sponte nascentes (Vol. 1(1–6)). Tipografia R. Masi, Bologna, 768 pp.

Blattner FR, Friesen N (2006) Relationship between Chinese chive (*Allium tuberosum*) and its putative progenitor *A. ramosum* as assessed by random amplified polymorphic DNA (RAPD). In: Zeder MA, Bradley DG, Emshwiller E, Smith BD (Eds) Documenting domestication: new genetic and archaeological paradigms. California University Press, Berkeley, Los Angeles, London, 134–142. https://doi.org/10.1525/9780520932425-013

de Vos MP (1985) Revision of the South African genus *Chasmanthe* (Iridaceae). South African Journal of Botany 51(4): 253–261. https://doi.org/10.1016/S0254-6299(16)31654-4

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

Dickoré WB, Kasperek G (2010) Species of *Cotoneaster* (Rosaceae, Maloideae) indigenous to, naturalising or commonly cultivated in Central Europe. Willdenowia 40(1): 13–45. https://doi.org/10.3372/wi.40.40102

EPPO (2009) The situation of *Rudbeckia laciniata* in the EPPO region. EPPO Reporting Service no. 02-2009, Num. article: 2009/040. https://gd.eppo.int/reporting/article-128 [accessed 09.04.2021]

Frey D, Baltisberger M, Edwards PJ (2003) Cytology of *Erigeron annuus* s.l. and its consequences in Europe. Botanica Helvetica 113(1): 1–14. https://doi.org/10.5169/seals-74395

Fryer J, Hylmö B (2009) Cotoneasters. A comprehensive guide to shrubs for flowers, fruit, and foliage. Timber Press, Portland, London.

Fryer J, Zika PF (2014) The typification of *Cotoneaster symondsii* (Rosaceae). Phytotaxa 164(2): 149–153. https://doi.org/10.11646/phytotaxa.164.2.9

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

Galasso G, Domina G, Adorni M, Ardenghi NMG, Banfi E, Bedini G, Bertolli A, Brundu G, Calbi M, Cecchi L, Cibei C, D'Antraccoli M, De Bastiani A, Faggi G, Ghillani L, Iberite M, Latini M, Lazzeri V, Liguori P, Marhold K, Masin R, Mauri S, Mereu G, Nicolella G, Olivieri N, Peccenini S, Perrino EV, Peruzzi L, Petraglia A, Pierini B, Prosser F, Roma-Marzio F, Romani R, Sammartino F, Selvaggi A, Signorile G, Stinca A, Verloove F, Nepi C (2016) Notulae to the Italian alien vascular flora: 1. Italian Botanist 1: 17–37. https://doi.org/10.3897/italianbotanist.1.8777

Galasso G, Domina G, Andreatta S, Angiolini C, Ardenghi NMG, Aristarchi C, Arnoul M, Azzella MM, Bacchetta G, Bartolucci F, Bodino S, Bommartini G, Bonari G, Buono S, Buono V, Caldarella O, Calvia G, Corti E, D'Antraccoli M, De Luca R, De Mattia F, Di Natale S, Di Turi A, Esposito A, Ferretti G, Fiaschi T, Fogu MC, Forte L, Frigerio J, Gubellini L, Guzzetti L, Hofmann N, Laface VLA, Laghetti G, Lallai A, La Rosa A, Lazzaro L, Lodetti S, Lonati M, Luchino F, Magrini S, Mainetti A, Marignani M, Maruca G, Medagli P, Mei G, Menini F, Mezzasalma V, Misuri A, Mossini S, Mugnai M, Musarella CM, Nota G, Olivieri N, Padula A, Pascale M, Pasquini F, Peruzzi L, Picella G, Pinzani L, Pirani S, Pittarello M, Podda L, Ravetto Enri S, Rifici CD, Roma-Marzio F, Romano R, Rosati L, Scafidi F, Scarici E, Scarici M, Spampinato G, Stinca A, Wagensommer RP, Zanoni G, Nepi C (2019) Notulae to the Italian alien vascular flora: 8. Italian Botanist 8: 63–93. https://doi.org/10.3897/italianbotanist.8.48621.suppl1

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

Grandis M (2016) Sulla presenza di *Chasmanthe floribunda* e *Chasmanthe aethiopica* in Italia. Acta Plantarum Notes 4: 137–139.

ItIsWet [Italian Islands Wetlands] (2019) ITG26SAR2741 – Foce di s'Ena sa Chitta. Updated: 06.2020. https://italiaiswet.it/general/report.php?id=2487&lang=en [accessed 20.11.2020]

Lambinon J (1995) Corrections et commentaires apportés aux exsiccata distribués dans les fascicules précédents: n° 8930 [17] – *Dichanthium saccharoides*. Bulletin. Société pour l'Échange des Plantes Vasculaires de l'Europe et du Bassin Méditerranéen 25: 19.

Lastrucci L, Calamassi R, Ferretti G, Galasso G, Foggi B (2012a) Contributo alla conoscenza della flora esotica dell'Isola di Capraia (Arcipelago Toscano, Italia). Atti della Società

Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano 153(1): 127–134. https://doi.org/10.4081/nhs.2012.127

Lastrucci L, Landucci F, Gonnelli V, Barocco R, Foggi B, Venanzoni R (2012b) The vegetation of the upper and middle River Tiber (Central Italy). Plant Sociology 49(2): 29–48. https://doi.org/10.7338/pls2012492/02

Lazzaro L, Ferretti G, Giuliani C, Foggi B (2014) A checklist of the alien flora of the Tuscan Archipelago (Italy). Webbia 69(1): 157–176. https://doi.org/10.1080/00837792.2014.907981

Lazzeri V (2016) Note floristiche tosco-sarde III: novità per le regioni Toscana e Sardegna. Quaderni del Museo di Storia Naturale di Livorno 25(2013–2014): 67–77.

Li X-w, Hedge IC (1994) Lamiaceae. In: Wu ZY, Raven PH (Eds) Flora of China (Vol. 17). Science Press, Beijing, Missouri Botanical Garden Press, St. Louis, 50–299.

Lu D, Gilbert MG (2003) Nyctaginaceae. In: Wu ZY, Raven PH, Hong DY (Eds) Flora of China (Vol. 5). Science Press, Beijing, Missouri Botanical Garden Press, St. Louis, 430–434.

Lucchese F (2017) Atlante della flora alloctona del Lazio: cartografia, ecologia e biogeografia. Vol. 1: Parte generale e flora alloctona. Regione Lazio, Direzione Ambiente e Sistemi Naturali, Roma.

Marshall RH, McAllister HA, Armitage JD (2017) A summary of hybrids detected in the genus *Hedera* (Araliaceae) with the provision of three new names. New Journal of Botany 7(1): 2–8. https://doi.org/10.1080/20423489.2017.1344041

Mastrogiuseppe J, Rothrock PE, Dibble AC, Reznicek AA (2002) *Carex* Linnaeus sect. *Ovales* Kunth. In: Flora of North America Editorial Committee (Ed.) Flora of North America North of Mexico (Vol. 23). Oxford University Press, New York, Oxford, 477–482.

Mauri ES (2020) Noterella 0276: *Cotoneaster franchetii* Bois. Acta Plantarum Notes 7: 260.

McAllister HA, Rutherford A (1990) *Hedera helix* L. and *H. hibernica* (Kirchner) Bean (Araliaceae) in the British Isles. Watsonia 18(1): 7–15.

Mugnai M, Lazzaro L, Di Nuzzo L, Foggi B, Viciani D, Ferretti G (2021) Synopsis of *Euphorbia* section *Anisophyllum* (Euphorbiaceae) in Italy, with an insight on variation of distribution over time in Tuscany. Phytotaxa 485(1): 1–65. https://doi.org/10.11646/phytotaxa.485.1.1

Nicolella G (2018) Noterella 0205. *Amaranthus muricatus* (Moq.) Gillies ex Hieron. Acta Plantarum Notes 6: 151.

O'Leary N, Thode V (2016) The genus *Glandularia* (Verbenaceae) in Brazil. Annals of the Missouri Botanical Garden 101(4): 699–749. https://doi.org/10.3417/2014008

Sennikov AN, Kurtto A (2019) The taxonomy and invasion status assessment of *Erigeron annuus* s.l. (Asteraceae) in East Fennoscandia. Memoranda Societatis pro Fauna et Flora Fennica 95: 40–59.

Sommier S (1900) Aggiunte alla flora dell'Elba. Bullettino della Società Botanica Italiana 1900(6): 204–212.

Stace CA (2010) New flora of the British Isles (Ed. 3.). Cambridge University Press, Cambridge.

Sweet R (1825–1830) Cistineæ. The natural order of *Cistus*, or rock-rose; illustrated by coloured figures & descriptions of all the distinct species, and the most prominent varieties, that could be at present procured in the gardens of Great Britain; with the best directions for their cultivation and propagation. James Ridgway, London. Re-printed in 2017 by Forgotten Books. https://doi.org/10.5962/bhl.title.20402

Tison J-M, de Foucault B [Eds] (2014) Flora gallica. Flore de France. Biotope, Mèze.
Tzvelev NN (1994) *Phalacroloma* Cass. In: Tzvelev NN (Ed.) Flora of the European part of the USSR (Vol. 7). Science Publishers, St. Petersburg, 203–204. [In Russian]
Udulutsch RG, Sá CFC, Rossetto EFS, Cidrão BB (2020) *Bougainvillea*. In: Flora do Brasil 2020. Jardim Botânico do Rio de Janeiro. http://floradobrasil.jbrj.gov.br/reflora/floradobrasil/FB10905 [accessed 15.04. 2021]
Vega AS (2000) Taxonomic revision of the North and South American species of the genus *Bothriochloa* (Poaceae: Panicoideae: Andropogoneae). Darwiniana 38(1–2): 127–186.
Verloove F, Ardenghi NMG (2015) New distributional records of non-native vascular plants in northern Italy. Natural History Sciences 2(1): 5–14. https://doi.org/10.4081/nhs.2015.219
Verloove F, Lambinon J (2008) Deux graminées introduites peut-être méconnues, nouvelles pour la flore française: *Bothriochloa laguroides* et *Dichanthelium acuminatum* subsp. *linheimeri* (Poaceae: Panicoideae). Le Monde des Plantes 497: 1–4.
Viegi L (1993) Contributo alla conoscenza della biologia delle infestanti delle colture della Sardegna nord-occidentale: censimento delle specie esotiche della Sardegna. Bollettino della Società Sarda di Scienze Naturali 29: 131–234.
Villa M (2020) Noterella 0277: *Cotoneaster simonsii* Baker. Acta Plantarum Notes 7: 261.
Wagenitz G (1965) Compositae (cont.). In: Hegi G (Ed.) Illustrierte Flora von Mitteleuropa ((Ed. 2), Vol. 6/3(2)). C. Hanser, München, 81–160.
Wallnöfer B, Essl F (2016) Overview on alien *Carex* species of section *Cyperoideae* (including *Ovales*) in Europe and the discovery of *Carex scoparia* in Austria. Annalen des Naturhistorischen Museums in Wien, Serie B 118: 115–127.
Whiteley AC (2000) *Elsholtzia* Willdenow. In: Cullen J, Alexander JCM, Brickell CD, Edmondson JR, Green PS, Heywood VH, Jørgensen P-M, Jury SL, Knees SG, Maxwell HS, Miller DM, Robson NKB, Walters SM, Yeo PF (Eds) The European garden flora. A manual for the identification of plants cultivated in Europe, both out-of-doors and under glass (Vol. 6). Cambridge University Press, Cambridge, 227–228.

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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SHORT COMMUNICATION

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Molecular phylogeny and morphology of *Pseudobaeospora cyanea*

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Abstract

Pseudobaeospora cyanea, a rare basidiomycete belonging to an underinvestigated genus, is currently recorded from only three localities of the Iberian Peninsula. Moreover, to date no sequences of this rare species have been deposited in GenBank. In this paper a new collection from NW Italy is reported with detailed morphological descriptions and iconography. The first ITS and LSU sequences for the species are provided and uploaded to GenBank, and the taxonomic placement of *P. cyanea* within the genus is discussed.

Keywords

Basidiomycota, distribution, *Pseudobaeospora*, taxonomy

Introduction

The genus *Pseudobaeospora* Singer, circumscribed in 1942 to accommodate the type species *Pseudobaeospora oligophylla* (Singer) Singer, currently includes 30 species (http://www.mycobank.org/ accessed February 2021) of small white-spored agarics characterized by small thick-walled dextrinoid basidiospores (Bas 2002). The ecology is unclear, although suggested to be presumably saprotroph (Arauzo 2011). Its current accommodation in the family Tricholomataceae, with *Leucopaxillus* as a sister taxon, is supported by Desjardin et al. (2014) and by Sánchez-Garcia and Matheny (2017), although this placement is questioned by Wu et al. (2017). The genus *Pseudobaeospora* has been overlooked by taxonomists for a long time and until 1995 only two species were known in Europe (Arnolds et

al. 2003), which were synonymized a few years later (Roniker and Moreau 2007). Several new European species have been described since then, mostly on a macro and micro-morphological basis (Bas 2002), leading to more than 20 species being currently known for Europe (Adamčík and Jančovičová 2011), most of which are rare and only known from very few locations. The coverage of genus *Pseudobaeospora* in GenBank and UNITE is currently insufficient, with only seven species identified (about 20% of the total of described species) having available sequences in the database (https://www.ncbi.nlm.nih.gov/genbank/ and https://unite.ut.ee/search.php#fndtn-panel1 accessed February 2021).

Pseudobaeospora cyanea Arnolds, Tabarés & Rocabruna is a species described in Spain, based on macro- and micro-morphological analyses of a collection from Vidreres, Catalonia. The holotype specimens were collected in early November on Mediterranean hills (200 m a.s.l.) with *Pinus pinaster* Aiton, *Arbutus unedo* L., and *Erica arborea* L. (Arnolds et al. 2003). The species has been reported again in late October 2007 from two localities of the Basque Country (N Spain), around 600 m a.s.l., in the litter of *Chamaecyparis lawsoniana* (Murray) Parl. plantations (Arauzo 2011).

In the present study, a new collection of *P. cyanea* from a locality near Genoa (NW Italy) is reported. Morphological and molecular analyses of this collection are carried out, with the aim of increasing the knowledge about distribution, genetics, and phylogenetic relationships in this poorly known genus.

Material and methods

Morphological analysis

The specimens were identified through macro-morphological observations and evaluation of micro-morphological features. The herbarium specimens were prepared with a dryer and deposited in the mycological herbarium of the "Giacomo Doria Civic Museum of Natural History" (GDOR M3986).

The dried specimens were rehydrated in pure water, and the microscope slides were mounted with Congo red. More slides were prepared with Melzer's reagent and cotton blue, to observe the dextrinoid and cyanophylic reactions of the basidiospores. The slides were observed at 100× magnification with a Leica DM 500 binocular optical microscope. For basidiospores and other structures, at least 20 individuals were measured.

DNA extraction and sequencing

Genomic DNA was extracted from 100 mg of dried specimens by a modified CTAB method (Doyle and Doyle 1987). The sample was disrupted by high-speed shaking (18 Hz) for 1 min using a TissueLyser (Retsch GmbH, Haan, Germany), and incubated for 1 hour at 65 °C in 350 ml CTAB extraction buffer (100 mM Tris-HCl pH 8.0; 20 mM EDTA; 1.4 M NaCl; 2% PVP; 2% CTAB) with 5 μg of proteinase K (Sigma-Aldrich, St Louis, MO, USA) and 15 μg of RNase A (Sigma-Aldrich). After the incubation the

sample was centrifuged (10 min × 5900 g), the aqueous layer was mixed (in proportion 1:1) in a new tube with phenol, chloroform, isoamyl alcohol mixture (25:24:1) (Sigma-Aldrich). The previous step was repeated mixing the supernatant with chloroform (in proportion 1:1) to clear the supernatant, which was then incubated (15 min 4 °C) in a new tube with 2-propanol (in proportion 3:2). After the incubation the tube was centrifuged (10 min × 9200 g), the aqueous layer was discarded; the DNA pellet was washed in ethanol, air-dried and resuspended in 100 µl of Milli-Q water. DNA extracts were stored at -20 °C. Universal primers ITS1F/ITS4 were used for the ITS region amplification (White et al. 1990), and LR0R/LR5 for the LSU (Vilgalys and Hester 1990). The PCR reaction contained 24 µl mix (15.875 µl Milli-Q water, 1.5 µl 50 mM $MgCl_2$, 5 µl 5× Green GoTaq Buffer, 0.5 µl 10 mM dNTPs, 0.5 µl 10 µM of each primer, 0.125 GoTaq 5 U/µl) and 1 µl of DNA template. The PCR program was: 2 min 95 °C, 35 × (45 sec 95 °C, 45 sec 55 °C, 2 min 72 °C), 5 min 72 °C, 10 °C for ∞. PCR products were purified and sequenced using BMR Genomics (Padua, Italy).

Sequence alignment and phylogenetic analysis

The BLASTN algorithm was used to compare the sequence obtained in the present work against the GenBank database. The sequence was then aligned with the other *Pseudobaeospora* sequences currently available on GenBank and UNITE, with the addition of *Xerula pudens* (Pers) Singer (Physalacriaceae) for rooting purposes, using the MUSCLE tool in the MEGA 7 software (Pennsylvania State University, PA, USA). Then a phylogenetic tree was inferred by maximum likelihood with 500 bootstrap replicates, using MEGA 7.

Results

Habitat and ecology

The specimens were collected on 6 December 2016, *D. Gisotti & F. Boccardo* (GDOR M3986) in the locality of Pegli, Genova, 44°25'53.4"N, 8°48'34.2"E, at an elevation of 95 m, in an area of shrub-like Mediterranean vegetation with *Pinus pinaster*, *Arbutus unedo*, *Erica arborea*, *Cistus salvifolius* L., and *Quercus ilex* L., on poor acidic soil with serpentine bedrock. The basidiomata are gregarious, growing in the needle litter of *P. pinaster*. The species is reported to be presumably saprotrophic (Arnolds et al. 2003).

Macro-morphological observations

Small collybioid basidiomata, with pileus 10–30 mm broad, campanulate to planoconvex, finally flattened, in some specimens vaguely umbonate, with somewhat undulate-revolute margin in mature specimens, dry and velvety, from blue to purple with a paler margin (Fig. 1A, B, D). Dried pileipellis showing a bluish-green reaction with KOH. Gills adnexed and quite crowded, rather thick, ventricose, 3–4 mm broad,

Figure 1. *Pseudobaeospora cyanea* **A, D** basidiomata **B** gills **C** pileus. Scale bars: 1 cm. (photos D. Gisotti).

cream to beige (Fig. 1B). Stipe 28–40 mm × 2–3 mm, purplish brown, sparsely covered by silky whitish fibrils, with long whitish strigose hair at the base (Fig. 1A, D). Basidiospore print white.

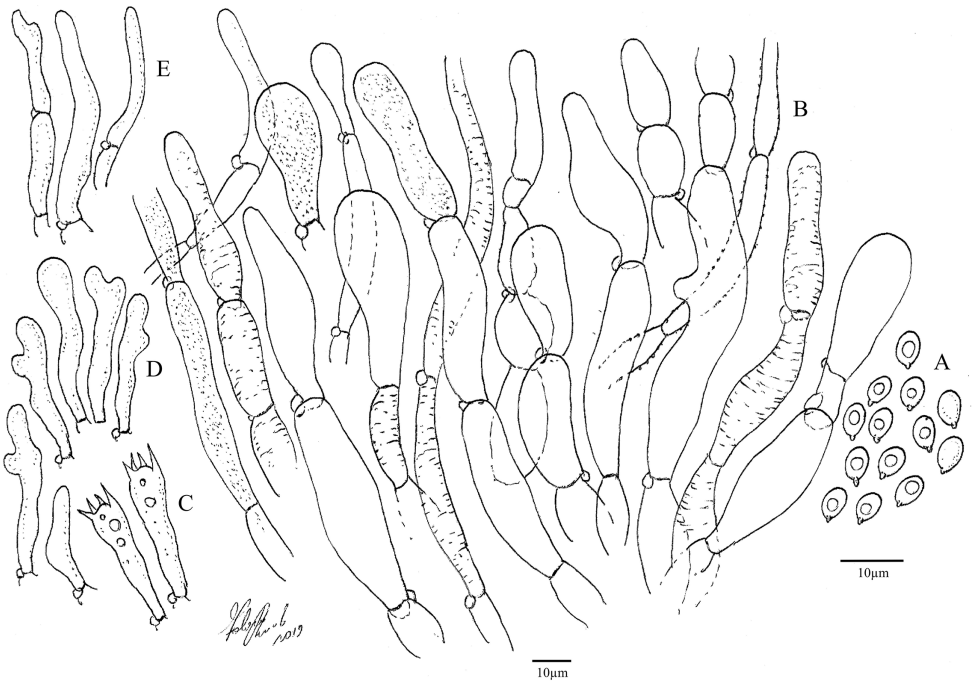

Figure 2. Micro-morphological features of *Pseudobaeospora cyanea* **A** basidiospores **B** pileipellis **C** basidia **D** cheilocystidia **E** caulocystidia (drawing F. Boccardo).

Micro-morphological observations

Basidiospores 4.5–5.3 × 3–4 µm (Q_{av} = 1.47, n = 30), from ellipsoid to ovoid, more or less oblong, smooth and hyaline, visibly apiculate, with central oil-drop, cyanophylic, thick-walled and dextrinoid at maturity (Fig. 2A). Basidia 20–25 × 5–6.5 µm, clavate, mostly tetrasporic (Fig. 2C), with some bisporic elements. Cheilocystidia 15–25 × 3.5–6 µm, irregularly cylindrical, lobed, often with a rounded bifurcated apex (Fig. 2D). Caulocystidia 15–70 × 3.5–7 µm, filiform and often septate, sometimes irregularly lobed (Fig. 2E). Pleurocystidia absent. Clamp connections present in all tissues (Fig. 2). Pileipellis trichoderma type, with ascending pluriseptate elements of subcylindrical shape, often with clavate or subglobose apex (Fig. 2C). Presence of encrusting extracellular pigments and bluish intracellular pigments

Sequencing and phylogenetic analysis

The sequences obtained from the specimen were uploaded with accession number MT271829 for ITS, and MT889638 for LSU, representing the first entry for this species in GenBank. The BLAST comparison of the ITS and LSU sequences obtained from our specimens did not show high similarity against any of the sequences contained in GenBank. In particular, the comparison of the ITS sequence showed the percent identity against other *Pseudobaeospora* sequences to be very low; the closest

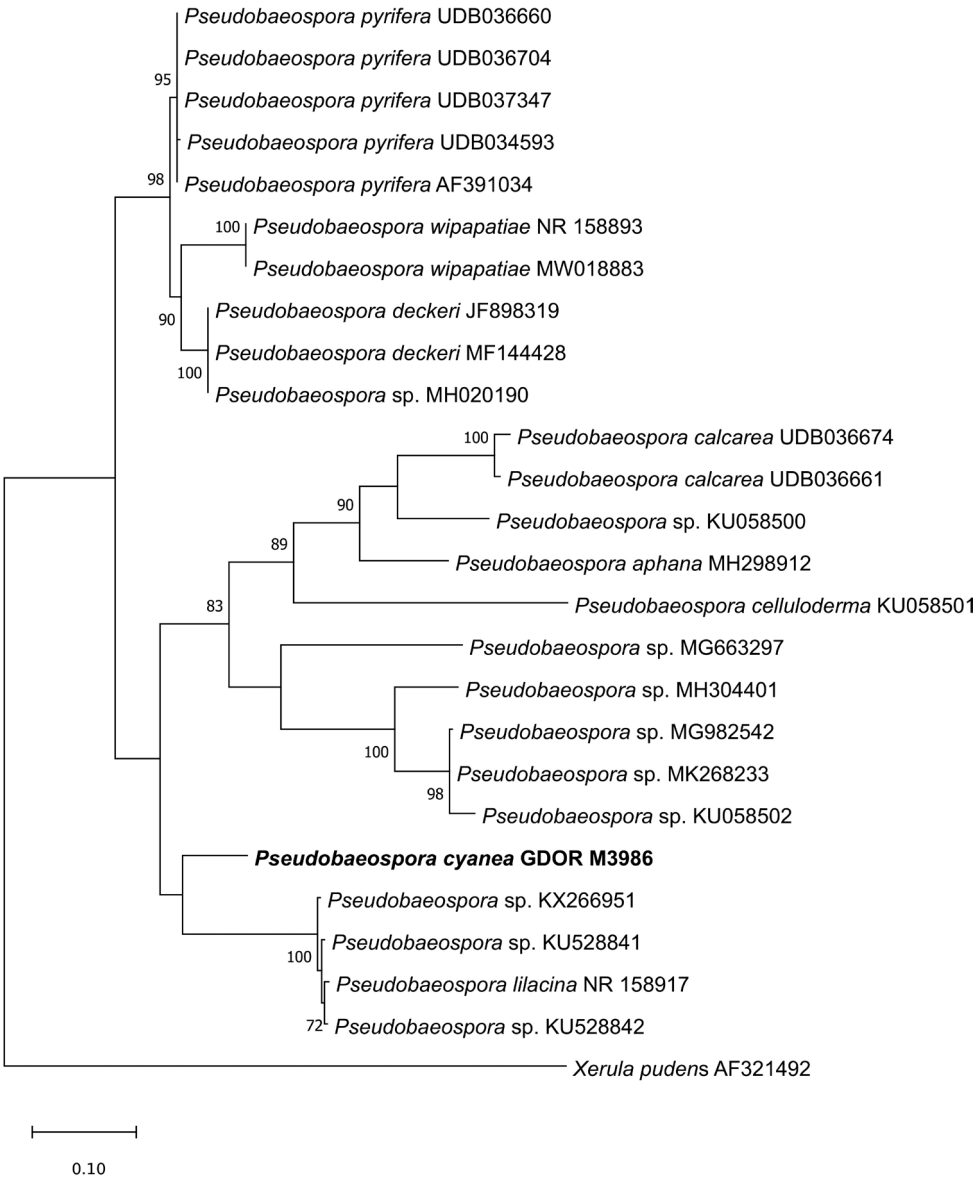

Figure 3. Maximum-likelihood phylogenetic tree with 500 bootstrap replicates, obtained from the ITS sequence alignment of *Pseudobaeospora* sequences in GenBank. *Xerula pudens* was used as outgroup taxon.

species is *P. pyrifera* with 85.23% of identity. The similarity search with LSU sequence retrieved *Pseudobaeospora lilacina* X.D. Yu, Ming Zhang & S.Y. Wu (95.99%), *P. wipapatiae* Desjardin, Hemmes & B.A. Perry (95.94%) and *P. pyrifera* Bas & L.G. Krieglst. (95.28%) as closest species. Figures 3 and 4 show the phylogenetic trees based on ITS and LSU sequences available in GenBank and UNITE.

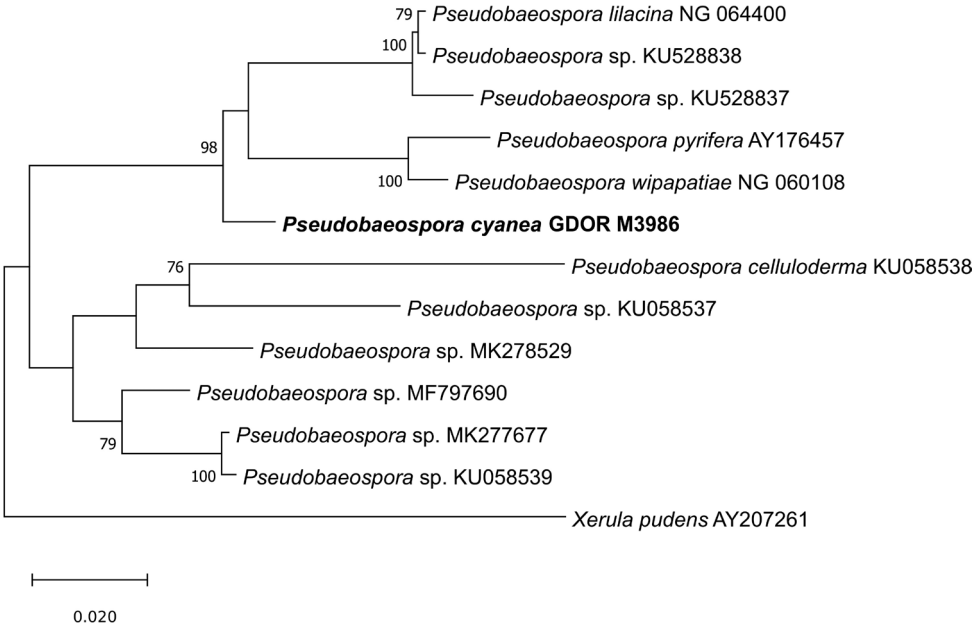

Figure 4. Maximum-likelihood phylogenetic tree with 500 bootstrap replicates, obtained from the LSU sequence alignment of *Pseudobaeospora* sequences in GenBank. *Xerula pudens* was used as outgroup taxon.

Discussion

The species is highly distinctive in terms of both macro- and micro-morphological features: the combination of pale gills, vivid bluish-purple pileus, green reaction of the pileipellis to KOH and the presence of cheilocystidia readily separates *P. cyanea* from other European species (Arnolds et al. 2003). Our observations are fully consistent with the original description, allowing for a confident identification of our collection. All three previous findings were in Spain (Arnolds et al. 2003; Arauzo 2011); the type specimens were collected in November on Mediterranean hills with *Pinus pinaster*, *Arbutus unedo* and *Erica arborea* (Arnolds et al. 2003). This Italian report, similar in habitat and season of growth, widens remarkably the known area of occurrence of this species, raising questions about its possible presence in other areas of Western Europe in which suitable habitats are present.

The original identification of the species is based on macro- and micro-morphological features, and no genetic data are available yet from the holotype specimens and from the material of the Basque collections. Since there are very few sequences of *Pseudobaeospora* available it is difficult to establish the taxonomic position of this species within the genus. The phylogenetic tree based on ITS (Fig. 3) suggests that *P. cyanea* is closely related with *P. lilacina*; while the LSU tree (Fig. 4) suggests that *P. cyanea* is part of a clade that also comprises *Pseudobaeospora lilacina*, *P. pyrifera*, and

P. wipapatiae. The difference between the two trees is due to the fact that the deposited ITS and LSU sequences do not always come from the same samples. Other taxa that show morphological affinity with the species, such as *P. dichroa* Bas, *P. pallidifolia* Bas, A. Gennari & Robich, *P. jamonii* Bas, Lalli & Lonati, and *P. laguncularis* Bas, could not be included in the phylogenetic tree because no sequences are currently available on the public database for any of them.

The species mentioned above share with *P. cyanea* several morphological features, like the coloured basidiomata, the greenish to lilac reaction of the pileipellis to KOH (except *P. lilacina*), the non hymenidermoid nature of the pileipellis (except *P. wipapatiae*) and the presence of clamp connections (Bas 2003; Schwarz 2012; Desjardin et al. 2014; Wu et al. 2017). Considering the intra-generic morphogroups proposed by Bas, based on basidioma coloration and micro-morphological features, *P. cyanea* fits in the "Pyrifera group", that includes *P. pyrifera*, *P. jamonii*, and *P. laguncularis*, grouped by the presence of cheilocystidia (Bas 2003). The species characterized by the absence of cheilocystidia, like *P. lilacina*, *P. deckeri*, *P. dichroa*, and *P. pallidifolia*, can be placed in the similar "group" (Bas 2003). Although these groups are deemed probably artificial by Bas himself, our molecular investigation indeed supports a rather close relationship between *P. cyanea* and *P. pyrifera*. This is in contrast with Voto's intra-generic arrangement, which separates these two species. Indeed, Voto (2009) placed *P. cyanea* in sect. *Anistoderma* Voto and *P. pyrifera* in sect. *Pseudobaeospora* Singer, based exclusively on the differences in the structure of the pileipellis.

The genus *Pseudobaeospora* includes several new species described in the recent past with a controversial position within the Tricholomatoid clade of Agaricales (Desjardin et al. 2014; Wu et al. 2017). Many unanswered questions also remain on its ecology, the distribution of its species, and their phylogenetic relationships. The scarcity of species with available genetic data is a liability to the definition of the phylogeny and intra-generic arrangement of *Pseudobaeospora*, and it is advisable to promote the sequencing of more species in the future.

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References

Adamčík S, Jančovičová S (2011) *Pseudobaeospora terrayi*, a new species from Slovakia. Sydowia 63(2): 131–140.

Arauzo S (2011) Estudios en el género *Pseudobaeospora*. Errotari 8: 135–158.

Arnolds E, Tabarés M, Rocabruna A (2003) *Pseudobaeospora cyanea*, a new agaric species from Catalonia. Revista Catalana de Micologia 25: 65–70.

Bas C, Gennari A, Robich G (1997) *Pseudobaeospora pallidifolia* Bas, Gennari et Robich. Una nuova specie dall'Italia. Rivista di Micologia 40(3): 195–199.

Bas C, Krieglsteiner L (1998) *Pseudobaeospora pyrifera*, a new species found in southern Germany and The Netherlands. Zeitschrift Fur Mykologie 64(2): 203–206.

Bas C, Lalli G, Lonati G (2002) *Pseudobaeospora jamonii*, una nuova specie in Italia. Micologia e Vegetazione Mediterranea 17(1): 31–35.

Bas C (2002) A reconnaissance of the genus *Pseudobaeospora* in Europe I. Persoonia 18(1): 115–122.

Bas C (2003) A reconnaissance of the genus *Pseudobaeospora* in Europe II. Persoonia 18(2): 163–199.

Desjardin DE, Hemmes DE, Perry BA (2014) A ruby-colored *Pseudobaeospora* species is described as new from material collected on the island of Hawaii. Mycologia 106(3): 456–463. https://doi.org/10.3852/13-030

Doyle JJ, Doyle JL (1987) Genomic plant DNA preparation from fresh tissue-CTAB method. Phytochemical Bulletin 19(11): 11–15.

Ronikier A, Moreau PA (2007) *Pseudobaeospora pillodii* and *P. oligophylla* (Tricholomataceae, Basidiomycota): two names for one species? Nova Hedwigia 84: 167–174. https://doi.org/10.1127/0029-5035/2007/0084-0167

Sánchez-García M, Matheny PB, Palfner G, Lodge DJ (2014) Deconstructing the Tricholomataceae (Agaricales) and introduction of the new genera *Albomagister*, *Corneriella*, *Pogonoloma* and *Pseudotricholoma*. Taxon 63(5): 993–1007. https://doi.org/10.12705/635.635.3

Sánchez García M, Matheny PB (2017) Is the switch to an ectomycorrhizal state an evolutionary key innovation in mushroom forming fungi? A case study in the Tricholomatineae (Agaricales). Evolution 71(1): 51–65. https://doi.org/10.1111/evo.13099

Schwarz C (2012) *Pseudobaeospora deckeri* sp. nov., a new agaric from central California. Mycotaxon 119: 459–465. https://doi.org/10.5248/119.459

Singer R (1938) Notes sur quelques Basidiomycetes. IV. Revue de Mycologie 3: 187–199.

Singer R (1942) Type studies on agarics. Lloydia 5: 97–135.

Singer R (1951) The Agaricales (Mushrooms) in modern taxonomy. Lilloa 22: 1–832.

Singer R (1963) The delimitation of the genus *Pseudobaeospora*. Mycologia 55(1): 13–17. https://doi.org/10.1080/00275514.1963.12017995

Vilgalys R, Hester M (1990) Rapid genetic identification and mapping of enzymatically amplified ribosomal DNA from several Cryptococcus species. Journal of Bacteriology 172: 4239–4246. https://doi.org/10.1128/JB.172.8.4238-4246.1990

Voto P (2009) Proposta di una sistematica infragenerica del Genere *Pseudobaeospora*, fondata su basi morfologiche, e note su due specie non ancora descritte. Rivista di Micologia 52(4): 291–311.

White TJ, Bruns T, Lee S, Taylor J (1990) Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. In: Innis MA, Gelfand DH, Sninsky JJ, White TJ (Eds) PCR protocols: a guide to methods and applications. Academic Press Inc., New York, 315–322. https://doi.org/10.1016/B978-0-12-372180-8.50042-1

Wu SY, Li JJ, Zhang M, Yu XD, Lv SX, Cao DX (2017) *Pseudobaeospora lilacina* sp. nov., the first report of the genus from China. Mycotaxon 132(2): 327–335. https://doi.org/10.5248/132.327

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RESEARCH ARTICLE

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Global and Regional IUCN Red List Assessments: 11

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Abstract

In this contribution, the conservation status assessment of three vascular plants according to IUCN categories and criteria is presented. It includes the global assessment of *Limonium parvifolium* Tineo and *Viscaria alpina* (L.) G.Don, and the regional assessment of *Rhazya stricta* Decne. (Iraq).

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.

Red List Assessments

Limonium parvifolium (Tineo) Pignatti

Global assessment
Taxonomy and nomenclature
Order: Caryophyllales *Family*: Plumbaginaceae

Limonium parvifolium (Tineo) Pignatti, Bot. J. Linn. Soc. 64(4): 364 (1971) ≡ *Statice parvifolia* Tineo, Fl. Sic. Syn. 2: 806 (1845) ≡ *Statice gracilis* Tineo, Fl. Sic. Syn. 2: 807 (1845) ≡ *Statice pygmaea* Tineo, Fl. Sic. Syn. 2: 807 (1845).

Common name: Limonio gracile, Limonio parvifloro (It).

Geographic distribution range: *Limonium parvifolium* (Fig. 1) is a narrow endemic of the island of Pantelleria (Sicily) and its distribution consists of a single population in a volcanic area called Gelfiser (Fig. 2). This species was described by Gussone (1845) as *Statice parvifolia*, on specimens sent to him by V. Tineo who collected it in Pantelleria. Later, Pignatti (1971) proposed a new combination of *L. parvifolium* based on *S. parvifolia*, which is currently the most correct and has priority compared to the other binomials (Brullo et al. 2020).

Distribution: *Countries of occurrence:* Italy (Sicily).

Biology: *Plant growth form:* perennial (suffruticose chamaephyte).

Flowering and fruiting time: Flowering from May to August and fruiting from August to September.

Reproduction: There is no detailed information on the pollination system and seed dispersal mechanism.

Habitat and ecology: *Limonium parvifolium* grows on volcanic rocky slopes of Pantelleria only in a locality known as Gelfiser. In particular, the species colonizes a tall and shaded vertical cliff characterized by rich lichen and mosses communities, where only a few other vascular plant species occur. The altitude range falls between 250 and 300 m a.s.l., within the lower thermomediteranean bioclimatic belt with lower dry ombrotype (Bazan et al. 2015). From a vegetational point of view, it is linked to a chomophytic moss-rich community dominated by *Polypodium vulgare* L. and referable to *Polypodietea vulgaris* Jurko & Peciar ex Boscaiu et al. 1966 class.

Population information: the species shows a very narrow distribution, with only one circumscribed stand on the island. Recent field surveys revealed that the population includes a few mature individuals (about 15); the trend for this population has shown a significant decline in the last 10 years.

Threats: *10.3 Avalanches/landslides*: this species grows on a volcanic rocky cliff subjected to natural erosion and, therefore, landslides.

11.1 Habitat shifting and alteration: fieldwork showed that the growth habitat could be threatened by climate change. Indeed, changes in pluviometric regimes could

Figure 1. *Limonium parvifolium* (Tineo) Pignatti on the volcanic rock cliff at Gelfiser (Pantelleria, Sicily). Photograph by S. Cambria.

Figure 2. Geographic range and distribution map of *Limonium parvifolium* (Tineo) Pignatti in Pantelleria (Sicily).

negatively impact on this species that is restricted to a particular microclimate characterized by humid and shady conditions.

11.2 Drought: the survival of *L. parvifolium* is linked to humid cliffs; extreme drought (linked to rainfall deficit) could cause the rapid disappearance of the species.

CRITERIA APPLIED

Criterion B: **AOO**: 4 Km^2 calculated with GeoCAT (Geospatial Conservation Assessment Tool) programme (Bachman et al. 2011).

a) Number of locations: the only known population is localized in a very restricted area. The most important threat is represented by climate change.
b) Several field observations revealed that habitat quality (iii) as well as the number of mature individuals (v) are declining.

Criterion D: Number of mature individuals < 50

Red List category and Criteria (Global Assessment)

CR	**Critically Endangered**	**B2ab(iii,v)+D**

Rationale for the assessment: *Limonium parvifolium* is an endemic species restricted to a small area on the island of Pantelleria where a recent survey revealed that it is represented by less than 50 mature individuals. In particular, it occurs on a vertical cliff, and various threats are expected to impact the species in the near future. The AOO is less than 10 km^2 so that, according to criteria B and D, this species can be assessed as Critically Endangered (CR).

Previous assessment: In the past, the species was reported as LR (Lower Risk) by Conti et al. (1997). More recently, it was evaluated as Least Concern (LC) at a global level (Orsenigo et. al. 2018). However, this evaluation was probably based on an overestimation of the number of individuals. In fact, some authors included the species within *L. cosyrense* (Guss.) Kuntze (Giardina et al. 2007), reporting its occurrence in locations with climatic and edaphic conditions different from those required by *L. parvifolium*, which is typically non-halophilic. These hypotheses are supported by recent field investigations (Brullo et al. 2020).

Conservation actions: Pantelleria is a National Park since 2016 because it represents an area of great naturalistic value. Despite this, *L. parvifolium* is not included in any conservation or monitoring activities. Moreover, the population falls within the SAC ITA010019 “Isola di Pantelleria: Montagna Grande e Monte Gibele”.

Conservation actions needed: Research and monitoring programmes are recommended in order to better understand the reproductive biology and population trends of the 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.

Salvatore Cambria, Gianmarco Tavilla, Dario Azzaro

Rhazya stricta Decne.

Regional assessment (Iraq)
Taxonomy and nomenclature
Order: Gentianales *Family:* Apocynaceae

Rhazya stricta Decne. Ann. Sc. Nat. Ser. 2, 4: 80 (1835).

Common name: Sihar, Hisawarg, Orgalama (Pakistan, India), Senhwar, Sahaer, Dogbane, Harmal, Luwaiza, Harmal (Arabic; in Iraq the name Harmal is more commonly used for *Peganum harmala*).

Geographic distribution range: *Rhazya stricta* (Fig. 3) is an evergreen woody shrub, mostly found in the Middle East and South Asia, whose actual current distribution is still uncertain in some countries. In Iraq there are only two populations, distributed in the desert of Al-Najaf province: the two sites, Al-Buwair (31.495218°N, 44.209923°E) and Birkat Al-Talhat (30.925388°N, 43.898037°E), are about 60 km apart (Fig. 4). There are sporadic isolated groups of few individuals (2–6) distributed north of the Al-Buwair site.

Distribution: Afghanistan, Bahrain, Kuwait, India, Iran, Iraq, Oman, Pakistan, Qatar, Saudi Arabia, United Arab Emirates, and Yemen (Kew Science 2021).

Biology: Perennial (chamaephyte).

Flowering and fruiting time: Flowering from December to May.

Reproduction: Reproduction occurs by seeds. No detailed information is available on the pollination system and seed dispersal mechanism.

Habitat and ecology: *Rhazya stricta* is a perennial evergreen woody shrub, up to 80 cm high, well adapted to harsh desert conditions with its strong foliage, tap roots and high salt tolerance. It grows on sandy or silty soil and represents one of the structural species of the desert vegetation on sand dunes and on gravelly or stony substrates (Ghazanfar and Osborne 2010). *Rhazya stricta* is a sand-fixing shrub for sand stabilization in the Al-Najaf desert, allowing various plant species to grow nearby and also offering shelter for wild animals. The area has hot summers and cool winters. Although precipitation is scarce (100–150 mm/year), the region receives transitory violent rainstorms in winter (Al-Rammahi and Mohammad 2020).

Population information: There is no detailed information available on population dynamics; however, an overall monitoring carried out in 2019–2021 shows that the Iraqi population consists of 13,296 mature plants, 7,989 of which in Al-Buwair and 5,307 at Birkat Al-Talhat.

Threats: *2.1 Annual & perennial non-timber crops*: since there are some fields cultivated intermittently with wheat or barley (rainfed irrigation), preparing the area for cultivation could have a negative impact on the shrubs found in the area.

3.2 Mining & quarrying: sand and gravel quarries, that provide construction works with raw material, are present in the sites where the population grows.

4.1 Roads & railroads: the increasing presence of 4WD off-road vehicles driving across the area is reducing the surface and quality of the population's habitat.

Figure 3. *Rhazya stricta* at Birkat Al-Talhat, Al-Najaf desert, Iraq. Photograph by Mohmmad K. Mohammad.

Figure 4. Geographic range and distribution map of *Rhazya stricta* in Iraq.

5.3 Logging & wood harvesting: the plant is used by locals in traditional medicine resulting in unregulated and continuous damage to individuals. Since almost all parts of the plant are used for this purpose (leaves, stems, roots, and seeds), individual survival and recruitment are strongly compromised.

6.2 War, *civil unrest & military exercises*: the continuous presence of military activities (transit of military vehicles, setting up of military camps) in the areas occupied by both populations impact negatively on this species.

9 Pollution (*9.2 Industrial & military effluents* and *9.3.2 Soil erosion*, *sedimentation*): The presence of a cement plant, along with pervasive agricultural practices, are promoting an overall loss of soil quality in the species' habitat.

11 Climate change & severe weather (*Droughts*, *Temperature extremes*, *and Storms & flooding*)*:* the rate of precipitation in Al-Najaf desert is very low (*ca.* 90 mm/year) leading to a severe shortage in water. Nonetheless, recurrent floods due to rainstorms result in uprooting of some individuals, especially juvenile ones. In addition, the annual average minimum temperature is increasing faster than maximum temperature, and the overall temperature in Iraq increases much faster than the global average (Salman et al. 2017). During summer, temperatures reach 50–54 °C in southern parts of Iraq (Ahmed and Hassan 2018).

CRITERIA APPLIED:

Criterion B: **EOO:** 629.8 km^2 calculated with GeoCAT (Geospatial Conservation Assessment Tool) software (Bachman et al. 2011).

AOO: 84 km^2 calculated with GeoCAT software (Bachman et al. 2011).

a) Number of locations: we identified two locations based on the main threat (2.1 Annual & perennial non-timber crops).
b) Due to the severe threats observed, habitat quality (iii) is declining in all sites as well as the number of mature individuals (v).

Red List category and Criteria (Regional Assessment)

EN	**Endangered**	**B1ab(iii,v)+2ab(iii,v)**

Rationale for the assessment: *Rhazya stricta* has a restricted distribution in Iraq, where it is located in the desert of Al-Najaf province, with only two populations about 60 km away from each other and affected by several threats. The EOO is less than 5,000 km^2, the AOO is less than 500 km^2, and according the main threat we can identify 2 locations as well as a continuous decline in habitat quality and number of mature plants. According to criterion B, this taxon can be assessed as Endangered (EN) at regional level. Because geographical isolation makes any contribution by populations occurring in neighbouring countries to the conservation status of the Iraqi ones unlikely, there is no reason for up- or down-grading the risk category resulting from this assessment procedure.

Previous assessment: Taxon not evaluated (NE) at the global level (IUCN 2021).

Conservation actions: At present, there are no conservation measures for this species in Iraq.

Conservation actions needed: The suggestion of Fenu et al. (2020) to declare a national protected area at the Talh for the occurrence of *Vachellia gerrardii* (Benth.) P.J.H.Hurter subsp. *negevensis* (Zohary) Ragup., Seigler, Ebinger & Maslin could be applied here also for *Rhazya stricta*. In fact, the distribution areas of both plants partially overlap. According to current legislation, this action could prevent the local authorities from renting lands where the two species are growing for agricultural or sand-gravel quarry purposes. Also, this will ensure a sustainable use of the plant for traditional medicine needs.

Note: *Rhazya stricta* leaves and branches are used in traditional medicine for the treatment of many diseases (Mariee et al. 1988). It is a poisonous plant for domestic animals (Mandaville 2011).

Mohammad K. Mohammad, Hayder M. Al-Rammahi, Giuseppe Fenu

Viscaria alpina (L.) G. Don

Global assessment

Taxonomy and nomenclature

Order: Caryophyllales *Family*: Caryophyllaceae

Viscaria alpina (L.) G.Don, Gen. Hist. 1: 415. 1831 ≡ *Lychnis alpina* L., Sp. Pl.: 436. 1753 ≡ *Agrostemma alpina* (L.) J.Forbes, Hort. Woburn.: 104. 1833 ≡ *Liponeurum alpinum* (L.) Schott, Nyman & Kotschy, Analect. Bot.: 55. 1854 ≡ *Silene liponeura* Neumayer, Vehm. Zool.-Bot. Ges. Vienna 72: 55. 1923 ≡ *Steris alpina* (L.) Šourková, Novit. Bot. Inst. Horto Bot. Univ. Carol.: 27. 1976 = *Lychnis frigida* Schrank, Denkschr. K. Baier. Bot. Ges. Regensburg 1 (2): 25. 1818 = *Lychnis suecica* Lodd., Bot. Taxi. 9: t. 881. 1824 ≡ *Viscaria suecica* (Lodd.) Sweet, Hort. Brit., Ed 3: 66. 1839 ≡ *Silene suecica* (Lodd.) Greuter & Burdet in Willdenowia 12: 190. 1982 = *Lychnis helvetica* G.Don ex Loudon, Hort. Brit.: 186. 1830 ≡ *Lychnis alpina* var. *americana* Fernald, Rhodora 42: 259. 1940 ≡ *Viscaria alpina* subsp. *americana* (Fernald) Böcher, Biol. Skr. 11: 27. 1963 ≡ *Lychnis alpina* subsp. *americana* (Fernald) Feilberg, Meddel. Gronland, Biosci. 15: 12. 1984 ≡ *Steris americana* (Fernald) Ikonn., Novosti Sist. Vyssh. Rast. 24: 81. 1987 = *Viscaria alpina* var. *serpentinicola* Rune, Acta Phytogeogr. Suec. 31: 56. 1953 ≡ *Lychnis alpina* var. *serpentinicola* (Rune) Kallio & Y.Mäkinen, Ann. Univ. Turku, A, Biol. Geogr. Geol. 67: 63. 1982 = *Viscaria alpina* subsp. *borealis* Böcher, Biol. Skr. 11: 27. 1963 ≡ *Steris alpina* subsp. *borealis* (Böcher) Á.Löve, Phytologia 50: 171. 1982 ≡ *Steris borealis* (Böcher) Ikonn., Novosti Sist. Vyssh. Rast. 24: 82. 1987.

Common name: Crotonella alpina (It), alpine catchfly (En), duottarbihkkarássi (Fin), fjellnellik (Nor), fjällnejlika (Swe), silène de Suède (Fr)

Geographic distribution range: *Viscaria alpina* (Fig. 5) is an amphi-atlantic arctic-alpine plant (Hultén 1958; Hegi et al. 1906), found in Scandinavia (Norway, Sweden,

Figure 5. *Viscaria alpina* at Mount Prado, Northern Apennines, Italy. Photograph by Thomas Abeli.

Finland), parts of north-western Russia, Scotland (UK), north-eastern North America (Canada), Greenland, and Iceland. Some isolated populations occur in the western and central Alps (France, Switzerland, Italy, Austria), northern Apennines (Mount Ragola and Mount Prado, Italy), Sierra Cantabrica, Sierra de Gredos, Pyrenees (Spain and France). This species has a continuous range in northern Europe, while in the south of Europe it has a fragmented distribution (Fig. 6).

Distribution: *Countries of occurrence*: Austria, Canada, Finland, France, Great Britain, Greenland, Iceland, Italy, Norway, Russia, Spain, Sweden, and Switzerland.

Biology: *Plant growth form*: perennial (hemicryptophyte rosette).

Chromosome number: $2n = 24$ (Nagy 2013).

Flowering time: From June to August.

Reproduction: Entomophilous pollination. At maturity, in the autumn, capsule open and seeds are passively dispersed (Nagy 2013). Germination and seed dormancy vary among populations. Germination occurs under warm temperatures (20/15 °C) and it is promoted by cold stratification. Subarctic populations of *V. alpina* are less dormant, showing a warmer suitable temperature range for germination, and a higher germinability than alpine populations (Mondoni et al. 2018).

Habitat and Ecology: *Viscaria alpina* grows especially in siliceous rocky cliffs and alpine grasslands between 2,000 and 2,850 m a.s.l. (Abeli et al. 2012). This species can be found in rocky outcrops and fell-field with neutral, slightly acidic soil, or ultramafic soil (high magnesium and nickel concentrations) in Britain and Scandinavia;

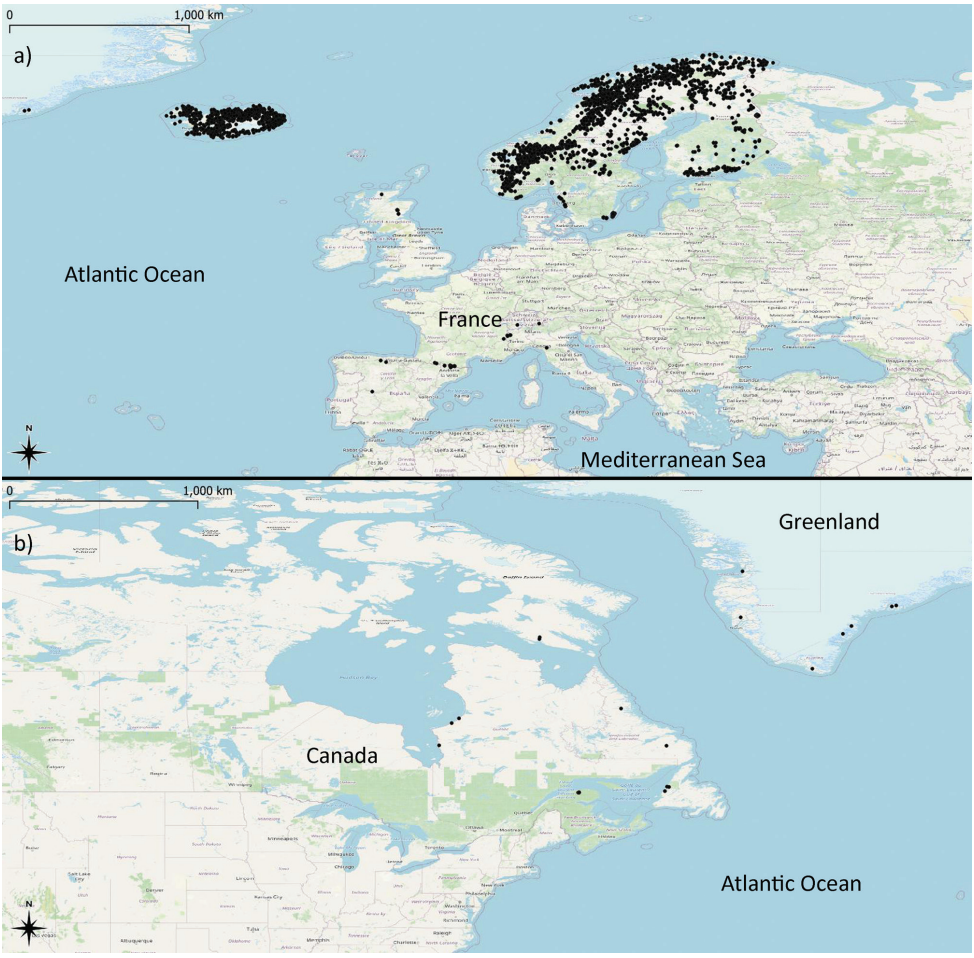

Figure 6. Global geographic range and distribution map of *Viscaria alpina*: a) Europe and b) North America and Greenland.

in mesic to dry alpine habitats (in the southern European mountain ranges); in open areas in the boreal/montane forest zone in Scandinavia and in the lowland alvar in Öland, Sweden. For *V. alpina* there are five climatic types related to its geographical distribution: oceanic-montane-low arctic (coastal Greenland, alpine zone of the Scandinavian mountains, and alpine mountains of southern and central European), continental low arctic (interior western Greenland), temperate subcontinental (Öland), subarctic-subcontinental (Scandinavian montane forest zone), and a subarctic-oceanic type (Iceland) (Nagy 2013).

Population information: There is no detailed information available on population dynamics. Abeli et al. (2012) showed that the reproductive performance of *V. alpina* at the southern range edge fluctuates greatly among years and it is affected by extreme weather events. In particular, heat waves can strongly reduce the species' reproductive performance in terms of flowers and fruits produced. The population of Mt. Prado

(northern Apennines, Italy) is being monitored for more than 20 years and it is highly stable in terms of flowering rosettes (T.A., personal observation).

Threats: *2.3.1 Livestock Farming & Ranching* (*nomadic grazing*)*:* some populations in southern Europe are threatened by livestock (sheep, goats) trampling and grazing. Soil nutrient enrichment due to droppings deposition is a further indirect threat caused by livestock.

6.1 Recreational activities: Human trampling during the tourist season. Some populations grow near hiking paths highly frequented by hikers during the flowering season, specifically the southernmost population in the northern Apennines (Italy).

11.2 Droughts & 11.3 Temperature extremes: Studies suggest that extreme temperatures recorded during summer heatwaves can reduce the reproductive performance of the species (Abeli et al. 2012). Most populations occur in remote areas especially in the northern part of the range, so the impact of the abovementioned threats is null or low.

CRITERIA APPLIED:
Criterion B: **EOO:** > 20,000 km^2
AOO: > 2,000 km^2

Number of locations > 10
No decline observed
No extreme fluctuations observed

Red List category and Criteria (Global Assessment)

LC	**Least Concern**

Rationale for the assessment: The species has a wide distribution with no observed decline. None of the criteria are applicable.

Previous assessment: This taxon is not evaluated (NE) at the global level (IUCN 2021). At a regional level, *Viscaria alpina* was assessed as NT in the UK (Cheffings and Farrell 2005), Finland (Hyvärinen et al. 2019), and Switzerland (Moser et al. 2002).

Conservation actions: Several populations are within protected areas like national parks and Natura 2000 sites. There are 35 seed accessions stored in the seed banks of the European Native Seed Conservation Network (http://ensconet.maich.gr/About.htm). These accessions are from Norway, Spain, UK, Italy, and Sweden. According to the Botanic Garden Conservation International database PlantSearch, there are 71 living collections of the species in botanic gardens worldwide (BGCI PlantSearch 2021; https://tools.bgci.org/plant_search.php). The population of Mt. Prado is being monitored since 20 years.

Conservation actions needed: To increase the genetic diversity of the *ex situ* collections more accessions from other populations and countries should be obtained. Monitoring programmes for populations at the range edges, the most vulnerable to climate change, should be established.

Martina D'Agostino, Thomas Abeli

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References

Abeli T, Rossi G, Gentili R, Mondoni A, Cristofanelli P (2012) Response of alpine plant flower production to temperature and snow cover fluctuation at the species range boundary. Plant Ecology 213(1): 1–13. https://doi.org/10.1007/s11258-011-0001-5

Ahmed ES, Hassan AS (2018) The Impact of the Extreme Air Temperatures on the Characteristics of Iraq Weather. Iraqi Journal of Science 59(2): 1139–1145. https://doi.org/10.24996/ijs.2018.59.2C.19

Al-Rammahi HM, Mohammad MK (2020) The current status, ecological and biometrical assessment and threats on *Acacia gerrardii negevensis* Zohary (Fabaceae) in Al-Najaf Desert, Iraq. Plant Archives 20: 4467–4476.

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

Bazan G, Marino P, Guarino R, Domina G, Schicchi S (2015) Bioclimatology and Vegetation Series in Sicily: A geostatistical approach. Annales Botanici Fennici 52(1–2): 1–18. https://doi.org/10.5735/085.052.0202

BGCI PlantSearch (2021) Botanic Garden Conservation International PlantSearch. https://tools.bgci.org/plant_search.php

Brullo S, Cambria S, Minissale P, Tavilla G (2020) Considerazioni fitogeografiche su tre specie rare e poco conosciute della flora dell'isola di Pantelleria (Sicilia). Notiziario della Società Botanica Italiana 4: 9–10.

Conti F, Manzi A, Pedrotti F (1997) Liste Rosse Regionali delle Piante d'Italia. WWF Italia, Società Botanica Italiana, CIAS, Univ. Camerino, 139 pp.

Cheffings CM, Farrell L (2005) Species status No. 7: The vascular plant Red Data List for Great Britain. Joint Nature Conservation Committee, Peterborough.

Fenu G, Al-Rammahi HM, Mohammad MK, Perrino EV, Rosati L, Wagensommer RP, Orsenigo S (2020) Global and Regional IUCN Red List Assessments: 10. Italian Botanist 10: 73–81. https://doi.org/10.3897/italianbotanist.10.60022

Ghazanfar SA, Osborne J (2010) Conservation through restoration: study of a degraded gravel plain in south-eastern Arabia. Pak. J. Bot., Special Issue (S.I. Ali Festschrift) 42: 193–204.

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

Gussone G (1845) Florae Siculae Synopsis, Addenda et Emendanda. Neapoli, 775–920.

Hegi G, Gams H, Marzell H (1906) Illustrierte Flora von Mitteleuropa Mit besonderer Berücksichtigung von Deutschland, Oesterreich und der Schweiz: Zum Gebrauche in den Schulen und zum Selbstunterricht, Lehmann.

Hultén E (1958) The amphi-atlantic plants and their phytogeographical connections. Kungl. Svenska Vetenskapsakademiens Handlingar, Fjarde Serien 7(1).

Hyvärinen E, Juslén A, Kemppainen E, Uddström A, Liukko UM [Eds] (2019) The 2019 Red List of Finnish Species. Ympäristöministeriö & Suomen ympäristökeskus. Helsinki, 704 pp.

IUCN (2021) The IUCN Red List of Threatened Species vers. 2020-1. http://www.iucnredlist.org

Kew Science (2021) Plants of the World online. http://www.plantsoftheworldonline.org/

Mandaville JP (2010) Bedouin Ethnobotany: Plant Concepts and Uses in a Desert Pastoral World. The University of Arizona Press, Tucson, 416 pp.

Mariee NK, Khalil AA, Nasser AA, Al-Hiti MM, Wafa MA (1988) Isolation of the Antimicrobial Alkaloid Stemmadenine from Iraqi *Rhazya stricta*. Journal of Natural Products 51(1): 186–187. https://doi.org/10.1021/np50055a036

Mondoni A, Orsenigo S, Müller JV, Carlsson-Graner U, Jiménez-Alfaro B. Abeli T (2018) Seed dormancy and longevity in subarctic and alpine populations of *Silene suecica*. Alpine Botany 128(1): 71–81. https://doi.org/10.1007/s00035-017-0194-x

Moser D, Gygax A, Bäumler B, Wyler N, Palese R (2002) Lista Rossa delle felci e piante a fiori minacciate della Svizzera. Ed. Ufficio federale dell'ambiente, delle foreste e del paesaggio, Berna; Centro della Rete Svizzera di Floristica, Chambésy; Conservatoire et Jardin Botaniques de la Ville de Genève, Chambésy. Collana UFAFP «Ambiente-Esecuzione», 118 pp.

Nagy L (2013) Biological flora of the British Isles: Silene suecica. Journal of Ecology 101(2): 532–544. https://doi.org/10.1111/1365-2745.12058

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

Pignatti S (1971) Studi sui Limonium. VIII. In: Heywood VH (Ed.) Flora Europaea. Notulae Systematicae ad Floram Europaeam spectantes No. 11. Botanical Journal of Linnean Society 64(4): 361–369. https://doi.org/10.1111/j.1095-8339.1971.tb02152.x

Salman SA, Shahid S, Ismail T, Chung E-S, Al-Abadi AM (2017) Long-term trends in daily temperature extremes in Iraq. Atmospheric Research 198: 97–107. https://doi.org/10.1016/j.atmosres.2017.08.011

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Chromosome numbers for the Italian flora: 11

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Abstract

In this contribution, new chromosome data obtained on material collected in Italy are presented. It includes counts for *Centaurea aegusae*, *Hieracium racemosum* subsp. *lucanum*, *H. australe* subsp. *australe*, *Lysimachia arvensis* subsp. *arvensis*, *Micromeria graeca* subsp. *graeca*, and *M. graeca* subsp. *consentina*.

Keywords

cytogeography, cytotaxonomy, endemic taxa, polyploidy

How to contribute

Texts concerning new chromosome data should be submitted electronically to Giovanni Astuti (giovanni.astuti@unipi.it), including indications on voucher specimens and methods used.

Chromosome counts

Centaurea aegusae Domina, Greuter & Raimondo (Asteraceae)

Chromosome number. $2n = 18$ (Fig. 1)

Voucher specimen. ITALY. Sicilia. Isola di Favignana, Mt. Santa Caterina, Scindo Passo (Favignana, Trapani) (WGS84: 37.920730°N, 12.307299°E), 50 m a.s.l., maritime carbonate cliffs, 25 July 2019, *G. Domina* (PAL).

Method. Squash preparations were made on root tips obtained from germinating seeds. Root tips were pre-treated with 0.4% colchicine for 3 hours and then fixed in Carnoy fixative solution for 1 hour. After hydrolysis in HCl 1N at 60 °C, the tips were stained in leuco-basic fuchsine for 7–8 minutes.

Observations. *Centaurea aegusae* is a rosulate chamaephyte endemic to the island of Favignana (Egadi Archipelago, western Sicily). In the past, it has been reported from all the Egadi islands under the name *C. cineraria* L. (Gussone 1843; Lojacono-Pojero 1903). On the basis of a statistical biometric study of the *C. busambarensis* Guss. complex, which represents the *C. cineraria* L. aggregate in Sicily and its offshore islets, *C. aegusae* is now recognized as a distinct species (Domina et al. 2017). The chromosome number $2n = 18$, reported here for the first time, is consistent with previous counts obtained for the other species belonging to the *C. busambarensis* complex (Viegi et al. 1972; Tornadore et al. 1974; Brullo and Pavone 1978; Cela Renzoni and Viegi 1982).

Figure 1. *Centaurea aegusae* Domina, Greuter & Raimondo from Isola di Favignana (Favignana, Trapani), $2n = 18$. Scale bar: 10 µm.

Hieracium racemosum subsp. *lucanum* Di Grist., Domina, Gottschl. & Scafidi (Asteraceae)

Chromosome number. $2n = 27$ (Fig. 2)

Voucher specimen. ITALY. Basilicata. Timpa Rossa (Lauria, Potenza), in clearings of *Quercus cerris* woods (WGS84: 40.107361°N, 15.934836°E), 846 m a.s.l., 18 August 2019, *E. Di Gristina*, *F. Maturo & F. Scafidi* (PAL n°109701).

Method. Squash preparations were made on root tips obtained from germinating seeds. Root tips were pre-treated with 0.4% colchicine for 3 hours and then fixed in Carnoy fixative solution for 1 hour. After hydrolysis in HCl 1N at 60 °C, the tips were stained in leuco-basic fuchsine for 7–8 minutes.

Observations. *Hieracium racemosum* subsp. *lucanum* is a scapose hemicryptophyte, flowering from August to early September. It is currently known only from Timpa Rossa (Lauria, province of Potenza, Basilicata, S Italy) (Di Gristina et al. 2019). The aggregate of *H. racemosum* Willd. is one of the most polymorphic aggregates in the genus *Hieracium* L. s.str. The chromosome number $2n = 3x = 27$, reported here for the first time on material from the *locus classicus* of this subspecies, is included in the variability ($2n = 27$, $2n = 36$) reported for the *H. racemosum* aggregate by Sell and West (1976), Brullo et al. (2005), Di Gristina et al. (2006) and Geraci et al. (2007).

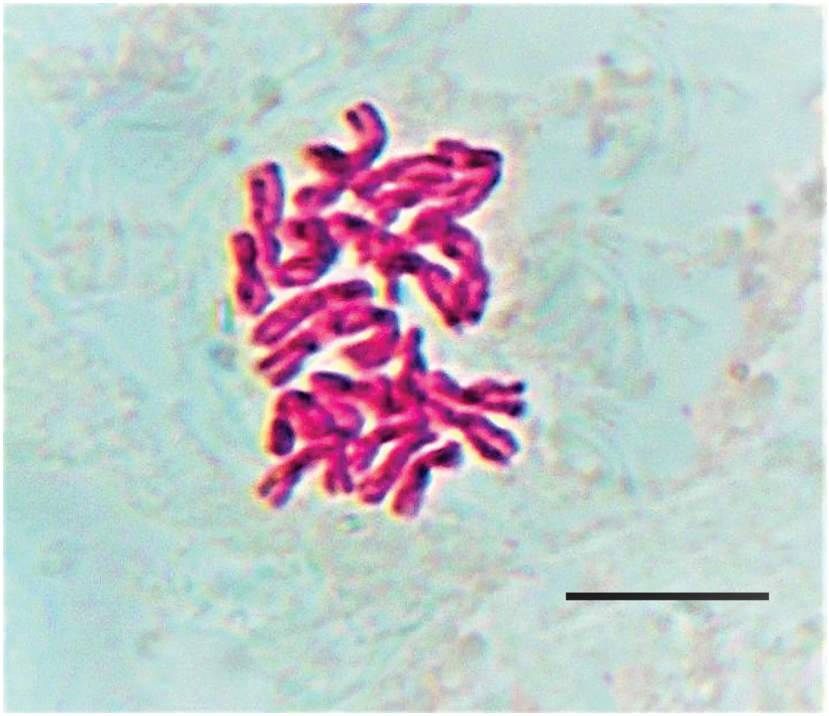

Figure 2. *Hieracium racemosum* subsp. *lucanum* Di Grist., Domina, Gottschl. & Scafidi from Timpa Rossa (Lauria, Potenza) $2n = 27$. Scale bar: 10 µm.

Lysimachia arvensis (L.) U.Manns & Anderb. subsp. *arvensis* (Primulaceae)

Chromosome number. 2*n* = 40 (Fig. 3)

Voucher specimen. ITALY. Sicilia. Fossa della Garofala (Palermo) (WGS84: 38.107529°N, 13.350157°E)**,** 30 m a.s.l., irrigated *Citrus* grove, 28 May 2021, *G. Barone* (SAF).

Method. Squash preparations were made on root tips obtained from germinating seeds. Root tips were pre-treated with 0.4% colchicine for 3 hours and then fixed in Carnoy fixative solution for 1 hour. After hydrolysis in HCl 1N at 60 °C, the tips were stained in leuco-basic fuchsine for 7–8 minutes.

Observations. *Lysimachia arvensis* subsp. *arvensis* is an annual plant native to the Mediterranean Basin, but widely distributed around the world (Jiménez-López et al. 2019). It displays a petal colour polymorphism. Indeed, blue- and orange-flowered plants occur in monomorphic and polymorphic populations across its native range in Europe (Sánchez-Cabrera et al. 2021). The chromosome number 2*n* = 40, found here in material with orange flowers, agrees with previous reports from Italy and abroad (Löve and Löve 1982; Moneim et al. 2003).

E. Di Gristina, G. Domina, G. Barone

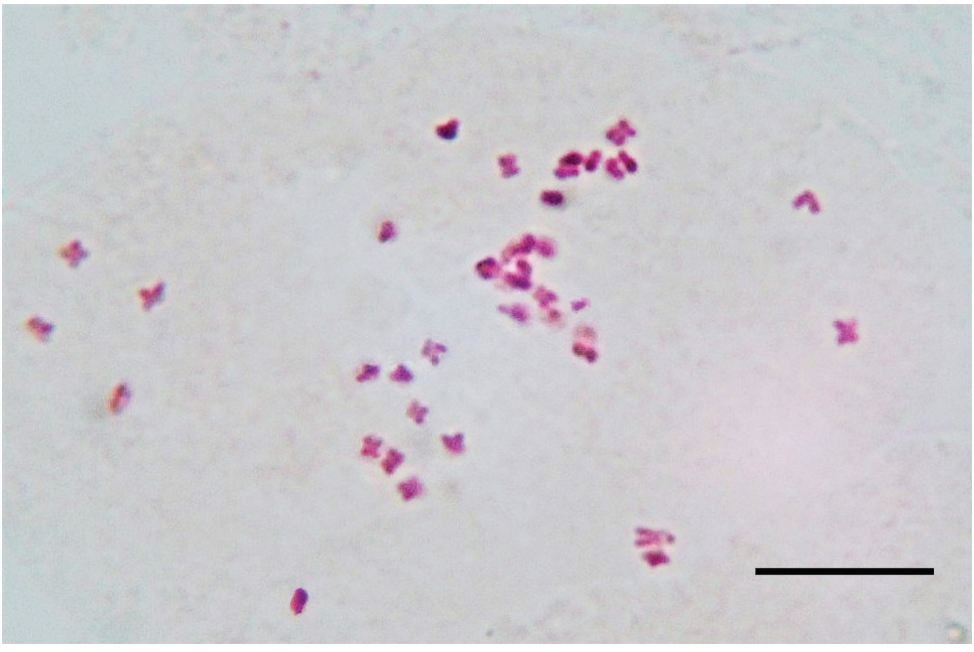

Figure 3. *Lysimachia arvensis* (L.) U.Manns & Anderb. subsp. *arvensis* from Fossa Garofala (Palermo), 2*n* = 40. Scale bar: 10 µm.

Micromeria graeca (L.) Benth. ex Rchb. subsp. *consentina* (Ten.) Guinea

Chromosome number. $2n = 30$ (Fig. 4)

Voucher specimen. ITALY. Calabria. Scalo Ferroviario di San Marco Argentano (Cosenza), nei pressi dello svincolo autostradale (WGS84: 39.62092°N, 16.22147°E), gariga a margine strada, 120 m s.l.m., 17 August 2018, *L. Peruzzi* (FI).

Method. Squash preparations were made on root tips obtained from seeds germinating on 1% agar in Petri dishes. Root tips were pre-treated with 0.4% colchicine for 3 hours and then fixed in Carnoy fixative solution for 1 hour. After hydrolysis in HCl 1N at 60 °C, the tips were stained in leuco-basic fuchsine.

Observations. This taxon is endemic to Italy, where it occurs in Calabria and Sicily, doubtful in Abruzzo and Basilicata, and no longer found in Campania and Puglia (Bartolucci et al. 2018). We here report the first chromosome count for this subspecies, $2n = 30$, which attests for a diploid status in contrast with the allegedly polyploid chromosome number $2n = 60$ reported for the typical *Micromeria graeca* subsp. *graeca* (Morales Valverde 1990; Luque and Dìaz Lifante 1991; see also below). This further attests for an independence at species level for this taxon, as already argued by Peruzzi in Roma-Marzio et al. (2018).

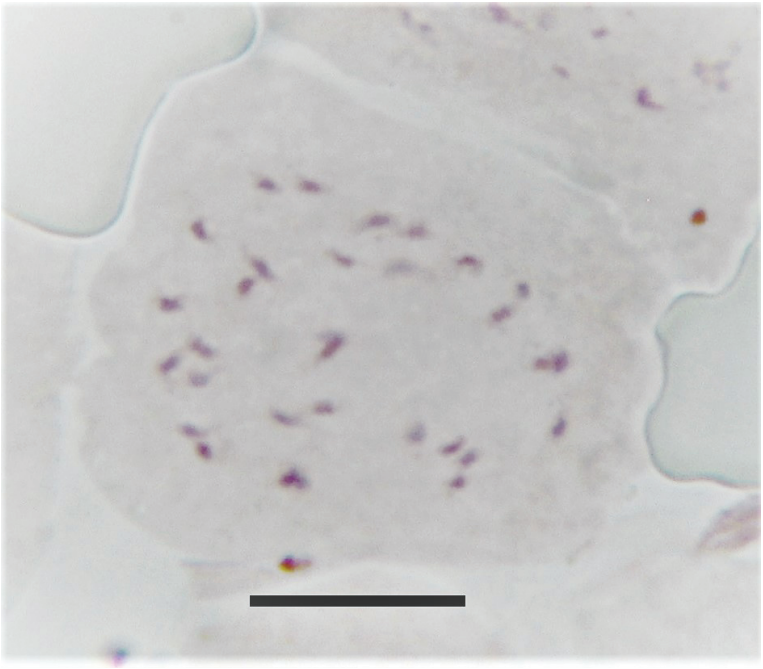

Figure 4. *Micromeria graeca* (L.) Benth. ex Rchb. subsp. *consentina* (Ten.) Guinea from San Marco Argentano (Cosenza), Scalo Ferroviario, $2n = 30$. Scale bar: 10 µm.

Micromeria graeca (L.) Benth. ex Rchb. subsp. *graeca*

Chromosome number. $2n = 60$ (Fig. 5)

Voucher specimen. ITALY. Calabria. Scalo Ferroviario di San Marco Argentano (Cosenza), nei pressi dello svincolo autostradale (WGS84: 39.62064°N, 16.22079°E), nelle fessure dell'asfalto a margine strada, 118 m s.l.m., 17 August 2018, *L. Peruzzi* (seeds collected and deposited at the germplasm bank of the Department of Biology, University of Pisa).

Method. Squash preparations were made on root tips obtained from seeds germinating on 1% agar in Petri dishes. Root tips were pre-treated with 0.4% colchicine for 3 hours and then fixed in Carnoy fixative solution for 1 hour. After hydrolysis in HCl 1N at 60 °C, the tips were stained in leuco-basic fuchsine.

Observations. This taxon is distributed throughout the Mediterranean region from Morocco to the Near East (Govaerts 2021). This is the first count of this subspecies for Italian populations, whereas other counts have been published for the Iberian Peninsula, where two different chromosome numbers have been reported so far, $2n = 20$ (Bjorkqvist et al. 1969) and $2n = 60$ (Morales Valverde 1990; Luque and Dìaz Lifante 1991). Our count confirms the latter number, which seems the commonest for the species. Concerning the genus *Micromeria* Benth., it seems that most counts showing $x = 10$, 11, and 25 have to be referred to species now belonging to *Clinopodium* L. (Rice 2014+), raising some doubts on the reliability of the count published by Bjorkvist et al. (1969). Assuming $x = 15$, the autonymic subspecies represents a tetraploid unit. It is of particular interest that the population studied here grows a few dozen metres away from the studied population of *M. graeca* subsp. *consentina* (Roma-Marzio et al. 2018).

A. Giacò, G. Astuti, L. Peruzzi

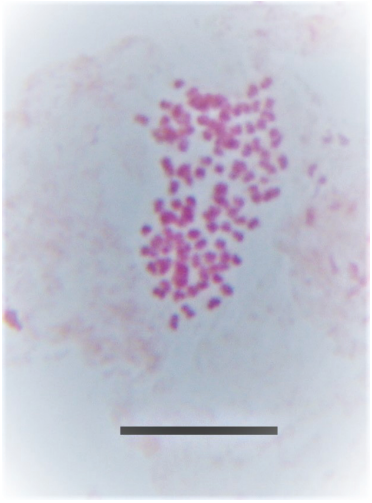

Figure 5. *Micromeria graeca* (L.) Benth. ex Rchb. subsp. *graeca* from San Marco Argentano (Cosenza), Scalo Ferroviario, $2n = 60$. Scale bar: 10 μm.

Hieracium australe Fr. subsp. *australe* (Asteraceae)

Chromosome number. $2n = 27$ (Fig. 6)

Voucher specimen. ITALY. Lombardia. Milano (WGS84 45.47032°N, 9.17739°E), mura del Castello Sforzesco, 125 m, 2014, *S. Orsenigo* (Kew Gardens Millennium Seed Bank, Serial No. 808376).

Method. Squash preparations were made on root tips obtained from germinating seeds. Root tips were pre-treated with 0.4% colchicine for 3 hours and then fixed in Carnoy fixative solution for 1 hour. After hydrolysis in HCl 1N at 60 °C, the tips were stained in leuco-basic fuchsine for 7–8 minutes.

Observations. *Hieracium australe* is a perennial species distributed in France, Italy, Hungary, and Romania (Greuter and Raab-Straube 2008). *Hieracium australe* subsp. *australe* is narrow endemic to Milan, where it grows on the ancient walls of the city and, in particular, on the walls of the Sforza castle (Orsenigo et al. 2019). The chromosome number $2n = 3x = 27$, reported here for the first time, is consistent with observations made on other species belonging to *H.* sect. *Italica* (Fr.) Arv-Touv., such as those of the *H. racemosum* aggregate (Brullo et al. 2005; Raimondo and Di Gristina 2004; Di Gristina et al. 2006), and to an apomictic (agamospermy) way of reproduction typical of the genus (Mráz and Zdvořák 2019).

G. Astuti, A. Giacò, S. Orsenigo

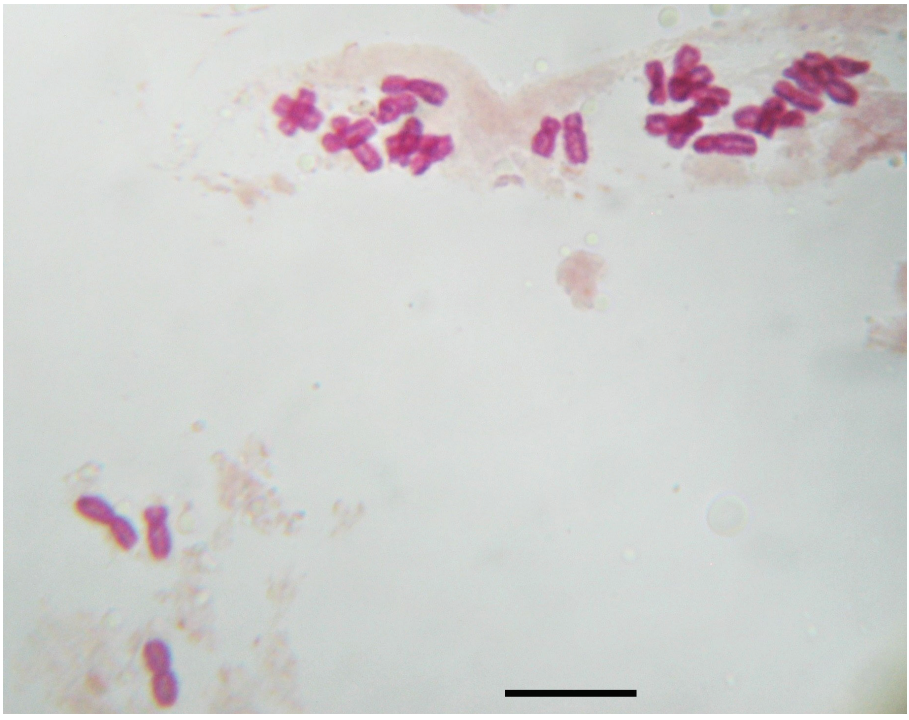

Figure 6. *Hieracium australe* Fr. subsp. *australe* from Sforza Castle (Milano), $2n = 27$. Scale bar: 10 µm.

References

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

Björnqvist I, von Bothmer R, Nilsson Ö, Nordenstam B (1969) Chromosome numbers in Iberian angiosperms. Botaniska Notiser 122: 271–283.

Brullo S, Campo G, Romano S (2005) Indagini citotassonomiche sul genere *Hieracium* L. (Asteraceae) in Sicilia. Informatore Botanico Italiano 36(2): 481–485.

Brullo S, Pavone P (1978) Numeri cromosomici per la flora italiana: 464–483. Informatore Botanico Italiano 10(2): 248–264.

Cela Renzoni G, Viegi L (1982) *Centaurea cineraria* s.l. (Asteraceae) in Italia. Revisione tassonomica. Atti della Società Toscana Scienze Naturali Pisa. Memorie, serie B 89: 99–144.

Di Gristina E, Geraci A, Raimondo FM (2006) Biosystematic investigation on *Hieracium symphytifolium* (Asteraceae). Bocconea 19: 275–286.

Di Gristina E, Domina G, Gottschlich G, Maturo F, Scafidi F (2019) *Hieracium racemosum* subsp. *lucanum* (Asteraceae), a new hawkweed from southern Italy. Phytotaxa 425(5): 297–300. https://doi.org/10.11646/phytotaxa.425.5.5

Domina G, Greuter W, Raimondo FM (2017) A taxonomic reassessment of the *Centaurea busambarensis* complex (Compositae, Cardueae), with description of a new species from the Egadi Islands (W Sicily). Israel Journal of Plant Sciences 64(1–2): e51.

Geraci A, Di Gristina E, Schicchi R (2007) Report (1641). In: Kamari G, Blanché C, Garbari F (Eds) Mediterranean chromosome number reports – 17. Flora Mediterranea 17: 315.

Govaerts R (2021) World Checklist of Lamiaceae. Facilitated by the Royal Botanic Gardens, Kew. http://wcsp.science.kew.org/ [Retrieved 14 June 2021]

Greuter W, Raab-Straube E (2008) Med-Checklist 2. OPTIMA Secretariat, Palermo, 798 pp. https://doi.org/10.3372/wi.38.38207

Jiménez-López FJ, Arista M, Talavera M, Pannell JR, Ortiz PL (2019) Heritabilities of lateral and vertical herkogamy in *Lysimachia arvensis*. Plant Species Biology 34: 31–37. https://doi.org/10.1111/1442-1984.12229

Löve A, Löve A (1982) IOPB chromosome number reports LXXVI. Taxon 31(3): 583–587. https://doi.org/10.1002/j.1996-8175.1982.tb03560.x

Luque T, Dìaz Lifante Z (1991) Chromosome numbers of plants collected during Iter Mediterraneum I in the SE of Spain. Bocconea 1: 303–364.

Moneim A, Aboel Atta II, Shehata AA (2003) On the delimitation of *Anagallis arvensis* L. (Primulaceae) 1. Evidence based on macromorphological characters, palynological features

and karyological studies. Pakistan Journal of Biological Sciences 6: 29–35. https://doi.org/10.3923/pjbs.2003.29.35

Morales Valverde R (1990) Números cromosomáticos de plantas occidentales, 582–590. Analés del Jardin Botánico de Madrid 47(1): 193–198.

Mráz P, Zdvořák P (2019) Reproductive pathways in *Hieracium* s.s. (Asteraceae): strict sexuality in diploids and apomixis in polyploids. Annals of Botany 123: 391–403. https://doi.org/10.1093/aob/mcy137

Orsenigo S, Gottschlich G, Galasso G (2019) The typification and identity of *Hieracium australe* Fr. (Asteraceae). Phytotaxa 388: 207–211. https://doi.org/10.11646/phytotaxa.388.2.8

Raimondo FM, Di Gristina E (2004) *Hieracium pignattianum* (Asteraceae), a new species from Madonie Mountains (N-Sicily). Bocconea 17: 313–324.

Rice A, Glick L, Abadi S, Einhorn M, Kopelman NM, Salman-Minkov A, Mayzel J, Chay O, Mayrose I (2014+) The Chromosome Counts Database (CCDB) a community resource of plant chromosome numbers. https://doi.org/10.1111/nph.13191 [accessed 14 June 2021]

Roma-Marzio F, Lastrucci L, Guzzon F, Ardenghi NMG, Peruzzi L, Mossini S (2018) Nuove segnalazioni floristiche italiane 5. Flora vascolare (28–46). Notiziario della Società Botanica Italiana 2(2): 205–210.

Sánchez-Cabrera M, Jiménez-López FJ, Narbona E, Arista M, Ortiz PL, Romero-Campero FJ, Ramanauskas K, Igić B, Fuller AA, Whittall JB (2021) Changes at a critical branchpoint in the anthocyanin biosynthetic pathway underlie the blue to orange flower color transition in *Lysimachia arvensis*. Frontiers in Plant Science. https://doi.org/10.3389/fpls.2021.633979

Sell PD, West C (1976) *Hieracium* L. In: Tutin TG, Heywood VH, Burges NA, Moore DM, Valentine DH, Walters SM, Webb DA (Eds) Flora Europaea (Vol. 4). Cambridge University Press, Cambridge, 358–410.

Tornadore N, Popova M, Garbari F (1974) Numeri cromosomici per la flora italiana:172–181. Informatore Botanico Italiano 6(1): 43–54.

Viegi L, Cela Renzoni G, Corsi G, Garbari F (1972) Numeri cromosomici per la flora italiana: 135–144. Informatore Botanico Italiano 4(3): 229–236.