Italian Botanist 7: 1–16 (2019)
doi: 10.3897/italianbotanist.7.31727
http://italianbotanist.pensoft.net

RESEARCH ARTICLE

Italian Botanist
Published by Società Botanica Italiana

The occurrence of *Brassica montana* Pourr. (Brassicaceae) in the Italian regions of Emilia-Romagna and Marche, and in the Republic of San Marino

Lorenzo Maggioni[1], Alessandro Alessandrini[2]

1 *Bioversity International, Via dei Tre Denari, 472/a, 00057 Maccarese (Roma), Italy* **2** *Istituto Beni Culturali, Regione Emilia-Romagna, Bologna, Italy*

Corresponding author: *Lorenzo Maggioni* (l.maggioni@cgiar.org)

Academic editor: *F. Bartolucci* | Received 17 November 2018 | Accepted 21 February 2019 | Published 7 March 2019

Citation: Maggioni L, Alessandrini A (2019) The occurrence of *Brassica montana* Pourr. (Brassicaceae) in the Italian regions of Emilia-Romagna and Marche, and in the Republic of San Marino. Italian Botanist 7: 1–16. https://doi.org/10.3897/italianbotanist.7.31727

Abstract

Brassica montana Pourr., a wild relative of the *Brassica oleracea* L. cole crops (broccoli, cabbage, cauliflower, etc.), deserves special attention for its potential to easily transfer agronomically useful traits to related crops. Monitoring existing *B. montana* populations is the first step to enabling long-term conservation and management of wild genetic resources. The main distribution area of *B. montana* extends along the coasts of the northern Mediterranean Sea from north-east Spain to north-west Italy (coast of Liguria and Apuan Alps in Tuscany). Further east and south, the distribution of *B. montana* is fragmentary, with isolated populations, in some cases, only observed in the 19th or early 20th century and never re-confirmed later. In this paper, we focus on all the *B. montana* reports for the Italian regions of Emilia-Romagna and Marche, and additionally for the neighbouring Republic of San Marino. Literature records were verified through field visits where possible. According to our analysis, the presence of *B. montana* is confirmed in the Marche and the Republic of San Marino, but not in Emilia-Romagna. We recommend further studies on the distribution of *B. montana* in Italy, also applying molecular means, beyond morphology, to distinguish *B. montana* from naturalized *B. oleracea* and other related taxa.

Keywords

Brassica montana, Northern Apennine, crop wild relatives

Introduction

Brassica montana Pourr. (Brassicaceae), belongs to *B.* sect. *Brassica*, which includes the taxa sharing the same C genome ($x = 9$) with the *B. oleracea* L. cole crops, as proposed by Stork et al. (1980) and elaborated by Snogerup et al. (1990). This genetically coherent group includes mainly Mediterranean chasmophytic suffrutescent species, which are highly interfertile and correspond to the *B. oleracea* primary genepool (Harlan and de Wet 1971). Together with *B. montana*, the section (also called "*Brassica oleracea* group") is represented in the Italian flora by the following species (Bartolucci et al. 2018): *B. rupestris* Raf. (with two subspecies), *B. incana* Ten., *B. villosa* Biv. (with five subspecies), *B. macrocarpa* Guss., *B. insularis* Moris, *B. thyrrena* Giotta, Piccitto & Arrigoni, and *B. trichocarpa* C.Brullo, Brullo, Giusso & Ilardi. All these taxa may be used as genetic resources, potentially hosting valuable traits that could be transferred to the respective cultivated crops (cabbage, cauliflower, broccoli, etc.). For example, drought and insect tolerance and high glucosinolate content, which have been recorded for *B. montana*, are traits of potential agronomic value (Warwick et al. 2009, Pelgrom et al. 2015). Particular attention should be dedicated to the knowledge of taxa with economic potential. Knowledge about distribution and status of their populations (i.e. size, level of threat, etc.) is the primary information for their conservation and possible use.

Brassica montana is distributed along the coasts of the northern Mediterranean Sea from north-eastern Spain to south-western Italy. In Italy, *B. montana* is more common along the coast of the Liguria region, in inland localities in the Apuan Alps (Tuscany) and on the Pontine Islands (Lazio). A localized presence has also been reported further east in Emilia-Romagna and Marche, the Republic of San Marino, as well as further south in Campania, Basilicata and Calabria regions (Biondi et al. 2002a, Bartolucci et al. 2018) (Figure 1). According to Biondi et al. (2012), the fragmentary distribution in Italy has a relic origin. Other authors discuss the identity of some populations, which they assume to have escaped from cultivation, such as in the area of Monte Conero (Marche) (Snogerup et al. 1990). Difficulties about the taxonomic identity of some populations were also pointed out by Anzalone and Caputo (1974–1975: 35–36) for the Pontine Islands, because of a possible confusion between *B. montana* and hairless individuals of *B. incana*.

This paper examines previous reports of *B. montana* for the most eastern part of its native range. This is intended as a contribution towards a complete inventory of all the Italian populations of *B. montana*. The most accurate and thorough study about the native range of *B. montana* (Snogerup et al. 1990) in fact, only summarily treated the eastern localities, without any mention of populations in southern Italy. According to the present study, *B. montana* is not confirmed in Emilia-Romagna, while it currently grows in the Marche and the Republic of San Marino.

Materials and methods

Available sources of information indicating the distribution of *B. montana* in Emilia-Romagna, Marche and San Marino were analysed, based on existing bibliography,

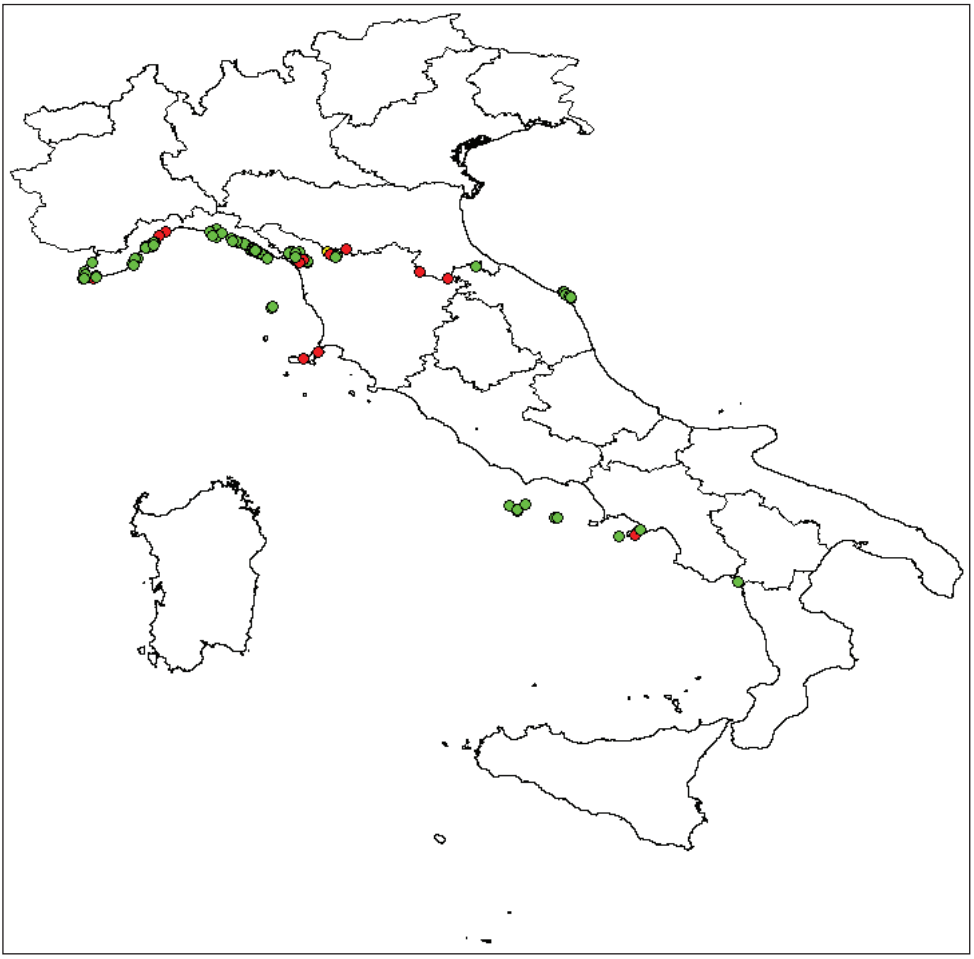

Figure 1. Distribution of *B. montana* in Italy, based on available public sources. For Liguria, among others, Wikiplantbase #Liguria, Barberis et al. (2016 onwards). For Tuscany, among others, Peruzzi and Bedini (2015 onwards). Green dots: records post 1950; red dots: records before 1950.

online resources such as the anArchive System (http://www.anarchive.it/anArchive), herbarium specimens and personal field observations. Herbarium material was directly consulted at FI, RO, and VER. Information from other herbaria (AQUI, BOLO, CAME, G, GE, MOD, NAP, PAV, SIENA, and TO) (herbarium acronyms follow Thiers 2019) was obtained from the Internet or via email exchange with the respective curators. The following names have been regarded as synonyms of *B. montana*, following Marhold (2011): *B. robertiana* J.Gay and *B. oleracea* subsp. *pourretii* Foucaud & Rouy. Other combinations based on *B. oleracea* var. *sylvestris* L. and used by Italian authors (e.g., Paoletti 1896) are synonyms of *B. oleracea* L. subsp. *oleracea* (Marhold 2011). The latter taxon is regarded as native to the Atlantic coasts of northern Spain, France, the British Isles and Helgoland (Germany) (Snogerup et al. 1990).

Results

Our survey of available resources identified seven localities where the presence of *B. montana* has been reported: four in Emilia-Romagna, two in the Marche and one in the Republic of San Marino. Information collected for each of these localities is described below.

Emilia-Romagna

Province of Modena

1. Lago Naro: the presence of *B. montana* has been recorded in the flora of the Modena province (Alessandrini et al. 2010) on just one site "*sopra al lago Naro nella valle del Baccio*" [above lake Naro, in the Baccio valley]. This locality, at about 1500 m a.s.l., is very close to the mountain ridge overlooking Tuscany. Repeated searches for living populations were made in this locality by Maggioni in August 2016 and April 2017, without success. It was not possible either to track down original herbarium specimens or photographic evidence on the first sighting of this population.

Province of Bologna

2. Riva di Dardagna: this locality was mentioned in a note by Cavara (1890), who described a perennial wild brassica originally found several years before by his friend Rodolfo Farneti and then collected together with Farneti in July 1885 (Figure 2). The sample was identified as a new variety, *Brassica robertiana* var. *apenninica* Cavara, owing to differences in leaf shape, siliqua shape and seed colour, compared to the description of *B. robertiana* included in contemporary floras of France (Grenier and Godron 1848: 79) and Spain (Willkomm and Lange 1861–1880: 858). The site is described as located in the upper Bologna Apennine at around 800 m a.s.l. The upper valley of the river Dardagna is close to the border between Emilia and Tuscany. The exact location, indicated as *Balza de' Coli* cliff, is impossible to pinpoint on a map. Several attempts to find remnant populations in this area were made in recent years without success. The so-called Riva (this name indicates a rocky slope) was observed by Alessandrini in 2014 to be steep and unstable, with frequent rock landslides, which might be the cause of the ancient population's extinction. In PAV, temporarily not accessible for consultation, five sheets have been found with specimens from the site in the Province of Bologna sub "*B. robertiana* Gay var. *appenninica* (sic!) Cavara"; the most precise indication of the place of discovery is: "*Alto appennino Bolognese nella Riva del Dardagna presso Ca' d'Julio in luogo detto balzo dei Pianacci e Balzo dei Coli*. 1887-8". In G two samples collected

Figure 2. Illustration of *Brassica robertiana* var. *apenninica*, from Cavara (1890), courtesy of Biblioteca Dipartimento BiGeA – Alma Mater Studiorum – Università degli Studi di Bologna. Photo credit: A. Alessandrini.

Figure 3. Type material (stated by S. Snogerup) of *Brassica robertiana* var. *apenninica* Cavara at G. Photo credit: Conservatoire et Jardin botaniques de la Ville de Genève.

by Cavara and Farneti between 1886–88 are preserved (barcode: G00426761 and G00426761_a), cited by Snogerup et al. (1990) from the same site; a label added by S. Snogerup (dated 1988) states that it is the "Type material of *B. robertiana* Gay var. *apenninica* Cavara" and that this is "Probably = *B. montana* Pourr., but material insufficient" (Figure 3).

Province of Forli-Cesena

The card index of the Zangheri's herbarium, deposited at VER, reports two specimens under *B. oleracea* L. subsp. *silvestris* L. (Mill.), found at the following two localities:

3. Balze: this place, currently called Balze di Verghereto (or Le Balze), is located at 1090 m a.s.l., on the border between Romagna and Tuscany. The herbarium specimen (collection number 4623) was collected by Zangheri in a rocky habitat (*rupi*) on 26 July 1923. The tag shows (Figure 4) that the specimen was determined by Béguinot. An anonymous note (in Italian), possibly written by Zangheri himself or by a subsequent reviewer, raises some doubts about the identification: "*Da raccogliere con frutti ben maturi ed allora si potrà [precisare?] meglio la determinazione!*" [to be collected with well mature fruits, so that the determination can be more accurate]. A survey of the cliffs at Le Balze was carried out by Maggioni in August 2016, but no wild brassicas were found.
4. Campigna: locality above 1000 m a.s.l., in the Bidente Valley, within the National Park of Casentino Forests, Monte Falterona and Campigna, at the border between Romagna and Tuscany. This specimen was collected by Zangheri in a rocky habitat (*rupi*) on 1 July 1924 (collection number 4622). The sample no longer exists and a note in the card index written by Zangheri himself (Salmaso, pers. comm. 2017) indicates that it was eliminated (Figure 5). An online portal of the flora of the National Park of Casentino Forests, Monte Falterona and Campigna (http://dryades.units.it/casentinesi/, accessed 30 June 2018) indicates that the species' presence in the park needs confirmation. This is in line with the findings of Viciani (2011).

Republic of San Marino

5. Monte Titano: Two samples collected at Monte Titano by Pampanini (sub "*B. oleracea* L. var. *silvestris* L. Mill.") in June 1912 ("San Marino, *sulle rupi calcaree*" [on the calcareous rocks]) and in May 1929 ("M. Titano, *vers. or.*" [eastern slope]) are conserved respectively at FI and VER (Figure 6).

When Snogerup et al. (1990) examined the specimen from FI they considered it of dubious identity, on account of its very broad, short-petiolate leaves. Biondi and Vagge (2004) also reported *B. oleracea* subsp. *robertiana* (= *B. montana*) for Monte Titano:

Figure 4. Herbarium specimen N. 4623, locality Balze, Zangheri collection, VER.

"M. Titano (*sotto il castello* [below the castle]), 19 May 1994" and "Borgo Maggiore, 26 June 1998" and found "on the limited vertical positions of the calcareous cliffs that are exposed to northeast". Possibly the same location of previous observations, pre-

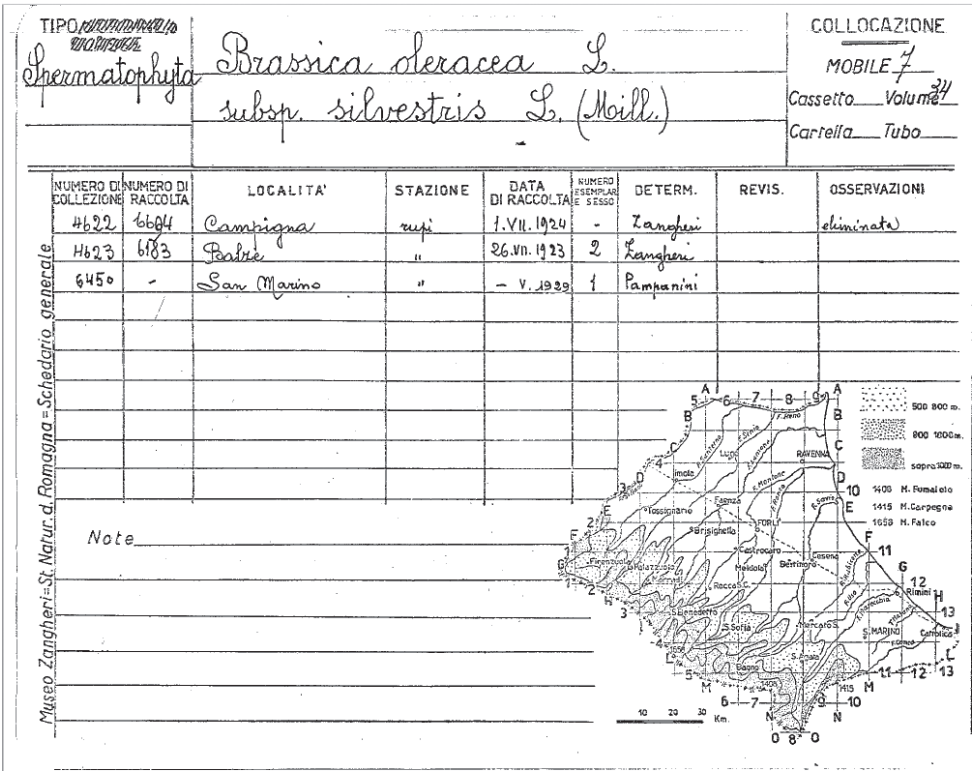

Figure 5. Card index for "*Brassica oleracea* L. subsp. *silvestris* L. (Mill.)" from the Zangheri collection, Museo Civico di Storia Naturale, Verona, Italy.

cisely on the rocky slope along the road Strada Sottomontana in Borgo Maggiore, east slope of M. Titano, at ca. 550 m a.s.l., was monitored by Maggioni in August 2014. The population of ca. 50 individuals shows the typical habit of *B. montana*; however, some individuals show very broad leaves and sometimes a glaucous and waxy leaf surface, which are typical of cultivated crops (Figure 7).

Marche

Province of Ancona

6. Monte Conero: *B. montana* is common in the Conero Regional Nature Park, where it is mainly included, according to Biondi et al. (2012) in the two vegetation communities described below. The halo-rupiculous *Reichardio maritimae-Brassicetum robertianae* Biondi 1982 develops in rocky crevices of the calcareous walls. In most elevated sectors of rocky walls, it is possible to find the "*Brassica montana* and *Matthiola incana* Community", both in marly-arenaceous and in most elevated stretch-

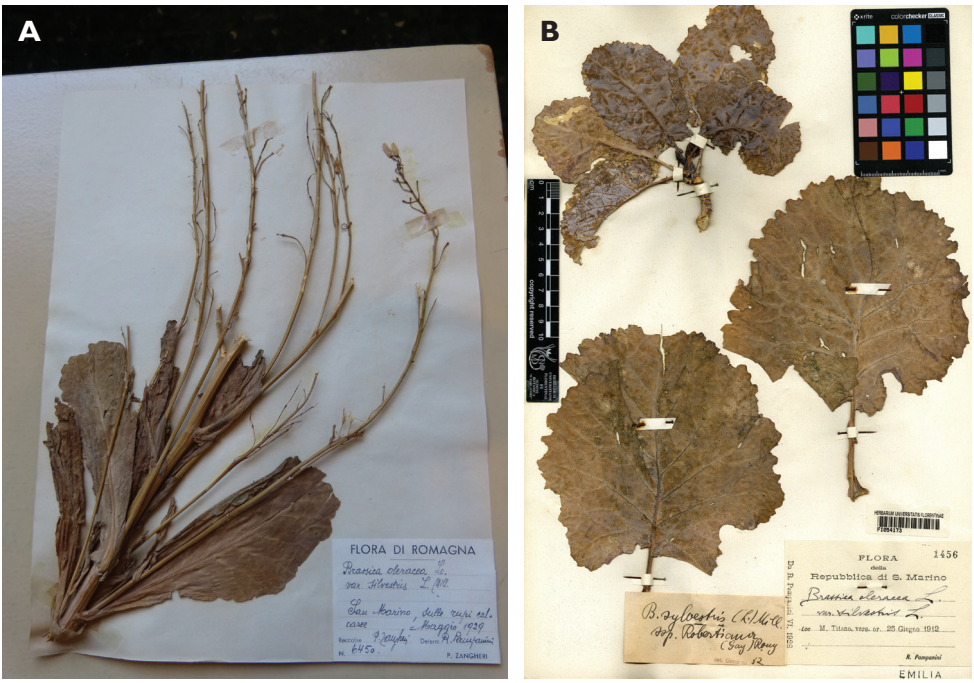

Figure 6. Herbarium specimens collected by Pampanini in San Marino. Courtesy of Museo Civico di Storia Naturale, Verona (left) and of Museo di Storia Naturale, Florence (Italy) (right).

es of calcareous cliffs (Biondi et al. 2012). Overall, *B. montana* colonizes the coastal cliffs from Monte dei Corvi southwards up to the Sassi Neri beach (Biondi et al. 2000). Records available from the online source anArchive (http://www.anarchive.it/anArchive/) list specific sites where the taxon has been observed or collected: Passo della Croce (herbarium specimen from Brilli-Cattarini, CAME#230, 1965); valley in front of Scoglio delle Due Sorelle, Portonovo; Scoglio della Vela; Spiaggia dei Gabbiani, Sirolo and Spiaggia Sassi Neri under Passo del Lupo (Biondi 1986); Scoglio del Libro and Valle delle Vellare (Biondi et al. 2002b). Maggioni also recorded the presence of a large population along the trail on both sides of Passo del Lupo (also called Passo della Croce) (Figure 8) in 2005. The oldest herbarium specimen known to us for the Monte Conero area, collected at Scogli degli Schiavi, is conserved at FI, where it was received from Narducci in July 1856. This sample was classified by Onno in 1932 as *B. sylvestris* (L.) Miller subsp. *robertiana* (Gay) Rouy.

7. Ancona: The presence of a population in Ancona was mentioned by Landucci et al. (2014), who reported it as a new finding made in 2012. However, several herbarium specimens collected in Ancona, possibly in the same locality, date back to 1876 (*Ricci*, FI), 1880 (*Costa Righini*, PI) and 1890 (*Narducci et Profili*, FI), as reported by Onno (1933). This population, visited by Maggioni in May 2017, consisted of no less than 200 individuals growing on the steep cliffs delimiting the

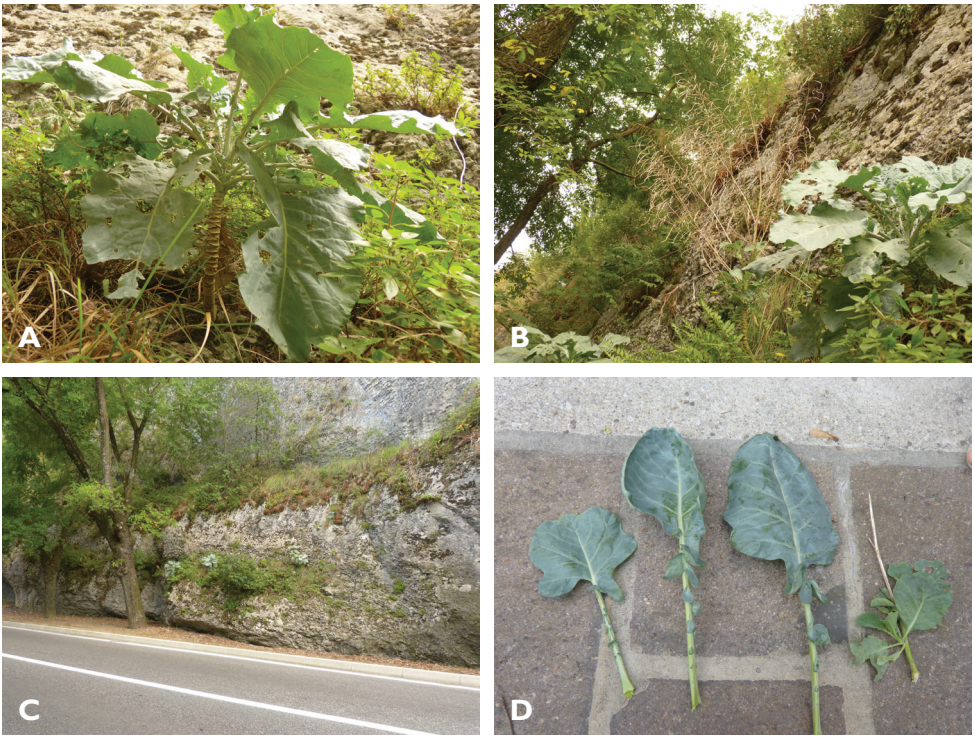

Figure 7. *Brassica montana*, Borgo Maggiore, San Marino, August 2014. Bottom right image shows glaucous and waxy leaves. Photo credit: L. Maggioni/Bioversity International.

narrow beach called Passetto, both north and south of the war memorial. Many plants could also be found among the walls of the fishermen's boat shelters in front of the beach (Figure 9). This population probably forms a continuum with the Monte Conero populations described above, as the cliffs' habitat extends in that direction without major interruptions. This locality is also included within the borders of the Conero Regional Nature Park.

Regarding the presence of *B. montana* in the Marche, it should be noted that Snogerup et al. (1990) mentioned that "a locality S of Ancona given by Onno (1933) refers to a population of escaped *B. oleracea*". Paolucci (1890) also considered this taxon, extensively growing on coastal cliffs between Ancona and M. Conero, to belong to *B. oleracea*. He specified that the broccoli, cauliflowers and cabbages were grown everywhere in gardens and fields. Based on the taxonomic key of Snogerup et al. (1990), we identified the populations of Monte Conero and Ancona as *B. montana*. The likely presence of cultivated plants escaped from gardens and/or situations of hybridization between cultivated and wild specimens are the probable reasons for different interpretations in the past.

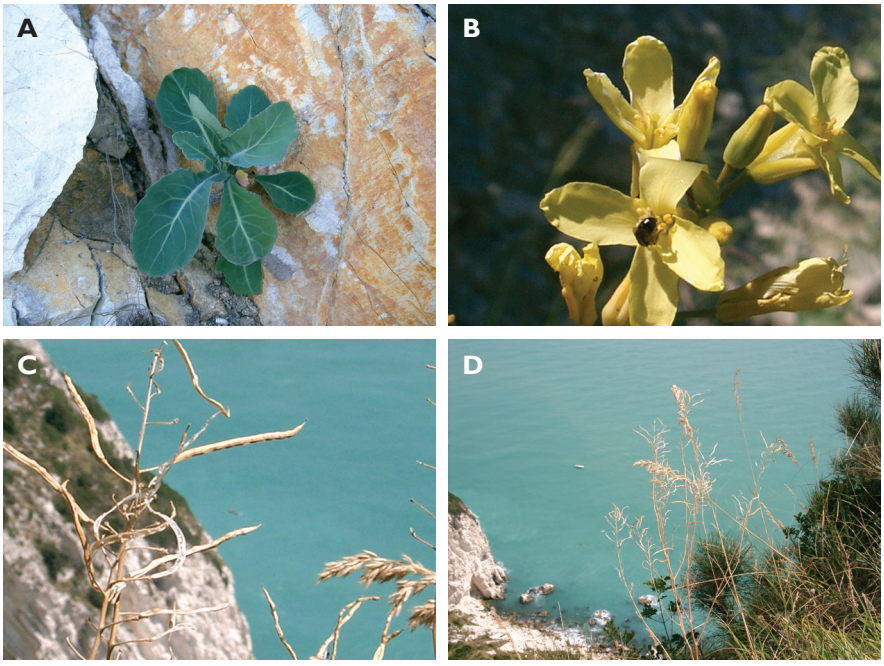

Figure 8. *Brassica montana* near Passo del Lupo, Monte Conero, May (left) and August (right) 2005. Photo credit: L. Maggioni/Bioversity International.

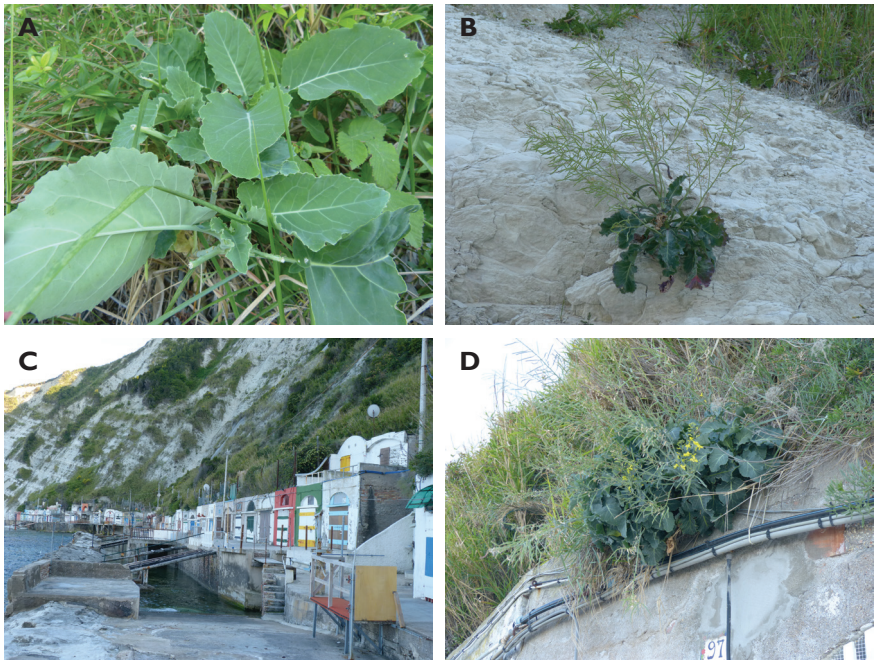

Figure 9. *Brassica montana*, il Passetto, Ancona, May 2017. Photo credit: L. Maggioni/Bioversity International.

Discussion

The presence of *B. montana* in Emilia-Romagna has not been confirmed by our research. The only recent observation of *B. montana* in this region refers to the Modena province (Lago Naro) and dates back to 2005. However, the species is no longer present here. Previous observations in other localities in the region were made between 1885 and 1923. It should also be noted that the only herbarium specimens we traced from Emilia-Romagna were collected at Le Balze in 1923 (*Zangheri*, VER) and at Riva di Dardagna in 1886–1888 (*Cavara et Farneti*, G and PAV), in both cases of uncertain identification. The illustrations and descriptions from Cavara (1890) of the individuals found in the Bologna province (Riva di Dardagna) are very detailed, but Cavara himself expressed several doubts about their identification with *B. montana*. He also took into consideration the hypothesis of a naturalization from ancient gardens, even though unlikely in his opinion, given the distance between the inaccessible cliffs where the plant was thriving and any ancient human settlement.

The eastern populations were known at least since 1856 in the case of Monte Conero (*Narducci*, FI), 1876 (Ancona) (*Ricci*, FI), and 1912 (San Marino) (*Pampanini*, FI). They have been repeatedly confirmed until now. It is noteworthy that from time to time various authors (Paolucci 1890, Onno 1933, Snogerup et al. 1990) regarded these populations as possibly originated from escaped individuals of *B. oleracea*. The possible reversion of escaped populations, becoming morphologically indistinguishable from wild plants within a few years, was discussed, among others, by Mitchell (1976) and Maggioni (2015). The discrimination between naturalized populations of *B. oleracea* and *B. montana* is mainly based on the colour of the leaves (greyish-glaucous in *B. oleracea*, slightly greyish, pure to bluish green in *B. montana*) (Snogerup et al. 1990). The ease with which any taxon belonging to the section can intercross with cultivated types also adds a further element of complication. A definitive clarification of the taxonomic status of the *Brassica* populations considered in this study will probably require accurate analysis, also at the molecular level, and a comparison with populations of *B. montana* group from its entire range.

On the other hand, if we assume that all the populations observed in the Northern Apennines truly belong to *B. montana*, an interesting pattern is drawn (Figure 10). In fact, the corresponding localities approximately follow the Northern Apennine ridgeline along the boundary between Tuscany and Emilia-Romagna, from the Apuan Alps in the west and eastwards to Monte Titano and Monte Conero. This pattern is in line with the statement by Biondi et al. (2012) that *B. montana* "…presents a fragmentary range of distribution having a relic origin". The fragmentary pattern also extends southwards, with the well-known populations on the Pontine Islands (Anzalone and Caputo 1974–1975), while confirmation of other isolated localities further south would require further investigation according to the authors.

An alternative explanation for the fragmentary distribution of *B. montana* at its eastern edge is a long-distance dissemination from the Apuan Alps populations. In this case, only few individuals might have occasionally overstepped the Apennine ridge to Emilia-Romagna, finding a favourable habitat only along the Adriatic coast.

Figure 10. Distribution of *Brassica montana* in the Northern Apennine, based on available public sources. For Tuscany, among others, Peruzzi and Bedini (2015 onwards). Green dots: records post 1950; red dots: records before 1950; yellow dot: recent observation, not confirmed by the present paper.

Conclusion

The current presence of *B. montana* in Emilia-Romagna cannot be confirmed, while populations of *B. montana* are thriving well in the province of Ancona and the Republic of San Marino. The full distribution range of *B. montana* in Italy needs to be further investigated, possibly following a careful identification, based on both morphological traits and molecular means.

Acknowledgments

The authors wish to acknowledge precious help and availability of Annalisa Managlia (BOLO), Chiara Nepi and Lorenzo Cecchi (FI), Laurence Loze and Laurent Gautier (G), Annalisa Santangelo (NAP), Nicola Ardenghi (PAV), Maurizio Pierfranceschi (RO), Francesco Di Carlo (VER), and Claudia Bonfiglioli (Biblioteca Erbario e Orto Botanico, Università di Bologna). We thank Elinor Lipman and Olga Spellman (Bioversity International) for English and copy editing. Finally, we thank two anonymous reviewers for critically reviewing the manuscript and suggesting substantial improvements.

References

Alessandrini A, Delfini L, Ferrari P, Fiandri F, Gualmini M, Lodesani U, Santini C (2010) Flora del Modenese: censimento, analisi, tutela. Provincia di Modena, Modena; Istituto Beni Culturali della Regione Emilia-Romagna, Bologna. http://flora.provincia.modena.it/

Anzalone B, Caputo G (1974–1975) Flora e vegetazione delle Isole Ponziane (Golfo di Gaeta). Delpinoa NS 16–17: 3–184.

Barberis G, Longo D, Peruzzi L, Bedini G, Peccenini S (2016 onwards) Wikiplantbase #Liguria v2.1. http://bot.biologia.unipi.it/wpb/liguria/index.html [Accessed 10 July 2018]

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

Biondi E (1986) La vegetazione del Monte Conero (con carta della vegetazione alla scala 1: 10.000). Regione Marche, Assessorato Urbanistica e Ambiente. Quaderni dell'ambiente della Regione Marche 7: 1–94.

Biondi E, Bagella S, Casavecchia S, Pinzi M (2000) Piano di gestione naturalistica del Parco Naturale del Conero. Università degli Studi di Ancona, Regione Marche, 229 pp.

Biondi E, Casavecchia S, Pinzi M, Bagella S, Calandra R (2002a) Excursion to the Conero regional natural park. Fitosociologia 39(1)[suppl. 3]: 5–32.

Biondi E, Bagella S, Casavecchia S, Pinzi M (2002b) La vegetazione arbustiva di un settore costiero dell'adriatico centrale italiano. Fitosociologia 39(1)[suppl. 2]: 75–80.

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

Biondi E, Vagge I (2004) The vegetal landscape of the Republic of San Marino. Fitosociologia 41(1)[suppl. 1]: 53–78.

Cavara F (1890) Di una rara specie di *Brassica* dell'Appennino Emiliano. Malpighia 4(4): 124–131.

Grenier M, Godron M (1848) Flore de France I, J.-B. Baillière, Paris.

Harlan JR, de Wet JMJ (1971) Towards a rational classification of cultivated plants. Taxon 20: 509–517. https://doi.org/10.2307/1218252

Landucci F, Panella L, Lucarini D, Gigante D, Donnini D, Kell S, Maxted N, Venanzoni R, Negri V (2014) A prioritized inventory of crop wild relatives and wild harvested plants of Italy. Crop Science 54: 1–17. https://doi.org/10.2135/cropsci2013.05.0355

Maggioni L (2015) Domestication of *Brassica oleracea* L. PhD Thesis, Swedish University of Agricultural Sciences, Alnarp. http://pub.epsilon.slu.se/12424/

Marhold K (2011) Brassicaceae. Euro+Med Plantbase – the information resource for Euro-Mediterranean plant diversity. http://ww2.bgbm.org/EuroPlusMed/ [Accessed 2 October 2018]

Mitchell ND (1976) The Status of *Brassica oleracea* L. subsp. *oleracea* (wild cabbage) in the British Isles. Watsonia 11: 97–103.

Onno M (1933) Die Wildformen aus dem Verwandtschaftskreis "*Brassica oleracea* L.". Österreichische Botanische Zeitschrift 82(4): 309–334. https://doi.org/10.1007/BF01251324

Paoletti G (1896) Brassica (Tourn.) L. In: Fiori A, Paoletti G (Eds) Flora Analitica d'Italia, 1. Tipografia del Seminario, Padova, 443–448.

Paolucci L (1890) Flora Marchigiana. Federici, Pesaro. https://www.scribd.com/document/351604923/Flora-Marchigiana-Di-Luigi-Paolucci-1890-Pg-794

Pelgrom KTB, Broekgaarden C, Voorrips RE, Bas N, Visser RGF, Vosman B (2015) Host plant resistance towards the cabbage whitefly in *Brassica oleracea* and its wild relatives. Euphythica 202: 297–306. https://doi.org/10.1007/s10681-014-1306-y

Peruzzi L, Bedini G (2015 onwards) Wikiplantbase #Toscana v2.1. http://bot.biologia.unipi.it/wpb/toscana/index.html [Accessed 16 July 2018]

Snogerup S, Gustafsson M, Bothmer R von (1990) *Brassica* sect. *Brassica* (Brassicaceae). I. Taxonomy and Variation. Willdenowia 19(2): 271–365.

Stork AL, Snogerup S, Wüest J (1980) Seed characters in *Brassica* section *Brassica* and some related groups. Candollea 35: 421–450.

Thiers B (2019) Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. Available from: http://sweetgum.nybg.org/science/ih/ [Accessed 26 January 2019]

Viciani D (2011) Notulae sulla flora del Parco Nazionale delle Foreste Casentinesi, Monte Falterona e Campigna (Appennino Tosco-Romagnolo): approfondimenti su alcuni campioni critici dell'Erbario Zangheri. Quaderno di Studi e Notizie di Storia Naturale della Romagna 34: 1–5.

Warwick SI, Francis A, Gugel RK (2009) Guide to wild germplasm of *Brassica* and allied crops (tribe Brassiceae, Brassicaceae) (3rd edn) – Part IV – Wild crucifer species as sources of agronomic traits. http://www.brassica.info/info/publications/guidewild/Guide_ed3_PART%20IV_16July2009.pdf [Accessed 4 July 2018]

Willkomm M, Lange J (1861–1880) Prodromus florae hispanicae III. E. Schweizerbart, Stuttgart.

Italian Botanist 7: 17–29 (2019)
doi: 10.3897/italianbotanist.@.33308
http://italianbotanist.pensoft.net

RESEARCH ARTICLE

Italian Botanist
Published by Società Botanica Italiana

Contribution to the knowledge of fungal diversity of the Marmore Waterfalls (Umbria, central Italy)

Roberto Venanzoni[1], Enrico Bini[1], Emma Bricchi[1], Paola Angelini[1]

1 *Department of Chemistry, Biology and Biotechnology, University of Perugia, via del Giochetto – 06123, Perugia, Italy*

Corresponding author: *Paola Angelini* (paola.angelini@unipg.it)

Academic editor: *L. Peruzzi* | Received 24 January 2019 | Accepted 9 March 2019 | Published 26 March 2019

Citation: Venanzoni R, Bini E, Bricchi E, Angelini P (2019) Contribution to the knowledge of fungal diversity of the Marmore Waterfalls (Umbria, central Italy). Italian Botanist 7: 17–29. https://doi.org/10.3897/italianbotanist.7.33308

Abstract

A list of the macrofungi collected from the Marmore Waterfalls (Umbria, Italy) is reported. In particular, a list of basidiomycetes and ascomycetes collected over a period of about ten years was compiled. A total of 125 species belonging to 78 genera, 46 families, and 15 orders were identified. Forty-four species are recorded in Umbria for the first time. Marmore Waterfalls may represent an important area for the conservation of fungal diversity, due to the presence of 34 species matching those included in Red Lists of several European countries.

Keywords

Ascomycota, Basidiomycota, ecological-trophic group, EU Habitat 7220*

Introduction

The Marmore Waterfalls (Terni, Umbria) are man-made waterfalls originally built by the Romans in 271 BC to divert the Velino River. Presently it is open to the public only when hydroelectric power is not being generated. With a total height of 165 m (541 feet), it is one of the highest man-made waterfalls in Italy and worldwide.

Due to the great biological richness in species and priority EU-Habitats, concentrated in about 0,86 km^2, it is included within the protected natural area of the 'Nera River Regional Park'. It is also recognized at the European level as a Special Area of Conservation and Special Protection Area (SAC/SPA IT5220017) of the Natura 2000 EU-wide network (Habitat Directive 92/43/EEC).

Among the habitats, the priority EU-Habitat 7220* [Petrifying springs with tufa formation (*Cratoneurion*)] is one of the most important for its naturalistic features. Petrifying springs are lime-rich water sources which deposit tufa or travertine. The emerging spring water is rich in carbon dioxide and dissolved calcium carbonate. On contact with the atmosphere, carbon dioxide is outgassed and calcium carbonate is deposited as tufa. Communities associated with petrifying springs, namely fungi, plants and animals are highly specialized due to their challenging environment (high pH, constant inundation by water and deposition of precipitated calcium carbonate) (Aleffi and Spampinato 2009, Lyons and Kelly 2016). At sites such as waterfalls (e.g., Marmore Waterfalls) and springs, carbonate deposition is frequently extremely local (Ford and Pedley 1996).

The specific microclimate of the Marmore Waterfalls, showing high levels of ionized water aerosols, gives rise to the presence of a significant mycological diversity, which makes the uniqueness of this Site of Community Importance even more evident. A research project has been underway in this area for about ten years, leading to the census of well over 100 species of epigeal fungi.

Fungi constitute one of the largest and most significant groups of organisms in the world. They are valuable not only for their vital roles in ecosystem functions, but also for their influence on humans and human-related activities (Zervakis and Venturella 2007, Saitta et al. 2011, Pecoraro et al. 2014, Angelini et al. 2015a, 2016a, 2016b). They are responsible for a range of key ecological functions, including nutrient cycling, water uptake by plants and soil health and formation (Picco et al. 2011, Perotto et al. 2013, Frąc et al. 2018).

With regard to human-related activities, mushrooms are also involved and/or exploited in forestry, pharmaceutical industry and food production. Hence, they represent a major economic resource worldwide (Angelini et al. 2008, 2015b, 2018, Pagiotti et al. 2011, Bonanno et al. 2019). In order to maintain and to improve their strategic importance, several conservation strategies are needed (Wagensommer et al. 2018).

In this paper, a checklist of fungi occurring at the Marmore Waterfalls is reported with the aim of contributing to the knowledge about the biodiversity in this area.

Material and methods

Study area

The Marmore Waterfalls (42°33'15.56"N, 12°42'44"E), extending over an area of about 1,59 km^2 (200–360 m a.s.l.), is located in the province of Terni, the south-eastern part of Umbria (Fig. 1).

The rock wall that gives rise to the waterfall is divided into three interspersed drops. When the waterfall is closed, ponds carved into the rock by the power of water can be seen.

The study area was located on the left side of the Nera River, specifically on a series of Pleistocene terraces characterized by fluvial-lacustrine and travertine deposits (Car-

rara et al. 1993), ending at the base of the waterfall where the Velino River flows into the Nera River. The study area continues along the pathways that rise to the upper overlook. The lithology is characterized by crossings, whose deposition of calcareus travertine (or tufa) is still active, and in which there are interesting cavities. According to IT5220017 Natura 2000-Standard Data Form (http://www.regione.umbria.it/ambiente/siti-di-importanza-comunitaria-sic/), the EU-habitats investigated were: 91E0*, alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*; 92A0, *Salix alba* and *Populus alba* galleries; 6430, hydrophilous tall herb fringe communities of the plains and the mountains to alpine levels; 7220*, petrifying springs with tufa formation (*Cratoneurion*); 9340, *Quercus ilex* and *Quercus rotundifolia* forests. They are mostly located at the base of rock faces, and subject to water spray on organic debris colonised by briophytes (Ellis et al. 2014, Poponessi et al. 2014, Ellis et al. 2016, 2017, 2018).

Macrofungal species sampling

Mycological sampling was carried out starting in 2008. Sampling was performed monthly, in particular, along the areas adjacent to the waterfall (EU-Habitat 7220*), along the different paths that go through the Park (Fig. 1).

Collections were made by samplings of each ascoma and basidioma. The surveys were limited to macromycetes that were visible to the naked eye (1 mm in size) (sensu Arnolds 1981).

The macromycetes were identified based on macro and micromorphological features according to the descriptions available in literature (Dennis 1978, Moser 1980, Jülich 1989, Candusso and Lanzoni 1990, Courtecuisse and Duhem 1994, Basso 1999, Hrouda 1999, Bernicchia 2005, Bernicchia and Gorjón 2010, Breitenbach and Kränzlin 1984, 1986, 1991, 1995, 2000, Franchi and Marchetti 2001, Robich 2003). For species names and author abbreviations, the Index Fungorum (http://www.indexfungorum.org/Names/Names.asp) and Dictionary of the Fungi (Kirk et al. 2008) were used.

The voucher specimens were dried in air-ventilated ovens at 30 °C for 72 h and deposited at the PeruMyc herbarium of the Department of Chemistry, Biology and Biotechnology of the University of Perugia (Italy).

Ecological and statistical analyses

Species richness was calculated as the number of taxa collected over the ten years. Macrofungal diversity was determined using Fisher's alpha (F), Shannon (H) and Simpson (1/D) indices (Fisher et al. 1943). Similarity of the macrofungal communities among the five EU-habitat was examined with similarity indices based on presence/absence data (Jaccard's index).

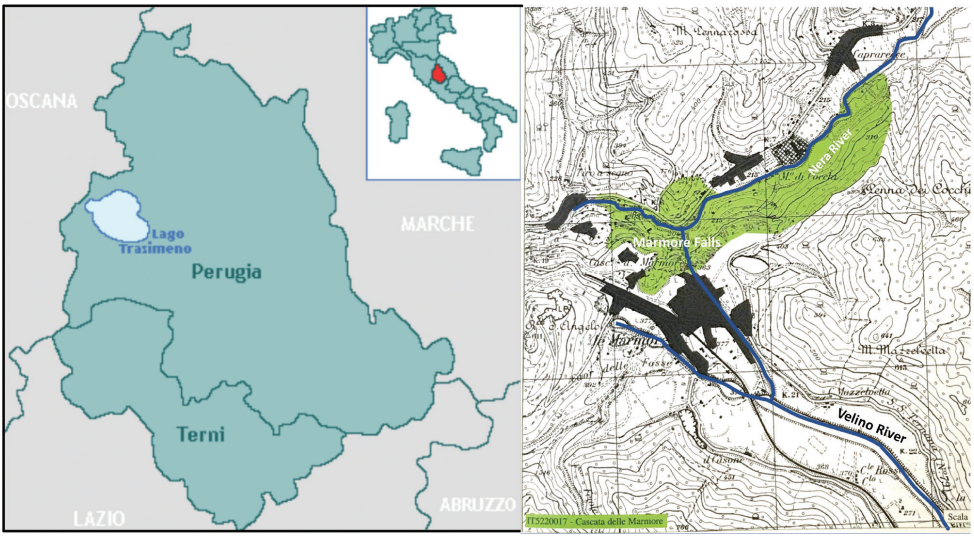

Figure 1. (draft) Marmore Waterfall Site of Community Importance according to Habitats Directive (92/43/EEC) IT IT5220017: the study area in green.

These parameters were calculated using ESTIMATES 9.1.0 (R.K. Colwell, http://purl.oclc.org/estimates). The macrofungal species were also classified into ecological trophic groups based on their primary mode of nutrition (Arnolds et al. 1995; Tedersoo and Smith 2013; Tedersoo et al. 2014).

Results

The Marmore Waterfalls, repeatedly surveyed from 2008–2018, showed the presence of 125 species belonging to 78 genera, 46 families, and 15 orders (Suppl. material 1: Table S1, Figs 2–3). Sixty-nine families belong to the Basidiomycota class and 7 to the Ascomycota.

The largest number of orders (12), genera (70) and species (107) belongs to Basidiomycota. Eighteen species, included in 8 genera, 7 families, and 3 orders belong to Ascomycota (Suppl. material 1: Table S1, Figs 2, 3). The Fisher's α, Shannon J' and Simpson (1/D) diversity indices, based on species number per genus, were 88.73, 4.18, and 52.26, respectively.

Agaricales was the most represented order, hosting the largest number of genera, followed by Polyporales and Boletales (Fig. 3). The families that had the highest number of species were Agaricaceae (10), Psathyrellaceae (9), Physalacriaceae, and Helvellaceae (7), Inocybaceae (6), and Tricholomataceae (6), which collectively accounted for approximately 30% of diversity (Suppl. material 1: Table S1). *Helvella* was the most diverse genus with 7 species, followed by *Coprinopsis* (6), *Mycena* (5), *Inocybe* (4), and *Peziza* (4) (Suppl. material 1: Table S1).

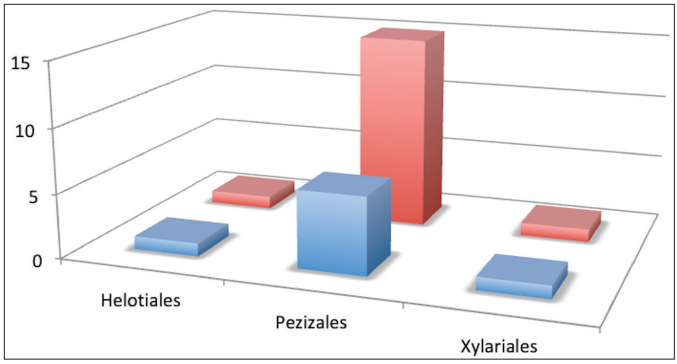

Figure 2. Distribution of macrofungal species and genera per order of Ascomycota: (i) blue columns indicate the number of genera; (ii) red columns indicate the number of species.

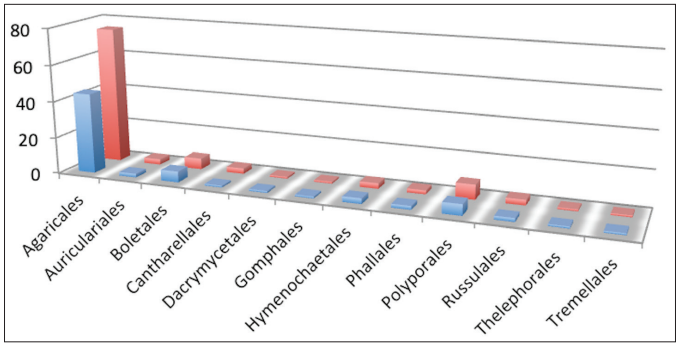

Figure 3. Distribution of macrofungal species and genera per order of Basidiomycota: (i) blue columns indicate the number of genera; (ii) red columns indicate the number of species.

The list of the species with their ecological trophic group is reported in Suppl. material 1: Table S1.

The two main trophic groups were the saprotrophs and ectomycorrhizals, with a total number of 97 and 22 species, respectively.

The saprotrophs were mainly either terrestrial (St) or lignicolous (Sh), which account for 33.6% and 29.6 %, respectively.

The other groups [Pn, Pn(Sh)] collectively represented only 4.8% of the total diversity (Suppl. material 1: Table S1, Fig. 4).

With reference to the Umbrian Checklist of macrofungi (Angelini et al. 2017), 44 species new for the region were found at the Marmore Waterfalls. Thirty-four species included in Red Lists of European countries (http://www.wsl.ch/eccf/) were also found at the site. These species are indicated with the symbols * and ^, respectively, in Suppl. material 1: Table S1.

Fungal community composition varied across the EU-habitat types, as shown in Suppl. material 1: Table S1. Most of the species were sparsely distributed, occurring

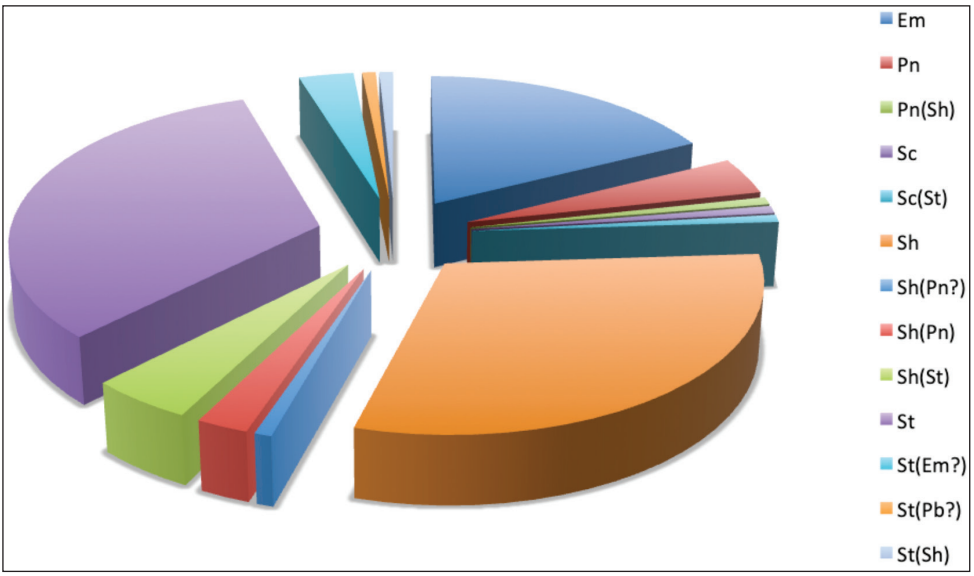

Figure 4. Distribution of macrofungal species per ecological-trophic group (Em, ectomycorrhizal; Pn, necrotrophic parasite; Pn(Sh), necrotrophic parasite or sometimes lignicolous saprotroph; Sc, coprophilous; Sc(St), coprophilous or maybe terrestrial saprotroph; Sh, lignicolous saprotroph; Sh(Pn), lignicolous saprotroph or sometimes necrotrophic parasite; Sh(Pn?), lignicolous saprotroph or maybe necrotrophic parasite; Sh(St), lignicolous saprotroph or sometimes terrestrial saprotroph; St, terrestrial saprotroph; St(Em?), terrestrial saprotroph or maybe ectomycorrhizal; St(Pb?); terrestrial saprotroph or maybe biotrophic parasite).

in few habitat types. More specifically, 108 species were found in only one habitat, 15 were in two types, and 3 in three types.

Regarding the main trophic groups, St species ranged from 22.95% in habitat 9340 to 58.33% in habitat 7220*; Sh species were absent in habitat 6430 and ranged from 22.95% in habitat 9340 to 39% in habitat 92A0. Em species in habitat 9340 (34.42%) were more abundant than saprophic species (Sh or St). Contrarily, in habitats 91E0* and 92A0, Em species were less abundant than Sh/St species. In habitats 6430 and 7220*, Em species were absent (Suppl. material 1: Table S2).

The similarity among EU-habitat types calculated on the basis of presence-absence of fungal species (Jaccard's index) ranged from 0.095 (EU-habitat 9340 vs. EU-habitat 92A0) to 0 (EU-habitat 9340 vs. EU-habitat 7220*) (Suppl. material 1: Table S3). EU-habitats 6340 and 7220* had the most distinctive macrofungal community. *Bolbitius titubans*, *Lacrymaria lacrymabunda* and *Agrocybe vervacti* were restricted to 6340 (Suppl. material 1: Table S1). Some Ascomycota, such as *Helvella corium*, *H. crispa*, *Peziza domiciliana*, *P. queletii*, *Scutellinia scutellata*, and *Tarzetta cupularis* seem to be important biotic components of the priority EU-Habitat 7220* together with some Basidiomycota, such as *Echinoderma calcicola*, *Mycena galopus*, *Phloeomana conopilea*, *P. hiemalis*, *P. speirea*, and *Psathyrella candolleana* (Suppl. material 1: Table S1, Figs S1, S2).

Discussion

This study provided a list of 125 macrofungal species identified at the Marmore Waterfalls over the last ten years (2008–2018) in different Natura 2000 EU-Habitats. Macrofungal communities are structured by host plants/EU-habitats. Similarity was very low among EU-Habitat types, with the exception of 9340 and 92A0 which shared 9 fungal species (*Agaricus moelleri*, *Auricularia mesenterica*, *Calocera cornea*, *Clathrus ruber*, *Schizophyllum commune*, *Lepista nuda*, *L. sordida*, *Tubaria furfuracea*, *T. romagnesiana*).

The dominant tree species of habitats 9340 and 92A0 differed; thus, 9340 showed higher mycorrhizal species richness, while 92A0 had a higher relative number of saprotrophic macrofungi.

Despite the fact that this study is an initial qualitative survey of the macrofungi (based on the presence-absence of species) from the Marmore Waterfalls, it provided a list of 12 fungal species for Habitat 7220*, "Petrifying spring with tufa formation (*Cratoneurion*)", reported here for the first time and never before documented in previous studies in Italy. In general, they are alkalotolerant species (ecological-trophic group: St, terrestrial saprotrophic) and represent, along with the bacteria, the major taxa responsible for decomposing and recycling various organic materials produced by primary producers, the resilient remains of other organisms (bryophytes, algae, protozoans, metazoans, etc.) and dissolved organic compounds (Madigan et al. 2003).

Among the small number of ascomycetes collected during this study, there are five species reported by Wagensommer et al. (2018) as endangered (*Morchella esculenta*, *Scutellinia scutellata*) or "vulnerable" (*Helvella leucomelaena*, *Peziza succosa*, *Saecoscypha coccinea*) in Umbria, because of the threat to their status due to natural or anthropic action.

Of the 34 fungal species included in Red Lists of European countries (http://www.wsl.ch/eccf/) is noteworthy the presence of: (1) *Coprinopsis strossmayeri*, a rare species in Italy (Suppl. material 1: Fig. S3), previously collected only in Piemonte (Vizzini 2001); (2) *Echinoderma calcicola*, a widespread but rare European species, reported only in five other Italian regions (Lombardia, Marche, Piemonte, Toscana, and Veneto) (Onofri et al. 2005). It is considered as "endangered" in the Sweden Red List (Tingstad et al. 2017).

While further study based on fruiting body abundance is needed to provide a measure of the relative importance of a species in EU-habitats, it can be concluded that this ten-year survey has demonstrated that the diversity of the fungi at the Marmore Waterfalls is remarkable, given the high number of species identified in a very small area. The data collected also contribute to draft a naturalistic plan of the Marmore Waterfalls, and provide useful information for monitoring habitats and species of European interest (as required by the Important Plant Areas program and Habitat Directive 92/43/EEC). Important Plant Areas (IPAs) are the most important places in the world for wild plant and fungal diversity, that can be protected and managed as specific sites (Blasi et al. 2009, 2011). The IPA project forms an integral part of a much wider conservation framework, from the global Convention on Biological Diversity framework to regional pan-European and European Union initiatives (Planta Europa

2008, Darbyshir et al. 2017). It gives the possibility of becoming part of conservation actions to countries, habitats and organisms, in some way not considered in the Habitat Directive 92/43/CEE (Perini et al. 2011). Its aim is to identify priority sites using three criteria (threatened species, exceptional botanical richness, and threatened habitats) and to work towards their conservation and management (Anderson 2002, Venturella et al. 2011).

References

Aleffi M, Spampinato G (2009) Habitat 7220. In: Biondi E, Blasi C, Burrascano S, Casavecchia S, Copiz R, Del Vico E, Galdenzi D, Gigante D, Lasen C, Spampinato G, Venanzoni R, Zivkovic L (Eds) Manuale Italiano di interpretazione degli habitat della Direttiva 92/43/CEE. SBI, MATTM, DPN.

Anderson S (2002) Identifying Important Plant Areas. Plantlife, 50 pp.

Angelini P, Arcangeli A, Bistocchi G, Rubini A, Venanzoni R, Perini C (2017) Current knowledge of Umbrian macrofungi (central Italy). Plant Biosystems 151(5): 915–923. https://doi.org/10.1080/11263504.2016.12656

Angelini P, Bistocchi G, Arcangeli A, Bricchi E, Venanzoni R (2015a) Diversity and ecological distribution of macrofungi in a Site of Community Importance of Umbria (Central Italy). The Open Environmental Research Journal 8: 1–8. https://doi.org/10.2174/1874213001508010001

Angelini P, Bistocchi G, Arcangeli A, Rubini A, Venanzoni R (2016a) Inventory, diversity and communities of macrofungi in the Collestrada forest (Umbria, Central Italy). Plant Biosystems 150(5): 1096–1105. https://doi.org/10.1080/11263504.2015.1108939

Angelini P, Compagno R, Arcangeli A, Bistocchi G, Gargano ML, Venanzoni R, Venturella G (2016b) Macrofungal diversity and ecology in two Mediterranean forest types. Plant Biosystems 150: 540–549. https://doi.org/10.1080/11263504.2014.987844

Angelini P, Granetti B, Pagiotti R (2008) Effect of antimicrobial activity of *Melaleuca alternifolia* essential oil on antagonistic potential of *Pleurotus* species against *Trichoderma harzianum* in dual culture. World Journal of Microbiology and Biotechnology 24: 197–202. https://doi.org/10.1007/s11274-007-9456-x

Angelini P, Tirillini B, Bistocchi G, Arcangeli A, Rubini A, Pellegino RM, Fabiani R, Cruciani G, Venanzoni R, Rosignoli P (2018) Overview of the biological activities of a methanol extract from wild Red Belt Conk, *Fomitopsis pinicola* (Agaricomycetes), fruiting bodies from central Italy. International Journal of Medicinal Mushrooms 20(11): 1047–1063. https://doi.org/10.1615/IntJMedMushrooms.2018028595

Angelini P, Tirillini B, Properzi A, Rol C, Venanzoni R (2015b) Identification and bioactivity of the growth inhibitors in *Tuber* spp. methanolic extracts. Plant Biosystems 149(6): 1000–1009. https://doi.org/10.1080/11263504.2014.983575

Arnolds E (1981) Ecology and coenology of macrofungi in grasslands and moist heathlands in Drenthe, the Netherlands. Part 1. Introduction and Synecology. Biblioteca Mycologica 83: 1–410.

Arnolds E, Kuyper TW, Noordeloos EM (1995) Overview of the fungi in the Netherlands. Wijster, Nederlandse Mycologische Vereniging, 872 pp.

Basso MT (1999) *Lactarius* Pers. Fungi Europaei. Alassio, 845 pp.

Bernicchia A (2005) Polyporaceae s.l., Fungi Europaei, 10. Alassio, 808 pp.

Bernicchia A, Gorjön SP (2010) Corticiaceae s.l. Fungi Europaei, 12. Alassio, 1008 pp.

Blasi C, Marignani M, Copiz R, Fipaldini M (2009) Mapping the Important Plant Areas in Italy. Palombi Editori, Roma.

Blasi C, Marignani M, Fipaldini M, Copiz R (2011) Between global priorities and local urgencies: the Important Plant Areas programme in Italy. Fitosociologia 48(2) suppl. 1: 137–143.

Bonanno A, Di Grigoli A, Vitale F, Di Miceli G, Todaro M, Alabiso M, Gargano ML, Venturella G, Anike FN, Isikhuemhen OS (2019) Effects of diets supplemented with medicinal mushroom myceliated grains on some production, health, and oxidation traits of dairy Ewes. International Journal of Medicinal Mushrooms 21(1): 69–103. https://doi.org/10.1615/IntJMedMushrooms.2018029327

Breitenbach J, Kränzlin F (1984) Champignons de Suisse, 1. Les Ascomycetes. Lucerne.

Breitenbach J, Kränzlin F (1986) Champignons de Suisse, 2. Champignons sans lames. Hétérobasidiomycétes, Aphyllophorales, Gastéromycétes. Lucerne.

Breitenbach J, Kränzlin F (1991) Champignons de Suisse, 3. Bolets et champignons a` lames. 1ére partie. Strobilomycetaceae, Boletaceae, Paxillaceae, Gomphidiaceae, Hygrophoraceae, Tricholomataceae, Polyporaceae (lamellées). Lucerne.

Breitenbach J, Kränzlin F (1995) Champignons de Suisse, 4. Bolets et champignons á lames. 2eme partie. Entolomataceae, Pluteaceae, Amanitaceae, Agaricaceae, Coprinaceae, Bolbitiaceae, Strophariaceae. Lucerne.

Breitenbach J, Kränzlin F (2000) Champignons de Suisse, 5. Champignons á lames. 3eme partie. Cortinariaceae. Lucerne.

Candusso M, Lanzoni G (1990) *Lepiota* s.l. Fungi Europaei 4. G. Biella Editions, Saronno, Italy, 743 pp.

Carrara C, Brunamonte F, Ferrell L, Lorenzoni P, Margheriti L, Michetti AM, Raglione M, Rosati M, Serva L (1993) I terrazzi della medio-bassa valle del F. Velino. Studi Geologici Camerti 1992(1): 97–102, 5ff., Camerino.

Courtecuisse R, Duhem B (1994) Les champignons de France. Paris.

Darbyshire I, Anderson S, Asatryan A, Byfield A, Cheek M, Clubbe C, Ghrabi Z, Harris T, Heatubun CH, Kalema J, Magassouba S, McCarthy B, Milliken W, de Montmollin B, Lughadha EN, Onana JM, Saïdou D, Sârbu A, Shrestha K, Radford EA (2017) Important Plant Areas: revised selection criteria for a global approach to plant conservation. Biodiversity Conservation 26: 1767–1800. https://doi.org/10.1007/s10531-017-1336-6

Dennis RWG (1978) British Ascomycetes. Vaduz.

Ellis LT, Afonina OM, Aleffi M, Andriamiarisoa RL, Bačkor M, Goga M, Bednarek-Ochyra H, Callaghan DA, Campisi P, Dia MG, Marino ML, Enroth J, Erzberger P, Hugonnot V, Ignatova EA, Kiebacher T, Kučera J, Lebouvier M, Maria GM, Ştefănuţ S, Nagy J, Pócs T, Poponessi S, Venanzoni R, Gigante D, Prosser F, Reeb C, Sabovljević MS, Shevock JR, Shirzadian S, Akhoondi Darzikolaei S, Souza ERF, Silva Pinto A, Silva JB, Lopes SF, Torzewski K, Kazienko A (2018) New national and regional bryophyte

records, 55. Journal of Bryology 40(2): 173–187. https://doi.org/10.1080/03736687.2018.1454161

Ellis LT, Alataş M, Aleffi M, Alegro A, Šegota V, Ozimec S, Vuković N, Koletić N, Prlić D, Bontek M, Asthana AK, Gupta D, Sahu V, Rawat KK, Bakalin VA, Klimova KG, Baráth K, Beldiman LN, Csiky J, Deme J, Kovács D, Cano MJ, Guerra J, Czernyadjeva IV, Dulin MV, Erzberger P, Ezer T, Fedosov VE, Fontinha S, Sim-Sim M, Garcia CA, Martins A, Granzow-de la Cerda I, Sáez L, Hassel K, Weibull H, Hodgetts NG, Infante M, Heras P, Kiebacher T, Kučera J, Lebouvier M, Ochyra R, Ören M, Papp B, Park SJ, Sun BY, Plášek V, Poponessi S, Venanzoni R, Purger D, Reis F, Sinigla M, Stebel A, Ştefănuţ S, Uyar G, Vončina G, Wigginton MJ, Yong KT, Chan MS, Yoon YJ (2017) New national and regional bryophyte records, 52. Journal of Bryology 39(3): 285–304. https://doi.org/10.1080/03736687.2017.1341752

Ellis LT, Aleffi M, Alegro A, Segota V, Asthana AK, Gupta R, Singh VJ, Bakalin VA, Bednarek-Ochyra H, Cykowska-Marzencka B, Benitez A, Borovichev EA, Vilnet AA, Konstantinova NA, Buck WR, Cacciatoro C, Sérgio C, Csiky J, Deme J, Kovács D, Damsholt K, Enroth J, Erzberger P, Fedosov VE, Fuertes E, Gradstein SR, Gremmen NJM, Hallingbäck T, Jukonienė I, Kiebacher T, Larraín J, Lebouvier M, Lüth M, Mamontov YS, Potemkin AD, Nemeth C, Nieuwkoop JAW, Nobis M, Węgrzyn M, Wietrzyk P, Osorio F, Parnikoza I, Virchenko VM, Peralta DF, Carmo DM, Plášek V, Skoupá Z, Poponessi S, Venanzoni R, Puche F, Purger D, Reeb C, Rios R, Rodriguez-Quiel E, Arrocha C, Sabovljević MS, Nikolić N, Sabovljević AD, dos Santos EL, Segarra-Moragues JG, Ştefănuţ S, Stončius D (2016) New national and regional bryophyte records, 48. Journal of Bryology 38(3): 223–244. https://doi.org/10.1080/03736687.2016.1206685

Ellis LT, Aleffi M, Asthana AK, Srivastava A, Bakalin VA, Batan N, Özdemir T, Bednarek-Ochyra H, Borovichev EA, Brugués M, Cano MJ, Choi SS, De Beer D, Eckstein J, Erzberger P, Fedosov VE, Ganeva A, Natcheva R, Garcia CA, Sérgio C, Garilleti R, Albertos B, Puche F, Gücel S, Higuchi M, Hugonnot V, Hylander K, Kirmaci M, Aslan G, Koponen T, Lara F, Mazimpaka V, van Melick H, Müller F, Özenoglu Kiremit H, Papp B, Szurdoki E, Plášek V, Čihal L, van der Pluijm A, Poponessi S, Mariotti MG, Reyniers J, Sabovljević MS, Sawicki J, Smith VR, Stebel A, Ştefănuţ S, Sun BY, Váňa J, Venanzoni R (2014) New national and regional bryophyte records, 40. Journal of Bryology 39(3): 235–259. https://doi.org/10.1179/1743282014Y.0000000115

Fisher RA, Corbet AS, Williams CB (1943) The relation between the number of species and the number of individuals in a random sample of an animal population. Journal of Animal Ecology 12: 42–58. https://doi.org/10.2307/1411

Ford TD, Pedley HM (1996) A review of tufa and travertine deposits of the world. Earth-Science Reviews 41: 117–175. http://doi.org/10.1016/S0012-8252(96)00030-X

Frąc M, Hannula SE, Bełka M, Jędryczka M (2018) Fungal biodiversity and their role in soil health. Frontiers in Microbiology 9: 107. http://doi.org/10.3389/fmicb.2018.00707

Franchi P, Marchetti M (2001) Introduzione allo studio del genere *Ramaria* in Europa. Fungi non Delineati 16: 1–104.

Hrouda P (1999) Hydnaceous fungi of the Czech Republic and Slovakia. Czech Mycology 51(2–3): 99–155.

Jülich W (1989) Guida alla determinazione dei funghi, 2. Aphyllophorales, Heterobasidiomycetes, Gasteromycetes. Saturnia Ed. Trento, 598 pp.

Kirk PM, Cannon PF, Stalpers JA (2008) Dictionary of the Fungi. 10th ed. Wallingford: CAB International. 784 pp.

Lyons MD, Kelly DL (2016) Monitoring guidelines for the assessment of petrifying springs in Ireland. Irish Wildlife Manuals, No. 94. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, Ireland.

Madigan MT, Martinko JM, Parker JPH (2003) Brock Biology of Microorganisms. 10th ed, Upper Saddle River, NJ Prentice Hall London Pearson Education.

Moser MM (1980) Guida alla determinazione dei funghi. (Polyporales, Boletales, Agaricales, Russulales). Saturnia, Trento, 565 pp.

Onofri S, Bernicchia A, Filipello Marchisio V, Padovan F, Perini C, Ripa C, Savino E, Venturella G, Vizzini A, Zotti M, Zucconi L (2005) Checklist of Italian fungi. Carlo Delfino Editions, Sassari.

Pagiotti R, Angelini P, Rubini A, Tirillini B, Granetti B, Venanzoni R (2011) Identification and characterisation of human pathogenic filamentous fungi and susceptibility to *Thymus schimperi* essential oil. Mycoses 54: e364–376. https://doi.org/10.1111/j.1439-0507.2010.01926.x

Pecoraro L, Angelini P, Arcangeli A, Bistocchi G, Gargano ML, La Rosa A, Lunghini D, Polemis E, Rubini A, Saitta S, Venanzoni R, Zervakis GI (2014) Macrofungi in mediterranean maquis along seashore and altitudinal transects. Plant Biosystems 148(2): 367–376. https://doi.org/10.1080/11263504.2013.877535

Perini C, Leonardi P, Pecoraro L, Salerni E (2011) The Important Plant Areas program from a mycological point of view: the regional experience in an European context. Fitosociologia 48(2) suppl. 1: 155–161.

Perotto S, Angelini P, Bianciotto V, Bonfante P, Girlanda M, Kull T, Mello A, Pecoraro L, Perini C, Persiani AM, Saitta A, Sarrocco S, Vannacci G, Venanzoni R, Venturella G, Selosse A (2013) Interaction of fungi with other organisms. Plant Biosystems 147: 208–218. https://doi.org/10.1080/11263504.2012.753136

Picco AM, Angelini P, Ciccarone C, Franceschini A, Ragazzi A, Rodolfi M, Varese GC, Zotti M (2011) Biodiversity of emerging pathogenic and invasive fungi in plants, animals and humans in Italy. Plant Biosystems 145: 988–996. https://doi.org/10.1080/11263504.2011.633118

Planta Europa (2008) A Sustainable future for Europe; the European strategy for plant conservation 2008–2014. Plant life International and the Council of Europe, 57 pp.

Poponessi S, Aleffi M, Venanzoni R (2014) *Conocephalum salebrosum* Szweykowski, Buczkowska et Odrzykoski (Conocephalaceae, Marchantiophyta), new to Italy. Cryptogamie, Bryologie 35(2): 223–226. https://doi.org/10.7872/cryb.v35.iss2.2014.223

Robich G (2003) *Mycena* d'Europa. A.M.B. Fondazione, Centro Studi. Micologici, Vicenza, 728 pp.

Saitta A, Bernicchia A, Gorjon SP, Altobelli E, Granito VM, Losi C, Lunghini D, Maggi O, Medardi G, Padovan F, Pecoraro L, Vizzini A, Persiani AM (2011) Biodiversity of wood-decay fungi in Italy. Plant Biosystems 145(4): 958–968. https://doi.org/10.1080/11263504.2011.633114

Tedersoo L, Smith ME (2013) Lineages of ectomycorrhizal fungi revisited: foraging strategies and novel lineages revealed by sequences from belowground. Fungal Biology Reviews 27: 83–99. https://doi.org/10.1016/j.fbr.2013.09.001

Tedersoo L, Bahram M, Põlme S, Kõljalg U, Yorou NS, Wijesundera R, Ruiz LV, Vasco-Palacios AM, Thu PQ, Suija A, Smith ME, Sharp C, Saluveer E, Saitta A, Rosas M, Riit T, Ratkowsky D, Pritsch K, Põldmaa K, Piepenbring M, Phosri C, Peterson M, Parts K, Pärtel K, Otsing E, Nouhra E, Njouonkou AL, Nilsson RH, Morgado LN, Mayor J, May TW, Majuakim L, Lodge DJ, Lee SS, Larsson KH, Kohout P, Hosaka K, Hiiesalu I, Henkel TW, Harend H, Guo L, Greslebin A, Grelet G, Geml J, Gates G, Dunstan W, Dunk C, Drenkhan R, Dearnaley J, Kesel AD, Dang T, Chen X, Buegger F, Brearley FQ, Bonito G, Anslan S, Abell S, Abarenkov K (2014) Global diversity and geography of soil fungi. Science 346(6213): 1256688. https://doi.org/10.1126/science.1256688

Tingstad L, Gjerde I, Dahlberg A, Grytnes JA (2017) The influence of spatial scales on Red List composition: forest species in Fennoscandia. Global Ecology and Conservation 11: 247–297. https://doi.org/10.1016/j.gecco.2017.07.005

Venturella G, Altobelli E, Bernicchia A, Di Piazza S, Donnini D, Gargano ML, Gorjòn SP, Granito VM, Lantieri A, Lunghini D, Montemartini A, Padovan F, Pavarino M, Pecoraro L, Perini C, Rana G, Ripa C, Salerni E, Savino E, Tomei PE, Vizzini A, Zambonelli A, Zotti M (2011) Fungal biodiversity and in situ conservation in Italy. Plant Biosystems 145: 950–957. https://doi.org/10.1080/11263504.2011.633115

Vizzini A (2001) A rare species in the Valentino Park (Turin): *Coprinopsis strossmayeri*. Bollettino del Gruppo Micologico G. Bresadola, n.s. 44(1): 4–12.

Wagensommer RP, Bistocchi G, Arcangeli A, Rubini A, Perini C, Venanzoni R, Angelini P (2018) An assessment of red list data for the Pezizomycotina (Ascomycota): Umbria (Italy) as a test case. Plant Biosystems 152(6): 1329–1337. https://doi.org/10.1080/11263504.2018.1448015

Zervakis GI, Venturella G (2007) Adverse effects of human activities on the diversity of macrofungi in forest ecosystems. Bocconea 21: 77–84.

Supplementary material 1

Supplementary tables and figures

Authors: Roberto Venanzoni, Enrico Bini, Emma Bricchi, Paola Angelini

Data type: species data

Explanation note: **Table S1.** List of macrofungal species collected in the Marmore Waterfalls, Terni, Umbria. **Table S2.** Percentage of relative abundance and number (in parentheses) of fungal species from each ecological group in the Marmore Waterfalls EU- habitats [91E0*, Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno Padion*, *Alnion incanae*, *Salicion albae*); 92A0, *Salix alba* and *Populus alba* galleries; 6430, Hydrophilous tall herb fringe communities of the plains and the mountains to alpine levels; 7220*, Petrifying springs with tufa formation (*Cratoneurion*); 9340, *Quercus ilex* and *Quercus rotundifolia* forests]. **Table S3.** Similarity of macrofungi communities with respect to EU-habitat [91E0*, Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*); 92A0, *Salix alba* and *Populus alba* galleries; 6430, Hydrophilous tall herb fringe communities of the plains and of the mountains to alpine levels; 7220*, Petrifying springs with tufa formation (*Cratoneurion*); 9340, *Quercus ilex* and *Quercus rotundifolia* forests], reflecting similarity based on presence/absence data only (Jaccard's index). **Figure S1.** Ascomycota species found in EU Habitat 7220* (Marmore Waterfalls, TR): 1) *Helvella corium* (O. Weberb.) Massee, 2) *H. crispa* (Scop.) Fr., 3) *Peziza domiciliana* Lantieri & Cacialli, 4) *Peziza queletii* Medardi, 5) *Scutellinia scutellata* (L.) Lambotte and 6) *Tarzetta cupularis* (L.) Svrček. **Figure S2.** Basidiomycota species found in EU Habitat 7220* (Marmore Waterfalls, Terni, Umbria): 1) *Echinoderma calcicola* (Knudsen) Bon, 2) *Mycena galopus* (Pers.) P. Kumm, 3) *Parasola conopilus* (Fr.) Örstadius & E. Larss, 4) *Phloeomana hiemalis* (Osbeck) Redhead, 5) *P. speirea* (Fr.) Redhead and 6) *Psathyrella candolleana* (Fr.) Maire. **Figure S3.** *Coprinopsis strossmayeri* (Schulzer) Redhead, Vilgalys & Moncalvo: 1) basidiocarps. Microscopic features (1000×): 2) hyphae with a joint buckle, 3) details of the veil, 4) spores.

Link: https://doi.org/10.3897/italianbotanist.7.33308.suppl1

Italian Botanist 7: 31–33 (2019)
doi: 10.3897/italianbotanist.7.34379
http://italianbotanist.pensoft.net

SHORT COMMUNICATION

Italian Botanist
Published by Società Botanica Italiana

New combinations for two hybrids in *Salvia* subg. *Rosmarinus* (Lamiaceae)

Francesco Roma-Marzio[1], Gabriele Galasso[2]

1 *Sistema Museale di Ateneo dell'Università di Pisa, Orto e Museo Botanico, Via Luca Ghini 13, 56126 Pisa, Italy* **2** *Sezione di Botanica, Museo di Storia Naturale di Milano, Corso Venezia 55, 20121 Milano, Italy*

Corresponding author: *Francesco Roma-Marzio* (francesco.romamarzio@unipi.it)

Academic editor: *L. Peruzzi* | Received 11 March 2019 | Accepted 14 March 2019 | Published 1 April 2019

Citation: Roma-Marzio F, Galasso G (2019) New combinations for two hybrids in *Salvia* subg. *Rosmarinus* (Lamiaceae). Italian Botanist 7: 31–33. https://doi.org/10.3897/italianbotanist.7.34379

Drew et al. (2017) proposed a new circumscription of the genus *Salvia* L., including the genera *Dorystaechas* Boiss. & Heldr. ex Benth., *Meriandra* Benth., *Perovskia* Kar., *Rosmarinus* L., and *Zhumeria* Rech.f. & Wendelbo, based on a wide-scale phylogenetic study.

Salvia subg. *Rosmarinus* (L.) J.B.Walker, B.T.Drew & J.G.González includes three species of aromatic shrubs native to the Mediterranean region (Upson 2006, Drew et al. 2017): *Salvia granatensis* B.T.Drew (≡ *Rosmarinus tomentosus* Hub.-Mor. & Maire), *Salvia jordanii* J.B.Walker (≡ *Rosmarinus eriocalix* Jord. & Fourr.), and *Salvia rosmarinus* Spenn. (≡ *Rosmarinus officinalis* L.). The latter name was erroneously reported by Drew et al. (2017) as a new combination of the later isonym *Salvia rosmarinus* Schleid. ("*S. rosmarinus* (L.) Schleid.").

Within the former genus *Rosmarinus*, two hybrids were described: *R.* ×*mendizabalii* Sagredo ex Rosua (*R. officinalis* × *R. tomentosus*) and *R.* ×*lavandulaceus* de Noé (*R. eriocalix* × *R. officinalis*). A third nothospecies, *R.* ×*noeanus* Maire, was described as a hybrid between *R. officinalis* and *R. tournefortii* (de Noé ex Jord. & Fourr.) Jahand. & Maire (Maire 1932). However, the latter parental taxon is currently considered as a heterotypic synonym of *R. eriocalix* (Rosúa 1986, Drew et al. 2017), so that *R.* ×*noeanus* is just a heterotypic synonym of *R.* ×*lavandulaceus*.

At the best of our knowledge, these hybrids were not recombined under *Salvia*, so that we propose here the two combinations under this genus.

***Salvia* ×*lavandulacea* (de Noé) Roma-Marzio & Galasso, comb. nov.**
urn:lsid:ipni.org:names:60478451-2

(*S. jordanii* × *S. rosmarinus*)

Rosmarinus ×*lavandulaceus* de Noé, Pl. Algérie [exsicc.]: n° 444 (1852) pro sp. (*R. eriocalix* × *R. officinalis*) [Basionym]. Type (lectotype, designated by Rosúa 1986: 184):—ALGERIA. *Rosmarinus lavandulaceus* De Noè, fragment du type! (*Balansa*, Plantes d'Algérie 1852, n° 444), Oran, les Andalouses, s.d., [*Balansa*; fragment collected by *Maire*] (MPU001245 [digital image!], isolectotypes: BM000796985 [digital image!], FI000836 [digital image!], FI-W000483 [digital image!], G00169751 [digital image!], K000193366 [digital image!], MPU001244 [digital image!], P00446728 [digital image!], P00076024 [digital image!], P00076025 [digital image!], W1889-0103569 [digital image!]; the image of the lectotype is available at: https://herbier.umontpellier.fr/zoomify/zoomify.php?fichier=MPU001245

Distribution. Spain, Morocco, Algeria, Tunisia, and Libya (Rosúa 1986).

Note. The basionym was published by indelible autograph on specimen labels (Arts. 30.5–6 of the ICN, Turland et al. 2018, see also Galasso et al. 2018 for similar cases). Accordingly, all the duplicates of *Rosmarinus lavandulaceus* de Noé linked to n° 444 of the exsiccata series "Plantes d'Algérie", preserved in several European herbaria, are syntypes and eligible for lectotypification. The type indicated by Rosúa (1986), although mounted on a sheet with a handwritten label different from those of series "Plantes d'Algérie" is also original material since it represents a fragment of one of the syntypes (see also Art. 8.3, Ex. 8 of the ICN).

***Salvia* ×*mendizabalii* (Sagredo ex Rosúa) Roma-Marzio & Galasso, comb. nov.**
urn:lsid:ipni.org:names:60478452-2

(*S. granatensis* × *S. rosmarinus*)

Rosmarinus ×*mendizabalii* Sagredo ex Rosúa, Anales Jard. Bot. Madrid 37(2): 594 (1981) (*R. officinalis* × *R. tomentosus*) [Basionym].

– *Rosmarinus* ×*mendizabalii* Sagredo, Anales Inst. Bot. Cavanilles 32(2): 310 (1975), nom. nud. Type:—SPAIN. In rupibus dolomiticas, prope littorale granatense, inter Castell de Ferro et Calahonda, 30S VF 6563, *J.L. Rosúa*, 20 November 1979 (holotype, GDAC7544).

Distribution. Spain (Rosúa 1986).

References

Drew BT, González-Gallegos JG, Xiang CL, Kriebel R, Drummond CP, Walker JB, Sytsma KJ (2017) *Salvia* united: the greatest good for the greatest number. Taxon 66(1): 133–145. https://doi.org/10.12705/661.7

Galasso G, Bartolucci F, Peruzzi L (2018) Printed, or just indelible? On the earliest legitimate names, authorship and typification of the taxa described from Italy by Huter, Porta and/or Rigo. Phytotaxa 361(1): 77–86. https://doi.org/10.11646/phytotaxa.361.1.6

Maire R (1932) Contributions à l'étude de la flore de l'Afrique du nord 19. Bulletin de la Société d'histoire naturelle d'Afrique du Nord 23(1): 163–222.

Rosúa JL (1986) Contribución al estudio del género *Rosmarinus* L. en el Mediterráneo occidental. Lagascalia 14(2): 179–187.

Turland NJ, Wiersema JH, Barrie FR, Greuter W, Hawksworth DL, Herendeen PS, Knapp S, Kusber WH, Li DZ, 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. Koeltz Botanical Books, Glashütten. https://doi.org/10.12705/Code.2018

Upson T (2006) *Rosmarinus eriocalyx* (Labiatae). Curtis's Botanical Magazine 551: 62–68. https://doi.org/10.1111/j.1355-4905.2006.00515.x

Italian Botanist 7: 35–50 (2019)
doi: 10.3897/italianbotanist.7.33361
http://italianbotanist.pensoft.net

RESEARCH ARTICLE

Italian Botanist
Published by Società Botanica Italiana

Lathyro asphodeloidis-Klaseetum lycopifoliae, a new plant association in the alliance *Cynosurion cristati* Tüxen, 1947 in Central Apennines

Giampiero Ciaschetti[1], Gianfranco Pirone[2]

1 *Majella National Park, Via Badia 28, I-67039 Sulmona, Italy* **2** *Department of Life Health and Environmental Sciences, University of L'Aquila, Via Vetoio, Coppito, I -67100 L'Aquila, Italy*

Corresponding author: *Giampiero Ciaschetti* (giampiero.ciaschetti@parcomajella.it)

Academic editor: *F. Bartolucci* | Received 25 January 2019 | Accepted 22 March 2019 | Published 9 April 2019

Citation: Ciaschetti G, Pirone G (2019) *Lathyro asphodeloidis-Klaseetum lycopifoliae*, a new plant association in the alliance *Cynosurion cristati* Tüxen, 1947 in Central Apennines. Italian Botanist 7: 35–50. https://doi.org/10.3897/italianbotanist.7.33361

Abstract

This study presents a new plant association discovered in the Central Apennines and named *Lathyro asphodeloidis-Klaseetum lycopifoliae*. It consists of a semi-natural meadow characterized by the co-dominance of two rare taxa, *Klasea lycopifolia* and *Lathyrus pannonicus* subsp. *asphodeloides*, occurring in Italy in only a few localities in the Central and Northen Apennines. The association was discovered on the Altopiano delle Rocche high plateau in the province of L'Aquila (Abruzzo region, Italy).

Multivariate analysis of the relevés shows two floristic and ecological aspects, corresponding to two different subassociations: *festucetosum circummediterraneae*, with elements from the *Festuco-Brometea* class, growing in the outer portions of the plateau, and *narcissetosum poëtici*, corresponding to the most typical aspect and occupying the central part of the plateau, differentiated by meso-hygrophilous species of the *Molinietalia* and *Trifolio-Hordeetalia* orders.

The plant association has great natural value, due to the presence of several rare plant species, and cultural importance in association with the traditional "Narcissus Fest" held each year in May.

Keywords

Klasea lycopifolia, Hay meadows, Sirente-Velino Regional Park, Abruzzo

Introduction

The herbaceous vegetation of the high karst plateaus in the Central Apennines has been the subject of a number of studies (e.g. Cortini Pedrotti et al. 1973; Pedrotti 1976, 1982a, 1982b, 1985; Pedrotti et al. 1976, 1992; Pedrotti and Cortini Pedrotti 1982; Biondi et al. 1999; Pirone 1987a, 1997; Venanzoni 1992; Ciaschetti et al. 2006; Blasi et al. 2012), but an exhaustive picture of the plant associations present in these environments has not yet been clearly defined.

In particular, although studied since the 1960s (e.g. Pedrotti 1963, 1967, 1976; Cortini Pedrotti et al. 1973), the syntaxonomic interpretation of the humid meadows still presents numerous difficulties, particularly with respect to the lower hierarchical levels. Setting aside the marshy aspects and those developing on regularly flooded land, corresponding to the *Phragmito-Magnocaricetea* and *Agrostietea stoloniferae* phytosociological classes and the *Molinietalia* and *Trifolio-Hordeetalia* orders, a number of associations and communities have been described in the Central Apennines in the *Arrhenatheretalia* and *Trifolio-Phleetalia* orders (Pedrotti 1963; Bruno and Covarelli 1968; Cortini Pedrotti et al. 1973; Ubaldi 1978; Biondi and Ballelli 1982, 1995; Biondi et al. 1989; Pedrotti et al. 1992; Venanzoni 1992; Francalancia et al. 1995; Baldoni et al. 1996; Blasi et al. 1998, 2009; Lombardi et al. 2000; Taffetani 2000; Angiolini et al. 2001; De Dominicis et al. 2001; Viciani et al. 2002a, 2002b; Allegrezza 2003; Biondi et al. 2004; Catorci et al. 2007; Allegrezza and Biondi 2011).

This study presents a new type of humid meadow, with a physiognomy characterized by the dominance of *Klasea lycopifolia* (Vill.) Á.Löve & D.Löve, a very rare member of the Asteraceae family with a W-C-Pontic SE-Sarmatic distribution and Pannonic, W-Illyrian and W-Alpine disjunct populations (Conti and Manzi 1997). Very rare throughout Italy, the species is present in just nine sites in Abruzzo, Emilia-Romagna, Umbria and Marche (Gigante et al. 2014). It was indicated for the first time in Italy in the Sirente-Velino Regional Park where it is present in four different sites (Conti and Manzi 1997; Ciaschetti 2003; De Santis and Soldati 2011).

In Italy, *Klasea lycopifolia* (Vill.) Á.Löve & D.Löve grows in various types of environment, ranging from steppe-continental xeric meadows to mesophilous meadows in montane and sub-alpine zones (Gigante et al. 2014). In the hay meadows on the Altopiano delle Rocche high plateau, *Klasea lycopifolia* (Vill.) Á.Löve & D.Löve is clearly dominant in the vegetation described here.

Included among the endangered species on the Italian Red List (Rossi et al. 2013) and as a priority species in Annex II of the Habitat Directive, *Klasea lycopifolia* (Vill.) Á.Löve & D.Löve is the subject of a Life project aimed at safeguarding and valorizing seven species of European interest in three national parks in the Central Apennines (Di Martino et al. 2016).

Lathyrus pannonicus (Jacq.) Garcke subsp. *asphodeloides* (Gouan) Bässler, a rare sub-species with a South-European distribution, is abundant in the studied vegetation. In Italy it is present only in Lazio, Abruzzo and Molise, while it is doubtful in Basilicata and Calabria (Bartolucci et al. 2018c).

Study area

The study area (Suppl. material 1: 1) corresponds to the Altopiano delle Rocche high plateau in the Sirente-Velino Regional Nature Park, L'Aquila province, Abruzzo region. In particular, the study considers the northernmost part of the high plateau, between the villages of Rocca di Mezzo, Rocca di Cambio and Terranera (42°13.85'N, 13°31.05'E). This consists of a vast "*polje*" type plain of tectonic-karst origin, once site of an ancient lacustrine basin, at a mean altitude of 1350 a.m.s.l. It is bordered to the north and west by Monte Cagno (2153 m a.m.s.l.), Forcamiccia (1909 m a.m.s.l.) and Monte Rotondo (2060 m a.m.s.l.), and to the east by a series of lower elevations including the Monti della Cerreta (1510 m a.m.s.l.), Colle Jannini (1432 m a.m.s.l.) and Monte Grilletti (1361 m a.m.s.l.), separating it from the Subequana Valley.

To the south, the high plateau extends beyond the village of Rocca di Mezzo as far as Ovindoli and the Arano Valley.

The majority of the plateau is occupied by Holocene lacustrine sediments overlaid by deep sometimes hydromorphic soils with an A-B-C- profile, with fine to moderately fine texture, almost no stony surface cover and a low skeleton content, generally decarbonated and with a slightly acid surface reaction, gradually progressing to neutral with depth (Vannicelli Casoni 1999).

To classify the climate, thirty years of data from the nearby precipitation and temperature station of Rocca di Mezzo (1329 a.m.s.l.) were analysed and used to construct the ombrothermic diagram (Suppl. material 1: 2). Analysis of the data showed the winter cold to be a significant characteristic of the area, with minimum temperatures below 0 °C for five months and mean temperatures below 10 °C for seven months. There is no summer aridity and near semi-arid conditions as defined by Rivas-Martínez (2011), i.e. $P \leq 2.5T$, occur only in July. According to the Rivas-Martínez bioclimatic classification (2011), the area can be classified in the sub-Mediterranean variant of the oceanic temperate bioclimate, upper supra-temperate thermotype, upper humid ombrotype.

The vegetation of the study area is mowed once a year, usually at the end of July, and only occasionally it is grazed by a few animals after mowing. For details on management and its implications on flora composition, see Giallonardo et al. (2019).

Material and methods

The vegetation under study was analysed using the classical phytosociological method of the Zurich-Montpellier sigmatist school (Braun-Blanquet 1964). The abundance-dominance indices were transformed by numerical processing according to the scale proposed by Van der Maarel (1979). The matrix of 77 species × 15 relevés thus obtained was cleaned of the companion species present in just one relevé and then processed using the multivariate analysis techniques in the SYNTAX-2000 package (Podani 2001). In particular, cluster analysis was performed using the chord distance as

Table 1. Phytosociological table (FES = *Festuco-Brometea*; GER = *Trifolio-Geranietea sanguinei*; MOL = *Molinio-Arrhenatheretea*; BUL = *Poetea bulbosae*; NAR = *Nardetea strictae*; ART = *Artemisietea vulgaris*; MUL = *Mulgedio-Aconitetea*; PHR = *Phragmito-Magnocaricetea*; EPI = *Epilobietea angustifolii*; SAC = *Stipo giganteae-Agrostietea castellanae*; SES = *Elyno-Seslerietea*).

	Relevé no.	**1***	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12***	**13**	**14**	**15**
	Aspect	NNE	NNE	NNE	-	-	-	-	-	-	-	-	-	-	-	-
	Slope (°)	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
	Area (sm)	50	60	60	70	100	100	100	80	100	100	120	100	100	100	100
	Coverage (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
***Lathyro asphodeloidis*-Klaseetum *lycopyfoliae* ass. nova**																
FES, GER	*Klasea lycopifolia* (Vill.) Á.Löve & D.Löve	2	2	3	2	3	2	4	2	3	5	4	3	4	2	3
MOL	*Lathyrus pannonicus* (Jacq.) Garcke subsp. *asphodeloides* (Gouan) Bässler	1	2	2	2	3	2	3	2	3	1	3	3	.	2	1
FES	*Centaurea jacea* L. subsp. *gaudinii* (Boiss. & Reut.) Gremli	+	+	+	.	2	1	1	2	+	.	.	1	.	.	2
***festucetosum circummediterraneae* subass. nova**																
FES	*Festuca circummediterranea* Patzke	2	3	3	3	.	.	.	.	.	.	.	.	.	.	.
BUL	*Poa bulbosa* L. subsp. *bulbosa*	2	3	3	3	.	.	1	.	.	.	.	.	.	.	.
FES	*Astragalus danicus* Retz.	1	1	1	1	.	.	+	.	.	.	.	.	.	.	.
NAR	*Podospermum canum* C.A.Mey.	2	+	1	1	+	.	.	.	.	.	.	.	.	.	.
FES, BUL, ART	*Medicago lupulina* L.	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.
FES	*Veronica orsiniana* Ten.	.	1	+	.	+	.	.	.	.	.	.	+	.	.	.
FES	*Bromopsis erecta* (Huds.) Fourr. subsp. erecta	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
***narcissetosum poëtici* subass. nova**																
MOL	*Narcissus poëticus* L.	.	+	.	.	3	3	2	2	3	2	3	2	+	3	2
MOL, MUL	*Rumex acetosa* L. subsp. *acetosa*	.	.	.	.	+	+	1	1	1	+	1	+	1	1	1
MOL, MUL	*Ranunculus marsicus* Guss. & Ten.	.	.	.	.	1	2	.	1	2	1	1	1	1	2	1
MOL	*Bistorta officinalis* Delarbre	.	1	.	+	.	3	1	2	2	.	2	2	2	2	3
FES	*Tulipa pumila* Moench	.	.	.	.	2	.	2	.	.	1	+	1	+	.	.
MOL	*Bromus racemosus* L. subsp. *racemosus*	.	.	.	.	+	1	1	2	+	1	.	1	1	.	.
PHR	*Myosotis scorpioides* L. subsp. *scorpioides*	.	.	.	.	.	+	.	.	1	.	.	+	+	1	+
MOL	*Lychnis flos-cuculi* L. subsp. *flos-cuculi*	.	.	.	.	.	.	.	+	1	1	+	+	.	.	+
Cynosurion cristati																
BUL, MOL	*Bellis perennis* L.	.	.	.	.	.	.	.	+	+	+	+	1	+	.	+
BUL, MOL	*Cynosurus cristatus* L.	.	.	.	.	1	.	+	+	+	.	.	.	.	.	.
MOL	*Trifolium repens* L.	.	.	.	+	+	.	.	.	.	.	.	.	.	1	+
MOL	*Veronica serpyllifolia* L.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	1
MOL	*Scorzoneroides autumnalis* (L.) Moench	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.
Upper units																
MOL	*Alopecurus pratensis* L. subsp. *pratensis*	.	2	+	1	+	3	1	4	3	2	3	3	3	4	2
MOL	*Taraxacum* sect. *Taraxacum*	1	+	1	+	1	2	.	1	1	1	+	1	+	1	.
MOL	*Trifolium pratense* L. subsp. *pratense*	1	1	1	+	.	.	2	2	1	2	2	2	1	1	2
MOL	*Cerastium holosteoides* Fr.	1	2	2	1	.	.	1	+	1	+	+	.	1	.	2

	Relevé no.	1*	2	3	4	5	6	7	8	9	10	11	12*	13	14	15
MOL	*Ranunculus acris* L. s.l.	.	.	.	+	+	2	.	2	3	+	1	1	+	2	2
BUL	*Anthoxanthum odoratum* L.	.	.	.	.	1	1	1	1	2	1	1	1	1	1	1
MOL	*Lathyrus pratensis* L. subsp. *pratensis*	.	3	2	1	.	.	1	+	1	.	1	1	.	.	1
MOL	*Rhinanthus minor* L.	+	.	.	.	.	.	.	1	1	1	1	2	+	+	.
FES, MOL	*Leontodon hispidus* L. subsp. *hispidus*	.	.	.	.	2	.	+	+	.	1	1	.	1	+	.
MOL	*Lotus corniculatus* L. subsp. *corniculatus*	1	1	1	1	1	.	+	.	.	.	.	.	.	.	.
MOL	*Colchicum lusitanum* Brot.	.	+	.	+	.	+	.	+	.	+	.	.	.	.	.
MOL	*Poa pratensis* L. subsp. *pratensis*	.	.	.	.	+	.	2	.	.	.	.	.	1	.	1
FES, MOL	*Ranunculus polyanthemoides* Boreau	.	.	.	.	.	.	.	.	.	1	2	2	2	.	.
ART, MOL	*Achillea millefolium* L. subsp. *millefolium*	2	.	1	1	.	.	.	.	.	.	.	.	.	.	.
MOL	*Carex distans* L.	.	.	.	+	.	.	.	+	.	.	.	.	.	1	.
MOL	*Leucanthemum vulgare* (Vaill.) Lam. subsp. *vulgare*	.	.	.	.	+	.	.	.	+	.	.	.	.	.	+
GER, MOL	*Galium mollugo* L.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+
MOL	*Sanguisorba officinalis* L.	.	.	.	.	2	+	.	.	.	.	.	.	.	.	.
MOL, NAR	*Serratula tinctoria* L. subsp. *tinctoria*	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.
MOL	*Agrostis stolonifera* L. subsp. *stolonifera*	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
EPI, MOL	*Valeriana officinalis* L. subsp. *officinalis*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Other species																
FES, GER	*Galium verum* L. subsp. *verum*	1	1	1	1	2	1	1	1	1	3	2	2	2	1	3
FES	*Ranunculus bulbosus* L.	+	3	3	2	.	.	+	1	+	.	.	+	+	+	.
FES	*Anacamptis morio* (L.) R.M.Bateman, Pridgeon & M.W.Chase	.	+	.	.	1	.	1	.	+	1	1	1	+	.	.
FES	*Filipendula vulgaris* Moench	.	.	.	.	2	2	2	.	1	2	3	2	.	2	.
FES, NAR, SAC	*Luzula campestris* (L.) DC. subsp. *campestris*	.	.	.	.	+	.	+	+	+	+	1	1	1	.	.
MOL	*Euphorbia gasparrini* Boiss. subsp. *samnitica* (Fiori) Pignatti	+	.	.	.	+	.	2	.	.	1	.	1	.	.	.
FES	*Saxifraga bulbifera* L.	.	.	.	.	.	.	+	1	+	+	+	.	1	.	+
FES, MOL	*Plantago media* L. subsp. *media*	1	+	1	1	.	.	.	.	.	.	.	.	.	.	+
FES	*Knautia calycina* (C.Presl) Guss.	+	+	+	.	.	.	+	.	.	.	.	+	.	.	.
MOL	*Potentilla reptans* L.	.	+	.	+	+	+	.	.	.	.	.	.	.	.	+
EPI	*Cruciata laevipes* Opiz	.	+	.	+	.	.	.	.	.	.	.	.	2	.	2
MOL	*Ajuga reptans* L.	.	.	.	.	.	.	.	.	.	1	+	1	+	.	.
MOL	*Dactylis glomerata* L. subsp. *glomerata*	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.
SES	*Poa alpina* L. subsp. *alpina*	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.
FES	*Muscari neglectum* Guss. ex Ten.	1	.	.	.	.	.	+	.	.	.	.	.	.	.	.
ART, SES	*Cerastium arvense* L. subsp. *arvense*	1	.	.	.	.	.	.	.	.	.	.	+	.	.	.
FES	*Ranunculus millefoliatus* Vahl	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.
ART, MOL	*Rumex obtusifolius* L. subsp. *obtusifolius*	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.
Sporadic species		3	0	0	1	2	1	3	0	0	0	0	1	1	1	2

the correlation coefficient and average linkage as the clustering strategy. Several ordinations (PCA, PCoA, NMDS) were carried out to confirm the validity and separation of the clusters identified.

A further PCoA was performed on the synoptic table built with the original tables of all the associations attributed by Blasi et al. (2012) to the suballiance *Cerastio arvensis-Cynosurenion*, plus the table presented here. The chord distance was used as dissimilarity coefficient.

The nomenclature follows the updated checklist of the vascular flora native to Italy (Bartolucci et al. 2018a, 2018b, 2018c), while the syntaxonomic classification follows the Prodrome of Italian Vegetation (Biondi et al. 2014).

The diagnostic species of the classes in Table 1 follow Mucina et al. (2016), with the exception of *Tulipa pumila* Moench (Aeschimann et al. 2004) and *Euphorbia gasparrini* Boiss. subsp. *samnitica* (Fiori) Pignatti (no data available, our own interpretation). For species in the *Cynosurion* alliance and *Trifolio-Phleetalia* order, reference was made to the Italian Vegetation Prodrome (Biondi et al. 2014).

Results

The studied vegetation is to be framed in the *Cynosurion cristati* alliance, as shown in Table 1. Regarding to the two sub-alliances identified in Central Italy (Blasi et al. 2012), the geographical, environmental and floristic features of this vegetation, together with the low presence of annual and Mediterranean species, led us to refer it to the *Cerastio arvensis-Cynosurenion* sub-alliance described for Central-Northen Apennines (Blasi et al. 2012).

The PCoA performed on the synoptic table built with all the associations attributed by Blasi et al. (2012) to this sub-alliance highlights the autonomy of the studied vegetation by putting it in a clearly separate space with respect to the others (Suppl. material 1: 3).

The hierarchical classification of the relevés (Suppl. material 1: 4) clearly highlights the distinction of two clusters within the described vegetation, also confirmed by several ordinations performed (PCA, PCoA, NMDS) but not presented here.

Discussion

The studied vegetation differs considerably from all the associations described in the *Cynosurion cristati* alliance for the Central Apennines (Bruno and Covarelli 1968; Cortini-Pedrotti et al. 1973; Pedrotti et al. 1976; Ubaldi 1978; Biondi et al. 1989; Pedrotti et al. 1992; Biondi and Ballelli 1995; Blasi et al. 2009), mainly for its particular physiognomy, represented by *Klasea lycopifolia* (Vill.) Á.Löve & D.Löve and *Lathyrus pannonicus* (Jacq.) Garcke subsp. *asphodeloides* (Gouan) Bässler, both very rare species in Abruzzo and Italy (Conti 1998; Gigante et al. 2014; Bartolucci et al. 2018c).

The various associations and groupments that were attributed to the *Cynosurion cristati* alliance in Central Italy show very varied physiognomies, but no communities had been ever described with such abundant *Klasea lycopifolia* (Vill.) Á.Löve & D.Löve and *Lathyrus pannonicus* (Jacq.) Garcke subsp. *asphodeloides* (Gouan) Bässler. Apart from *Cynosurus cristatus* L. (e.g. Cortini Pedrotti et al. 1973; Pedrotti et al. 1992; Biondi et al. 1989; Biondi and Ballelli 1995; Francalancia et al. 1995; Blasi et al. 1998, 2009; Viciani et al. 2002a, 2002b; Allegrezza 2003; Biondi et al. 2004; Pirone et al. 2005; Catorci et al. 2007) several other species are dominant in the phytosociological tables. The most frequent are *Lolium perenne* L. (e.g. Bruno and Covarelli 1968; Venanzoni 1992; Francalancia et al. 1995; Pedrotti 2008; Blasi et al. 2009), and *Poa trivialis* L. (e.g. Cortini Pedrotti et al. 1973; Venanzoni 1992; Biondi and Ballelli 1995; Pedrotti 2008; Blasi et al. 2009), while less frequent are *Holcus lanatus* L. (Biondi et al. 1989; Venanzoni 1992; Lombardi et al. 2000), *Dactylis glomerata* L. (Lombardi et al. 2000; Blasi et al. 2009), *Festuca rubra* L. s.l. (Lorenzoni et al. 1983; Biondi et al. 1989; Francalancia et al. 1995), *Ononis spinosa* L., *Genista tinctoria* L. or *Nardus stricta* L. (Lorenzoni et al. 1983), *Festuca circummediterranea* Patzke (Francalancia et al. 1995, Allegrezza 2003), *Lolium pratense* (Huds.) Darbysh. (= *Festuca pratensis* Huds.) (Francalancia et al. 1995), *Anthoxanthum odoratum* L. (Cortini Pedrotti et al. 1973; Pedrotti et al. 1992; Blasi et al. 2009), *Bromopsis erecta* (Huds.) Fourr. (Biondi et al. 1989); *Bromus hordeaceus* L. (Allegrezza 2003; Blasi et al. 2009), *Poa pratensis* L. subsp. *pratensis* (Francalancia et al. 1995; Blasi et al. 2009), *Trifolium repens* L. (Cortini Pedrotti et al. 1973), and *Trifolium pratense* L. subsp. *pratense* or *Rhinanthus minor* L. (Pedrotti et al. 1992).

Even if the framing of the studied vegetation is to be in the *Cynosurion alliance* and in the *Cerastio arvensis-Cynosurenion* sub-alliance, this vegetation does not spread far from the altitudinal and ecological limits of the alliance, with some affinities with the communities of the *Ranunculion velutini* alliance with which it is in topographical contact (Suppl. material 1: 5).

The studied vegetation also differs considerably from those described for the nearby Piano di Pezza (Ciaschetti et al. 2006) which is located at a higher altitude and only grazed.

All these differences led us to propose a new association with the name of *Lathyro asphodeloidis-Klaseetum lycopifoliae* (typus rel. 12, Table 1) in the *Cynosurion cristati* alliance. At suballiance level, it is to be classified in the *Cerastio arvensis-Cynosurenion cristati* suballiance described by Blasi et al. (2012) for the Central-Northern Apennines.

Consisting of four relevés, the cluster I of the dendrogram (Suppl. material 1: 4) refers to the more xeric aspects of the association prevailing in the outermost areas of the plain characterized by lower edaphic humidity. These aspects are differentiated by a contingent of species characteristic of xeric and semi-mesophilous secondary pastures of the *Festuco-Brometea* class, such as *Festuca circummediterranea* Patzke, *Poa bulbosa* L. subsp. *bulbosa*, *Astragalus danicus* Retz., *Podospermum canum* C.A.Mey., *Medicago lupulina* L., *Veronica orsiniana* Ten. and *Bromopsis erecta* (Huds.) Fourr. subsp. *erecta*. This group of relevés corresponds to the subassociation *festucetosum circummediterraneae* (typus: rel. 1, Table 1).

The second group (cluster II) corresponds to the typical and widespread aspect of the association (Suppl. material 1: 4), characterizing a large part of the central and lowest-lying portion of the high plateau. As well as *Klasea lycopifolia* (Vill.) Á.Löve & D.Löve and *Lathyrus pannonicus* (Jacq.) Garcke subsp. *asphodeloides* (Gouan) Bässler, also contributing to the physiognomy are *Narcissus poëticus* L., *Bistorta officinalis* Delarbre and *Alopecurus pratensis* L. subsp. *pratensis*. Respect to the first cluster, the floristic composition shows a greater abundance of species belonging to the *Molinio-Arrhenatheretea*, such as *Anthoxanthum odoratum* L. subsp. *odoratum*, *Ranunculus acris* L. s.l., *Leontodon hispidus* L. subsp. *hispidus, Rumex acetosa* L. subsp. *acetosa*, etc. The typical subassociation *narcissetosum poëtici* is differentiated by *Narcissus poëticus* L., *Ranunculus marsicus* Guss. & Ten., *Bistorta officinalis* Delarbre, *Tulipa pumila* Moench, *Bromus racemosus* L. subsp. *racemosus*, *Myosotis scorpioides* L. subsp. *scorpioides* and *Lychnis flos-cuculi* L. subsp. *flos-cuculi*.

The position of the two subassociations along a sequence following a water-soil gradient in the plateau is shown in suppl. material 1: 5.

The new association shows a particular floristic composition with the low presence or absence of some characteristic species of the *Cynosurion* alliance, such as *Lolium perenne* L., *Phleum pratense* L. subsp. *pratense*, *Phleum nodosum* L., *Scorzoneroides autumnalis* (L.) Moench and *Veronica serpyllifolia* L. On the other hand, probably due to less disturbance by grazing cattle, it includes several rare species, making this vegetation important from a conservation point of view:

Klasea lycopifolia (Vill.) Á.Löve & D.Löve [= *Serratula lycopifolia* (Vill.) A.Kern.]
In Italy, according to Gigante et al. (2014) and Bartolucci et al. (2018c) this species occurs in Emilia-Romagna, Umbria, Marche and Abruzzo. In the latter region, it is indicated for the localities of Le Prata and Campo di Rovere on the Altopiano delle Rocche (Conti and Manzi 1997; Ciaschetti 2003), Prati del Sirente (Ciaschetti 2003) and Campo Felice (De Santis and Soldati 2011). It is listed as a priority species in Annex II of the Habitat Directive and included in Category 1 (Extremely rare or endangered species, or species with a very small population, exclusive or at the limit of their distribution area and known for few point localities) in Conti and Bartolucci (2012).

Lathyrus pannonicus (Jacq.) Garcke subsp. *asphodeloides* (Gouan) Bässler
In Italy, according to Bartolucci et al. (2018c) this taxon is certainly known only for Abruzzo, Lazio and Molise. It is found on the main tectonic-karst high plateaus in Abruzzo (Tenore 1831–42; Pedrotti 1969; Tammaro 1971; Anzalone and Veri 1975; Pignatti 1982, 2017; Pirone 1987b; Conti 1992b; Conti 1998; Conti and Bartolucci 2016). The population growing in Altopiano delle Rocche was recently analysed also from a molecular and karyological (2n = 14) point of view (Schlee et al. 2011; Peruzzi et al. 2016) and needs further studies.

It is listed as a priority species in Annex II of the Habitat Directive, indicated as Vulnerable (VU) in the Regional Red List of Endangered Flora (Conti et al. 1997) and included in Category 1 (Extremely rare or endangered species, or species with a very small population, exclusive or at the limit of their distribution area and known for few

point localities) in the List of Plants of Conservation Interest in Abruzzo (Conti and Bartolucci 2012).

Astragalus danicus Retz.
Species with a Central European – South Siberian distribution area (Pignatti 2017), at its southernmost limit in the Central Apennines. In Abruzzo, it is indicated for the Abruzzo, Lazio and Molise National Park (Conti and Bartolucci 2015), Sirente-Velino Regional Park (Tammaro 1971; Lucchese and Lattanzi 1991; Dinter 1996) Monte Rotella (Petriccione 1986), Piano Aremogna (Conti 1998), Piano delle Cinquemiglia (Conti 1995), Palena at Colle Fauno (Ciaschetti et al. 2015), Monte Focalone (Dinter 1996) and Passo San Leonardo (pers. obs.).

It is protected by the Regional Law for the Protection of Spontaneous Flora (Abruzzo Regional Laws 45/79 and 66/80) and is included as a species at low risk (LR) in the Regional Red List of Endangered Flora (Conti et al. 1997).

Euphorbia gasparrini Boiss. subsp. *samnitica* (Fiori) Pignatti
Taxon endemic to the Central Apennines (Peruzzi et al. 2014; Cresti et al. 2019). In Abruzzo, it occurs in just a few localities (Basile et al. 1970; Tammaro and Veri 1971; Pignatti 1982; Tammaro 1986, 1995; Pirone 1987b; Conti 1992a; Conti 1998; Conti and Bartolucci 2015, 2016).

According to the IUCN criteria, is evaluated as Least Concern (LC; Orsenigo et al. 2018) and included in Category 2 (Endemic but not endangered species) in the List of Plants of Conservation Interest in Abruzzo (Conti and Bartolucci 2012).

Ranunculus marsicus Guss. & Ten.
Species endemic to the Central Apennines, occurring from the Gran Sasso massif to the Monti della Meta (Dunkel 2011).

It is evaluated as Data Deficient (DD; Orsenigo et al. 2018) and included in Category 0 (Extremely rare or endangered species, or species with a very small population, exclusive or at the limit of their distribution area and known for few point localities) in the List of Plants of Conservation Interest in Abruzzo (Conti and Bartolucci 2012).

Tulipa pumila Moench (= *T. australis* Link)
Species with a Mediterranean-montane distribution (Pignatti 2017), very rare in Abruzzo where it is indicated for the Piano di Ovindoli (Pignatti 1982) and the Collelongo area (Conti and Bartolucci 2015). It is included in Category 1 (Extremely rare or endangered species, or species with a very small population, exclusive or at the limit of their distribution area and known for few point localities) in the List of Plants of Conservation Interest in Abruzzo (Conti and Bartolucci 2012).

Sanguisorba officinalis L.
Species quite rare in Abruzzo, indicated for a number of localities (Mauri et al. 1830; Tenore and Gussone 1842; Tammaro 1986, Pirone 1987a; Guarrera and Tammaro

1994; Buchwald 1995; Conti 1998). It is included in Category 3 (Rare or exclusive species, or species at the limit of their distribution area, not endangered, but sometimes in decline) in the List of Plants of Conservation Interest in Abruzzo (Conti and Bartolucci 2012).

Serratula tinctoria L. subsp. *tinctoria*
In Abruzzo, the species occurs on the Altipiani Maggiori, at Villavallelonga and Collelongo (Conti and Bartolucci 2015), Torricella Sicura and Vallaspra di Atessa (Conti and Pirone 1992) and in the Gran Sasso and Monti della Laga National Park (Conti and Bartolucci 2016).

The species is indicated as Vulnerable (VU) in the Regional Red List of Endangered Flora (Conti et al. 1997).

Conclusions

Phytosociological analysis of the meadow vegetation of the Altopiano delle Rocche high plateau led to identification of a new association, *Lathyro asphodeloidis-Klaseetum lycopifoliae*, currently known to be present exclusively between Rocca di Mezzo, Rocca di Cambio and Terranera on the Altopiano delle Rocche. With its own distinct floristic identity with respect to the other *Cynosurion* formations described, including at physiognomic level, the association has high biogeographic and conservation value for the presence of a number of species rare in Abruzzo and/or in Italy as a whole, above all in the *narcissetosum poëtici* subassociation, relating to the most widespread aspect occurring in the Le Prata area.

It is therefore to be hoped that in the future, the area, included in the Sirente-Velino Regional Park, will not be subjected to environmental disturbance or variations in forms of use which could compromise its conservation, and that, in addition to the LIFE project FLORANET (Di Martino et al. 2016) currently underway, the Park Authority implements the due monitoring measures in order to assess possible modifications over time in the extension and floristic composition of this very particular and unique plant community.

Acknowledgements

We are grateful to Sarah Gregg for translating the text in good English.

References

Aeschimann D, Lauber K, Moser DM, Theurillat J-P (2004) Flora Alpina. Zanichelli editore, Bologna.

Allegrezza M (2003) Vegetazione e paesaggio vegetale della dorsale del monte San Vicino (Appennino centrale). Fitosociologia 40(1) (suppl. 1): 3–118.

Allegrezza M, Biondi E (2011) Syntaxonomic revision of the *Arrhenatherum elatius* grasslands of Central Italy. Fitosociologia 48(1): 23–40.

Angiolini C, Maccherini S, Chiarucci A, Gabellini A, De Dominicis V (2001) Memoria illustrativa alla carta della vegetazione della Riserva Naturale Poggio all'Olmo (Grosseto, Toscana meridionale). Atti Mus. St. Nat. Maremma 19: 29–47.

Anzalone B, Veri L (1975) Su alcune piante nuove o interessanti per Lazio e Abruzzo. Nuovo Giornale Botanico Italiano 109: 251–255. https://doi.org/10.1080/11263507509426389

Baldoni MA, Ballelli S, Biondi E, Orsomando E, Catorci A (1996) Studio fitosociologico delle formazioni prative del Monte Subasio (Appennino umbro-marchigiano). Doc. Phytosoc. NS 16: 427–448.

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 (2018a) Notulae to the Italian native vascular flora: 6. Italian Botanist 6: 45–64. https://doi.org/10.3897/italianbotanist.6.30575

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, 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 (2018c) An updated checklist of the vascular flora native to Italy. Plant Biosystems 152(2): 179–303. https://doi.org/10.1080/11263504.2017.1419996

Basile S, Contoli L, Palladino S, Sbordoni V, Sebasti R, Tammaro F, Veri L, Vigna Taglianti A, Salviati V (1970) Programma di Ricerca Territoriale sulle Aree Naturali da Proteggere. II. Carte regionali dei biotopi. C.N.R., Ministero dei Lavori Pubblici, Abruzzo, 1–42.

Biondi E, Ballelli S (1982) La vegetation du massif du Catria (Apennin central) avec carte phytosociologique 1:15.000. In: Pedrotti F (Ed.) Guide-Itinérarie de l'Excursion Internationale de Phytosociologie en Italie centrale (2–11 juillet 1982): 211–235.

Biondi E, Ballelli S (1995) Le praterie del Monte Coscerno e Monte di Civitella (Appennino umbro-marchigiano – Italia centrale). Fitosociologia 30: 91–121.

Biondi E, Allegrezza M, Ballelli S, Guitian J, Taffetani F (1989) La componente vegetale: flora, vegetazione e rappresentazione cartografica. In: Cassano C, Pennacchi F (Eds): Sistemi agricoli marginali: lo scenario della Comunità Montana Catria-Nerone. C.N.R., Progetto finalizzato I.S.P.R.A, Perugia, 499 pp.

Biondi E, Ballelli S, Allegrezza M, Taffetani F, Frattaroli AR, Guitian J, Zuccarello V (1999) La vegetazione di Campo Imperatore (Gran Sasso d'Italia). Braun-Blanquetia 16: 53–115.

Biondi E, Pinzi M, Gubellini L (2004) Vegetazione e paesaggio vegetale del Massiccio del Monte Cucco (Appennino centrale – Dorsale Umbro Marchigiana). Fitosociologia 41(2) (suppl. 1): 3–81.

Biondi E, Blasi C, Allegrezza M, Anzellotti I, Azzella MM, Carli E, Casavecchia S, Copiz R, Del Vico E, Facioni L, Galdenzi D, Gasparri R, Lasen C, Pesaresi S, Poldini L, Sburlino G, Taffetani F, Vagge I, Zitti S, Zivkovic L (2014) Plant communities of Italy: The vegetation Prodrome. Plant Biosystems 148: 728–814. https://doi.org/10.1080/11263504.2014.948527

Blasi C, Capotorti G, Fortini P (1998) On the vegetation series in the northern sector of the Simbruini mountains (Central Apennines). Fitosociologia 35: 85–102.

Blasi C, Burrascano S, Del Vico E, Di Pietro R, Iocchi M, Rosati L (2009) *Cynosurion cristati* grasslands in the central Apennines (Tyrrhenian sector): A phytosociological survey in the Lepini and Prenestini mountains. Plant Biosystems 143 (suppl.): 69–77. https://doi.org/10.1080/11263500903498192

Blasi C, Tilia A, Rosati L, Del Vico E, Copiz R, Ciaschetti G, Burrascano S (2012) Geographical and ecological differentiation in Italian mesophilous pastures referred to the alliance *Cynosurion cristati* Tx. 1947. Phytocoenologia 41 (4): 217–229. https://doi.org/10.1127/0340-269X/2011/0041-0504

Braun-Blanquet J (1964) Pflanzensoziologie-Grundzuge der Vegetationkunde. Springer, Wien and New York. https://doi.org/10.1007/978-3-7091-8110-2

Bruno F, Covarelli G (1968) I pascoli ed i prati-pascoli della Valsorda (Appennino Umbro). Not. Fitosoc. 5: 47–65.

Buchwald R (1995) Vegetazione e odontofauna negli ambienti acquatici dell'Italia centrale. Braun-Blanquetia 11: 1–77.

Catorci A, Gatti R, Ballelli S (2007) Studio fitosociologico della vegetazione delle praterie montane dell'Appennino maceratese (Italia centrale). Braun-Blanquetia 42: 101–143.

Ciaschetti G (2003) Segnalazioni floristiche italiane, n. 1062–1064. Inf. Bot. Ital. 35 (1): 101–102.

Ciaschetti G, Pirone G, Frattaroli AR, Corbetta F (2006) La vegetazione del Piano di Pezza (Parco Naturale Regionale "Sirente-Velino", Italia Centrale). Fitosociologia 43 (1): 67–84.

Ciaschetti G, Conti F, Bartolucci F, Di Martino L, Di Cecco M, Manzi A, Marcantonio G, Stinca A (2015) Contributo alla Flora del Parco Nazionale della Majella. Micol. e Veget. Medit. 30 (1): 65–72.

Conti F (1992a) Note floristiche per l'Italia centro-meridionale. Arch. Bot. 68: 26–34.

Conti F (1992b) Su alcune piante nuove o notevoli per la Flora del Parco Nazionale d'Abruzzo. Ann. Bot. (Roma) 50(9): 97–105.

Conti F (1995) Prodromo della Flora del Parco Nazionale d'Abruzzo. In: Tassi F. (Ed.) Progetto Biodiversità, Ente Autonomo del Parco Nazionale d'Abruzzo, Almadue srl, Roma.

Conti F (1998) An annotated Check-list of the Flora of the Abruzzo. Bocconea 10: 1–276.

Conti F, Bartolucci F (2012) Specie a rischio in Abruzzo. Elenco delle piante di interesse conservazionistico. In: Console C, Conti F, Contu F, Frattaroli AR, Pirone G (Eds) La Biodiversità vegetale in Abruzzo. Tutela e conservazione del patrimonio vegetale abruzzese, One Group Edizioni, L'Aquila: 81–109.

Conti F, Bartolucci F (2015) The Vascular Flora of the National Park of Abruzzo, Lazio and Molise (Central Italy). Geobotany Studies, Springer, 254 pp. https://doi.org/10.1007/978-3-319-09701-5

Conti F, Bartolucci F (2016) The vascular flora of Gran Sasso and Monti della Laga National Park (Central Italy). Phytotaxa 256(1): 1–119. http://dx.doi.org/10.11646/phytotaxa.256.1.1

Conti F, Manzi A (1997) *Serratula lycopifolia* (ViII.) A. Kelll., new for the Italian flora. FI. Medit. 7: 181–183.

Conti F, Pirone G (1992) Le cenosi di *Fraxinus oxycarpa* Bieb. e di *Ulmus minor* Miller del bosco di "Vali aspra" nel bacino del Sangro (Abruzzo-Italia). Doc. Phytosoc. 14: 167–175.

Conti F, Manzi A, Pedrotti F (1997) Liste Rosse regionali delle piante d'Italia. WWF, Società Botanica Italiana, Università di Camerino.

Cortini Pedrotti C, Orsomando E, Pedrotti F, Sanesi G (1973) La vegetazione ed i suoli del Pian Grande di Castelluccio di Norcia (Appennino centrale). Atti Ist. Bot. Lab. Critt. Univ. Pavia 9: 155–249.

Cresti L, Schönswetter P, Peruzzi L, Barfuss MHJ, Frajman B (2019) Pleistocene survival in three Mediterranean refugia: origin and diversification of the Italian endemic *Euphorbia gasparrinii* from the *E. verrucosa* alliance (Euphorbiaceae). Botanical Journal of the Linnean Society 189(3): 262–280. https://doi.org/10.1093/botlinnean/boy082

De Dominicis V, Gabellini A, Viciani D, Morrocchi D, Gonnelli V (2001) Contributo alla conoscenza vegetazionale della Riserva Naturale del Sasso Simone (Toscana Orientale). Atti Soc. Tosc. Sci. Nat. Mem. (B)108: 7–26.

De Santis E, Soldati R (2011) Guida fotografica alla flora di Campo Felice. Lucoli.

Di Martino L, Conti F, Bartolucci F, Ciaschetti G, Di Cecco M (2016) Conservazione delle piante di interesse comunitario (Direttiva 92/43/CEE) dell'Appennino centrale: il progetto Life Floranet. Notiziario della Società Botanica Italiana 0: 45–46.

Dinter I (1996) Natur-Excursionen. Abruzzen. Botanische Studienwanderreise. 25.07–08.08.1996, Lauffen: 1–84

Dunkel FG (2011) The *Ranunculus auricomus* L. complex (*Ranunculaceae*) in Central and Southern Italy, with additions to North Italian taxa. Webbia 66(2): 165–193. https://doi.org/10.1080/00837792.2011.10670895

Francalancia C, Galli P, Paradisi L (1995) Variazioni nella composizione floristica dei prati a *Cynosurus cristatus* L. delle alte Valli di Tazza e di Fematre (Appennino marchigiano), in rapporto alle pratiche colturali. Fitosociologia 29: 89–93.

Giallonardo T, Angiolini C, Ciaschetti G, Landi M, Pirone G, Frattaroli AR (2019) Relative importance of environment and management for floristic composition of sub-Mediterranean hay meadows in Central Italy. Applied Vegetation Science. https://doi.org/10.1111/avsc.12433

Gigante D, Alessandrini A, Ballelli S, Bartolucci F, Conti F, Ferri V, Gubellini L, Hofmann N, Montagnani C, Pinzi M, Venanzoni R, Wagensommer RP (2014) Schede per una Lis-

ta Rossa della Flora vascolare e crittogamica Italiana: *Klasea lycopifolia* (Vill.) Á.Löve et D.Löve. Inform. Bot. Ital. 46(1): 93–152.

Guarrera P, Tammaro F (1994) La Flora del M. Sirente e zone limitrofe (Appennino Abruzzese). Ann. Bot. (Roma) 52(11): 267–381.

Lombardi L, Galeotti L, Viciani D (2000) Ricerche fitosociologiche in un bacino a rischio idrogeologico delle Alpi Apuane: il Fosso della Rave (Toscana). Parlatorea 4: 75–90.

Lorenzoni GG, Marchiori S, Sburlino G (1983) Il corso di Fitosociologia applicata ai problemi agro-silvo-pastorali. Borgo Val di Taro (PR) 13–18 luglio 1981. Not. Fitosoc. 18: 71–79.

Lucchese F, Lattanzi E (1991) Nuovo contributo alla flora del Massiccio del M.Velino (Appennino Abruzzese). Ann. Bot. (Roma) 49 (Suppl. 8): 137–199.

Mauri E, Orsini A, Tenore M (1830) Enumeratio plantarum quas in itinere per Aprutium, vel per Pontificiae Ditionis finitimas provincias, aestate anni 1829 collegerunt Emestus Mauri, Antonius Orsini et Michael Tenore. Atti Accad. Pontano Napoli l: 41–90.

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 MC, Wagensommer RP, Wilhalm T, Tartaglini N, Duprè E, Blasi C, Rossi G (2018) Red Listing plants under full national responsibility: extinction risks and threats in the vascular flora endemic to Italy. Biological Conservation 224: 213–222. https://doi.org/10.1016/j.biocon.2018.05.030

Pedrotti F (1963) Esempio di *Arrhenetheretum* dell'Appennino Umbro-Marchigiano. Rend. Ist. Sci. Camerino 4: 210–215.

Pedrotti F (1967) Carta Fitosociologica (1:3000) della vegetazione dei piani di Montelago (Camerino). Not. Fitosoc. 4: 1–8.

Pedrotti F (1969) Einfiihrung in die Vegetation des Zentral-Apennins. Mitt. ostalp.-din. pflanzensoz. Arbeitsgem. 9: 38–57.

Pedrotti F (1976) Les prairies permanentes humides de l'Apennin central: phytosociologie et cartographie. Coll. Phytosoc. 5: 181–187.

Pedrotti F (1982a) Les "piani" de Montelago (Camerino). In: Pedrotti F (Ed.) Guide-Itinérarie de l'Excursion Internationale de Phytosociologie en Italie centrale (2 – 11 juillet 1982): 242–249.

Pedrotti F (1982b) Le marais de Colfiorito (Foligno). In: Pedrotti F. (Ed.) Guide-Itinérarie de l'Excursion Internationale de Phytosociologie en Italie centrale (2 – 11 juillet 1982): 258–264.

Pedrotti F (1985) Végétation et geomorphologie dans les bassins kartiques de l'Apennin. Coll. Phytosoc. 13: 507–539.

Pedrotti F (2008) La vegetazione delle marcite di Norcia (Italia Centrale). Braun-Blanquetia 44: 3–31.

Pedrotti F, Cortini Pedrotti C (1982) Les "Cariceta" du Pian Perduto de Gualdo. In: Pedrotti F (Ed.) Guide-Itinérarie de l'Excursion Internationale de Phytosociologie en Italie centrale (2 – 11 juillet 1982): 337–340.

Pedrotti F, Sanesi G, Cortini Pedrotti C, Orsomando E (1976) Il Piano di Rascino (Rieti): note fitogeografiche. Lavori Soc. Ital. Biogeogr., n.s. 4: 3–15.

Pedrotti F, Gafta D, Manzi A, Canullo R (1992) Le associazioni vegetali della piana di Pescasseroli (Parco Nazionale d'Abruzzo). Doc. Phytosoc. 14: 123–147.

Peruzzi L, Conti F, Bartolucci F (2014) An inventory of vascular plants endemic to Italy. Phytotaxa 168(1): 1–75. https://doi.org/10.11646/phytotaxa.168.1.1

Peruzzi L, Astuti G, Bartolucci F, Conti F, Rizzotto M, Roma-Marzio F (2016) Chromosome numbers for the Italian flora: 1. Italian Botanist 1: 39–53. https://doi.org/10.3897/italianbotanist.1.8818

Petriccione B (1986) Segnalazioni Floristiche per il Parco Nazionale d'Abruzzo. Ann. Bot. (Roma) 64(4): 159–166.

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

Pignatti S (2017) Flora d'Italia 1–2 (II ed). Edagricole, Milano.

Pirone G (1987a) I magnocariceti degli Altipiani Maggiori d'Abruzzo. Inf. Bot. Ital. 19(2): 131–135.

Pirone G (1987b) Il patrimonio vegetale della Provincia di Pescara. Amministrazione Provinciale di Pescara, Pescara.

Pirone G (1997) Il paesaggio vegetale di Rivisondoli, aspetti della flora e della vegetazione. Azienda Autonoma di Soggiorno e Turismo Rivisondoli (AQ), Teramo: 110 pp.

Pirone G, Ciaschetti G, Frattaroli AR (2005) La vegetazione della Riserva Naturale Regionale "Abetina di Rosello" (Abruzzo, Italia). Fitosociologia 42(1): 121–137.

Podani J (2001) Syn-tax 2000 Computer program for data analysis in ecology and systematics. Scientia Publishing, Budapest.

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.

Schlee M, Göker M, Grimm GW, Hemleben V (2011) Genetic patterns in the *Lathyrus pannonicus* complex (Fabaceae) reflect ecological differentiation rather than biogeography and traditional subspecific division. Botanical Journal of the Linnean Society 165: 402–421. https://doi.org/10.1111/j.1095-8339.2011.01125.x

Taffetani F (2000) Serie di vegetazione del complesso geomorfologico del Monte dell'Ascensione (Italia centrale). Fitosociologia 37(1): 93–151.

Tammaro F (1971) Su alcune entità di M. Sirente (Appennino Abruzzese) di particolare interesse fitogeografico. Lav. Soc. Ital. Biogeogr. 2: 89–105. https://doi.org/10.21426/B62110473

Tammaro F (1986) Documenti per la conoscenza naturalistica della Majella. Repertorio Sistematico della Flora. Regione Abruzzo:1–267.

Tammaro F (1995) Lineamenti floristici e vegetazionali del Gran Sasso meridionale. Documenti naturalistici per la conoscenza del Parco Nazionale del Gran Sasso-Laga. BolI. Mus. Civ. St. Nat. Verona 19: 1–256.

Tammaro F, Veri L (1971) Notizie geografiche e botaniche sul Sirente. Ann. Univ. L'Aquila 5: 1–11.

Tenore M (1831–42) Sylloge plantarum vascularium Florae Napolitanae hucusque detectarum. Tizzoni, Napoli.

Tenore M, Gussone G (1842) Memorie sulle peregrinazioni eseguite dai soci ordinari Signori M. Tenore e G. Gussone. Stamperia Reale, Napoli: 1–171.

Rivas-Martínez S (2011) Worldwide bioclimatic classification system. Global Geobotany 1: 1–634.
Ubaldi D (1978) I prati a *Cynosurus cristatus* del Montefeltro. Not. Fitosoc. 13: 13–21.
Van Der Maarel E (1979) Transformation of cover-abundance values in Phytosociology and its effects on community similarity. Vegetatio 39 (2): 97–114. https://doi.org/10.1007/BF00052021
Vannicelli Casoni L (1999) Carta di riconoscimento dei suoli. In "Studi preliminari al Piano del Parco". Regione Abruzzo, Parco Regionale Sirente-Velino.
Venanzoni R (1992) I prati umidi e inondati dell'Alta Valle del Velino (Rieti-Italia Centrale). Doc. Phytosoc. 14: 149–164.
Viciani D, Gabellini A, Gonnelli V, De Dominicis V (2002a) La vegetazione della Riserva Naturale Alta Valle del Tevere-Monte Nero (Arezzo, Toscana) ed i suoi aspetti di interesse botanico-conservazionistico. Atti Soc. Tosc. Sci. Nat. Mem. (B)109: 11–25.
Viciani D, Gabellini A, Gonnelli V, De Dominicis V (2002b) La vegetazione della Riserva Naturale Alpe della Luna (Arezzo, Toscana) ed i suoi aspetti di interesse botanico-conservazionistico. Webbia 57(1): 153–170. https://doi.org/10.1080/00837792.2002.10670729

Supplementary material 1

Study area, data analyses and pictures

Authors: Giampiero Ciaschetti, Gianfranco Pirone

Data type: multimedia

Link: https://doi.org/10.3897/italianbotanist.7.33361.suppl1

Supplementary material 2

Relevés date and sporadic species

Authors: Giampiero Ciaschetti, Gianfranco Pirone

Data type: occurrence

Link: https://doi.org/10.3897/italianbotanist.7.33361.suppl2

Italian Botanist 7: 51–67 (2019)
doi: 10.3897/italianbotanist.7.33763
http://italianbotanist.pensoft.net

RESEARCH ARTICLE

Italian Botanist
Published by Società Botanica Italiana

Contribution to the knowledge of the vascular flora of Miniera di Murlo area (southern Tuscany, Italy)

Silvia Cannucci[1], Claudia Angiolini[1], Barbara Anselmi[2], Enrico Banfi[3], Marco Biagioli[4], Paolo Castagnini[1], Chiara Centi[1], Tiberio Fiaschi[1], Bruno Foggi[5], Antonio Gabellini[6], Lorenzo Lastrucci[7], Edda Lattanzi[8], Anna Scoppola[9], Federico Selvi[10], Daniele Viciani[5], Gianmaria Bonari[11]

1 *Department of Life Sciences, University of Siena, Via P.A. Mattioli 4, 53100 Siena, Italy* **2** *Associazione Culturale di Murlo, piazza Cattedrale s.n., 53016 Murlo (Siena), Italy* **3** *Sezione di Botanica, Museo di Storia Naturale di Milano, Corso Venezia 55, 20121 Milano, Italy* **4** *Meteo Siena 24, Via Piave 2, 53100 Siena, Italy* **5** *Department of Biology, University of Florence, Via G. La Pira 4, 50121 Florence, Italy* **6** *Via Grocco 20, 50144 Florence, Italy* **7** *Museum of Natural History of the University of Florence, Botany, Via La Pira 4, 50121, Florence, Italy* **8** *Via V. Cerulli 59, 00143 Rome, Italy* **9** *Department of Agricultural and Forestry Sciences, Tuscia University, Via C. De Lellis s.n.c., 01100 Viterbo, Italy* **10** *Department of Agrifood Production and Environmental Sciences Section of Soil and Plant Sciences Laboratories of Botany University of Florence, P.le Cascine 28, 50144 Florence, Italy* **11** *Department of Botany and Zoology, Masaryk University, Kotlářská 2, CZ-611 37 Brno, Czech Republic*

Corresponding author: *Gianmaria Bonari* (gianmaria.bonari@gmail.com)

Academic editor: *L. Peruzzi* | Received 9 February 2019 | Accepted 27 March 2019 | Published 19 April 2019

Citation: Cannucci S, Angiolini C , Anselmi B, Banfi E, Biagioli M, 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 Miniera di Murlo area (southern Tuscany, Italy). Italian Botanist 7: 51–67. https://doi.org/10.3897/italianbotanist.7.33763

Abstract

This work aims to increase the floristic knowledge of southern Tuscany by means of a floristic investigation which took place in the Miniera di Murlo (southern Tuscany, Italy). The study area, located in the province of Siena, has an extension of 2.26 km^2 and hosts a heterogeneity of habitats like rocky outcrops, woodlands, meadows and riparian formations. The prevalent geological type is an acidic sedimentary rock known as diaspri formation (jasper). The checklist of vascular flora consists of 501 taxa and includes six endemics and 13 alien species, among which *Vitis labrusca* is a newly-found species for the Province of Siena along with the native *Rosa balsamica* and *Rosa squarrosa*. The most interesting species, such as *Anthoxanthum aristatum*, *Gagea bohemica*, *Paragymnopteris marantae*, *Saxifraga granulata,* and *Teesdalia coronopifolia*,

are found on acidic rocks. Species of the Italian Red List, such as *Ruscus aculeatus*, and species of Regional conservation interest, such as *Centaurea aplolepa* subsp. *carueliana*, *Ervilia loiseleurii*, and *Vicia nigricans*, were recorded. The chorological spectrum reveals a dominance of Mediterranean species indicating warm climate conditions and mild winters whereas the life-form spectrum shows a slight dominance of hemicryptophytes followed by therophytes. However, a clear dominance of one life-form type over the other is lacking, since the acidic and dry rocky substrate partially compensates for the humidity provided by the stream. This study highlights the relevant floristic value of the Miniera di Murlo area and supports the possible creation of a protected area or its inclusion in the adjacent one.

Keywords
Central Italy, flora, floristic research, jasper, conservation, rare species, Italy, vascular plants

Introduction

Tuscany is a part of the Italian territory where discrepancies in floristic knowledge are recognized; it, therefore, represents a suitable area to carry out studies on plant diversity (D'Antraccoli et al. 2018). In recent years, Tuscan botanists have filled the gaps with regional (Arrigoni 2016, 2017, 2018) and local floristic inventories in the Siena province (Bonari et al. 2016, 2018), along with records of single plant species (Peruzzi et al. 2015a, 2016, 2017, 2018). The present research will contribute to increase the floristic knowledge across Tuscany.

This study involves an area in the surroundings of the Miniera di Murlo village in the Province of Siena (southern Tuscany, Italy). The bedrock consists of sedimentary rocks entirely made by silica, representing a sort of "geological island" occurring in an area with a completely different geological type. This edaphic condition primarily led us to the selection of Miniera di Murlo as an interesting area to investigate. According to preliminary floristic surveys, the Miniera di Murlo area could belong to those areas of high biodiversity value not included in any nature reserve. In Italy, unsuitable conservation of plant diversity hotspots may occur (Fois et al. 2018a, 2018b, Signorello et al. 2018) and the current nature reserves of Tuscany do not completely include all the areas of high naturalistic value.

Current floristic knowledge of Miniera di Murlo is based on previous research by Chiarucci (1993, 1994) and Centi (2001–2002), who investigated the vegetation of ophiolitic and jasper outcrops in the Murlo area. Beside these studies, some species of high botanical interest, such as *Asplenium septentrionale* subsp. *septentrionale*, *Ervilia loiseleurii*, *Gagea bohemica*, and *Vicia nigricans* were also found in this area (Angiolini and Centi 2001, Frignani et al. 2005, Peruzzi et al. 2010a, 2017). Despite this, the floristic information regarding the area is still incomplete and a comprehensive survey is needed.

Accordingly, the aim of this work was to compile a checklist of vascular plants of the Miniera di Murlo area and to analyse its ecological attributes.

Study area

The study was carried out in an area extending for 2.26 km^2 that includes the jasper outcrops near the Miniera di Murlo village (Siena) in southern Tuscany (43.140713N, 11.383862E; Fig. 1). The area develops into the basin of the river Ombrone among the reliefs of the Dorsal Monticiano-Roccastrada and a hilly area made up of Pliocene sediments called Crete Senesi (De Dominicis and Casini 1997, Anselmi 2001). The investigated area is crossed by the Crevole stream and presents a high degree of naturalness although it has been subjected to anthropogenic exploitation due to the presence of mines. It also includes the Monte Pertuso relief, which is the highest point of the study area (273 m a.s.l.). The Miniera di Murlo area is adjacent, but not included in, the Special Area of Conservation (SAC) Basso Merse (IT5190007) and the Basso Merse Nature Reserve established in 1995 and 1996, respectively.

Geology

The main geological outcrop in the investigated area is the diaspri formation (jasper), a sedimentary late-Jurassic formation belonging to the Ophiolitic Unit of the Ligurian Domain. The diaspri formation (Suppl. material 1: Fig. 1) is made up of thin layers of radiolarite, 4- to 10-cm thick, usually reddish-brown with green veins, sometimes also fully green in colour (Scaramucci et al. 2016), which are intercalated by centimetric layers of siltstone. This rock formation is known as radiolarite because of the presence of radiolari shells (microorganisms with a siliceous skeleton). It presents a red colour because of the presence of a hematic pigment with, sometimes, clay inclusions.

Jasper of the Ophiolitic Unit makes a basal contact with serpentine, basalt, and gabbro (igneous and metamorphic rocks from the oceanic crust) and an upper one with siliceous limestone, shale, and marl (Bucci et al. 2015). Moreover, the presence of microfossils shows that jasper belongs to Malm (Kimmeridgian-Tithonian stratigraphic stage of Upper Jurassic), while a low zone of carbonate dissolution, during the Upper Jurassic, explains the absence of carbon residues in jasper.

Climate

Climatic data were retrieved from the Hydrological Tuscan Service (SIR; http://www.sir.toscana.it) of Monteroni d'Arbia (43.229343N; 11.422277E, 165 m a.s.l.) located at 12.4 km from Miniera di Murlo. The climate is typical of Tuscan hill valleys, more continental compared to sites at higher altitudes in the same area. As evidenced by Pesaresi et al. (2014), the Miniera di Murlo area lies between the Mediterranean and temperate macroclimates. During anticyclonic weather conditions, the area is prone to strong nocturnal thermal inversions, especially during autumn and winter.

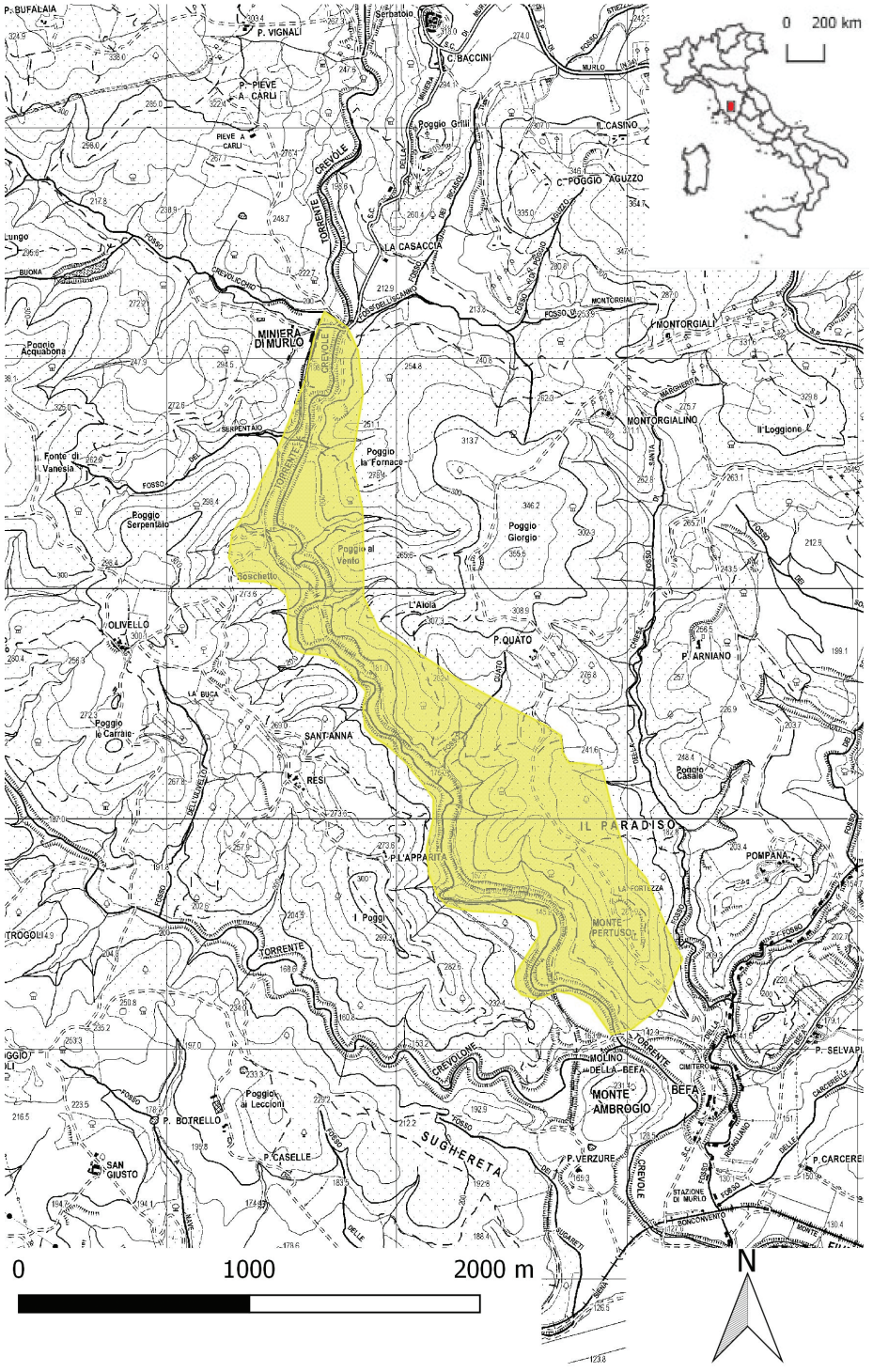

Figure 1. Boundaries of the study area (Miniera di Murlo, Siena).

Data for the period 2012–2017 showed an average annual temperature of 13.8 °C. The hottest months are July (average temperature 22.9 °C) and August (average temperature 23.2 °C), the coldest are January and February with an average temperature of 5.7 °C. The average annual rainfall is 871.3 mm with maximum values in October (138.8 mm) and November (125.6 mm), although in 2015 the month with maximum rainfall was August (278.4 mm). The thermopluviometric diagram (Suppl. material 1: Fig. 2) according to Bagnouls and Gaussen (1935), shows that the period of water deficit, derived from the ratio of precipitation to average temperature, concerns only June and July, but not August.

Vegetation types

The study area is characterised by different vegetation types typical of the Mediterranean area. Arid and acidic substrates with low fertility, such as jasper, promote the growth of Mediterranean evergreen sclerophyllous species, with a medium-high *Quercus ilex* cover and a relative abundance of shrubs, such as *Arbutus unedo*, *Erica arborea*, *E. scoparia*, and *Phillyrea latifolia*. The herb layer under this (semi-)closed canopy of evergreen woody species is strongly shaded and relatively poor in species. A less widespread forest type with different oak species (*Quercus cerris*, *Q. pubescens* and sparse *Q. suber*) also occurs. In addition, the study area presents scrublands with *Calluna vulgaris, Cytisus* spp., *Pyracantha coccinea*, and *Spartium junceum*, mostly located along wood edges, indicating the connection between the forest and a habitat with less developed soils.

Riparian vegetation along the stream is dominated by *Salix eleagnos, S. purpurea* subsp. *purpurea*, and *Populus nigra* subsp. *nigra.* Typical grassland vegetation with graminoids is also present. However, the most interesting vegetation type of the area is linked to the presence of jasper outcrops (Suppl. material 1: Fig. 3). This vegetation is dominated by vernal therophytes and succulent plants of the genera *Petrosedum* and *Sedum*. On the outcrops, patches of xerophilous and heliophilous Caryophyllaceae, such as *Scleranthus annuus* and *S. perennis* are dominant. The vegetation of the rocky slopes exposed to higher humidity (Suppl. material 1: Fig. 4) is dominated by hemicryptophytes, including several fern species.

Materials and methods

The floristic field surveys were carried out in 2017–2018. Plants collected in the field were dried in order to prepare herbarium specimens and were subsequently identified in the laboratory. The collected data were integrated with those from previous studies (Angiolini and Centi 2001, Centi 2001–2002, Frignani et al. 2005, Peruzzi et al. 2010a, 2017). The specimens collected during the field surveys are preserved at the herbaria of Siena (SIENA), Florence (FI) and Viterbo (UTV; acronyms according to Thiers 2015 onwards). For species identification, we mainly referred to Castroviejo et

al. (1984–2005), Fiori (1923–1929), Pignatti (1982, 2017a, 2017b, 2018) and Tutin et al. (1964–1980, 1993). For critical groups, specific monographs, books, and papers were consulted (Arrigoni 2003, 2016, 2017, 2018, Ciccarelli and Garbari 2004, Roma-Marzio et al. 2017). For native species, the nomenclature follows Bartolucci et al. (2018a) and further updates (Bartolucci et al. 2018b, 2018c), while for alien species Galasso et al. (2018a) and further updates (Galasso et al. 2018b, 2018c). The order of families is in accordance with Peruzzi (2010b), whereas genera and species are arranged in alphabetical order. Life forms and chorological types are in accordance with Pignatti (1982). Life-form and chorological type graphs are presented for both the general flora and for the species growing on jasper bedrock only. The distribution of endemic taxa follows Peruzzi et al. (2015b). To verify the conservation status of each taxon, the Red List of the Italian flora (Rossi et al. 2013), the List of plants of Regional conservation interest – Re.Na.To. Project (Sposimo and Castelli 2005, Viciani et al. 2014; http://www.regione.toscana.it/-/repertorio-naturalistico-toscano-re-na-to-http://www.regione.toscana.it/-/repertorio-naturalistico-toscano-re-na-to-) and the Italian Endemics Red List (Orsenigo et al. 2018) were checked. The checklist reports the following information for each taxon: scientific name, life form, chorological type, inclusion in the Italian Red List and in the List of plants of Regional conservation interest, species occurring on jasper, endemic/alien/cultivated species status, and the herbarium where the specimen is preserved. Graphs were plotted using R software (R Core Team 2018).

Results

The checklist consists of 501 taxa, distributed in 294 genera and 67 families (Suppl. material 1). The most represented families are Poaceae (67 taxa), Fabaceae (63 taxa) and Asteraceae (61 taxa). Among the 501 species, five occur in conservation lists: *Gagea bohemica* (EN; *Endangered*), *Vicia nigricans* (NT; *Near Threatened*), *Ruscus aculeatus*, *Centaurea aplolepa* subsp. *carueliana*, and *Ervilia loiseleurii* (all LC; *Least Concern*). Overall, the checklist includes 13 alien species (Table 1), mainly related to the Crevole stream riverbed.

The biological spectrum (Fig. 2A) of the entire flora shows a dominance of hemicryptophytes (H: 38.4%) and therophytes (Th: 36.6%), while less represented are the phanerophytes (Ph: 9%), geophytes (G: 8.5%), chamaephytes (Ch: 5.1%), and nanophanerophytes (NP: 2.4%); one helophytic species is also present. The H/Th ratio (bioclimatic index) is 1.01.

The jasper flora shows higher proportions of hemicryptophytes (H: 40.2%), chamaephytes (Ch: 7.2%), and nanophanerophytes (NP: 3.3%) versus a decrease of therophytes (Th: 32%) and geophytes (G: 8.3%); the percentage of phanerophytes does not change (Ph: 9%) (Fig. 2B).

Regarding chorological types (Fig. 3A), the checklist contains 25% of Steno-Mediterranean, 22% of Euro-Mediterranean, 17% of wide distribution species, 15% of

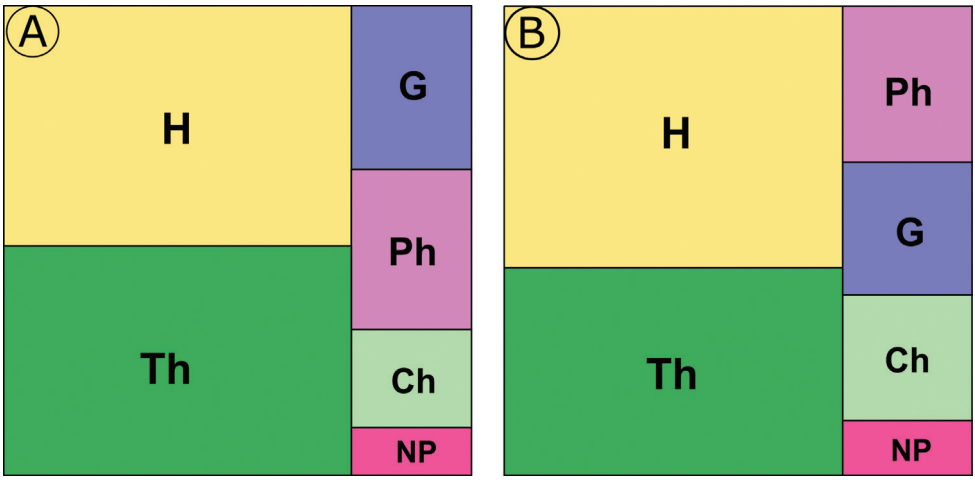

Figure 2. Life-form spectrum of species found at Miniera di Murlo (Siena). The spectrum shows the categories that appear more than five times in the checklist. **A** Life forms of all species found in the study area **B** Life forms of species occurring on jasper bedrock only. Categories are according to Pignatti (1982): hemicryptophytes (H); therophytes (Th); phanerophytes (Ph); nanophanerophytes (NP); geophytes (G); chamaephytes (Ch).

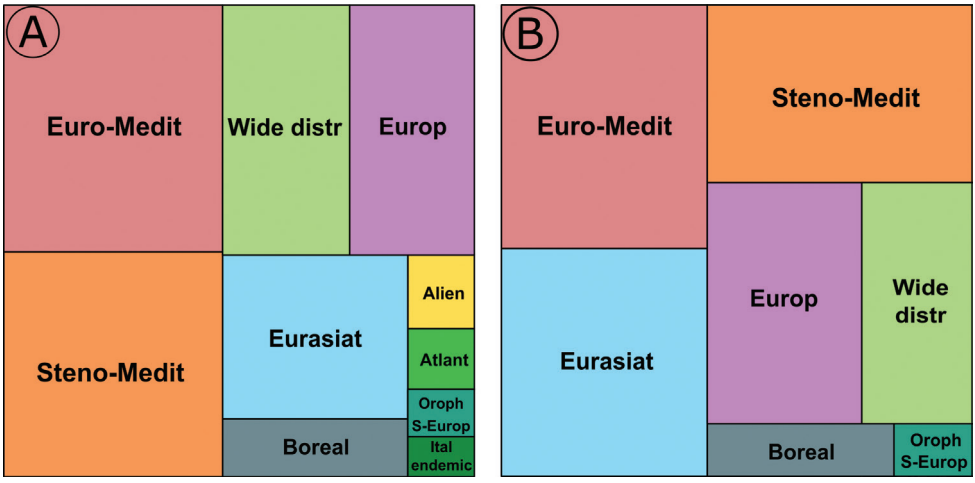

Figure 3. Chorological spectrum of species found at Miniera di Murlo (Siena). The spectrum shows the categories that appear more than five times in the checklist **A** Life forms of all species found in the study area **B** Life forms of species occurring on jasper bedrock only. Categories are according to Pignatti (1982): Alien= Alien species, Atlant= Atlantic species, Boreal= Boreal species, Eurasiat= Eurasiatic species, Euro-Medit= Euro-Mediterranean species, Europ= European species, Ital endemic= Italian endemics, Oroph S-Europ= South-European orophilous species, Steno-Medit= Steno-Mediterranean species, Wide distr= wide distribution species.

Table 1. Alien species found at Miniera di Murlo (Siena). The status and associated code in the study area, in Tuscany and in Italy for alien species follow Galasso et al. (2018a). A (archaeophyte), N (neophyte), T (taxonomically doubtful), FER (feral: wild plant originated from a culton escaped from domestication), NAT (naturalized alien) and INV (invasive alien).

Alien species	Status in the study area	Status in Tuscany	Status in Italy
Bidens frondosa	INV	P A NAT	N INV
Erigeron bonariensis	NAT	P A INV	N INV
Erigeron sumatrensis	NAT	P A INV	N INV
Euphorbia humifusa	NAT	P A NAT	N NAT
Helianthus tuberosus	CAS	P A INV	N INV
Malus domestica	CAS	P A CAS	A NAT FER
Opuntia engelmannii	INV	P A NAT	N NAT
Robinia pseudoacacia	NAT	P A INV	N INV
Setaria italica subsp. *pycnocoma*	NAT	P A NAT	N NAT FER
Setaria italica subsp. *viridis*	NAT	P A NAT	N NAT FER
Vitis labrusca	CAS	P A CAS	N NAT FER
Veronica persica	NAT	P A INV	N INV
Xanthium italicum	INV	P A NAT	T N INV

Table 2. Distribution of Italian endemic *taxa* according to Bartolucci et al. (2018a) found at Miniera di Murlo (Siena) and their status according to Orsenigo et al. (2018). Species are sorted in increasing order of regional occurrence and acronyms (from north to south Italy): EMR= Emilia Romagna, TOS= Tuscany, MAR= Marche, UMB= Umbria, LAZ= Lazio, ABR= Abruzzo, MOL= Molise, CAM= Campania, PUG= Puglia, BAS= Basilicata, CAL= Calabria, SIC= Sicily. Status acronyms: LC= Least Concern, DD: Data Deficient, (DD*): not reported in Orsenigo et al. (2018).

Italian endemics	Status	Distribution
Centaurea aplolepa subsp. *carueliana*	LC	PIE; LIG; TOS
Vicia ochroleuca subsp. *ochroleuca*	LC	TOS; CAM; BAS; CAL; SIC
Polygala flavescens subsp. *flavescens*	DD	EMR; TOS; MAR; UMB; LAZ; ABR; MOL; CAM; PUG; BAS
Helleborus viridis subsp. *bocconei*	LC	EMR; TOS; MAR; UMB; LAZ; ABR; MOL; CAM; BAS; CAL; SIC
Digitalis micrantha	(DD*)	EMR; TOS; MAR; UMB; LAZ; ABR; MOL; CAM; PUG; BAS; CAL
Linaria purpurea	LC	EMR; TOS; MAR; UMB; LAZ; ABR; MOL; CAM; PUG; BAS; CAL; SIC

European, 13.5% of Eurasiatic, and 5% of Boreal species, while alien, Atlantic, south-European orophilous, and Italian endemic species (Table 2) are less than 5%.

The jasper chorological spectrum (Fig. 3B) reveals the dominance of Steno-Mediterranean, Euro-Mediterranean, and Eurasiatic species (all > 20%). Both European (16.3%) and wide distribution (11.7%) species are well represented, while few are Boreal species (4.2%), south-European orophilous species (1.7%) and Italian endemics (1.4%). Moreover, the jasper checklist comprises two Atlantic and one alien species.

Discussion

Diversity, distribution, and conservation aspects

The checklist includes many species related to the physical and chemical features of the substrate. Low levels of nutrients, especially nitrates, are highlighted by numerous Fabaceae (Christenhusz et al. 2017). In addition, jasper outcrops host perennial and annual succulents (particularly Crassulaceae). Moreover, the acidity of jasper favours the development of typical species of siliceous rocky habitats, like *Gagea bohemica*, *Paragymnopteris marantae*, *Scleranthus perennis*, and *Teesdalia coronopifolia* (Biondi et al. 2009). This peculiar flora has its phenological optimum in the spring when low evaporation allows higher moisture. It is linked to very shallow and skeletal soils, with a low amount of nutrients and acidic reaction and it largely corresponds to *Habitat* 8230 of Annex I of the EU Habitats Directive 92/43/EEC (Selvaggi and Giusso del Galdo 2016). In these conditions, calcifuge and/or acidophilous species, such as *Centaurea aplolepa* subsp. *carueliana*, *Festuca lachenalii* and *Iberis umbellata*, also occur, while many ferns (mainly of the genera *Asplenium* and *Polypodium*; *Habitat* 8220 of Annex I of the EU Habitats Directive 92/43/EEC) grow on the siliceous cliffs. Some of the recorded species have a narrow distribution range: in Tuscany, *Saxifraga granulata* is present only in the northern Apennines and on the Island of Elba (Foggi et al. 2006, Mannocci et al. 2016, Carta et al. 2018, Coppi et al. 2018), while *Gagea bohemica* occurs in the continental part of Tuscany only in Miniera di Murlo (Peruzzi et al. 2017). In addition, *Ruscus aculeatus* is included in the Italian Red List (Rossi et al. 2013) with LC status, while *Vicia nigricans* and *Gagea bohemica* are both included in the Regional conservation list as NT and EN, respectively (Sposimo and Castelli 2005, Viciani et al. 2014). Moreover, *Centaurea aplolepa* subsp. *carueliana* and *Ervilia loiseleurii* are also listed there as LC. Only one cultivated species occurs (*Malus pumila*).

Among the alien species, *Bidens frondosa* and *Opuntia engelmannii* are those with the most worrying alien status (*sensu* Galasso et al. 2018a). They show a higher alien status in the study area compared to the one assigned at the Regional and national level (see Galasso et al. 2018a). *Opuntia engelmannii* is the most aggressive, growing on the jasper outcrop of Monte Pertuso where it is invasive (Suppl. material 1: Fig. 5; Selvaggi and Giusso del Galdo 2016). *Vitis labrusca* is a newly-found alien species for the province of Siena along with the native *Rosa balsamica* and *Rosa squarrosa* (Roma-Marzio et al. 2016, https://goo.gl/QUkDjT).

Life-form spectrum

The life-form spectrum shows the clear predominance of hemicryptophytes and therophytes. The H/Th ratio, indicator of the Mediterranean (values <1) or continental (values >1) nature of the flora (Sabato and Valenzano 1975), shows a value close to 1, underlying no prevalence of hemicryptophytes over therophytes (and *vice versa*) and

no clear bioclimatic character of the flora. The acidic and dry substrate might influence the life-form spectrum, by contrasting the humidity provided by the Crevole stream. Despite a similar acidic substrate, a different H/Th ratio was found in the floras of Monte Leoni (H/Th: 1.2; Selvi 1998) or in the Merse river valley (H/Th: 2.02; Landi et al. 2009) since these areas are situated in a more humid bioclimatic context compared to Miniera di Murlo. The percentage of geophytes is lower than in other floras due to the abundance of poorly evolved soils, being probably harsh environments for the growth of these species (e.g. Landi et al. 2009, Bonari et al. 2018). The significant proportion of phanerophytes, along with the nanophanerophytes, highlights the large surface area covered by forests. Due to the low water regime of the Crevole stream, no hydrophytes are present, while only one helophyte occurs (*Lythrum salicaria*).

In comparison with the life-form spectrum of the general flora, the one relating to plant species growing on jasper bedrock reveals a prevalence of hemicryptophytes followed by a lower percentage of therophytes. The decrease in therophytes, short-cycle plants favoured by open and disturbed environments (Kalusová et al. 2017), is likely due to the reduced presence of these habitats on jasper.

The flora of the jasper substrate shows an increase of chamaephytes compared to the percentage of the general flora. This shows that soils derived from jasper bedrock promote the growth of drought-tolerant species. Rocky substrates, although with different chemistry, lead to the development of selective vegetation types and associated plants. This is evident when the life-form spectrum of Miniera di Murlo is compared with that of Tuscan serpentine floras, showing only small differences (Chiarucci 2004).

Chorological spectrum

The analysis of the chorological spectrum reveals a prevalence of Mediterranean species that indicate warm conditions and mild winters (Pignatti 1994). Euro-Mediterranean and Steno-Mediterranean species represent almost the 50% of the chorological spectrum. Moreover, the percentages of European, Eurasiatic, and Boreal species indicate that the flora of Miniera di Murlo is mainly composed by Mediterranean species, although a substantial influence from typical species of the Euro-Siberian region occurs. The species with wide distribution indicate the presence of areas with anthropogenic disturbance (i.e., abandoned or grazed areas, and trails) or with azonal vegetation (i.e., rocky outcrops and riverbed). Atlantic species are scarcely present, as in the Italian territory in general, except for western regions, such as Tuscany and Sardinia (Pignatti 1994). The very low percentage of south-European orophilous species follows the geomorphology of the area, dominated by a hilly territory. Italian endemics are linked to the bedrock, as found on serpentine by Chiarucci (2004). Among them, *Centaurea aplolepa* subsp. *carueliana* is the only endemic with a restricted range that is limited to the Regions of Piedmont, Tuscany, and Liguria (Bartolucci et al. 2018a).

The chorological spectrum of plant species growing on jasper reveals a prevalence of Mediterranean species and an increase of Eurasiatic ones. This suggests that soils on jasper bedrock keep promoting the growth of Mediterranean species while improving the growth of species typical of the Euro-Siberian region, showing an equilibrium between Mediterranean and Euro-Siberian species.

Conclusions

This work contributes to the knowledge of the vascular flora of a poorly researched area of southern Tuscany. Our results showed that the Miniera di Murlo area represents a hotspot for vascular plants, mainly due to the presence of a peculiar bedrock: the jasper. Despite the past presence of mines and its exploitation, the area hosts some rare species that support its inclusion in a new Special Area of Conservation, or within the current Basso Merse SAC or Nature Reserve. Active management projects or the inclusion of the Miniera di Murlo area inside a nature reserve would help to limit the spread of alien species and to better preserve the native ones.

This work has highlighted how gaps in floristic knowledge can lead to incorrect delimitation of protected areas, causing the exclusion of relevant sites with particular habitats, such as jasper outcrops. It is important to promote awareness in public administrations regarding the potential of floristic investigations as a fundamental and decisive tool to support the establishment of protected areas.

Acknowledgements

We are grateful to the participants of the annual excursion of the Tuscan Section of the Società Botanica Italiana (S.B.I.) held in this area on May 31st 2017, to Elisa Mammoliti for revising the geology paragraph and to Daniel Gerrard for English language revision. We thank Francesco Roma-Marzio and Riccardo Guarino for their helpful remarks.

References

Angiolini C, Centi C (2001) Segnalazioni floristiche italiane: 1041. *Lens nigricans* (M.Bieb.) Gordon (*Leguminosae*). Informatore Botanico Italiano 33(2): 424.

Anselmi B (2001) Le Riserve Naturali della Provincia di Siena. Amm. Prov. di Siena.

Arrigoni PV (2003) Le centauree italiane del gruppo "*Centaurea paniculata* L.". Parlatorea 6: 49–78.

Arrigoni PV (2016) Flora analitica della Toscana. Volume 1. Edizioni Polistampa, Firenze, 408 pp.

Arrigoni PV (2017) Flora analitica della Toscana. Volume 2. Edizioni Polistampa, Firenze, 335 pp.

Arrigoni PV (2018) Flora analitica della Toscana. Volume 3. Edizioni Polistampa, Firenze, 336 pp.

Bagnouls F, Gaussen H (1935) Saison sèche et indice xèrothermique. Bulletin de la Société d'Histoire Naturel de Toulouse 88: 19–239.

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

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, 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 (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

Biondi E, Blasi C, Burrascano S, Casavecchia S, Copiz R, Del Vico E, Galdenzi D, Gigante D, Lasen C, Spampinato G, Venanzoni R, Zivkovic L (2009) Manuale Italiano di Interpretazione degli habitat della Direttiva 92/43/CEE. SBI, MATTM, DPN. http://vnr.unipg.it/habitat/index.jsp

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. https://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 Reserve (Central Tuscany, Italy). Atti della Società Toscana di Scienze Naturali, Memorie, Serie B 125: 77–86. https://doi.org/10.2424/ASTSN.M.2018.13

Bucci F, Costantini A, Lazzarotto A, Moroni A, Scaramucci S (2015) Lo sperone roccioso di La Pietra. In: Costantini A. Geositi: Eccellenze della natura nel parco delle Colline Metallifere – Tuscan Mining Geopark. Pacini Editore, Florence, 9–113.

Carta A, Forbicioni L, Frangini G, Pierini B, Peruzzi L (2018) An updated inventory of the vascular flora of Elba island (Tuscan Archipelago, Italy). Italian Botanist 6: 1–22. https://doi.org/10.3897/italianbotanist.6.26568

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.

Centi C (2001–2002) Contributo alla conoscenza delle serie di vegetazione dei diaspri di Murlo (Toscana, Italia centrale). Bachelor Thesis, Department of Life Sciences, University of Siena.

Chiarucci A (1993) Vegetation communities of Murlo ophiolitic complex (Southern Tuscany, Italy). Giornale Botanico Italiano 127: 713.

Chiarucci A (1994) Successional pathway of mediterranean ultramafic vegetation in central Italy. Acta Botanica Croatica 53: 83–94.

Chiarucci A (2004) Vegetation ecology and conservation of Tuscan ultramafic soils. The Botanical Review 69(3): 252–268. https://doi.org/10.1663/0006-8101(2003)069[0252:VEACOT]2.0.CO;2

Christenhusz MJ, Fay MF, Chase MW (2017) Plants of the World: an illustrated encyclopedia of vascular plants. University of Chicago Press, Chicago, Usa, 792 pp. https://doi.org/10.7208/chicago/9780226536705.001.0001

Ciccarelli D, Garbari F (2004) Le unità italiane di *Hypericum* (Clusiaceae), serie *Hypericum*. Informatore Botanico Italiano 36(2): 413–424.

Coppi A, Lastrucci L, Ferretti G, Viciani D (2018) A phylogenetic study of two recently described endemic species of the *Saxifraga granulata* group from the central-north Mediterranean region (Italy) and their position in the context of the series *Saxifraga* (Saxifragaceae). Systematics and Biodiversity 16: 784–790. https://doi.org/10.1080/14772000.2018.1492997

D'Antraccoli M, Pierini B, Roma-Marzio F, Gestri G, Caparelli KF, Bonari G, De Gaetano F, Dolci D, Consagra A, Calcara B, Pacifico B, Giannotti A, Cataldi G, Carta A, Bedini G, Peruzzi L (2018) Un lustro di Wikiplantbase #Toscana: storia, traguardi e prospettive future. Codice Armonico 2018: 170–178.

De Dominicis V, Casini S (1997) La vegetazione dei territori comunali di Monteroni d'Arbia e di Murlo. Tra Siena e il Vescovado: l'area della Selva. Accademia Senese degli Intronati. Tipografia Toscana, 641–735.

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

Foggi B, Cartei L, Pignotti L, Signorini MA, Viciani D, Dell'Olmo L, Menicagli E (2006) Il paesaggio vegetale dell'Isola d'Elba (Arcipelago Toscano). Studio fitosociologico e cartografico. Fitosociologia 43(1): 3–95.

Fois M, Bacchetta G, Cogoni D, Fenu G (2018b) Current and future effectiveness of the Natura 2000 network for protecting plant species in Sardinia: a nice and complex strategy in its raw state? Journal of Environmental Planning and Management 61(2): 332–347. https://doi.org/10.1080/09640568.2017.1306496

Fois M, Fenu G, Bacchetta G (2018a) Identifying and assessing the efficiency of different networks of a fine-scale hierarchy of biodiversity hotspots. Plant Ecology and Diversity 11(1): 121–132. https://doi.org/10.1080/17550874.2018.1474281

Frignani F, Centi C, Angiolini C (2005) *Vicia loiseleurii* (M.Bieb.) Litv. (Fabaceae). Sezione Toscana della Società Botanica Italiana. Notule floristiche per la Toscana. Edizioni ETS, 9–10.

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/italianbotanist.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

Kalusová V, Čeplová N, Lososová Z (2017) Which traits influence the frequency of plant species occurrence in urban habitat types? Urban ecosystems, 20(1): 65–75. https://doi.org/10.1007/s11252-016-0588-3

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

Mannocci M, Ferretti G, Mazzoncini V, Fiorini G, Foggi G, Lastrucci L, Lazzaro L, Viciani D (2016) Two new *Saxifraga* species (Saxifragaceae) endemic to Tuscan Archipelago (central northern Mediterranean, Italy). Phytotaxa 284(2): 108–130. https://doi.org/10.11646/phytotaxa.284.2.2

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, VaggeI, 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

Peruzzi L (2010b) Checklist dei generi e delle famiglie della flora vascolare italiana. Informatore Botanico Italiano 42(1): 151–170.

Peruzzi L, Domina G, Bartolucci F, Galasso G, Peccenini S, Raimondo FM, Albano A, Alessandrini A, Banfi E, Barberis G, Bernardo L, Bovio M, Brullo S, Brundu G, Brunu A, Camarda I, Carta L, Conti F, Croce A, Iamonico D, Iberite M, Iiriti G, Longo D, Marsili S, Medagli P, Pistarino A, Salmeri C, Santangelo A, Scassellati E, Selvi F, Soldano A, Stinca

A, Villani M, Wagensommer RP, Passalacqua NG (2015b) An inventory of the names of vascular plants endemic to Italy, their loci classici and types. Phytotaxa 196(1): 1–217. https://doi.org/10.11646/phytotaxa.196.1.1

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 (2016) 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, Avanzi A, Baldanzi C, Benesperi R, Bonari G, Bonini I, D'Antraccoli M, Castellani B, Dell'Olmo L, Di Nuzzo L, Domina G, Ercolini P, Ferretti G, Fontana D, Gestri G, Gottschlich G, Grazzini A, Lastrucci L, Lazzaro L, Malfanti F, Marsiaj G, Piazzini S, Pierini B, Roma-Marzio F, Sani A, Selvi F, Vicenti C, Bedini G (2015a) Contributi per una flora vascolare di Toscana. VII (357–439). Atti della Società Toscana di Scienze Naturali, Memorie, Serie B 122: 61–72. https://doi.org/10.2424/ASTSN.M.2015.07

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, Marchetti D, Marsaj 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

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 (2017) 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, Bedini G (2010a) Contributi per una flora vascolare di Toscana I (1–85). Atti della Società Toscana di Scienze Naturali, Memorie, Serie B 116(2009): 33–44.

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

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

Pignatti S (1994) Ecologia del paesaggio. Utet, Torino, 228 pp.

Pignatti S (2017a) Nuova Flora d'Italia. Vol. 1. Edagricole-New Business Media, Bologna, 1064 pp.

Pignatti S (2017b) Nuova Flora d'Italia. Vol. 2. Edagricole-New Business Media, Bologna, 1178 pp.

Pignatti S (2018) Nuova Flora d'Italia. Vol. 3. Edagricole-New Business Media, Bologna, 1287 pp.

R Core Team (2018) R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.r-project.org/ [accessed 01.07.2018]

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

Roma-Marzio F, Najar B, Alessandri J, Pistelli L, Peruzzi L (2017) Taxonomy of prickly juniper (*Juniperus oxycedrus* group): A phytochemical-morphometric combined approach at the contact zone of two cryptospecies. Phytochemistry 141: 48–60. https://doi.org/10.1016/j.phytochem.2017.05.008

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 (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.

Sabato S, Valenzano S (1975) Flora e Vegetazione di una zona dell'Appennino centro-settentrionale (Rincine). I. La Flora. Centro Sper. Agric. For. Ente nazionale Cellulosa e Carta, Roma vol. XIII, 85–192.

Scaramucci S, Volpi V, Costantini A, Giamello M, Donati A, Aranguren B, Moroni A (2016) New challenges in the study of lithic raw materials in central Italy at the dawn of metal working societies: La Pietra and other radiolarite quarry-workshops in Tuscany. Journal of Lithic Studies 3(2): 1–28. https://doi.org/10.2218/jls.v3i2.1466

Selvaggi A, Giusso Del Galdo G (2016) 8230 Rocce silicee con vegetazione pioniera del *Sedo-Scleranthion* o del *Sedo albi-Veronicion dillenii*. In: Angelini P, Casella L, Grignetti A, Genovesi P (Eds) Manuali per il monitoraggio di specie e habitat di interesse comunitario (Direttiva 92/43/CEE) in Italia: habitat. ISPRA, Serie Manuali e Linee Guida, 142/2016.

Selvi F (1998) Flora vascolare del Monte Leoni (Toscana Meridionale). Webbia 52(2): 265–306. https://doi.org/10.1080/00837792.1998.10670644

Signorello G, Prato C, Marzo A, Ientile R, Cucuzza G, Sciandrello S, Martínez-López J, Balbi S, Villa F (2018) Are protected areas covering important biodiversity sites? An assessment of the nature protection network in Sicily (Italy). Land Use Policy 78: 593–602. https://doi.org/10.1016/j.landusepol.2018.07.032

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, 1–302.

Thiers B (2015 onwards). Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. Available at http://sweetgum.nybg.org/science/ih/ [accessed 01.07.2018]

Tutin TG, Burges NA, Chater AO, Edmondson JR, Heywood VH, Moore DM, Valentine DH, Walters SM, Webb DA (1993) Flora Europaea, 2° Ed, Vol. 1. Cambridge University Press, Cambridge, 629 pp.

Tutin TG, Heywood VH, Burgers NA, Moore DM, Valentine DH, Walters SM, Webb DA (1964–1980) Flora Europaea. Vols. 2–5. 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

Supplementary material 1

Checklist of the vascular flora of the Miniere di Murlo area (Siena, Italy)

Authors: Silvia Cannucci, Claudia Angiolini, Barbara Anselmi, Enrico Banfi, Marco Biagioli, Paolo Castagnini, Chiara Centi, Tiberio Fiaschi, Bruno Foggi, Antonio Gabellini, Lorenzo Lastrucci, Edda Lattanzi, Anna Scoppola, Federico Selvi, Daniele Viciani, Gianmaria Bonari

Data type: floristic inventory

Link: https://doi.org/10.3897/italianbotanist.7.33763.suppl1

Italian Botanist 7: 69–91 (2019)
doi: 10.3897/italianbotanist.7.34285
http://italianbotanist.pensoft.net

RESEARCH ARTICLE

Italian Botanist
Published by Società Botanica Italiana

Notulae to the Italian flora of algae, bryophytes, fungi and lichens: 7

Sonia Ravera[1], Marta Puglisi[2], Alfredo Vizzini[3], Cecilia Totti[4], Michele Aleffi[5], Giuseppina Barberis[6], Renato Benesperi[7], Wolfgang von Brackel[8], Davide Dagnino[6], Antonio B. De Giuseppe[9], Zuzana Fačkovcová[10], Gabriele Gheza[11], Paolo Giordani[12], Anna Guttová[10], Petra Mair[13], Helmut Mayrhofer[14], Juri Nascimbene[15], Pier Luigi Nimis[16], Luca Paoli[17], Nicodemo G. Passalacqua[9], Elena Pittao[16], Silvia Poponessi[18], Filippo Prosser[19], Mauro Ottonello[20], Domenico Puntillo[9], Michele Puntillo[9], Giovanni Sicoli[21], Francesco Sguazzin[22], Daniel Spitale[13], Wilhelm Tratter[13], Claudia Turcato[6], Chiara Vallese[15]

1 *Dipartimento di Bioscienze e Territorio, Università degli Studi del Molise, C.da Fonte Lappone, 86090 Pesche (Isernia), Italy* **2** *Dipartimento di Scienze Biologiche, Geologiche e Ambientali, Sezione di Biologia vegetale, Università di Catania, v. A. Longo 19, 95125, Catania, Italy* **3** *Dipartimento di Scienze della Vita e Biologia dei Sistemi, Università di Torino, viale P.A. Mattioli 25, 10125 Torino, Italy and Institute for Sustainable Plant Protection (IPSP) – CNR, viale P.A. Mattioli 25, 10125, Torino, Italy* **4** *Dipartimento di Scienze della Vita e dell'Ambiente, Università Politecnica delle Marche, via Brecce Bianche, 60131 Ancona, Italy* **5** *Scuola di Bioscienze e Medicina veterinaria, Unità di Biodiversità Vegetale e Gestione degli Ecosistemi, Laboratorio ed Erbario di Briologia, Università di Camerino, via Pontoni 5, 62032 Camerino (Macerata), Italy* **6** *Dipartimento di Scienze della Terra, dell'Ambiente e della Vita (DISTAV), Università degli Studi di Genova, Corso Europa 26, 16132 Genova, Italy* **7** *Dipartimento di Biologia, Università di Firenze, via La Pira 4, 50121 Firenze, Italy* **8** *Kirchenweg 2, D-91341 Röttenbach, Germany* **9** *Museo di Storia Naturale della Calabria ed Orto Botanico, Università della Calabria, 87036 Arcavàcata di Rende (Cosenza), Italy* **10** *Plant Science and Biodiversity Centre, Slovak Academy of Sciences, Dúbravská cesta 9, SK-84523 Bratislava, Slovakia* **11** *Sezione di Ecologia del Territorio, Dipartimento di Scienze della Terra e dell'Ambiente, Università di Pavia, via S. Epifanio 14, 27100 Pavia, Italy* **12** *Dipartimento di Farmacia (DIFAR), Università di Genova, viale Cembrano 4, 16148 Genova, Italy* **13** *Museo di Scienze Naturali dell'Alto Adige, via dei Bottai 1, 39100 Bolzano, Italy* **14** *Institut für Biologie, Bereich Pflanzenwissenschaften, Karl-Franzens-Universität Graz, Holteigasse 6, 8010 Graz, Österreich* **15** *Dipartimento di Scienze Biologiche, Geologiche e Ambientali (BiGeA), Università di Bologna, via Irnerio 42, 40126 Bologna, Italy* **16** *Dipartimento di Scienze della Vita, Università degli Studi di Trieste, via L. Giorgieri 10, 34127 Trieste, Italy* **17** *Dipartimento di Biologia, Università di Pisa, via Luca Ghini 13, 56126 Pisa, Italy* **18** *Dipartimento di Chimica, Biologia e Biotecnologia, Università di Perugia, v. del Giochetto 6, 06126 Perugia, Italy* **19** *Fondazione Museo Civico di Rovereto, Largo S. Caterina 41, 38068 Rovereto (Trento), Italy* **20** *Via Primo Maggio 46, 18018 Taggia (Imperia), Italy* **21** *Dipartimento di Biologia, Ecologia e Scienze della Terra, Università della Calabria, 87036 Arcavàcata di Rende (Cosenza), Italy* **22** *Via Selvotta 61, 33055 Muzzana del Turgnano (Udine), Italy*

Corresponding author: *Sonia Ravera* (sonia.ravera@unimol.it)

Academic editor: *L. Peruzzi* | Received 4 March 2019 | Accepted 28 March 2019 | Published 22 April 2019

Citation: Ravera S, Puglisi M, Vizzini A, Totti C, Aleffi M, Barberis G, Benesperi R, von Brackel W, Dagnino D, De Giuseppe AB, Fačkovcová Z, Gheza G, Giordani P, Guttová A, Mair P, Mayrhofer H, Nascimbene J, Nimis PL, Paoli L, Passalacqua NG, Pittao E, Poponessi S, Prosser F, Ottonello M, Puntillo D, Puntillo M, Sicoli G, Sguazzin F, Spitale D, Tratter W, Turcato C, Vallese C (2019) Notulae to the Italian flora of algae, bryophytes, fungi and lichens: 7. Italian Botanist 7: 69–91. https://doi.org/10.3897/italianbotanist.7.34285

Abstract

In this contribution, new data concerning algae, bryophytes, fungi, and lichens of the Italian flora are presented. It includes new records and confirmations for the algae genus *Chara*, the bryophyte genera *Cephalozia*, *Conardia*, *Conocephalum*, *Didymodon*, *Sphagnum*, *Tetraplodon*, and *Tortula*, the fungal genera *Endophyllum*, *Gymnosporangium*, *Microbotryum*, *Phragmidium*, and *Pluteus*, and the lichen genera *Candelariella*, *Cladonia*, *Flavoplaca*, *Lichenothelia*, *Peltigera*, *Placolecis*, *Rinodina*, *Scytinium*, and *Solenopsora*.

Keywords

Ascomycota, Basidiomycota, Bryidae, Charophyceae, Jungermanniidae

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@unimol.it) for lichens.

Floristic records

ALGAE

Chara globularis Thuill. (Charophyceae)

+ **LIG**: via Scarpanto, Genova Pegli (Genova) cement tank for irrigation purposes (UTM WGS84: 32T 484124.4920804), 195 m, 6 June 2018, *D. Dagnino, C. Turcato* (GE-578, FI). – Species new for the flora of Liguria.

The site of discovery belongs to a private property within an agricultural area in proximity of the city of Genova, characterized by a Mediterranean climate. The persistence of this site is strictly dependent on the use of the irrigation tank (assuring the water flow) and its management (e.g., cleaning-up of the tank, use of fertilizers, etc). *Chara globularis* is very similar to *Chara delicatula* C.Agardh (following Bazzichelli and Abdelahad 2009), from which it is distinguished because of the characteristics of the stipuloid (rudimentary), of the leaflets (shorter) and by the isostic cortex (Bazzichelli and Abdelahad 2009). Another difference is in their ecology: *Chara delicatula* has been reported in oligotrophic lakes with low calcium concentration, while *C. globularis* has

been observed in lakes rich in calcium and phosphorus (Krause 1997). *Chara globularis* is the species most frequently reported in Italy after *Chara vulgaris* L. It has been reported in Trentino-Alto Adige, Piemonte, Lombardia, Veneto, Friuli Venezia Giulia, Toscana, Marche, Umbria, Lazio, Sardegna, and Sicilia (Bazzichelli and Abdelahad 2009).

D. Dagnino, C. Turcato, G. Barberis

Chara contraria A.Braun ex Kützing (Charophyceae)

+ **LIG**: agricultural landscape along via Scarpanto, hills near Genova Pegli (Genova) cement tank for irrigation purposes (UTM WGS84: 32T 484112.4921069), 230 m, 6 June 2018, *D. Dagnino*, *C. Turcato* (GE 572, FI); Rio Pareto valley, Valbrevenna (Genova) puddle close to the road (UTM WGS84: 32T 507040.4935428), 960 m, 1 September 2018, *D. Dagnino*, *A. Costa* (GE 571, FI). – Species new for the flora of Liguria.

+**PIE**: Brignola lake, Maudagna valley, Alps of Cuneo, Magliano Alpi (Cuneo) (UTM WGS84: 32T 402318.4894083), 2139 m, 9 August 2018, *D. Dagnino*, *C. Calise* (GE 570, FI); tributary placed northeast of Molino del Pio, along the SP147 road, Borbera valley, Carrega Ligure (Alessandria), puddle close to the road (UTM WGS84: 32T 512404.4942485), 685 m, 10 September 2018, *D. Dagnino*, *C. Turcato* (GE 573, FI); Northern slope of Costa Lavezzara, "Alberghi" road, Bosio (Alessandria) ditch along the road (UTM WGS84: 32T 483847.4933913 and UTM WGS84: 32T 483795.4933883), 573 m, 12 July 2018, *D. Dagnino, C. Turcato, G. Barberis* (GE 574, FI; GE 590, FI); Northwestern slopes of M. Tobbio, along the road between Capanne di Marcarolo and Eremiti, Bosio (Alessandria), cane field of *Phragmites australis* (Cav.) Trin. ex Steud. (UTM WGS84: 32T 484135.4938346), 551 m, 12 July 2018, *D. Dagnino, C. Turcato, G. Barberis* (GE 575). Between C.na Meriana e C. Acquestriate, Voltaggio (Alessandria), puddles along the creek (UTM WGS84: 32T 488217.4937024), 457 m, 12 July 2018, *D. Dagnino, C. Turcato, G. Barberis* (GE 576, FI). – Species new for the flora of Piemonte.

The listed sites differ from each other in ecological (puddles, cement tank, cane field, lake) and climatic conditions (Mediterranean, Continental, and sub-Alpine). *Chara contraria* was found in connection with the habitat of Community interest cod. 7220* (GE 571 and GE 573) and cod. 3130 (GE 570). Except for the alpine site (GE 570), where *C. contraria* covers more than 1,000 m^2, all the sites occupy much smaller areas and are subjected to human frequentation. Some of them belong to protected areas (i.e., Site of Community Importance "Alte Valli Pesio e Tanaro" cod. IT1160057, GE 570 and "Capanne di Marcarolo" cod. IT 1180026, GE 574, 576, 590). The difficulties in distinguishing *C. contraria* from *C. vulgaris* L. could explain the low number of reports in Italy, where the species is known from Veneto, Lombardia, Lazio, Sicilia (Bazzichelli and Abdelahad 2009), Trentino-Alto Adige (Bolpagni et al. 2013) and Friuli Venezia Giulia (Tomasella and Oriolo 2007). We identified the specimen GE 570 as *C. contraria* f. *hispidula* (A.Braun) A.Braun, according to Mouronval et al. (2015); this taxon is not listed in the Italian flora (Bazzichelli and Abdelahad 2009).

D. Dagnino, C. Turcato, G. Barberis

BRYOPHYTES

Cephalozia pleniceps (Austin) Lindb. (Cephaloziaceae)

+ **FVG**: Casera Cordin Grande, Paularo (Udine), on moist soil in a peat bog (UTM WGS84: 33T 359977.5159429), 1726 m, 26 October 2014, *F. Sguazzin, L. Boemo, A. Boemo* (Bryophytorum Herbarium F. Sguazzin). – Species new for the flora of Friuli Venezia Giulia.

Cephalozia pleniceps is a circumpolar-boreo-arctic montane floristic element (Dierßen 2001). It grows creeping on specimens of *Sphagnum centrale* C.E.O.Jensen. It is a small, pale green leafy liverwort with longitudinally inserted, bilobed leaves and has no underleaves. The leaves are divided with the lobes rather shortly triangular, not drawn out to long, narrow points (Lockhart et al. 2012). According to Aleffi et al. (2008), the presence in Italy of *C. pleniceps* is restricted to a number of northern localities in the Administrative Regions of Valle d'Aosta, Piemonte, Lombardia, Trentino-Alto Adige, and Veneto. The report for Toscana (between Pariana and S. Carlo) by Ferrarini and Marchetti (1983) corresponds to *C. lunulifolia* (Dumort.) Dumort. Other old records for Piemonte, Lombardia and Friuli Venezia Giulia correspond to *C. bicuspidata* (L.) Dumort. Considering the confusion among *C. lunulifolia*, *C. connivens* (Dicks.) Lindb., *C. macrostachya* Kaal., and *C. bicuspidata* (L.) Dumort, herbarium material pre-dating Müllers' flora (1951–58) should be revised (Aleffi et al. 2008). The species is not widespread in the Mediterranean basin, being reported only for Montenegro, Turkey, Spain, France, and Italy (Ros et al. 2007). Its range includes central and eastern Europe, including Fennoscandia, Baltic States, Poland, Belarus, Ukraine, Russia, Caucasus, Switzerland, Austria, Slovakia, Slovenia, and Romania (Lockhart et al. 2012). According to Hodgetts (2015), *C. pleniceps* is considered Vulnerable in Ireland, Spain and Czech Republic, Critically Endangered in Italy, Regionally Extinct in Netherlands, Data Deficient in Bulgaria and Hungary, Near Threatened in Slovenia.

S. Poponessi, F. Sguazzin, M. Aleffi

Conardia compacta (Müll.Hal.) H.Rob. (Amblystegiaceae)

+ **TAA**: Castle ruin of Salegg, Sciliar-Catinaccio Nature Park (Naturpark Schlern-Rosengarten), Castelrotto (Bolzano) at the foot of the castle wall, shady, damp soil, calcareous/dolomite coarse gravel (UTM WGS84: 32T 696170.5156802), 1110 m, 30 March 2018, *W. Tratter*, conf. *D. Spitale* (Herb. BOZ: BRYO 2615); on the northern site of the castle ruin of Castelvecchio di Siusi, Sciliar-Catinaccio Nature Park (Naturpark Schlern-Rosengarten), Castelrotto (Bolzano), at the foot of the castle rocks (dolomite) on damp soil and under boulders, (UTM WGS84: 32T 696956.5156837), 1210 m, 2 April 2018, *W. Tratter* (Herb. BOZ: BRYO 2617). – Species confirmed for the flora of Trentino-Alto Adige.

The occurrence at the castle ruin of Salegg is new, while the presence at the castle ruin of Castelvecchio di Siusi is confirmed after more than 100 years (Dalla Torre and Sarnthein 1904). Cortini Pedrotti (2006) reported this rare species for old walls, clay soil, damp, alkaline, shady substrates, especially dolomitic rocks, distributed from the hilly to the subalpine zone. According to Aleffi et al. (2008), this species occurs in Italy only in three Administrative Regions: Piemonte, Lombardia and Trentino-Alto Adige. In the latter Region, records have not been confirmed over the last 50 years. *C. compacta* is considered threatened in many European countries (Hodgetts 2015).

P. Mair, W. Tratter, D. Spitale

Conocephalum salebrosum Szweyk., Buczk. & Odrzyk (Conocephalaceae)

+ **CAL**: Pachina torrent, Canolo (Reggio Calabria), on calcareous rocks (UTM WGS84: 33S 602074.4241854), 630 m, 1 July 2018, leg. *G. Spanpinato,* det. *M. Puglisi* (CAT). – Species new for the flora of Calabria.

Conocephalum salebrosum is a recently described species, strictly related to *C. conicum* (L.) Dumort. It was considered a cryptic species of the *C. conicum* complex, originally detected on the basis of isozyme studies (Szweykowski et al. 2005). Later, some morpho-anatomical differences were found in the structure of archegoniophores and sporophytes, as well as in sterile thalli, thus establishing a set of diagnostic characters distinguishing *C. conicum* from *C. salebrosum*. It is reported as a holarctic species, widespread throughout Europe, eastern Asia and North America. Conversely, in Italy this species is known only for a few localities of the northern and central peninsula, where it was collected on moist substrata (rocks, soil, sandstone) (Tacchi et al. 2009, Privitera et al. 2010, Poponessi et al. 2014, Ravera et al. 2017). In the summer 2018, during a field study carried out along the humid areas of the Thyrrenian slope (eastern foothills) of the Aspromonte massif, *C. salebrosum* was collected along stream banks where it colonized damp calcareous rocks mixed to *Oxyrrhynchium speciosum* (Brid.) Warnst. The site is characterized by the presence of the rare fern *Woodwardia radicans* (L.) Sm.. The vegetation belongs to the alliance *Adiantion capilli-veneris* Br.-Bl. ex Horvatic 1939, referred to the habitat 7250 Mediterranean wet inland cliffs of the 92/43/EC Habitat Directive.

M. Puglisi

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

+ **MAR**: Fiorenzuola di Focara (Pesaro) (UTM WGS84: 33T 325211.4868748 on moist wall, 165 m, 5 September 2018, leg. and det. *F. Prosser*, conf. *J. Kučera* (Herb. Prosser No. 03054). – Species new for the flora of Marche.

Didymodon umbrosus was reported in Italy only from Sicilia (Aleffi et al. 2008), where it was found by Gueli et al. (2001). According to Frahm (2006), it is probably a

neophyte of American origin, found for the first time in Europe in Barcelona (Spain) by Casas de Puig (1970). It is a robust plant with leaves up to 2 mm long, mamillose rather than papillose, bistratified at margin, with cells of the lower part clearly different from those of the median and upper parts. The specimens from Fiorenzuola lack the typical specialized asexual reproduction by multicellular tubers on proximal rhizoids, as also noted by Jan Kučera who confirmed the determination.

F. Prosser

Sphagnum angustifolium (C.E.O.Jensen ex Russow) C.E.O.Jensen (Sphagnaceae)

+ **FVG**: Corona Mountain, Pontebba (Udine), in a peat bog, (UTM WGS84: 33T 371686.5156999), 1757 m, 2 November 2014, *F. Sguazzin, L. Boemo, A. Boemo* (Bryophytorum Herbarium F. Sguazzin). – Species new for the flora of Friuli Venezia Giulia.

Sphagnum angustifolium forms loose carpets of slender green or yellowish shoots in minerotrophic flushes on banked and raised bogs, or in woodland (Lockhart et al. 2012). It is rarely found in Italy and has been confirmed only for Valle d'Aosta, Piemonte and Lombardia; according to Aleffi et al. (2008), this taxon is reported, with old reports, for Emilia-Romagna too. In the Mediterranean basin it is known for Bulgaria, Spain, France, Italy, Portugal, Serbia, Slovenia, and, with only a single locality, for Greece and Montenegro (Ros et al. 2013). Besides Europe, this species is reported for North America and Asia. It is assigned to the Circumpolar Boreal-montane geographic element (Smith 2004). According to Hodgetts (2015), *S. angustifolium* is considered Vulnerable in Serbia and Near Threatened in Hungary, Switzerland, and Germany.

S. Poponessi, F. Sguazzin, M. Aleffi

Tetraplodon angustatus (Hedw.) Bruch & Schimp. (Splachnaceae)

+ **TAA**: 0,5 km SW of Bad Maistatt, Alta Val Pusteria, Villabassa (Bolzano) on top of a boulder wall along the forest road in spruce forest (UTM WGS84: 33T 284500.5178500) 1370 m, 9 May 2013, *W. Tratter*, conf. *P. Mair* (Herb. BOZ: BRYO 1086); 0,5 km E Ober-Gerstgras Hof, Val di Senales, Gruppo di Tessa (Bolzano) on a shaded rock in a boulder field on the hillside above the road (UTM WGS84: 32T 638500.5177500), together with *Tetraplodon mnioides* (Hedw.) Bruch & Schimp. on boulders densely covered by bryophytes (*Hedwigia ciliata* (Hedw) P.Beauv. and *Hypnum cupressiforme* Hedw.) and lichens, 1800 m, 12 June 2014, *W. Tratter*, conf. *P. Mair* (Herb. BOZ: BRYO 4610); 'Rotwandwiesen' on path no. 15a, in direction of Passo Monte Croce Comelico, Croda Rossa di Sesto, Tre Cime Nature Park (Naturpark Drei Zinnen) (Bolzano) (UTM WGS84: 33T 291498.5164664), together with *T. mnioides* within a bryophyte cushion consisting mostly of *Campylium stellatum* (Hedw.) Lange & C.E.O.Jensen and scattered shoots of *Tayloria serrata* (Hedw.) Bruch & Schimp., 1950 m, 27 July 2016, *W. Tratter*, conf. *P. Mair* (Herb. BOZ: BRYO 4612). – Species confirmed for the flora of Trentino-Alto Adige.

All specimens were found with abundant capsules. The type of substrate is undetermined in all three sites, but considering the environmental context it is likely that the species have grown above remains of dung/excrements, probably of chamois in the higher places, or on bones of animal carcasses. According to Cortini Pedrotti (2001), this species grows on dung, dead animals and plants in decomposition, from the subalpine to the alpine zone. Dierßen (2001) mentions also decaying bones of deer and sheep and, less frequently, dung and decaying wood. Therefore, the distribution is typically scattered. Previously, *T. angustatus* was reported for Trentino-Alto Adige from the eastern part of the Bolzano province – Val Pusteria and some lateral valleys (Dalla Torre and Sarnthein 1904) – and for the Trentino province before 1900 (according to Lorentz 1865, in Aleffi et al. 2008). According to Aleffi et al. (2008), the species is signaled also for Lombardia and Emilia Romagna. The species is not widespread in Europe, where it is considered Vulnerable in Czech Republic, Slovakia, and Romania and Endangered in Switzerland (Hodgetts 2015).

P. Mair, W. Tratter, D. Spitale

Tetraplodon mnioides (Hedw.) Bruch & Schimp. (Splachnaceae)

+ **TAA**: 0,5 km E Ober-Gerstgras Hof, Val di Senales, Gruppo di Tessa (Bolzano) on a shaded rock in a boulder field on the hillside above the road (UTM WGS84: 32T 638500.5177500), 1800 m, 12 June 2014, *W. Tratter*, conf. *P. Mair* (Herb. BOZ: BRYO 4611), together with *Tetraplodon angustatus* (Hedw.) Bruch & Schimp.; Innerfeldtal, 1,5 km S Dreischusterhütte, on the «Dolomitenhöhenweg», Tre Cime Nature Park (Naturpark Drei Zinnen), Dolomiti di Sesto, Sesto (Bolzano) (UTM WGS84: 33T 293500.5170500), 1730 m, 21 July 2015, *W. Tratter*, conf. *P. Mair* (Herb. BOZ: BRYO 4615); 'Rotwandwiesen' on path no. 15a, in direction of Passo Monte Croce Comelico, Croda Rossa di Sesto, Tre Cime Nature Park (Naturpark Drei Zinnen) (Bolzano) (UTM WGS84: 33T 300500.5169500), with *T. angustatus* and *Tayloria serrata* (Hedw.) Bruch & Schimp. 1950 m, 27 July 2016, *W. Tratter*, conf. *P. Mair* (Herb. BOZ: BRYO 4612). – Species confirmed for the flora of Trentino-Alto Adige.

All specimens were found with abundant capsules. In Italy, this species is considered rare, growing on dung, dead animals and plants in decomposition in the subalpine zone (Cortini Pedrotti 2001). Dierßen (2001) reports similar substrate preference as for *T. angustatus*, i.e., decaying bones of deer and sheep, occasionally dung and bogs or the surface of cadavers; it grows alongside paths and tracks. This species is rare in Italy, where it is recorded with old reports for Piemonte and Trentino-Alto Adige and with recent records for Lombardia (Aleffi et al. 2008). For Trentino-Alto Adige, *T. mnioides* was reported only once by Dalla Torre and Sarnthein (1904: "Taufers: St. Wolfgang im Reintal"). In Europe, it is considered threatened in many countries, i.e., Endangered in Slovakia, Romania, and Slovenia and Vulnerable in Czech Republic, Switzerland, and Montenegro (Hodgetts 2015).

P. Mair, W. Tratter, D. Spitale

Tortula cernua (Huebener) Lindb. (Pottiaceae)

+ **TAA**: Castle ruin of Salegg, Sciliar-Catinaccio Nature Park (Naturpark Schlern-Rosengarten), Castelrotto (Bolzano) at the foot of the castle wall, shady, damp soil, calcareous/dolomite coarse gravel (UTM WGS84: 32T 696170.5156802), 1110 m, 30 March 2018, *W. Tratter* (Herb. BOZ: BRYO 2616); on the northern site of the castle ruin of Castelvecchio di Siusi, Sciliar-Catinaccio Nature Park (Naturpark Schlern-Rosengarten), Castelrotto (Bolzano), at the foot of the castle rocks (dolomite) on damp soil and under boulders, (UTM WGS84: 32T 696956.5156837), 1210 m, 2 April 2018, *W. Tratter*, conf. *D. Spitale* (Herb. BOZ: BRYO 2618). – Species confirmed for the flora of Trentino-Alto Adige.

The habitats preferred by this rare species are alkaline rock crevices, walls, soils of damp habitats, from the hilly to the alpine zone (Cortini Pedrotti 2001). Dierßen (2001) emphasized the alkaline preference of this species, e.g., lime waste and basic lake-sides as well as mortar, rocks etc. Dalla Torre and Sarnthein (1904) reported an observation in the area of the "Schlerngebiet" and several occurrences within the province of Bolzano. There are old reports (before 1950) for Trentino-Alto Adige, Veneto, and Friuli- Venezia Giulia and more recent records for Lombardia (Aleffi et al. 2008). In Europe, *T. cernua* is considered threatened in many countries (Hodgetts 2015).

P. Mair, W. Tratter, D. Spitale

FUNGI

Endophyllum sempervivi (Alb. & Schwein.) de Bary (Pucciniaceae)

+ **CAL**: Monte Pollino, Parco Nazionale del Pollino (Cosenza), on leaves of *Sempervivum tectorum* L. (UTM WGS84: 33S 601578.4417919), 2193 m, 6 May 2018, *D. Puntillo* (CLU No. 82). – Species new for the flora of Calabria.

As all the species of the genus, *E. sempervivi* has two spore stages: spermogonia and aecia. Spermogonia are subepidermal, scattered amongst the aecidia, roundish, sunken into the leaf tissue just protruding as small brown cones. The aecia are crateriforms where the aeciospores are produced. Germinating aeciospores give rise to a protobasidium; they act as teleospores, aecidioid telia with aeciditeliospores (Horst 2013). Infested leaves are strongly elongated and appear reddish at the apex. The infection is observable especially when the plants produce the first leaf rosettes. The species is present in Europe, including the Italian Alps, USA and Canada (Tykhonenko and Heluta 2017). In Calabria, it is quite common throughout the territory of the Pollino National Park.

D. Puntillo, M. Puntillo

Gymnosporangium sabinae (Dicks.) G.Winter (Pucciniaceae)

+ **CAL**: Orto Botanico Università della Calabria, Rende (Cosenza), hypophyllous on leaves of *Pyrus amygdaliformis* Vill. (UTM WGS84: 33S 605850.4357176), 213 m, 19 September 2018, *D. Puntillo* (CLU No. 169). – Species new for the flora of Calabria.

The genus *Gymnosporangium* R.Hedw. ex DC. includes heteroecious, demicyclic (lacking uredinia) rusts with plants belonging to Rosaceae subfam. Maloideae (*Amelanchier*, *Crataegus*, *Cydonia*, *Malus*, *Pyrus*, and *Sorbus*) as alternate hosts and species of *Juniperus* and *Cupressus* (in Europe) as telial hosts (Kern 1911, Helfer 2005). The collected specimen had hypophyllous roestelioid aecia on gall-like protuberances growing on *Pyrus amygdaliformis* Vill. leaves. In Italy, this species is known for Toscana (Barsali 1906, Saccardo 1912, Verona 1932 sub *Gymnosporangium fuscum* DC.), and Valle d'Aosta (Traverso 1912). It is also known in aecidal form from Piemonte, Liguria, Lombardia, Veneto, Friuli Venezia Giulia, Emilia-Romagna, Lazio, Umbria, and Campania and in teleutosporic form from Piemonte, Friuli Venezia Giulia, Campania, and Puglia (Trotter 1910), Piemonte (Noelli 1905) and Lazio (Cecchi 1942).

D. Puntillo

Microbotryum saponariae M.Lutz, Göker, Piątek, Kemler, Begerow & Oberw. (Microbotryaceae)

+ **CAL**: Piano di Maio, Rende (Cosenza) on anther of *Saponaria officinalis* L. (UTM WGS84: 33S 605703.4355968), 213 m, 19 July 2012, *D. Puntillo* (CLU No. 80). – Species new for the flora of Calabria.

For a long time, *Microbotryum violaceum* s.l. included many taxa, revealed recently by molecular investigations (Lutz et al. 2005), as *M. saponariae*. *Microbotryum saponariae*, as typical of the genus, cause anther-smut disease characterized by production of violet-coloured fungal spores instead of pollen in the anther of infected flowers of *Saponaria* (Caryophyllaceae), with reduced ovaries that become sterile. For Italy, Tomasi (2013) listed 13 species of *Microbotryum*. All the old collections indicated by Ciferri (1938) do not belong to *M. saponariae*, because the specimens were collected on different genera of the family ("in antheris staminibusque Caryophyllacearum plurimarum"), but never on *Saponaria officinalis* L. On the contrary, the record by Venturella (1991) for Sicilia and by Tomasi (2013) for Friuli-Venezia Giulia are to be referred to *M. saponariae*.

D. Puntillo

Phragmidium mucronatum (Pers.) Schltdl. (Phragmidiaceae)

+ **CAL**: Piano del Ratto, Pollino National Park (Cosenza), hypophyllous on *Rosa canina* L., (UTM WGS84: 33S 609643.4414547), 1384 m, 19 July 2018, *D. Puntillo* (CLU No. 100). – Species new for the flora of Calabria.

The genus *Phragmidium* Link is characterized by uredinial paraphyses, by erumpent or +/- pulverulent telia, by 3–9-celled verrucose and pedicellate teliospores provided by two or more germ-pores (including apical cell). *Phragmidium mucronatum* is distinguished by teliospores mostly 7-celled, ellipsoid with apical long papilla (15–21 μm). In Italy, it has been recorded for Lombardia, Friuli Venezia Giulia, and Veneto under the name *Phragmidium rosarum* Rabh. (Saccardo 1873); in Emilia-Romagna also under the name *P. rosarum* (Passerini 1877) and in Umbria as *Phragmidium subcorticium* (Schrank) G.Winter (Trotter 1910). More recently, it has been confirmed for Friuli Venezia Giulia (Tomasi 2007).

D. Puntillo

Pluteus pellitus (Pers.) P.Kummer (Pluteaceae)

+ **CAL**: Orto Botanico Università della Calabria, Rende (Cosenza), on a dead trunk belonging to a downy oak (*Quercus pubescens* Willd.) tree (UTM WGS84: 33S 606118.4357233), 220 m, 9 October 2018, *G. Sicoli, A.B. De Giuseppe, N.G. Passalacqua* (CLU No. 303). – Species new for the flora of Calabria.

Pluteus pellitus is an agaricaceous, lignicolous, saprotrophic fungus, showing pileate and stipitate basidiomata, with a whitish pileus but pale brown around centre, pleurocystidia provided with 2–4 apical hooks, and clamp connections on the pileipellis hyphae, clearly distinguishing it from *Pluteus petasatus* (Fr.) Gillet (Justo et al. 2014). This species is widely distributed in northern and central Italy, but apparently not detected in southern Italy so far, except for Sicily.

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

LICHENS

Candelariella efflorescens R.C.Harris & W.R.Buck (Candelariaceae)

+ **CAM**: Fosso di Pruno, Pruno di Laurino, Laurino (Salerno), on *Alnus glutinosa* (L.) Gaertn. (UTM WGS84: 33T 533363.4457236), 600 m, 12 May 2010, *S. Ravera* (Herb. Ravera). – Species new for the flora of Campania.

Candelariella efflorescens is a widespread species, recorded in temperate parts of North America and Europe (Westberg 2004). It is easy to find in the field because of its yellow thallus, characteristic of this genus. However, according to Nimis (2016), its distribution in Italy is still poorly known because of the similarity with the more

common *C. reflexa* (Nyl.) Lettau., usually growing in exposed and nitrogen-enriched localities. It differs from *C. efflorescens* by its distinctly effigurate almost rosette-like thallus, with lobes up to 0.6 mm long. Furthermore, the soredia are larger and formed in crateriform soralia arising in the center of the thallus and not from the margin as in *C. efflorescens*. This specimen was found in a riparian wood, in moderately shaded and humid conditions in the "Cilento, Vallo di Diano and Alburni" National Park.

S. Ravera

Candelariella subdeflexa (Nyl.) Lettau (Candelariaceae)

+ **CAM**: Marina di Pisciotta (Salerno), on *Pyrus* sp. (UTM WGS84: 33T 519319.4439914), 20 m, 22 February 2011, leg. *G. Brunialti*, *V. Genovesi*, *S. Ravera*, det. *S. Ravera* (Herb. Ravera). – Species new for the flora of Campania.

Candelariella subdeflexa is a a mild-temperate, perhaps holarctic epiphytic lichen recorded in North America, southern and central Europe, North Africa, and New Zealand (Westberg 2004). It is characterised by its gray, squamulose thallus and biatorine apothecia. The lack of a thalline margin and algae at all stages of development is an uncommon character shared by few species (Westberg 2007). Among them, *C. subdeflexa* and the recently described *C. blastidiata* Yakovch. represent a "species pair" where *C. subdeflexa* reproduces by sexual propagules and *C. blastidiata* mostly vegetatively. Moreover, *C. subdeflexa* morphologically differs from the latter by having an epinecral layer and the absence of blastidia (Yakovchenko et al. 2017). *Candelariella subdeflexa* is included in the Italian red list of epiphytic lichens as "Near-threatened" (Nascimbene et al. 2013), but it is easily overlooked as the apothecia are small, mostly c. 0.2–0.4 mm wide.

S. Ravera

Candelariella viae-lacteae G.Thor & V.Wirth (Candelariaceae)

+ **CAM**: Marina di Pisciotta (Salerno), on *Olea europaea* L. (UTM WGS84: 33T 519319.4439914), 20 m, 22 February 2011, leg. *G. Brunialti*, *V. Genovesi*, *S. Ravera*, det. *S. Ravera* (Herb. Ravera). – Species new for the flora of Campania.

Candelariella viae-lacteae is a mild-temperate lichen. It is characterised by a grey thallus, uniformly composed of delicate granular blastidia. In a sterile state, *C. viae-lacteae* could be confused with the recently described (Yakovchenko et al. 2017) *C. blastidiata* Yakovch. Accordingly, Italian herbarium specimens should be checked, considering also that *C. viae-lacteae* is included in the Italian red list of epiphytic lichens as "Data Deficient" (Nascimbene et al. 2013) and it is easily overlooked. The specimen from Marina di Pisciotta was collected on a centenary olive tree, in an olive grove not far from the sea.

S. Ravera

Catillaria servitii Szatala (Catillariaceae)

+ **CAM**: Marina di Camerota (Salerno), on *Juniperus* sp. (UTM WGS84: 33T 527578.4430836), 0 m, 24 February 2011, leg. *G. Brunialti*, *V. Genovesi*, *S. Ravera*, det. *S. Ravera* (Herb. Ravera). – Species new for the flora of Campania.

Catillaria servitii is a Mediterranean epyphitic lichen, common on twigs and boles of shrubs in natural or semi-natural vegetation along the coast, in areas with maritime winds. It is closely related to *C. mediterranea* Hafellner, but mostly differs for the number of spores per ascus and ecology, the latter typically occurring on several foliose and fruticose lichens (Tretiach and Hafellner 1998). Italian populations were described as *Catillaria praedicta* Tretiach & Hafellner, and only recently *C. servitii* has been found to be the earliest legitimate name for *C. praedicta* (Şenkardeşler et al. 2014). This species has been recorded in Toscana, Sardegna, Puglia, and Sicilia (Nimis 2016). The specimen from Marina di Camerota was found within Mediterranean macchia plants close to the sea, on wood of *Juniperus* shrubs.

S. Ravera

Cladonia conista (Ach.) Robbins (Cladoniaceae)

+ **LOM**: surroundings of Sant'Alberto di Butrio, Abbadia Sant'Alberto, Ponte Nizza (Pavia), on basic soil at the edge of a footpath in a chestnut grove (UTM WGS84: 32T 511581.4966732), 679 m, 14 April 2017, leg. *G. Gheza*, det. *H. Mayrhofer* (Herb. Gheza). – Species confirmed for Lombardia.

Cladonia conista has been considered as a simple chemotype of *Cladonia humilis* (With.) J.R.Laundon, but recently Pino-Bodas et al. (2012) confirmed that the two species are well distinct. This species has been reported so far in Italy only from acidic dry grasslands in the Po Plain (Gheza et al. 2018). The record reported here is the first for the Apennines and for basic substrates, therefore widening the knowledge about the geographical distribution and the ecology of this species in Italy. The analyzed specimen contained fumarprotocetraric and bourgeanic acids, and differed slightly in morphology from those reported by Gheza et al. (2018), having short and wide cups on the podetia and soredia along the margin of the primary squamules, whereas the specimens from the Po Plain had more slender podetia and esorediate squamules.

G. Gheza, H. Mayrhofer

Cladonia grayi G.Merr. ex Sandst. (Cladoniaceae)

+ **LOM**: surroundings of Passo del Vivione, Schilpario (Bergamo), on acidic organic soil at the edge of a footpath in a subalpine pasture with *Rhododendron* and *Vaccinium* (UTM WGS84: 32T 592509.5098876), 1830 m, 19 August 2016, leg. *G. Gheza*, det. *H. Mayrhofer* (Herb. Gheza). – Species new for the flora of Lombardia.

Cladonia grayi is a species of the *C. chlorophaea* complex in broad sense, characterized by the presence of grayanic acid (Coassini Lokar et al. 1986). The analyzed specimen contained only grayanic acid, even if the species can sometimes contain also fumarprotocetraric acid as accessory substance (Coassini Lokar et al. 1986). It occurs under *Rhododendron* shrubs at the edge of a footpath, together with *Cladonia chlorophaea* (Sommerf.) Spreng., *C. deformis* (L.) Hoffm. and *C. pyxidata* (L.) Hoffm.

G. Gheza, H. Mayrhofer

Cladonia pulvinata (Sandst.) Herk & Aptroot (Cladoniaceae)

+ **LOM**: trail between Pianezza and the Diga del Gleno, Vilminore di Scalve (Bergamo), on soil at the edge of the trail in a small clearing in a coniferous wood (UTM WGS84: 32T 583715.5095347), 1480 m, 30 April 2018, leg. *G. Gheza,* det. *H. Mayrhofer* (Herb. Gheza, GZU); trail verging the peat bog of Pian Gembro, Trivigno (Sondrio), on soil in a clearing with shrubs of *Erica carnea* and schist outcrops at the edge of the trail (UTM WGS84: 588899.5113126), 1375 m, 18 August 2018, *G. Gheza* (Herb. Gheza). – Species confirmed for Lombardia.

Cladonia pulvinata is a taxon of the *C. cervicornis* group raised at species level by Herk and Aptroot (2003) whose distinction from *C. cervicornis* is confirmed also by genetic data (Pino-Bodas et al. 2010, 2013). It is characterized by greenish-brown, slightly or not incised squamules which are often erected and not curled upwards when dry and by the presence of psoromic acid (P+ yellow) (Herk and Aptroot 2003). The records from Vilminore di Scalve (Val di Scalve, Orobic Prealps) and Pian Gembro (Valtellina, Rhaetic Alps) widen the Italian range of the species, which was known so far only from dry habitats in lowland areas (Gheza et al. 2018). They are also the first records of this species for the Alps (see Nimis et al. 2018). Furthermore, the specimen from Vilminore di Scalve had some podetia, being the first fertile one found in Italy. The two clearings in which the species was recorded had a semi-dry vegetation dominated by ericaceous shrubs (*Erica carnea* L., *Vaccinium myrtillus* L.) and a lichen vegetation dominated, besides *C. pulvinata* itself, by *C. floerkeana* (Fr.) Flörke in the first site and by *C. cervicornis* (Ach.) Flot. in the second site. The species could be more widespread in montane areas where proper habitat conditions occur and should also be looked for in *Pycnothelio-Cladonietum cervicornis* lichen vegetation in montane and alpine heaths.

G. Gheza, H. Mayrhofer

Cladonia subcervicornis (Vain.) Kernst. (Cladoniaceae)

+ **CAM**: Capo Palinuro, Centola (Salerno), (UTM WGS84: 33T 523341.4431313), on humus in crevices on rocks and boulderson a promontory overlooking the sea, 50 m, 12 April 2011, leg. *G. Brunialti*, *V. Genovesi*, *S. Ravera*, det. *S. Ravera* (Herb. Ravera). – Species new for the flora of Campania.

Cladonia subcervicornis (Vain.) Kernst. is a locally abundant lichen species in W Europe, Greenland and Macaronesia usually growing on siliceous rocks and on soil rich in humus in open habitats (James 2009). The primary thallus forms dense mats or small cushions of erected squamules, rather thick, up to 2 cm tall, but podezia appear very variable, branched or scyphoid, because of an unusual non-linear morphogenesis (Hammer 1992). This species has been recorded in Veneto, Piemonte, Liguria, Toscana, Sardegna, and Calabria, but it is probably somehow overlooked and more widespread in Tyrrhenian Italy (Nimis 2016).

S. Ravera

Flavoplaca flavocitrina (Nyl.) Arup, Frödén & Søchting (Teloschistaceae)

+ **BAS**: Monastery of Monticchio near Melfi (Potenza), on a wall (UTM WGS84: 33T 551880.4531800), 810 m, 16 April 1997, *P.L. Nimis, M. Tretiach* (sub *Caloplaca citrina*, very untypical!), rev. *P.L. Nimis*, 25 January 2019 (TSB No. 29663). – Species new for the flora of Basilicata.

+ **CAM**: Sorrento Peninsula, Punta Campanella (Napoli), on cement walls (UTM WGS84: 33T 442850.4491250), 30100 m, 19 April 2000, *P.L. Nimis, M. Tretiach* (sub *Caloplaca citrina*), rev. *P.L. Nimis*, 25 January 2019 (TSB No. 31713). – Species new for the flora of Campania.

+ **FVG**: Friulian plain, Tarcento (Udine), on a cement wall (UTM WGS84: 33T 362100.5119400), 250 m, August 1979, *P.L. Nimis* (sub *Caloplaca citrina*), rev. *P.L. Nimis*, 25 January 2019 (TSB No. 2793); Cemetery of Sant'Anna (Trieste), on a cement wall (UTM WGS84: 33T 406200.5053500), 2050 m, May 1995, *P.L. Nimis* (sub *Caloplaca citrina*), rev. *P.L. Nimis*, 25 January 2019 (TSB No. 20621). – Species new for the flora of Friuli Venezia Giulia.

+ **LAZ**: Anzio, Villa di Nerone (Roma), on tuff and cement wall (UTM WGS84: 33T 301250.4591100), 020 m, 1987, *P.L. Nimis, M. Tretiach* (sub *Caloplaca citrina*), rev. *P.L. Nimis*, 25 January 2019 (TSB No. 10013). – Species new for the flora of Lazio.

+ **MOL**: Road between Ururi and Serracapriola, half way, Casone Cantalupo (Campobasso), on wall along a creek (UTM WGS84: 33T 507900.4626350), 95 m, 13 April 1998, *P.L. Nimis, M. Tretiach* (sub *Caloplaca citrina*), rev. *P.L. Nimis*, 25 January 2019 (TSB No. 30202). – Species new for the flora of Molise.

+ **PIE**: Alpi Cozie, on the ridge W above Colle del Vallonetto – Vallone dell'Arma (Cuneo), on calcareous cliffs and boulders in alpine vegetation (UTM WGS84: 32T 349987.4916483), 2500 m, 23 July 2000, *P.L. Nimis, M. Tretiach, with J. Hafellner* (sub *Caloplaca citrina*), rev. *P.L. Nimis*, 25 January 2019 (TSB No. 34086). – Species new for the flora of Piemonte.

+ **PUG**: Gravina in Puglia, necropolis (Bari), on soft calcareous rocks (UTM WGS84: 33T 619000.4520000), 330 m, 7 April 1996, *P.L. Nimis, M. Tretiach* (sub *Caloplaca citrina*), rev. *P.L. Nimis*, 25 January 2019 (TSB No. 22726). – Species new for the flora of Puglia.

+ **SAR**: Nuraghe Santu Antine (Sassari), on asbestos wall (UTM WGS84: 32T 480500.4481800), 350 m, May 1986, *P.L. Nimis* (sub *Caloplaca citrina*), rev. *P.L. Nimis*, 25 January 2019 (TSB No. 7489). – Species new for the flora of Sardegna.

+ **SIC**: Isole Pelagie, Linosa (Agrigento), near the lighthouse, on lava (UTM WGS84: 33S 308450.3971800), 15 m, 16 April 1992, *M. Tretiach* (sub *Caloplaca* gr. *citrina*, not typical!), rev. *P.L. Nimis*, 25 January 2019 (TSB No. 17319). – Species new for the flora of Sicilia.

In the last decade, the "*Caloplaca citrina*" complex, recently transferred to the genus *Flavoplaca* (Arup et al. 2013), has been the object of revision, both in northern (Arup 2006; Powell and Vondrák 2011) and southern Europe (Vondrák et al. 2009). This species complex, which still needs a thorough revision in Italy, occurs on a wide variety of substrata, from asbestos-cement, concrete and mortar to basic siliceous rocks or even eutrophicated wood. It is very tolerant to, and even favoured by, eutrophication (e.g. urine-deposits) and is common also in urban areas and along the main highways. Most earlier samples from Italy were filed under the name *Caloplaca citrina* (Hoffm.) Th.Fr., purported to be a widespread and very common species, reported from all Regions of Italy (Nimis 1992, 1993). That species, however, proved to have a rather restricted distribution in central and northern Europe, being largely substituted by other species in the Mediterranean region (see Nimis 2016). Pending a revision of the whole complex in Italy, here we report the presence of *Flavoplaca flavocitrina*, likely the most common species of the complex in Italy, as new to several Italian Administrative Regions. The species is characterized by a relatively thin, areolate-squamulose thallus with marginal yellow soralia, and differs from *Flavoplaca citrina* s.str. in molecular characters as well as in several, subtle morpho-anatomical features (see Arup 2006).

P.L. Nimis, E. Pittao

Lichenothelia convexa Henssen (Lichenotheliaceae)

+ **ITA** (**SAR**): SE Monte Rasu, near the strada provinciale ex militare, Tertenia (Nuoro), schist rocks in the macchia, on rock and on *Ingvariella bispora* (Bagl.) Guderley & Lumbsch (UTM WGS84: 32S 546835.4387442), 450 m, 25 August 2014, *W. v. Brackel* (Herb. Brackel 8063). – Species new for the flora of Italy (Sardegna).

This species is a non-lichenized fungus growing on siliceous rocks, either directly on the rock or on the thalli of saxicolous lichens such as *Lecidea* Ach. and *Acarospora* A.Massal. It is known from several European countries (Austria, Czech Republic, France, Germany, Luxembourg, Netherlands, Sweden, United Kingdom), Asia (India, Turkey), and North America (California, Colorado, Maine, Washington). This species is characterized by dispersed, sometimes congregated, black, irregularly rounded stromata of c. 100–200(–400) µm diameter with a granular surface, 8-spored asci and 1–4-septate dark brown ascospores, 10–14 × 5.0–6.5 µm (Henssen 1987, Kocourková and Knudsen 2011, Muggia et al. 2015).

W. v. Brackel

Lichenothelia scopularia (Nyl.) D. Hawksw. (Lichenotheliaceae)

+ **SAR**: S Arzachena near Via Stazzu Sarra Lucia, Olbia (Olbia-Tempio), granite rocks on the roadside, on rock (UTM WGS84: 32T 533126.4542134), 390 m, 6 August 2014, W. v. Brackel (Herb. Brackel 7795); Monte dei Sette Fratelli, near Rio Picocca, Burcei (Cagliari), granite rock in the macchia, on rock and on *Aspicilia* sp. (UTM WGS84: 32S 536539.4353080), 245 m, 24 August 2014, W. v. Brackel (Herb. Brackel 7922). – Species new for the flora of Sardegna.

This species is a widespread non-lichenized fungus growing on acid rock or mica schists, sometimes also on saxicolous lichens such as *Aspicilia* A.Massal., in Italy until currently known only from the Alps (Trentino-Alto Adige, Lombardia, Piemonte; Nimis 2016). This species is characterized by a black aerolate thallus, ascomata 12–170(–300) µm, 8-spored asci and 1–3-septate to submuriform golden to dark brown ascospores (Hawksworth 1981).

W. v. Brackel

Peltigera extenuata (Nyl. ex Vain.) Lojka (Peltigeraceae)

+ **PIE**: I Ronchi, Valsesia (Vercelli), on terricolous mosses in mixed forest (UTM WGS84: 32T 417955.5079233), 1390 m, 20 August 2017, leg. *C. Vallese* det. *R. Benesperi, C. Vallese* (Herb. Benesperi). – Species new for the flora of Lombardia.

Peltigera extenuata is a foliose species characterized by the presence of strictly laminal soredia (Goward et al. 1995). It is a terricolous species ecologically and morphologically similar to *P. didactyla* (With.) J.R.Laundon, but differs having a C+ red reaction of the medulla (Nimis et al. 2016). It is often considered as a variety of the latter species, but according to Goffinet et al. (2003) these species are well distinct.

C. Vallese, J. Nascimbene, R. Benesperi

Peltigera membranacea (Ach.) Nyl. (Peltigeraceae)

+ **LIG**: Margheria dei Boschi (Imperia), on terricolous mosses in a fir wood (UTM WGS84: 32T 388517.4867105), 1220 m, 23 April 2016, leg. *M. Ottonello*, det. *R. Benesperi, C. Vallese* (Herb. Benesperi). – Species new for the flora of Liguria.

Peltigera membranacea is a foliose species growing on mosses, mossy rocks, at the base of trunks in old woodlands and on calcareous soils with an optimum in the mountain belt (Vitikainen 1994; Goward et al. 1995; Nimis et al. 2016). This species is characterized by the absence of lichen substances and a tomentose upper surface, and it may be distinguished by the lower surface with narrow veins with polygonal interstices and by the simple tomentose rizines (Goward et al. 1995; Benesperi and Giordani 2012). In accordance with the phylogenetic analysis of Miadlikowska and Lutzoni

(2000), *P. membranacea* is included in the *Peltigera* group with other common species for Italy, such as *P. canina* (L.) Willd., *P. rufescens* (Weiss) Humb., *P. praetextata* (Sommerf.) Zopf, *P. ponojensis* Gyeln., *P. didactyla* (With.) J.R.Laudon, or rare species, such as *P. lepidophora* (Vain.) Bitter and *P. kristinsonnii* Vitik.

C. Vallese, M. Ottonello, P. Giordani, R. Benesperi

Peltigera ponojensis (Stenh.) Gyeln. (Peltigeraceae)

+ **LIG**: S. Giovanni dei Prati (Imperia), on clayish soil (UTM WGS84: 32T 400010.4867831), 1170 m, 24 April 2016, *M. Ottonello det. R. Benesperi, C. Vallese*; Margheria dei Boschi (Imperia), on terricolous mosses in a fir wood (UTM WGS84: 32T 388517.4867105), 1220 m, 15 May 2016, leg. *M. Ottonello*, det. *R. Benesperi*, *C. Vallese* (Herb.Benesperi). – Species new for the flora of Liguria.

Peltigera ponojensis is a terricolous foliose species with a tomentose upper surface with upturned lobes (Vitikainen 1994; Nimis et al. 2016). According to Nimis and Martellos (2017) this species is rare on upland areas of Italian Alps. However, it could be more widespread since it can be confused with several *Peltigera* species as in the case of *P. rufescens* (Weiss) Humb. *P. ponjensis* has typical simple rhizines and thicker, paler and protuding veins (Vitikainen 1994; Goward et al. 1995; Benesperi and Giordani 2012).

C. Vallese, M. Ottonello, P. Giordani, R. Benesperi

Placolecis opaca (Dufour) Hafellner (Catillariaceae)

+ **TOS**: Convento del Petreto, Scansano (Grosseto), oak wood on the SW facing slope with *Lobaria pulmonaria* (L.) Hoffm., on shaded mossy calcareous rock (UTM WGS84: 32T 691415.4729062), 445 m, 25 February 2012, leg. *A. Guttová, L. Paoli*, det. *A. Guttová* (SAV); La Castellaccia, near Convento del Petreto, shaded calcareous outcrops in an oak forest with *Lobaria pulmonaria*, on overhanging rock (UTM WGS84: 32T 691764.4729809), 509 m, 1 September 2018, leg. *A. Bérešová, L. Paoli*, det. *A. Bérešová* (SAV). – Species confirmed for Toscana.

Placolecis opaca forms olive-brown placodioid thallus, frequently fertile, with characteristic orange medulla because of the production of anthraquinones. It grows on calcareous rocks. The species is reported mainly from the Mediterranean area, however, few isolated occurrences have been recorded also in central Europe, e.g., low altitudes of the western Carpathians (Czarnota et al. 2006). This species is distributed across Italy mainly in the Mediterranean (less often in submediterranean) belt (Nimis 2016). Records from Toscana date back to the 18th and 19th centuries (Nimis 1993), but recent data were missing (Nimis 2016).

L. Paoli, A. Guttová

Rinodina oxydata (A.Massal.) A.Massal. (Physciaceae)

+ **TOS**: Riserva Naturale La Pietra, Roccastrada (Grosseto), on jasper outcrops at the top of the hill (UTM WGS84: 32T 672050.4771400), 420 m, 4 January 2019, *L. Paoli, Z. Fačkovcová*, det. *Z. Fačkovcová* (SAV). – Species new for the flora of Toscana.

Rinodina oxydata is a crustose species with rimose-areolate thallus. It grows mainly on siliceous rocks, occasionally on basalts, with a preference for humid and nutrient-rich substrates. Its distribution in Italy is still poorly understood: it seems widespread in the Alps, but has been occasionally found also in Mediterranean mountains (Nimis 2016). In the reported locality, it was accompanied by *R. aspersa* (Borrer) J.R.Laundon, *Lasallia pustulata* (L.) Mérat, *Monerolechia badia* (Fr.) Kalb, *Solenopsora vulturiensis* A.Massal.

L. Paoli, Z. Fačkovcová

Scytinium teretiusculum (Wallr.) Otálora, P.M. Jørg. & Wedin (Collemataceae)

+ **TOS**: La Castellaccia, Scansano (Grosseto), shaded calcareous outcrops in oak forest with *Lobaria pulmonaria* (L.) Hoffm., on bark of *Quercus* sp. (UTM WGS84: 32T 691764.4729809), 509 m, 1 September 2018, leg. *A. Bérešová*, *L. Paoli*, det. A. *Bérešová* (SAV). – Species confirmed for Toscana.

This species generally grows on the basal parts of old trees, sometimes directly on soil or weathered rocks. It is considered a component of epiphytic *Lobarion* communities (Rose 1988). In Italy, there is an increasing number of records of *S. teretiusculum* (Nimis 2016). However, the occurrence in Toscana was reported only from the past (Rose 1988, van den Boom and Aptroot 1990) and recent data were missing (Nimis 2016). The reported specimen also contains an often overlooked epibryophytic species: *Agonimia opuntiella* (Buschardt & Poelt) Vězda.

L. Paoli, A. Guttová

Solenopsora holophaea (Mont.) Samp. (Catillariaceae)

+ **TOS**: Cala San Quirico, Populonia (Livorno), in the fissures of siliceous sandstone, along the coast (UTM WGS84: 32T 621325.4759270), 10 m, 8 June 2018, *L. Paoli, Z. Fačkovcová* (SAV). – Species confirmed for Toscana.

Solenopsora holophaea has an epruinose thallus, made of shiny, red-brown, greenish-brown squamules (up to 2.5 mm wide) with rounded, entire margin; the outer lobes are loose, apothecia are frequent, sessile, often shortly stipitate, with disc red-brown up to blackish. In the Mediterranean region, it grows on basic siliceous soils and rock fissures (siliceous breccia, basalt, sandstone), especially along the coast, being able to tolerate direct sun in open habitats (Guttová et al. 2014, 2019). Recently developed habitat suitability maps suggest that the centres of high suitability for *S. holophaea* in

Italy are related to lower altitudes along the Tyrrhenian coastline, Sardegna, Sicilia, and the extreme south of Puglia (Guttová et al. 2019). Apart from Capraia island (Nimis et al. 1990), this is the only recent record in Toscana.

L. Paoli, Z. Fačkovcová

Acknowledgements

Giuseppina Barberis, Davide Dagnino and Claudia Turcato wish to thank Nadia Abdelahad for the support in *Chara* identification and in bibliographic research. Filippo Prosser wishes to thank Jan Kučera, specialist of the genus *Didymodon*, who confirmed the identification of *Didymodon umbrosus*, and Michele Aleffi for providing important information.

References

Aleffi M, Tacchi R, Cortini Pedrotti C (2008) Check-list of the Hornworts, Liverworts and Mosses of Italy. Bocconea 22: 1–255.

Arup U (2006) A new taxonomy of the *Caloplaca citrina* group in the Nordic countries, except Iceland. The Lichenologist 38: 1–20. https://doi.org/10.1017/S0024282905005402

Arup U, Søchting U, Frödén P (2013) A new taxonomy of the family Teloschistaceae. Nordic Journal of Botany 31: 16–83. https://doi.org/10.1111/j.1756-1051.2013.00062.x

Barsali E (1906) Aggiunte alla Micologia Pisana. Quarta nota. Nuovo Giornale Botanico Italiano n.s., 13: 97.

Bazzichelli G, Abdelahad N (2009) Alghe d'acqua dolce d'Italia. Flora analitica delle Caroficee. Università degli Studi di Roma La Sapienza – Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Roma. 73 pp.

Benesperi R, Giordani P (2012) Indicazione per l'identificazione delle specie appartenenti al genere *Peltigera*. Notiziario della Società Lichenologica Italiana 25: 71–76.

Bolpagni R, Bettoni E, Bonomi F, Bresciani M, Caraffini K, Costaraoss S, Giacomazzi F, Monauni C, Montanari P, Mosconi MC, Oggioni A, Pellegrini G, Zampieri C (2013) Charophytes of Garda lake (Northern Italy): a preliminary assessment of diversity and distribution. Journal of limnology 72: 388–393. https://doi.org/10.4081/jlimnol.2013.e31

Casas de Puig C (1970) Notulae briologicae III. *Trichostomopsis umbrosa* (C.Müll) H.Robinsons en la ciudad de Barcelona. Acta Phytotaxonomica Barcinonensia 6: 16–22.

Cecchi G (1942) Un caso di ruggine del pero. Rivista della Società Toscana di Orticultura 27: 24–26.

Coassini Lokar L, Nimis PL, Ciconi G (1986) Chemistry and chorology of the *Cladonia chlorophaea-pyxidata* complex (Lichenes, Cladoniaceae) in Italy. Webbia 39: 259–273. https://doi.org/10.1080/00837792.1986.10670373

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

Cortini Pedrotti C (2006) Flora dei muschi d'Italia, II parte. Antonio Delfino Editore. Sassari. 432 pp.

Czarnota P, Guttová A, Halda JP, Kukwa M, Liška J, Palice Z, Peksa O, Svoboda D, Vondrák J (2006) Lišajníky zaznamenané počas 13. jarného stretnutia Bryologicko-lichenologickej Sekcie ČBS na exkurzii v Tematínskych vrchoch (Považský Inovec, Slovensko) [Lichens recorded during the 13th Spring Meeting of the Bryological and Lichenological Section CBS, on an excursion to the Tematínske vrchy hills (Považský Inovec Mts., Slovakia)]. Bryonora 38: 26–39.

Dalla Torre KW, Sarnthein L (1904) Die Moose (Bryophyta) von Tirol, Vorarlberg und Liechtenstein. Flora der Gefürsteten Grafschaft von Tirol, des Landes Vorarlberg und des Fürstenthumes Liechtenstein. Band V. Wagnersche Universitäts-Buchhandlung, Innsbruck. 671 pp.

Dalla Torre KW, Sarnthein L (1904) Die Moose (Bryophyta) von Tirol, Vorarlberg und Liechtenstein. Flora der Gefürsteten Grafschaft von Tirol, des Landes Vorarlberg und des Fürstenthumes Liechtenstein. Band V. Wagnersche Universitäts-Buchhandlung, Innsbruck. 671 pp.

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

Ferrarini E, Marchetti D (1983) *Hymenophyllum tunbrigense* (L.) Sm. sulle Alpi Apuane. Bollettino del Museo di Storia Naturale del Lunigiano 3: 5–26.

Frahm J-P (2006) Notulae Bryologicae Rhenanae 2: Ein dritter Nachweis von *Trichostomopsis umbrosus* (C.Müll.) Robins. in Deutschland. Archive for Bryology 7: 1–4.

Gheza G, Nascimbene J, Mayrhofer H, Barcella M, Assini S (2018) Two *Cladonia* species new to Italy from dry habitats in the Po Plain. Herzogia 31: 293–303. https://doi.org/10.13158/099.031.0112

Goffinet B, Miadlikowska J, Goward T (2003) Phylogenetic inferences based on nrDNA sequences support five morphospecies within the *Peltigera didactyla* complex (Lichenized Ascomycota). The Bryologist 106: 349–364. https://doi.org/10.1639/01

Goward T, Goffinet B, Vitikainen O (1995) Synopsis of the genus *Peltigera* (lichenized Ascomycetes) in British Columbia, with a key to the North American species. Canadian Journal of Botany 73: 91–111. https://doi.org/10.1139/b95-012

Gueli L, Dia MG, Lo Giudice (2001) New or interesting records for the Sicilian moss flora. Flora Mediterranea 11: 5–10.

Guttová A, Fačkovcová Z, Martellos S, Paoli L, Munzi S, Pittao E, Ongaro S (2019) Ecological specialization of lichen congeners with a strong link to Mediterranean-type climate: a case study of the genus *Solenopsora* in the Apennine peninsula. The Lichenologist 51: 75–88. https://doi.org/10.1017/S0024282918000543

Guttová A, Zozomová-Lihová J, Timdal E, Kučera J, Slovák M, Piknová K, Paoli L (2014) First insights into genetic diversity and relationships of European taxa of the genus *Solenopsora* (Catillariaceae, Ascomycota) with implications on their delimitation. Botanical Journal of the Linnean Society 176: 203–223.

Hammer S (1992) Process and Pattern in *Cladonia subcervicornis*. The Lichenologist 30: 567–576.

Hawksworth DL (1981) *Lichenothelia*, a new genus from the *Microthelia aterrima* group. The Lichenologist 13: 141–152. https://doi.org/10.1017/S0024282981000182

Helfer S (2005) Overview of the rust fungi (*Uredinales*) occurring on Rosaceae in Europe. Nova Hedwigia 81: 325–370. https://doi.org/10.1127/0029-5035/2005/0081-0325

Henssen A (1987) *Lichenothelia*, a genus of microfungi on rocks. Bibliotheca Lichenologica 25: 257–293.

Hodgetts NG (2015) Checklist and country status of European bryophytes – towards a new Red List for Europe. Irish Wildlife Manuals, No. 84. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht. Ireland. 130 pp.

Horst RK (2013) Rusts. In: Horst RK (Ed.) Westcott's Plant Disease Handbook Springer Netherlands, 341–362. https://doi.org/10.1007/978-94-007-2141-8_42

James PW (2009) *Cladonia* P.Browne (1756). In: Smith CW, Aptroot A, Coppins BJ, Fletcher A, Gilbert OL, James PW, Wolseley PA (Eds) The Lichens of Great Britain and Ireland. The British Lichen Society, Department of Botany, The Natural History Museum, Cromwell Road, London. 1046 pp.

Justo A, Malysheva E, Bulyonkova T, Vellinga EC, Cobian G, Nguyen N, Minnis AM, Hibbett DS (2014). Molecular phylogeny and phylogeography of Holarctic species of *Pluteus* section *Pluteus* (Agaricales: Pluteaceae), with description of twelve new species. Phytotaxa 180: 1–85. https://doi.org/10.11646/phytotaxa.180.1.1

Kocourková J, Knudsen K (2011) Lichenological notes 2: *Lichenothelia convexa*, a poorly known rock-inhabiting and lichenicolous fungus. Mycotaxon 115: 345–351. https://doi.org/10.5248/115.345

Krause W (1997) Charales (Charophyceae). Süsswasserflora von Mitteleuropa, Band 18. Gustav Fischer. Jena. 202 pp.

Lockhart N, Hodgetts N, Holyoak D (2012) Rare and threatened bryophytes of Ireland. Holywood: National Museums Northern Ireland. 656 pp.

Miadlikowska J, Lutzoni F (2000) Phylogenetic revision of the genus *Peltigera* (Lichen-forming Ascomycota) based on morphological, chemical, and large subunit nuclear ribosomal DNA data. Internationa Journal of Plant Sciences 161: 925–958. https://doi.org/10.1086/317568

Mouronval JB, Baudouin S, Borel N, Soulié-Märsche I, Klesczewski M, Grillas P (2015) Guide des characées de France méditerranéenne. ONCFS, Office National de la Chasse et de la Faune Sauvage. 214 pp.

Muggia L, Kocourkova J, Knudsen K (2015) Disentangling the complex of *Lichenothelia* species from rock communities in the desert. Mycologia 107: 1233–1253. https://doi.org/10.3852/15-021

Müller K (1951–1958) Die Lebermoose Europas. Eine Gesamtdarstellung der europäischen Arten. In: Rabenhorst L (Ed.) Kriptogamen-Flora von Deutschland, Österriesh und der Schweiz, 3 Aufl., VI, 1–2 Abtlg. New York-London. 954 pp.

Nimis PL (1992) Chiavi analitiche del genere *Caloplaca* Th.Fr. in Italia. Notiziario della Società Lichenologica Italiana 5: 9–28.

Nimis PL (1993) The Lichens of Italy – An annotated catalogue. Monografie XII. Museo Regionale di Scienze Naturali, Torino. 897 pp.

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

Nimis PL, Martellos S (2017) ITALIC – The Information System on Italian Lichens. Version 5.0. University of Trieste, Dept. of Biology (http://dryades.units.it/italic)

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

Noelli A (1905) Contribuzione allo studio dei micromiceti del Piemonte. Malpighia 19: 350.

Passerini G (1877) Funghi parmensi enumerati dal Prof. G. Passerini. Nuovo Giornale Botanico Italiano 9: 263.

Pino-Bodas R, Martìn MP, Burgaz AR (2010) Insight into the *Cladonia convoluta-C. foliacea* (Cladoniaceae, Ascomycota) complex and related species, revealed through morphological, biochemical and phylogenetic analyses. Systematics and Biodiversity 8: 575–586. https://doi.org/10.1080/14772000.2010.532834

Pino-Bodas R, Ahti T, Stenroos S, Martìn MP, Burgaz AR (2012) *Cladonia conista* and *C. humilis* (Cladoniaceae) are different species. Bibliotheca Lichenologica 108: 161–176.

Pino-Bodas R, Martìn MP, Stenroos S, Burgaz AR (2013) *Cladonia verticillata* (Cladoniaceae, Ascomycota), new record to Iberian Peninsula. Botanica Complutensis 37: 21–25.

Poponessi S, Aleffi M, Venanzoni R (2014) *Conocephalum salebrosum* Szweykowski, Buczkowska et Odrzykoski (Conocephalaceae, Marchantiophyta), new to Italy. Cryptogamie, Bryologie 35: 223–226. https://doi.org/10.7872/cryb.v35.iss2.2014.223

Powell M, Vondrák J (2011) *Caloplaca citrina* and *C. lactea* are incorrectly understood in the British Isles. British Lichen Society Bulletin 109: 25–30.

Privitera M, Aleffi M, Bertani G, Campisi P, Carratello A, Codogno M, Cogoni A, Miserere L, Perego S, Puglisi M, Sguazzin F, Tacchi R, Zimbone A (2010) Survey of the bryophyte diversity of the Carnic Alps, including some interesting records for the Italian bryoflora. Flora Mediterranea 20: 193–209.

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

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 M, 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

Rose F (1988) Phytogeographical and ecological aspects of *Lobarion* communities in Europe. Botanical Journal of the Linnean Society 96: 69–79. https://doi.org/10.1111/j.1095-8339.1988.tb00628.x

Saccardo PA (1873) Mycologiae Venetae Specimens. Atti della Società Veneto-Trentina di Scienze Naturali 2: 127.

Saccardo PA (1912) Sylloge Fungorum VIII, Hymenomycetae – Phycomycetae. Patavii. 611 pp.

Şenkardeşler A, Lőkös L, Farkas E (2014) Lectotypification of names of lichen taxa described by Ödön Szatala. Taxon 63: 139–145. https://doi.org/10.12705/631.9

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

Szweykowski J, Buczkowska K, Odrzykoski IJ (2005) *Conocephalum salebrosum* (Marchantiopsida, Conocephalaceae) – a new Holarctic liverwort species. Plant Systematics and Evolution 253: 133–158. https://doi.org/10.1007/s00606-005-0301-0

Tacchi R, Miserere L, Aleffi M (2009) Ecological aspects of the bryoflora of some ravines of the Umbro-Marchegian Apennines. Plant Biosystems 143(Supplement): S88–S96. https://doi.org/10.1080/11263500903220141

Tomasella M, Oriolo G (2007) Primo contributo alla conoscenza delle Characeae del Friuli Venezia Giulia e dei territori limitrofi: il genere *Chara* L. Gortania 28: 109–122.

Tomasi E (2007) Indagine cecidiologica sulle Prealpi Giulie occidentali (Friuli Venezia Giulia-Italia). Atti del Museo Civico di Storia Naturale di Trieste 53: 101–185.

Tomasi E (2013) Indagine cecidologica sulla pianura e le lagune friulane (Italia NE). Atti del Museo Civico di Storia Naturale di Trieste 56: 43–202.

Traverso GB (1912) Manipolo di Funghi della Valle Pellina. Société de la Flore Valdotaine 8: 40.

Tretiach M, Hafellner J (1998) A new species of *Catillaria* from Coastal Mediterranean Regions. The Lichenologist 30: 221–229. https://doi.org/10.1006/lich.1998.0126

Trotter A (1910) *Uredinales* in Flora Italica Cryptogama Vol. 1: Fungi. Rocca San Casciano: 347–348.

Tykhonenko YY, Heluta VP (2017) Distribution of *Endophyllum sempervivi* (Pucciniales) in Ukraine. Ukrainian Botanical Journal: 74: 71–75. https://doi.org/10.15407/ukrbotj74.01.071

van Herk K, Aptroot A (2003) A new status for the Western European taxa of the *Cladonia cervicornis* group. Bibliotheca Lichenologica 86: 193–203.

Van den Boom PPG, Aptroot A (1990) Contribution to the lichen flora of Italy. Cryptogamie, Bryologie Lichénologie 11: 391–400.

Venturella G (1991) A check-list of Sicilian fungi. Bocconea 2: 108.

Verona A (1932) Conspectus Mycetum Agri Pisani. Atti della Società Toscana di Scienze Naturali, Memorie, 42: 143–190.

Vitikainen O (1994) Taxonomic revision of *Peltigera* (lichenized Ascomycotina) in Europe. Acta Botanica Fennica 152: 1–96.

Vondrák J, Říha P, U. Arup U, Søchting U (2009) The taxonomy of the *Caloplaca citrina* group (Teloschistaceae) in the Black Sea region; with contributions to the cryptic species concept in lichenology. The Lichenologist 41: 571–604. https://doi.org/10.1017/S0024282909008317

Westberg M (2004) Candelariella. In: Nash III TH, Ryan BD, Diederich P, Gries C, Bungartz F (Eds) Lichen Flora of the Greater Sonoran Desert Region. 2, Lichens Unlimited, Tempe, Arizona: 46–53.

Westberg M (2007) *Candelariella* (Candelariaceae) in western United States and northern Mexico: the species with biatorine apothecia. Bryologist 110: 365–374. https://doi.org/10.1639/0007-2745(2007)110[365:CCIWUS]2.0.CO;2

Italian Botanist 7: 93–100 (2019)
doi: 10.3897/italianbotanist.7.34697
http://italianbotanist.pensoft.net

RESEARCH ARTICLE

Italian Botanist
Published by Società Botanica Italiana

Contribution to the floristic knowledge of Velino and Aterno valleys (Lazio-Abruzzo, central Italy)

Fabrizio Bartolucci[1,*], Laura Cancellieri[2,*], Fabio Conti[1,*], Enrico Banfi[3], Daniela Bouvet[4], Michela Celestini[2], Giampiero Ciaschetti[5], Romeo Di Pietro[6], Francesco Falcinelli[7], Simonetta Fascetti[8], Gabriele Galasso[3], Edda Lattanzi[9], Rizzieri R. Masin[10], Riccardo Pennesi[11], Leonardo Rosati[8], Adriano Stinca[12], Agnese Tilia[13], T'ai G.W. Forte[4], Anna Scoppola[2,*]

1 *Centro Ricerche Floristiche dell'Appennino (Università di Camerino – Parco Nazionale del Gran Sasso e Monti della Laga), San Colombo, 67021 Barisciano (L'Aquila), Italy* **2** *DAFNE, Dipartimento di Scienze Agrarie e Forestali, Università della Tuscia, Via San Camillo de Lellis snc 01100 Viterbo, Italy* **3** *Sezione di Botanica, Museo di Storia Naturale di Milano, Corso Venezia 55, 20121 Milano, Italy* **4** *Dipartimento di Scienze della Vita e Biologia dei Sistemi, Università di Torino, Viale P.A. Mattioli 25, 10125 Torino, Italy* **5** *Ufficio Botanico, Parco Nazionale della Majella, Via Badia 28, 67039 Sulmona (L'Aquila), Italy* **6** *Dipartimento PDTA, Sapienza Università di Roma, Via Flaminia 72, 00196 Roma, Italy* **7** *Via Martiri di Modena 26, 06033 Cannara (Perugia), Italy* **8** *Scuola di Scienze Agrarie, Forestali, Alimentari ed Ambientali Università della Basilicata, Via Ateneo Lucano 10, 85100 Potenza, Italy* **9** *Via V. Cerulli 59, 00143 Roma, Italy* **10** *Via Regazzoni Bassa 3, 35036 Montegrotto Terme (Padova), Italy* **11** *Scuola di Bioscienze e MedicinaVeterinaria, Università di Camerino, Via Pontoni 5, 62032 Camerino (Macerata), Italy* **12** *Dipartimento di Scienze e Tecnologie Ambientali, Biologiche e Farmaceutiche, Università della Campania Luigi Vanvitelli, Via Vivaldi 43, 81100 Caserta, Italy* **13** *Dipartimento di Biologia Ambientale, Sapienza Università di Roma, Piazzale A. Moro 5, 00185 Roma, Italy*

Corresponding author: *Laura Cancellieri* (cancellieri@unitus.it)

Academic editor: *L. Peruzzi* | Received 20 March 2019 | Accepted 9 April 2019 | Published 22 April 2019

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

Abstract

The inventory of the taxa collected during the annual field trip of the working group for Floristics, Systematics and Evolution of the Italian Botanical Society is reported. The field trip was held in 2016 along the Velino and Aterno valleys located between Lazio and Abruzzo administrative regions (central Italy). The flora documented for the studied area amounts to 629 specific and subspecific taxa (including two hybrids)

* these authors equally contributed to the paper

belonging to 300 genera and 69 families. Thirty-eight taxa are endemic to Italy, and only 16 alien taxa were detected. Thirty-eight taxa are included in the IUCN Red List of the Italian Flora. Twenty-four taxa have to be considered as floristic novelties because either new or confirmed for the regional flora of Lazio or Abruzzo. In particular, 15 taxa are new and 6 are confirmed for Lazio. Regarding Abruzzo, 2 taxa are new for the regional flora and one is confirmed. Furthermore, the alien status in Lazio has been updated for one taxon.

Keywords
Abruzzo, central Apennines, endemic, Lazio, floristic novelties, vascular flora

Introduction

Since 2003, the working group for Floristics, Systematics and Evolution of the Italian Botanical Society has been very active in increasing the knowledge about the vascular flora of poorly known areas of Italy. The selection of the territories to be investigated has been mostly addressed to fill the gaps pointed out on the map of the floristic knowledge of Italy updated to 2005 (Anzalone et al. 2005; Conti et al. 2005). Here we present the results of the field trip held in 2016 in Central Italy, organised by the botanists of the CRFA (Barisciano, L'Aquila) and the DAFNE department of the Viterbo University (Suppl. material 1.1). The study area is located between Lazio and Abruzzo administrative regions, along the Velino and Aterno valleys, and includes territories on the edge of the group of M. Terminillo (Rieti) that span towards the wooded environments of Montereale (L'Aquila). Based on the mentioned map, this area had not been yet explored, apart from some studies (Anzalone et al. 2005; Conti et al. 2005; Del Vico et al. 2014).

Study area

The investigated area is localized in the Cittareale (Rieti) and Montereale (L'Aquila) municipalities, in the upper Velino valley and in the Aterno valley (Suppl. material 1.2). The altitude ranges from 760 m a.s.l. at the bottom of Velino valley, to 1824 m a.s.l. at the top of Monte Borragine. The other main summits for the mountain sector of Lazio are Monte S. Venanzio and Monte la Speluca (both 1801 m a.s.l), and Monte Verrico (1309 m a.s.l.) in Abruzzo.

The areas of Monte Borragine and Capo d'Acqua are characterized by limestone. In the Velino valley, going from the top to the valley floor, there are marls and sandy clays, followed by Molasse and sandstones. The latter characterizes the areas between the village of S. Croce and Monte Verrico. The base of the Velino valley and the Montereale plain are characterized by floods (Servizio Geologico d'Italia 1955).

Rainfall is concentrated in the autumn–winter period, with a maximum in November–December and a minimum in summer (July–August), showing a two-month drought occurring during the summer. Annual average temperature ranges from 9.2 to 10.4 °C, with the hottest months in summer (July-August) and the coldest in winter (December–February). The Rivas-Martinez indices show that the investigated area shows

a temperate oceanic subcontinental macrobioclimate (Suppl. material 1.3), ranging from low supratemperate to low orotemperate humid/hyperhumid types (Del Vico et al. 2014).

The forest vegetation is dominated by coppice beech woods and secondly Turkey oaks forests. Along the medium-high altitude slopes, pastures are characterized by xerophilous *Bromopsis erecta* (Huds.) Fourr. communities, sometimes chamaephytic, and *Festuca* L. sp. pl. communities, both of which are more or less closed. Together with fragments of grasslands dominated by *Stipa dasyvaginata* Martinovský subsp. *apenninicola* Martinovský & Moraldo, the northern sector of the study area hosts shrubs, mowing pastures and small fallows.

Materials and methods

To maximize vascular flora sampling, 13 sites were selected as representative of the local diversity in terms of climate, litho-morphology, and habitats (Suppl. material 1.2). The sites were intensively sampled during the period 15–18 June 2016 by 18 participants, and some further investigations by organizers on 29 March 2016, 15 and 29 April 2016, 23 March 2017, 2–3 June 2017 (Suppl. material 1.4). The floristic list followed the same methodology used in previous contributions (e.g., Rosati et al. 2017; Bouvet et al. 2018). The work, together with the floristic list, was coordinated and drawn up by the organisers with the contribution of all participants to the excursion. A revision of the samples collected during the field work was carried out at Centro Ricerche Floristiche dell'Appennino (23–25 February 2017), followed by specific studies and comparisons of unidentified taxa. Some herbarium specimens belonging to critical genera were sent to specialists for determination: *Alchemilla* L. (F. Festi, Rovereto), *Hieracium* L. and *Pilosella* Hill (G. Gottschlich, Tübingen), *Orobanche* L. (G. Domina, Palermo), *Oenothera* L. (A. Soldano, Vercelli), *Pulmonaria* L. and some specimens of *Cynoglossum* L. (L. Cecchi, Firenze), *Taraxacum* F.H.Wigg. (J. Štěpánek, Prague).

The nomenclature used to draw up the floristic list (see Suppl. material 1.6) follows the updated checklists of the vascular flora native (Bartolucci et al. 2018a, 2018b, 2018c) and alien (Galasso et al. 2018a, 2018b, 2018c) to Italy, with the exception of native hybrids, not considered in the above-mentioned checklists. The systematic order of the families follows Bartolucci et al. (2018c) and Galasso et al. (2018a). Taxa are ordered alphabetically within each family. For each taxon the following information is reported: accepted name, endemic, cryptogenic and alien status, sampling site (see Suppl. material 1.3), *Herbarium* (see Suppl. material 1.5).

Abbreviations or symbols used in the floristic list are:

E Italian endemic (Peruzzi et al. 2014, 2015; Bartolucci et al. 2018c)
A Alien taxa: [CAS (Casual), NAT (Naturalized), INV (Invasive)]
C Cryptogenic (doubtfully native taxon, whose origin of occurrence in Italy is unknown)
** New record for the regional flora
* Taxon confirmed for the regional flora

Results

During the field investigations, 2,449 samples of vascular plants were collected, belonging to 629 species and subspecies, 300 genera, and 69 families (Suppl. material 1.6), including two hybrids (*Crataegus* ×*media* Bechst. and *Narcissus* ×*medioluteus* Mill.). Thirty-eight taxa are endemic to Italy, and only 16 are alien (*Aesculus hippocastanum* L., *Alnus cordata* (Loisel.) Duby, *Bromopsis inermis* (Leyss.) Holub subsp. *inermis*, *Cedrus atlantica* (Endl.) G.Manetti ex Carrière, *Erigeron annuus* (L.) Desf., *E. canadensis* L., *Euphorbia lathyris* L., *Isatis tinctoria* L. subsp. *tinctoria*, *Malus domestica* (Borkh.) Borkh., *Matricaria discoidea* DC. subsp. *discoidea*, *Oenothera glazioviana* Micheli, *Pseudotsuga menziesii* (Mirb.) Franco, *Rubus laciniatus* Weston, *Rumex patientia* L. subsp. *patientia*, *Symphoricarpos albus* (L.) S.F.Blake, and *Trifolium incarnatum* L. subsp. *incarnatum*). Thirty-eight taxa are included in the IUCN Red List of the Italian Flora (Rossi et al. 2013, Orsenigo et al. 2018). Twenty-four taxa have to be considered as floristic novelties, because either new or confirmed for the regional flora of Lazio or Abruzzo. The alien status of one taxon has been updated for Lazio.

In particular, the following 15 taxa are new for the flora of Lazio:

- *Bromopsis erecta* (Huds.) Fourr. subsp. *stenophylla* (Link) H.Scholz & Valdés
- *Festuca maritima* L.
- *Festuca stricta* Host subsp. *sulcata* (Hack.) Patzke ex Pils
- *Ficaria verna* Huds. subsp. *calthifolia* (Rchb.) Nyman
- *Hieracium glaucinum* Jord. subsp. *pseudobasalticum* Gottschl.
- *Hieracium pseudogrovesianum* Gottschl. subsp. *opertum* Gottschl.
- *Koeleria lucana* Brullo, Giusso & Miniss.
- *Orobanche amethystea* Thuill.
- *Pilosella corvigena* (Gottschl.) Gottschl.
- *Pilosella cymiflora* (Nägeli & Peter) S.Bräut. & Greuter
- *Pilosella ziziana* (Tausch) F.W.Schultz & Sch.Bip.
- *Plantago argentea* Chaix subsp. *argentea*
- *Potentilla neglecta* Baumg.
- *Pseudotsuga menziesii* (Mirb.) Franco
- *Trifolium lucanicum* Gasp. ex Guss.

The following six taxa are confirmed for the flora of Lazio:

- *Anthoxanthum nipponicum* Honda
- *Anthyllis vulneraria* L. subsp. *maura* (Beck) Maire
- *Luzula sylvatica* (Huds.) Gaudin subsp. *sieberi* (Tausch) K.Richt.
- *Orchis mascula* (L.) L. subsp. *speciosa* (Mutel) Hegi
- *Trisetaria flavescens* (L.) Baumg. subsp. *flavescens*
- *Vicia tenuifolia* Roth subsp. *tenuifolia*

The alien status in Lazio has been changed from CAS to NAT for:

- *Matricaria discoidea* DC. subsp. *discoidea*

The following two taxa are new for Abruzzo:

- *Adenocarpus complicatus* (L.) J.Gay subsp. *samniticus* (Brullo, De Marco & Siracusa) Peruzzi
- *Potentilla neglecta* Baumg.

The following species is confirmed for the flora of Abruzzo:

- *Ornithopus perpusillus* L.

Acknowledgements

We are grateful to F. Festi (Rovereto), G. Gottschlich (Tübingen), G. Domina (Palermo), A. Soldano (Vercelli), L. Cecchi (Firenze), and J. Štěpánek (Prague) for the identification of some critical samples.

References

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

Anzalone B, Iberite M, Lattanzi E, Scoppola A (2005) Stato delle conoscenze floristiche del Lazio. In: Scoppola A, Blasi C (Eds) Stato delle conoscenze sulla flora vascolare d'Italia. Palombi Editori, Roma, 159–165.

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 (2018a) Notulae to the Italian native vascular flora: 6. Italian Botanist 6: 45–64. https://doi.org/10.3897/italianbotanist.6.30575

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, 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 Pi-

etro 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 (2018c) An updated checklist of the vascular flora native to Italy. Plant Biosystems 152(2): 179–303. https://doi.org/10.1080/11263504.2017.1419996

Bouvet D, Pistarino A, Soldano A, Banfi E, Barbo M, Bartolucci F, Bovio M, Cancellieri L, Conti F, Di Pietro R, Faraoni F, Fascetti S, Galasso G, Gangale C, Lattanzi E, Peccenini S, Perrino EV, Rizzieri Masin R, Romano VA, Rosati L, Salerno G, Stinca A, Tilia A, Uzunov D (2018) Contribution to the floristic knowledge of the head of the Po Valley (Piedmont, north Italy). Italian Botanist 5: 57–69. https://doi.org/10.3897/italianbotanist.5.24546

Conti F, Bartolucci F, Manzi A, Tinti D (2005) Stato delle conoscenze floristiche della regione Abruzzo. In: Scoppola A, Blasi C (Eds) Stato delle conoscenze sulla flora vascolare d'Italia. Palombi Editori, Roma, 167–171.

Conti F, Bracchetti L, Uzunov D, Bartolucci F (2019) A new subspecies of *Corydalis densiflora* (Papaveraceae) from the Apennines (Italy). Willdenowia 49(1): 53–64. https://doi.org/10.3372/wi.49.49107

Del Vico E, Lattanzi E, Marignani M, Rosati L (2014) Specie rare e di interesse conservazionistico di un settore poco conosciuto dell'Appennino centrale (Cittareale, Rieti). In: Peruzzi L, Domina G (Eds) Riunione scientifica del Gruppo per la Floristica, Sistematica ed Evoluzione, Società Botanica Italiana, 21–22/11/2014. Società Botanica Italiana, Roma, 33–34.

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/italianbotanist.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

Lucchese F (2018) Atlante della Flora Vascolare del Lazio, cartografia, ecologia e biogeografia. Vol. 2. La flora di maggiore interesse conservazionistico. Regione Lazio, Direzione Capitale Naturale, Parchi e Aree Protette, Roma, 400 pp.

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 MC, Wagensommer RP, Wilhalm T, Tartaglini N, Duprè E, Blasi C, Rossi G (2018) Red Listing plants under full national responsibility: extinction risks and threats in the vascular flora endemic to Italy. Biological Conservation 224: 213–222. https://doi.org/10.1016/j.biocon.2018.05.030

Peruzzi L, Conti F, Bartolucci F (2014) An inventory of vascular plants endemic to Italy. Phytotaxa 168: 1–75. https://doi.org/10.11646/phytotaxa.168.1.1

Peruzzi L, Domina G, Bartolucci F, Galasso G, Peccenini S, Raimondo FM, Albano A, Alessandrini A, Banfi E, Barberis G, Bernardo L, Bovio M, Brullo S, Brundu G, Brunu A, Camarda I, Conti F, Croce A, Iamonico D, Iberite M, Iiriti G, Longo D, Manca A, Marsili S, Medagli P, Pistarino A, Salmeri C, Santangelo A, Scassellati E, Selvi F, Soldano A, Stinca A, Vacca G, Villani MC, Wagensommer RP, Passalacqua NG (2015) An inventory of the names of vascular plants endemic to Italy, their loci classici and types. Phytotaxa. 196: 1–217. https://doi.org/10.11646/phytotaxa.196.1.1

Rosati L, Romano V, Bartolucci F, Bernardo L, Bouvet D, Cancellieri L, Caruso G, Conti F, Faraoni F, Banfi E, Galasso G, Lattanzi E, Lavezzo P, Peccenini S, Perrino EV, Salerno G, Sciandra A, Soldano A, Stinca A, Totta C, Fascetti S (2017) Contribution to the floristic knowledge of the Maddalena Mountains (Basilicata and Campania, southern Italy). Italian Botanist 3: 73–82. https://doi.org/10.3897/ib.3.12519

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 (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, 1–58.

Servizio Geologico d'Italia (1955) foglio geologico 139 "L'Aquila" alla scala 1:100,000.

Tondi G, Di Pietro R, Ballelli S, Minutillo F (2003) New contribution to the knowledge of the flora of the Laga Mountains (Central Apennines). Webbia 58(1): 57–76. https://doi.org/10.1080/00837792.2003.10670744

Supplementary material 1

Supplementary data

Authors: Fabrizio Bartolucci, Laura Cancellieri, Fabio Conti, Enrico Banfi, Daniela Bouvet, Michela Celestini, Giampiero Ciaschetti, Romeo Di Pietro, Francesco Falcinelli, Simonetta Fascetti, Gabriele Galasso, Edda Lattanzi, Rizzieri R. Masin, Riccardo Pennesi, Leonardo Rosati, Adriano Stinca, Agnese Tilia, T'ai G.W. Forte, Anna Scoppola

Data type: supplementary data

Explanation note: **1.** Participants to the field trip of the working group for Floristics, Systematics and Evolution of the Italian Botanical Society (15–18 June 2016). **2.** Study area and sampling sites. **3.** Thermo-pluviometric diagram of Cittareale, representative meteorological station in Velino and Aterno valleys. **4.** List of sampling sites, with reference number, locality name with short description, altitude, main habitats, cartographic coordinates (WGS84 33T) and date of collection. **5.** Public and private herbaria in which the collected exsiccata are kept. Acronyms of public herbaria follow Thiers (2018). **6.** Inventory of the taxa collected during the field trip held in 2016 (and some further investigations by organizers on 29 March 2016, 15 and 29 April 2016, 23 March 2017, 2–3 June 2017) in Velino and Aterno valleys (Lazio-Abruzzo, central Italy).

Link: https://doi.org/10.3897/italianbotanist.7.34697.suppl1

Italian Botanist 7: 101–105 (2019)
doi: 10.3897/italianbotanist.7.35004
http://italianbotanist.pensoft.net

RESEARCH ARTICLE

Italian Botanist
Published by Società Botanica Italiana

Anemonoides ×*lipsiensis* comb. nov. (Ranunculaceae), new for the Italian flora

Giovanni Astuti[1], Giancarlo Marconi[2], Paolo Pupillo[3], Lorenzo Peruzzi[1]

1 *Dipartimento di Biologia, Università di Pisa, Via Derna 1, 56126 Pisa, Italy* **2** *Associazione Pangea, San Lazzaro di Savena (Bologna), Italy* **3** *Department of Pharmacy and Biotechnology, University of Bologna, Bologna, Italy*

Corresponding author: *Giovanni Astuti* (gastuti@biologia.unipi.it)

Academic editor: *F. Bartolucci* | Received 29 March 2019 | Accepted 30 April 2019 | Published 17 May 2019

Citation: Astuti G, Marconi G, Pupillo P, Peruzzi L (2019) *Anemonoides* ×*lipsiensis* comb. nov. (Ranunculaceae), new for the Italian flora. Italian Botanist 7: 101–105. https://doi.org/10.3897/italianbotanist.7.35004

Abstract

The hybrid *Anemonoides nemorosa* × *A. ranunculoides* is recorded for the first time in Italy at the southern periphery of Bologna (N Italy, Emilia-Romagna). Its status is supported by both morphological features and chromosome number ($2n = 31$). For this taxon, a new nomenclatural combination is proposed.

Keywords

chromosome number, hybrid, vascular flora

Introduction

Anemonoides nemorosa (L.) Holub is a circumboreal species, quite common in woods and clearings throughout the Alps and peninsular Italy. *Anemonoides ranunculoides* (L.) Holub occurs in Europe and the Caucasus area, and is widespread in the forests of northern Italy, but increasingly rare to the south (Pignatti 2017; Bartolucci et al. 2018).

Natural hybrids among these species have been described since the first half of the nineteenth century for several areas of Austria, Germany, Denmark, and Sweden (Pritzel 1841; Beck von Mannagetta 1890; Camus 1898; Hegi 1912; Bernström 1946).

Since 2012, morphologically intermediate individuals have been known at the southern periphery of Bologna, N Italy (Fig. 1), where *A. nemorosa* and *A. ranunculoides* co-exist. Given that the first species shows typically $2n = 30$ and the second $2n = 32$ chromosomes (Mlinarec et al. 2012), we expect that putatively F1 hybrid plants should show $2n = 31$, as reported by Bernström (1946) for Sweden.

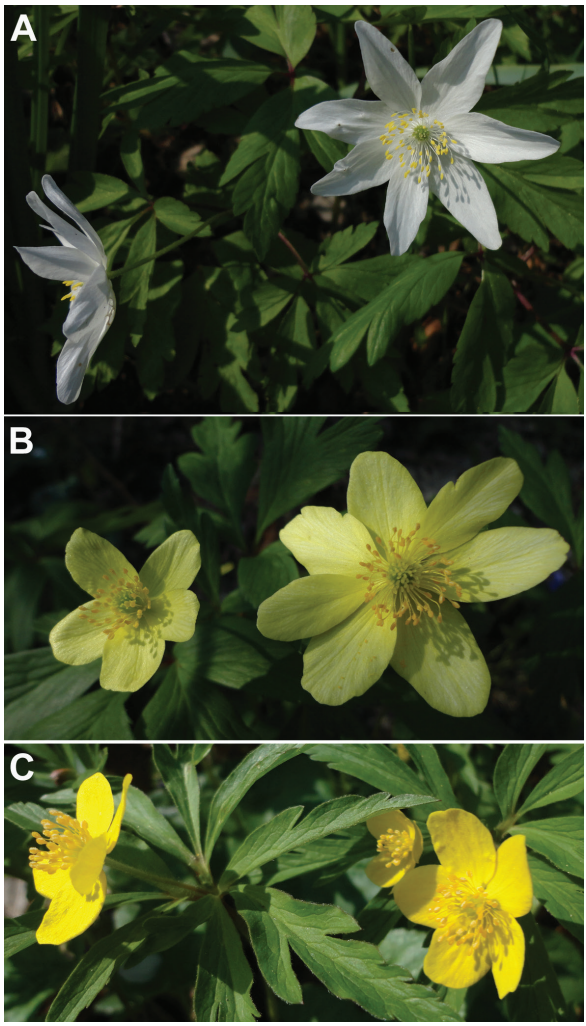

Figure 1. *Anemonoides nemorosa* (L.) Holub (**A**), *A. ranunculoides* (L.) Holub (**C**) and their putative hybrid (**B**) from Via di Roncrio, Bologna, N Italy. March 2017. Photo by L. Peruzzi.

Material and methods

Specimens seen

Italy. *Anemonoides* ×*lipsiensis* (Beck) Peruzzi & G.Astuti, Bologna, lungo la strada di Roncrio (UTM WGS84: 44.462742N, 11.336363E), margine di bosco, 120 m, 25 March 2017, *G. Astuti, G. Marconi, L. Peruzzi, P. Pupillo* (PI, n. 019279). *Anemonoides nemorosa* (L.) Holub, *ibidem* (PI, n. 019277). *Anemonoides ranunculoides* (L.) Holub, *ibidem* (PI, n. 019278).

Morphological observations

Based on Brennenstuhl (2004), we measured the following characters on three dried individuals for each taxon: number of flowers per shoot, flower colour, flower diameter, number of petals, peduncle length.

Chromosome number

Squash preparations were made on root-tips taken from plants native to the Bologna site and grown in the Botanical Garden of Pisa. Root-tips were pretreated 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.

Results

Results of morphological observations are reported in Table 1. For all the features evaluated, the putative hybrid shows intermediate values between those of putative parental species.

The putatively hybrid plants show $2n = 31$ chromosomes.

Table 1. Floral morphological features of *Anemonoides nemorosa*, *A.* ×*lipsiensis*, and *A. ranunculoides* in the investigated site.

	A. nemorosa	***A.* ×*lipsiensis***	***A. ranunculoides***
Number of flowers per shoot	1	1–2	2
Flower colour	white	pale yellow	yellow
Flower diameter (cm)	4.0–4.5	3.0–3.5	2.0–2.5
Number of petals	7	5–7	5
Peduncle length (cm)	6.5–8.0	4.5–6.0	3.0–4.0

Discussion

The morphological features of the plants studied agree perfectly with those reported for the hybrid *A. nemorosa* ×*A. ranunculoides* from Saxony-Anhalt, NE Germany, ca. 200 km N-NW to Leipzig (Brennenstuhl 2004). Our chromosome count carried out on the Italian population, $2n = 31$, also agrees with previous counts based on extra-Italian material (Bernström 1946).

The circumscription of tribe Anemoninae has been much controversial in recent years, and a wide array of taxonomic solutions were proposed, ranging from the inclusion of a number of morphologically well-established genera in a large and highly

heterogeneous *Anemone* (Hoot et al. 2012), to the disintegration of the traditional concept of *Anemone* in a number of smaller genera (e.g., Mosyakin 2016; Bartolucci et al. 2018; Christenhusz et al. 2018) to allow the recognition of monophyletic groups. Among the scholars favouring this latter approach, the taxonomic independence of the genus *Anemonoides* Mill. (= *Anemone* sect. *Anemonanthea* DC.) is disputed by some authors preferring a wider concept of *Anemone* (e.g., Ziman et al. 2008; Mosyakin 2016; Pignatti 2017). On the contrary, other authors as Starodubtsev (1991), Banfi et al. (2005), and Bartolucci et al. (2018) recognize it as a distinct genus, an option we also follow here. Under *Anemonoides*, the hybrid *A. nemorosa* × *A. ranunculoides* has been named *A.* ×*seemenii* (E.G.Camus) Holub so far (Holub 1983). However, the name holding priority at (notho-)species level is *Anemone* ×*lipsiensis* Beck, so that the following new combination is needed under that genus:

***Anemonoides* ×*lipsiensis* (Beck) Peruzzi & G.Astuti, comb. nov.**
urn:lsid:ipni.org:names:60478801-2

Anemone ×*lipsiensis* Beck, Fl. Nieder-Österreich 1: 407. 1890 (Basionym)
= *Anemone* ×*vindobonensis* Beck, Fl. Nieder-Österreich 1: 407. 1890
= *Anemone* ×*seemenii* E.G.Camus, J. Bot. (Morot) 12: 101. 1898 ≡ *Anemonoides* ×*seemenii* (E.G.Camus) Holub, Folia Geobot. Phytotax. 18(2): 206. 1983
– *Anemone intermedia* M.Winkl. ex Pritz., Linnaea 15: 652. 1842, nom. nud.

Note. Beck von Mannagetta (1890) lists *A. lipsiensis* and *A. vindobonensis* as "6a" and "6b" respectively, "6" representing the same hybrid formula "*A. nemorosa* ×*ranunculoides*" (Beck von Mannagetta 1890: 406). This guarantees that he considered both these taxa as nothospecies (from the Preface at pag. V: "...sämmtliche Kreutzungen zweier Arten wurden unter einer Nummer vereinigt und die einzelnen Hybriden, insoweit deren Unterscheidung überhaupt möglich ist, unter den gemeinsamen Nummer mit fortlaufenden Buchstaben bezeichnet." ["...all the crosses between two species are united under the same number and the single hybrids, unless they can be differentiated, are indicated by that number followed by consecutive letters"]). Consequently, both names are legitimate (Art. H.4 of ICN, Turland et al. 2018) and of equal priority (Art. 11.5 of ICN), so that we select here *A. lipsiesis* as priority name.

References

Beck von Mannagetta GR (1890) Flora von Nieder-Österreich 1. Carl Gerold's Sohn, Wien. 430 pp.

Banfi E, Galasso G, Soldano A (2005) Notes on systematics and taxonomy for the Italian vascular flora. 1. Atti della Società Italiana di Scienze Naturali, Museo Civico di Storia Naturale di Milano 146(2): 219–244.

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, Gubellini L, Gottschlich G, Iamonico D, Iberite M, Jinénez-Mejías P, Lattanzi E, Martinetto E, Masin RR, Medagli P, Passalacqua NG, Peccenini S, Pennesi R, Pierini B, Poldini L, Prosser F, Raimondo FM, Marchetti D, 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

Bernström P (1946) Chromosome numbers in *Anemone nemorosa* and *A. ranunculoides*. Hereditas 32(3–4): 514–520. https://doi.org/10.1111/j.1601-5223.1946.tb02790.x

Brennenstuhl G (2004) *Anemone* ×*lipsiensis* G.Beck im Bürgerholz bei Salzwedel. Mitteilungen zur floristischen Kartierung Sachsen-Anhalts 9: 27–31.

Camus MEG (1898) Statistique ou catalogue des plantes hybrides spontanées de la flore européenne. Journal de Botanique 12: 97–103.

Christenhusz MJM, Fay MF, Byng JW (Eds) (2018) The Global Flora. Vol. 4: Special Edition, GLOVAP Nomenclature Part 1. Plant Gateway Ltd., Bradford, United Kingdom, 155 pp.

Hegi G (1912) Illustrierte Flora von Mittel-Europa. Band III. A. Pichler's Witwe & John, Wien. 607 pp.

Holub J (1983) Reclassification and new names for some European phanerogams. Folia Geobotanica & Phytotaxonomica 18(2): 203–206. https://doi.org/10.1007/BF02857457

Hoot SB, Meyer KM, Manning JC (2012) Phylogeny and reclassification of *Anemone* (Ranunculaceae), with an emphasis on Austral species. Systematic Botany 37: 139–152. https://doi.org/10.1600/036364412X616729

Mlinarec J, Šatović Z, Mihelj D, Malenica N, Besendorfer W (2012) Cytogenetic and phylogenetic studies of diploid and polyploid members of Tribe Anemoninae (Ranunculaceae). Plant Biology 14: 525–536. https://doi.org/10.1111/j.1438-8677.2011.00519.x

Mosyakin SL (2016) Nomenclatural notes on North American taxa of *Anemonastrum* and *Pulsatilla* (Ranunculaceae), with comments on the circumscription of *Anemone* and related genera. Phytoneuron 2016–79: 1–12.

Pignatti S (2017) Flora d'Italia. Vol. 1, ed. 2. Edagricole-New Business Media, Milano, 1064 pp.

Pritzel GA (1841) Anemonarum revisio. Flora 15: 561–698.

Starodubtsev VN (1991) Anemones: Systematics and Evolution. Nauka, Leningrad. [In Russian]

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

Ziman SN, Bulakh EV, Kadota Y, Keener CS (2008) Modern view on the taxonomy of the genus *Anemone* L. sensu stricto (Ranunculaceae). Journal of Japanese Botany 83: 127–155.

Italian Botanist 7: 107–124 (2019)
doi: 10.3897/italianbotanist.7.35467
http://italianbotanist.pensoft.net

RESEARCH ARTICLE

Italian Botanist
Published by Società Botanica Italiana

Global and regional IUCN Red List assessments: 7

Simone Orsenigo[1], Michele Adorni[2], Alessandro Alessandrini[3], Stefano Armiraglio[4], Miris Castello[5], Luigi Forte[6], Matilde Gennai[7], Sara Magrini[8], Pietro Medagli[9], Chiara Montagnani[10], Filippo Prosser[11], Alberto Selvaggi[12], Mariacristina Villani[13], Daniele Viciani[7], Robert P. Wagensommer[14], Giuseppe Fenu[15]

1 *Department of Agricultural and Environmental Sciences - Production, Landscape, Agroenergy, University of Milan, Milan, Via Celoria 2, 20122, Italy* **2** *Via degli Alpini 7, 43037 Lesignano de' Bagni (Parma), Italy* **3** *Istituto Beni Culturali, Regione Emilia-Romagna, 40121 Bologna, Italy* **4** *Museo di Scienze Naturali, 25128 Brescia, Italy* **5** *Department of Life Sciences, University of Trieste, 34127 Trieste, Italy* **6** *Department of Biology - Botanical Garden Museum, University of Bari "Aldo Moro", Via Orabona 4, 70125 Bari, Italy* **7** *Department of Biology, University of Florence, Via La Pira 4, 50121 Florence, Italy* **8** *Banca del Germoplasma della Tuscia, Università della Tuscia, Largo dell'Università snc, blocco c, 01100 Viterbo, Italy* **9** *Department of Biological and Environmental Sciences and Technologies (Di.S.Te.B.A.), University of Salento, Via Prov.le Lecce-Monteroni 165, 73100 Lecce, Italy* **10** *Department of Earth and Environmental Sciences, University of Milano Bicocca, Milan, 20126, Italy* **11** *Fondazione Museo Civico di Rovereto, Largo S. Caterina 41, 38068 Rovereto (Trento), Italy* **12** *Istituto Piante da Legno e l'Ambiente, corso Casale 476, 10132 Torino, Italy* **13** *Botanical Garden of Padua, University of Padua, 35123 Padua, Italy* **14** *Department of Chemistry, Biology and Biotechnology, University of Perugia, Via del Giochetto 6, 06123 Perugia, Italy* **15** *Centre for the Conservation of Biodiversity (CCB), Department of Life and Environmental Sciences, University of Cagliari, Cagliari, 09123, Italy*

Corresponding author: *Simone Orsenigo* (simone.orsenigo@unimi.it)

Academic editor: *L. Peruzzi* | Received 15 April 2019 | Accepted 10 May 2019 | Published 29 May 2019

Citation: Orsenigo S, Adorni M, Alessandrini A, Armiraglio S, Castello M, Forte L, Gennai M, Magrini S, Medagli P, Montagnani C, Prosser F, Selvaggi A, Villani M, Viciani D, Wagensommer RP, Fenu G (2019) Global and regional IUCN Red List assessments: 7. Italian Botanist 7: 107–124. https://doi.org/10.3897/italianbotanist.7.35467

Abstract

In this contribution, the conservation status assessment of four vascular plants according to IUCN categories and criteria are presented. It includes the assessments of *Aurinia leucadea* (Guss.) K.Koch, *Chondrilla chondrilloides* (Ard.) H.Karst., *Daphne cneorum* L., and *Ophioglossum azoricum* C.Presl at regional level (Italy).

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@unimi.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

Aurinia leucadea (Guss.) K.Koch

Regional assessment (Italy)
Taxonomy and nomenclature
Order: Brassicales *Family:* Brassicaceae

Aurinia leucadea (Guss.) K.Koch, Hort. Dendrol.: 23 (1853) ≡ *Alyssum leucadeum* Guss., Pl. Rar.: 268(-269) (1826) = *Aurinia scopulorum* (Ginzb.) Trinajstić, Suppl. Fl. Anal. Jugosl. 8: 5 (1982) = *Aurinia leucadea* (Guss.) K.Koch subsp. *diomedea* Brullo, De Marco & Giusso, Inform. Bot. Ital. 35(1): 243 (2003) = *Aurinia leucadea* (Guss.) K.Koch subsp. *scopulorum* (Ginzb.) Plazibat, Nat. Croat. 18(2): 416 (2009).

Common name: Alisso di Leuca (It), Leuca Alison (En).

Geographic distribution range: *Aurinia leucadea* (Fig. 1) is endemic to Italy and Croatia (Plazibat 2009). It was erroneously reported from Ukraine (Euro+Med 2006), probably due to confusion between *Alyssum medium* Host and *Alyssum medium* A.P.Iljinsk., nom. illeg., and from the former Serbia & Montenegro (Euro+Med 2006, based on Trinajstić 1982 in which, however, the species is indicated only for Croatia under the name *A. scopulorum*). In Italy, it occurs only in Puglia, in two disjunct areas (Salento and Tremiti Islands). In Salento, this species occurs in many localities between Punta Palascia (Otranto) and Leuca, whereas its occurrence between Leuca and Torre Uluzzo (Nardò) is discontinuous. The indication for Torre Inserraglio (Tornadore 1981) is probably due to confusion with Torre Uluzzo. On the Tremiti Islands, *A. leucadea* occurs on the islands of San Nicola and Capraia (Fig. 2).

Distribution: Countries of occurrence: Italy and Croatia.

Biology: *Plant growth form:* Perennial (chamaephyte). *Chromosome number:* $2n$ = 16 (material from Salento, Tornadore 1981).

Flowering and fruiting time: Flowering from March to May, fruiting from April to late May.

Reproduction: Pollination by bees, dispersal by seeds. Germination tests on material collected on the Tremiti Islands (L. Forte and collaborators, unpublished

Figure 1. *Aurinia leucadea* photographed in Torre Minervino (Salento, Italy). Picture by P. Medagli.

data) show that the seeds have no mucilage on the teguments, in contrast with the seeds of other taxa of the same genus [e.g., *A. saxatilis* (L.) Desv. subsp. *megalocarpa* (Hausskn.) T.R.Dudley] or of the genus *Alyssum*. Consequently, *A. leucadea* cannot benefit from the ecological advantages that the presence of seed mucilage implies in the reproductive biology of a species (Sun et al. 2012, Yang et al. 2012). In addition, *A. leucadea* does not show any type of dormancy, given that the seeds can germinate, even at very high rates (> 95%), in the dark and at a constant temperature ranging between 3 and 21°C. Only at a constant temperature of 24°C in the dark, the germination rate drops to about 50% (L. Forte and collaborators, unpublished data).

Habitat and ecology: In Italy, *A. leucadea* grows on calcareous rocks near the sea, up to about 75 m a.s.l. In Salento, the species is characteristic of the association *Campanulo versicoloris-Aurinietum leucadeae* Bianco, Brullo, Pignatti & Pignatti, 1988 (Bianco et al. 1988).

Population information: There is no available detailed information on population dynamics. The populations seem to be stable.

Threats: *1.3 Tourism & Recreation areas:* All the occurrence sites in Italy are affected by possible stronger anthropization of the coast, especially by the development

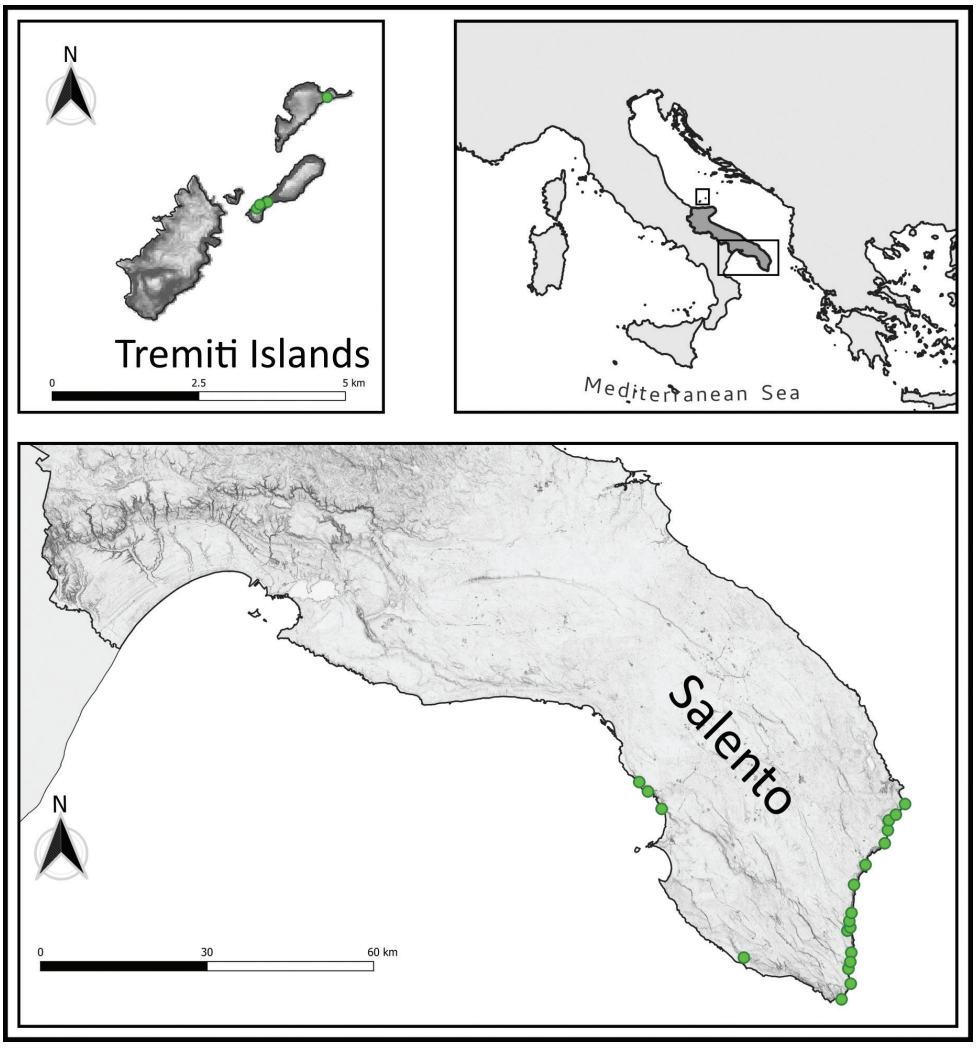

Figure 2. Geographic range and distribution map of *Aurinia leucadea* in Italy.

of touristic infrastructures. However, considering that *A. leucadea* grows on rocky habitats, this threat is more hypothetical than real and, in any case, it would affect only specific areas and not the sites where the species mostly occurs.

5.2 Gathering terrestrial plants: The population growing on the Fortress-Abbey of Santa Maria a Mare on the Island of San Nicola (Tremiti) is threatened by the projected cleaning of the walls of the ancient Abbey. Considering the low number of individuals of *A. leucadea* growing on the Tremiti Islands, the cleaning could have a considerable impact on the population of San Nicola.

CRITERIA APPLIED:

Criterion B: **AOO:** 84 km^2 calculated with a 2 × 2 km-cell fixed grid by GeoCAT (Bachman et al. 2011)

EOO: 7,483 km^2 calculated with minimum convex hull by GeoCAT (Bachman et al. 2011).

a) Not severely fragmented; number of locations > 10

b) No continuing decline

Red List category and criteria (regional assessment)

LC	**Least Concern**

Rationale for the assessment: In Italy, *Aurinia leucadea* occurs only in Puglia, with many localities on the rocky coast of Salento and with a small population on the Tremiti Islands. The habitat of this species is quite conservative and neither continuing decline nor extreme fluctuations have been observed or can be projected. The distribution is not severely fragmented and the identified threats are only potential in most of the occurrence sites. Only the population on San Nicola (Tremiti Islands) is affected by a concrete threat (5.2). Therefore, the species is assigned to the Least Concern (LC) category.

Previous assessment: At the Regional level (Italy), this species was previously indicated as Endangered (EN) (Wagensommer et al. 2013). At a global level, it has not been evaluated (NE) to date (IUCN 2019).

Conservation actions: *Aurinia leucadea* is unprotected by international, national and regional laws. Accessions collected in 2010 on San Nicola (Tremiti Islands) are stored *ex situ* in the Germplasm Bank of the Botanical Garden Museum of the University of Bari "Aldo Moro" (BG-MOBB) (Forte et al. 2015). The Salento sites are included in the Regional Natural Parks "Costa Otranto-Santa Maria di Leuca e Bosco di Tricase", "Litorale di Ugento" and "Porto Selvaggio e Palude del Capitano", and in the Natura 2000 sites "Costa Otranto-Santa Maria di Leuca" (SCI IT9150002), "Litorale di Ugento" (SCI IT9150009), "Montagna Spaccata e Rupi di San Mauro" (SCI IT9150008), and "Torre Uluzzo" (SCI IT9150007). The sites on the Tremiti Islands are included in the Gargano National Park and in the Natura 2000 site "Isole Tremiti" (SAC/SPA IT9110011).

Conservation actions needed: Research activities are recommended in order to better understand the reproductive biology and the population dynamics of this species; monitoring programs are encouraged in order to evaluate the possible development of threats. The increase in the number of accessions in seed banks for *ex situ* conservation is desirable, especially regarding the Salento sites.

Notes: According to some authors (Brullo et al. 2003, Plazibat 2009), the populations from the Tremiti Islands (and from two Croatian islands, Kamik and Jabuka) might be distinguished at subspecific rank, as *A. leucadea* (Guss.) K.Koch subsp. *diomedea* Brullo, De Marco & Giusso, but the latter taxon is not recognised in the recent checklist of the

Italian vascular flora (Bartolucci et al. 2018). By considering them as two different taxa, the Regional assessments (Italy) would be as follows: *A. leucadea* subsp. *leucadea* Least Concern (LC), *A. leucadea* subsp. *diomedea* Endangered [EN B1ab(iii,v)+2ab(iii,v)].

R.P. Wagensommer, P. Medagli, L. Forte

Chondrilla chondrilloides (Ard.) H.Karst.

Regional Assessment (Italy)
Taxonomy and nomenclature
Order: Asterales *Family:* Asteraceae

Chondrilla chondrilloides (Ard.) H.Karst., Deut. Fl.: 1139. 1883 ≡ *Prenanthes chondrilloides* Ard. (basionym), Animadv. Bot. Spec. Alt.: 36 (1764)

Common name: Condrilla falsa condrilla (It), Lattugaccio dei torrenti (It), Alpen-Knorpelsalat (De), Chondrille faux Prénanthe (Fr)

Geographic distribution range: *C. chondrilloides* (Fig. 3) is endemic to the eastern Alps, growing in Switzerland, Germany, Austria, Italy, and Slovenia (Euro+Med 2006, Prosser 2017).

In Italy, *C. chondrilloides* occurs in Trentino-Alto Adige, Veneto, and Friuli Venezia Giulia (Fig. 4), while it is considered extinct in Lombardia (Poldini 2002, Prosser 2017, Bartolucci et al. 2018). Its Italian distribution range is in regression, because several populations have not been confirmed in recent times (Prosser 2017).

Distribution: Countries of occurrence: Austria, Germany, Italy, Slovenia, and Switzerland.

Biology: *Plant growth form:* herbaceous perennial (hemicryptophyte).

Flowering time: From June to August.

Reproduction: According to Bergman (1952), *C. chondrilloides* is a diploid species reproducing amphimictically. No information on pollination, dispersal strategy, and seed germination is available.

Habitat and ecology: *Chondrilla chondrilloides* typically grows in stony riverbeds and riverbanks of montane rivers and streams, in particular on calcareous substrates. It is a stenoecious species, strictly linked to riverbanks subject to natural dynamics, while it is lacking in man-modified riverine habitats. It can be considered a typical member of the Habitat Natura 2000 code 3220 "*Alpine rivers and the herbaceous vegetation along their banks*" but, to a lesser extent, it can also be found in the habitats "*Alpine rivers and their ligneous vegetation with Myricaria germanica*" and "*Alpine rivers and their ligneous vegetation with Salix eleagnos*" (codes 3230 and 3240, respectively, of the Habitat Directive 92/43/EEC).

Population information: Populations range from few to hundreds of individuals, up to a maximum of 1800–2000 at a single site (riverbed of Centa stream in Caldon-

Figure 3. *Chondrilla chondrilloides* photographed in Caldonazzo (Trento, Italy). Picture by F. Prosser.

azzo, Prosser 2017). Many of the past sites of occurrence documented by herbarium specimens and field surveys were not recently confirmed. In some sites, the species was surely present and abundant in 1997–1998, and completely lacking in 2014–2016

(Prosser 2017). There is no other detailed information available on population dynamics and trends.

Threats: *3.2 Mining & Quarrying*: in Valsugana, the extraction of gravel and sand from river beds, and the consequent modification of hydrodynamics, can interfere with the normal development of the herbaceous vegetation of the banks.

6.1 Recreational Activities: in Friuli, sport activities that involve the use of motorized vehicles (such as off-road vehicles) on gravelly riverbanks can threat populations.

7.2.9 Small Dams: construction of dams alters the fluvial regime and the morphological features of the banks of the downstream reaches.

7.3 *Other ecosystem modifications*: removal of snags from streams, management and containment of the rivers and river banks maintenance could damage the populations of *C. chondrilloides*.

8.1.2 Invasive Non-Native/Alien Species/Diseases: in some sites the quick expansion of *Impatiens glandulifera* Royle and *Reynoutria japonica* Houtt. can pose a serious threat to the species.

CRITERIA APPLIED:

Criterion B: **AOO:** 168 km^2 calculated with a 2×2 km-cell fixed grid.

EOO: 11,156 km^2 calculated with minimum convex hull in QGis 2.18.9.

b) Documented decline in (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals.

c) Extreme fluctuations in (ii) area of occupancy; (iii) number of locations or subpopulations, due to the habitat types in which it occurs (riparian natural dynamics, anthropic disturbances).

Red List category and criteria (regional assessment)

EN	**Endangered**	**B2b(i,ii,iii,iv,v)c(ii,iii)**

Rationale for the assessment: *Chondrilla chondrilloides* is endemic to the eastern Alps, growing in montane riverbanks and riverbeds subjected to natural dynamics. The anthropic modifications and exploitations of riverine habitats have caused a reduction in AOO. Moreover, *C. chondrilloides* populations are subjected to extreme fluctuations due to riparian system dynamics. Because of the overall decline of EOO, AOO, habitat quality, number of populations, and number of mature individuals this taxon qualifies as Endangered at a regional level (Italy).

Previous assessment: *Chondrilla chondrilloides* was not previously evaluated (NE) neither at national (Italy) nor at global level (NE, IUCN 2019). In the other countries of occurrence, *C. chondrilloides* is included in national red lists, as EN in Switzerland (www.infoflora.ch), Germany (www.floraweb.de), and Austria (Niklfeld & Schratt-Ehrendorfer 1999), or as VU (Vulnerable) in Slovenia (Anonymous 2002).

Conservation actions: *Chondrilla chondrilloides* is not protected by international or Italian laws, while it is protected or included in attention lists in Switzerland, Ger-

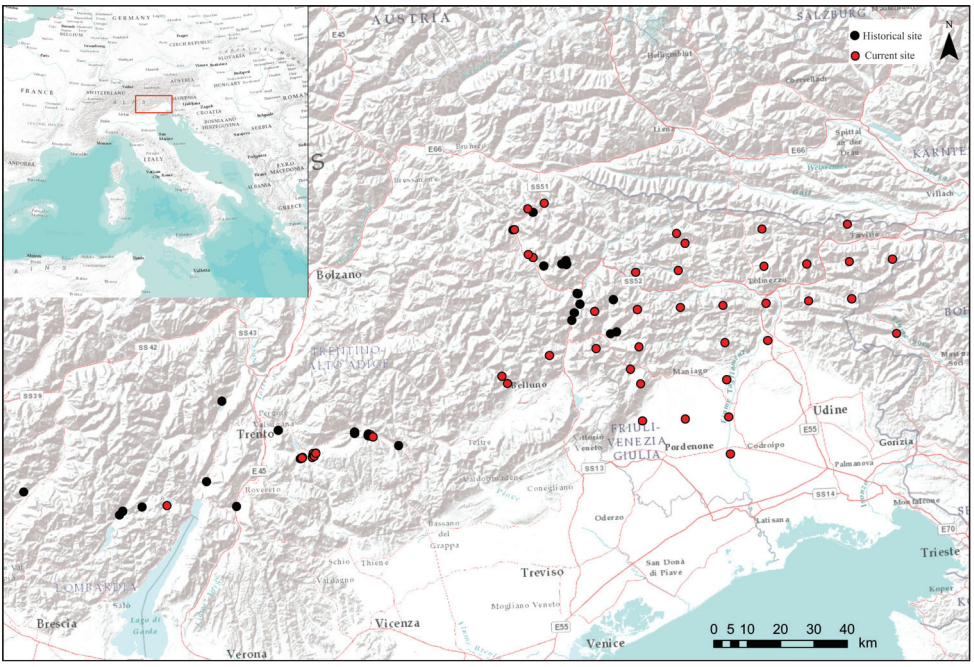

Figure 4. Geographic range and distribution map of *Chondrilla chondrilloides* in Italy (black dots: historical sites not recently confirmed; red dots: current/confirmed sites).

many, Austria, and Slovenia. Some of the Italian sites (33%) are included in the Natura 2000 protected areas network.

Conservation actions needed: Further monitoring and research activities are recommended in order to better understand the species' population trends in Italy.

D. Viciani, M. Adorni, A. Alessandrini, S. Armiraglio, M. Castello, C. Montagnani, F. Prosser, A. Selvaggi, M. Villani, M. Gennai

Daphne cneorum L.

Regional Assessment (Italy)
Taxonomy and nomenclature
Order: Malvales *Family:* Thymelaeaceae

Daphne cneorum L., Sp. Pl.: 357. 1753

Common name: Dafne odorosa (It), Cneoro (It), Rose daphne (En)

Geographic distribution range: *Daphne cneorum* (Fig. 5) is an orophilous central-southern European species, and it grows in mountain and sub-mountain areas from Spain to central European Russia, being particularly widespread in alpine and Balkan

Figure 5. *Daphne cneorum* in Piedmont (Italy). Picture by Alberto Selvaggi.

areas (Euro+Med 2006). In Italy, *D. cneorum* has been reported for Piemonte, Lombardia, Trentino-Alto Adige, Veneto, Friuli Venezia Giulia, Liguria, Emilia-Romagna, and Toscana (Fig. 6; Bartolucci et al. 2018).

Distribution: Countries of occurrence: Albania, Andorra, Austria, Bulgaria, Czech Republic, Croatia, France, Germany, Hungary, Italy, Republic of Macedonia, Poland, Romania, Russia (central European), Serbia, Slovakia, Slovenia, Spain, Switzerland, and Ukraine (Euro+Med 2006).

Biology: *Plant growth form:* small evergreen shrub (chamaephyte/nano-phanerophyte).

Flowering time: From April to July.

Reproduction: *Daphne cneorum* probably reproduces amphimictically by seeds, which could be dispersed by birds, even if detailed information on reproduction, pollination, dispersal strategy, and seed germination is poor or absent. Several literature sources report that *Daphne* species, and specifically *D. cneorum,* have low reproductive potential (Melnik 1997, Malà and Bylinsky 2004).

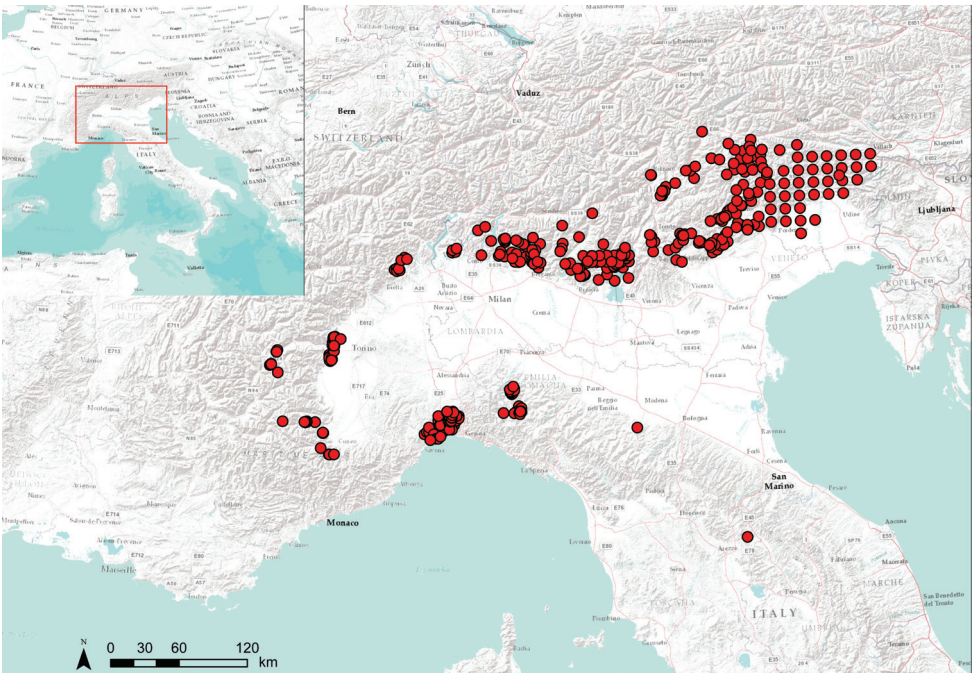

Figure 6. Geographic range and distribution map of *Daphne cneorum* in Italy.

Habitat and ecology: *Daphne cneorum* typically grows in relatively warm, dry, stony areas, screes, low grasslands, rocky steppes, shrublands, and open oak woods (*Quercus pubescens* Willd. or *Q. petraea* (Matt.) Liebl.), pine woods (*Pinus sylvestris* L., *P. nigra* J.F.Arnold) or conifer plantations, particularly on poor soils on basic (limestone, dolomite), mafic or ultramafic substrata (peridotite, serpentine, basalt, gabbro, lherzolite). This species grows at altitudes between 350 and 1700 m a.s.l., from the plain to the subalpine level; occasionally, some populations can also be found in dry grasslands and gravel beds in the lowlands, floated down by rivers and streams. *Daphne cneorum* can be found in several different habitats listed in Annex I of the Habitats Directive 92/43/EEC (e.g., code 5130, *Juniperus communis* formations on heaths or calcareous grasslands; code 6130, Calaminarian grasslands of the *Violetalia calaminariae*; code 6210, semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*); code 62A0, eastern sub-Mediterranean dry grasslands (*Scorzoneretalia villosae*); code 8120, calcareous and calcschist screes of the montane to alpine levels (*Thlaspietea rotundifolii*); code 8130, western Mediterranean and thermophilous screes, etc).

Population information: In each site, the subpopulations generally consist of few to tens of individuals, reaching hundreds of individuals only in a few sites. There is no information available on population dynamics.

Threats: *2.2.1 Small-holder plantations*: in the ophiolitic sites, resinous plantations often occur.

3.2 Mining and quarrying: the extraction of gravel and sand from river beds, and the consequent modification of hydrodynamics, can interfere with the normal development of the herbaceous vegetation of the gravel river banks, where *D. cneorum* can be found.

4.1 Roads and railroads: D. cneorum can occur on rocks along roadsides, where it can be threatened by road safety or enlargement works.

5.2.1 Gathering terrestrial plants, intentional use: the plant is harvested because of the attractiveness and fragrance of the flowers. Locally, as in Givoletto (Torino; Selvaggi 2009), the wild plants were traditionally collected in spring and commercialized. In general, *D. cneorum* is one of the most popular shrubs among floriculturists and the introduction of wild *Daphne* species into breeding programs (*in vitro* cultures) is currently being pursued because of their natural resistance to fungal root pathogens (Wiszniewska et al. 2013).

6.1 Recreational activities: in Friuli Venezia Giulia, sport activities that involve the use of motorized vehicles (such as off-road vehicles) on gravel river banks can threaten lowland populations.

7.2.9 Small dams: construction of dams alters the fluvial regime and the morphological features of the banks of the downstream reaches.

7.3. Other ecosystem modifications: natural habitat evolution (development of shrubs, e.g., *Erica scoparia* L., *Juniperus* sp. pl., or closing of the canopy layer of pine formations) threatens some sites, particularly the ophiolitic ones.

9.3 Agricultural and forestry effluents: lowland sites may be affected by pollution resulting from widespread areas of intensive agriculture (nutrient load, herbicides, and pesticides).

8.1.2 Invasive non-native/alien species/diseases: lowland sites along gravel riverbanks may be affected by invasive species, such as *Buddleja davidii* Franch. and *Senecio inaequidens* DC.

CRITERIA APPLIED:

Criterion B: **AOO:** 1,396 km^2 calculated with a 2×2 km-cell fixed grid
EOO: 118,173 km^2 calculated with minimum convex hull in QGis 2.18.9
a) Number of locations: > 10
b) Decline in quality and extent of habitat (iii)

Red List category and criteria (regional assessment)

LC	**Least Concern**

Rationale for the assessment: *Daphne cneorum* is an orophilous central-southern European species, that grows in several northern and central Italian Regions. It has an extent of occurrence of *ca*. 118,000 km^2 and an area of occurrence of *ca*. 1,400 km^2. Despite the small size of most populations, the various threats and the observed decline in quality and extent of the habitat, there is no evidence of a decline. For this reason, this *taxon* is assessed as Least Concern at Regional level (Italy).

Previous assessment: *Daphne cneorum* was not evaluated (NE) previously, neither at a global (IUCN 2019) nor regional level (Italy). In many other countries, *D. cneorum* (*D. cneorum* subsp. *cneorum* and/or *D. cneorum* subsp. *arbusculoides* (Tuzson) Soó) is included in national red lists, assessed as EN (Endangered) in Switzerland, Croatia, Bulgaria, and CR (Critically Endangered) in Czech Republic and Germany (http://www.nationalredlist.org/).

Conservation actions: *Daphne cneorum* is not protected at national or international levels, while it is protected or included in attention lists at a local level: it is protected by Regional laws in Liguria (L.R. 9/1984), Piemonte (L.R. 32/1982), Lombardia (L.R. 10/2008), Veneto (L.R. 53/1974 and DPGR 1475/1982), and Emilia-Romagna (L.R. 2/1977); it is included in an attention plant list in Toscana. (REpertorio NAturalistico TOscano http://www502.regione.toscana.it/geoscopio/arprot.html). Some of the Italian sites (44%) are included in protected areas of the Natura 2000 network.

Conservation actions needed: Further monitoring and research activities are recommended in order to better understand the population trends of the species in Italy, especially in the peripheral locations, as well as reproductive and biological traits relevant for its conservation. Where not yet protected, it would be strongly advisable to include it in lists of plants whose collection is prohibited by Regional laws.

D. Viciani, M. Adorni, A. Alessandrini, S. Armiraglio, M. Castello, C. Montagnani, S. Orsenigo, F. Prosser, A. Selvaggi, M. Villani, M. Gennai

Ophioglossum azoricum C.Presl

Regional Assessment (Italy)

Taxonomy and nomenclature

Order: Ophioglossales *Family*: Ophioglossaceae

Ophioglossum azoricum C.Presl, Suppl. Tent. Pterid.: 49 (1845) = *Ophioglossum sabulicolum* Sauzé & Maillard = *Ophioglossum vulgatum* L. subsp. *ambiguum* (Coss. & Germ.) E.F.Warb.

Common name: Small Adder's-tongue (En), Ophioglosse des Açores (Fr), Ofioglosso delle Azzorre (It).

Geographic distribution range: *Ophioglossum azoricum* (Fig. 7) is an Atlantic-Mediterranean species found in the Macaronesian Islands (Azores, Madeira, Canary Islands), coastal Greenland, and across western and southwestern Europe to central Europe and further east (Cyprus and Turkey) where it is very localized (Christenhusz et al. 2017). In the past, it was repeatedly reported for Italy, in Sardegna, Toscana (Apuan Alps and Monte Pisano mountain range), Lazio, and Veneto (Argenti et al. 2013, Peruzzi et al. 2015). Currently, its occurrence is confirmed only for Lazio, in the Selva

Figure 7. *Ophioglossum azoricum* photographed in the Selva del Lamone (Ischia di Castro, Viterbo, Latium). Picture by S. Magrini.

del Lamone (Ischia di Castro, Viterbo; Fig. 8) (Argenti et al. 2013); the record from Sardegna is erroneous (Marchetti, 2004), the two known populations in the Apuan Alps are considered extinct, the current populations from Monte Pisano are hybrids (Peruzzi et al. 2015), and the hexaploid population from Veneto is actually morphologically closer to *O. vulgatum* (Argenti et al. 2013, Peruzzi et al. 2015).

Distribution: Countries of occurrence: Belgium, Cyprus, Czech Republic, France (Corsica, mainland France), Great Britain, Iceland, Ireland, Italy, Netherlands, Poland, Portugal (Azores, Madeira, mainland Portugal), Spain (Canary Islands, mainland Spain), and Turkey (Christenhusz et al. 2017).

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

Sporulation time: From April to June.

Reproduction: *Ophioglossum azoricum* is an eusporangiate fern with subterranean achlorophyllous mycoheterotrophic gametophytes. Sporophytes are initially subterranean, achlorophyllous and mycoheterotrophic, while a mutualistic symbiosis characterizes the photosynthetic stage of the sporophyte (Field et al. 2015). The sporangia have no specialised dehiscence mechanism.

Habitat and ecology: *Ophioglossum azoricum* grows in low-lying, damp, sandy-peaty habitats, such as dune slacks, cliff-tops and turf along the coast, heaths and

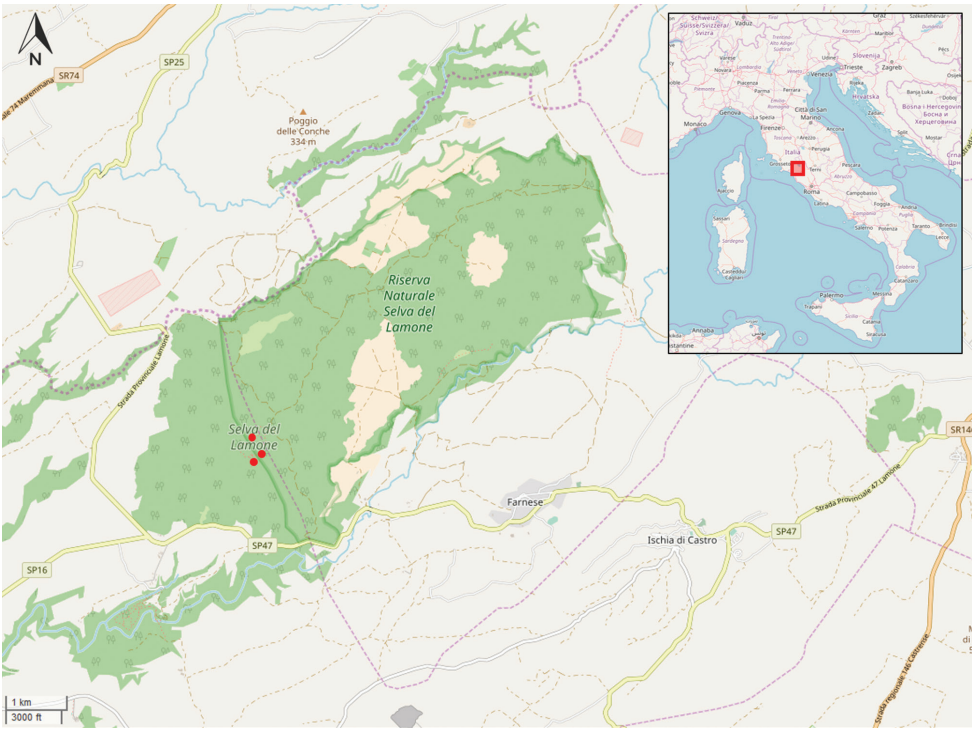

Figure 8. Distribution map of *Ophioglossum azoricum* in Italy.

scrublands (Christenhusz et al. 2017) from 0 to 1,600 m a.s.l. In Italy, it grows in clearings in a mixed oak forest (mainly with Turkey oak) on a volcanic substrate, at about 280–300 m a.s.l. (Argenti et al. 2013).

Population information: A strong decline in the number of individuals was observed in 2010 due to logging activities, but there is no further detailed information available on quantitative population estimation or on population dynamics and trends.

Threats: 5.3 *Logging & wood harvesting*. The logging activities have already led in the recent past to the reduction of the suitable sites for the persistence of the species and of the number of individuals; the risk is still present due to current forestry practices in the area, therefore, a further decline in habitat quality and in the number of individuals can be expected.

CRITERIA APPLIED:
Criterion B: **AOO**: 4 km^2 calculated with a 2×2 km-cell fixed grid.
a) Number of locations: only a single location has been identified according to threat 5.3.
b) Decline in quality and extent of habitat (iii) and number of mature individuals (v).

Red List category and criteria (regional assessment)

CR	**Critically Endangered**	**B2ab(iii,v)**

Rationale for the assessment: In Italy, this species occurs only in three sites close each other, located in northern Lazio with an AOO of 4 km^2. Due to the difficult reproduction mechanisms (subterranean fecundation) and to the scarce dispersal ability, the three small Italian subpopulations are isolated in clearings in a *Quercus cerris* L. forest occupying an area that is less than 100 m^2. The population is threatened by forestry activities linked to logging practices that also impact the surroundings of the areas of active forest utilization, particularly due to the construction of facilities for logging camps (roads and storage areas). The ongoing threats to the only known Italian population, the decline in habitat quality and in the number of mature individuals support the classification of the species as Critically Endangered at a regional level (Italy) according to the formula B2ab(iii,v).

Previous assessment: *Ophioglossum azoricum* was previously assessed at the regional level as Lower Risk (LR) for Italy (Conti et al. 1997) and, recently, as Least Concern (LC) for Europe (Christenhusz et al. 2017, García Criado et al. 2017). The species has not been evaluated at a global level (IUCN 2019).

Conservation actions: *Ophioglossum azoricum* is not protected at either regional, national or international levels. All the Italian sites are included in the SCA IT6010013 "Selva del Lamone" and two out of three are included in the Regional protected area "Riserva Naturale Selva del Lamone". Spores of the Italian population are long-term stored in the Tuscia Germplasm Bank (Viterbo, Italy).

Conservation actions needed: Further monitoring is needed in order to better understand the population trends of the species in Italy and research activities focused on its reproductive biology and ecology are recommended.

S. Magrini

References

AAVV (2019) FloraFaunaAltoAdige – Il portale della distribuzione di specie animali e vegetali in Alto Adige (http://www.florafauna.it/index.jsp?project=florafauna&view=BOT&locale=it). [Accessed 8 February 2019]

Anonymous (2002) Pravilnik o uvrstitvi ogroženih rastlinskih in živalskih vrst v rdeči seznam. Uradni list RS 82/2002

Argenti C, Fratolin F, Magrini S, Marchetti D, Scoppola A, Viane R (2013) Prima segnalazione in Italia di due popolazioni di *Ophioglossum* realmente esaploidi (*O. «azoricum»* C.Presl, Ophioglossaceae, Pteridophyta). Annali Museo civico Rovereto, Sez.: Architettura, Storia, Scienze naturali 28 (2012): 119–124.

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

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 Pi-

etro 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

Bergman B (1952) *Chondrilla chondrilloides*, a new sexual *Chondrilla* species. Hereditas 38: 367–369. https://doi.org/10.1111/j.1601-5223.1952.tb02932.x

Bianco P, Brullo S, Pignatti E, Pignatti S (1988) La vegetazione delle rupi calcaree della Puglia. Braun-Blanquetia 2: 133–151.

Brullo S, De Marco G, Giusso del Galdo G (2003) Considerazioni tassonomiche su *Aurinia leucadea* (Guss.) C.Koch (Brassicaceae). Informatore Botanico Italiano 35(1): 241–243.

Christenhusz M, Bento Elias R, Dyer R, Ivanenko Y, Rouhan G, Rumsey F, Väre H (2017) *Ophioglossum azoricum*. The IUCN Red List of Threatened Species 2017: e.T83610391A85446988. [Downloaded on 20 August 2018]

Conti F, Manzi A, Pedrotti F (1997) Liste rosse regionali delle piante d'Italia. Dipartimento Botanica ed Ecologia, Università Camerino, Camerino, 139 pp.

Euro+Med (2006) Euro+Med PlantBase – the information resource for Euro-Mediterranean plant diversity. Published on the Internet http://ww2.bgbm.org/EuroPlusMed/ [Accessed 7 February 2019]

Field KJ, Leake JR, Tille S, Allinson KE, Rimington WR, Bidartondo MI, Beerling DJ, Cameron DD (2015) From mycoheterotrophy to mutualism: mycorrhizal specificity and functioning in *Ophioglossum vulgatum* sporophytes. New Phytologist 205(4): 1492–1502. https://doi.org/10.1111/nph.13263

Forte L, Carruggio F, Mantino F, Wagensommer RP, Cavallaro V (2015) Conservazione ex situ in Banca del Germoplasma di taxa di interesse conservazionistico del Parco Nazionale del Gargano. Informatore Botanico Italiano 47(2): 293–295.

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

IUCN (2019). The IUCN Red List of Threatened Species. Version 2018-2. http://www.iucnredlist.org [accessed 13 March 2019]

Malá J, Bylinský V (2004) Micropropagation of endangered species *Daphne cneorum*. Biologia Plantarum, 48(4): 633–636. https://doi.org/10.1023/B:BIOP.0000047167.18592.f7

Marchetti D (2004) Le pteridofite d'Italia. Annali Museo civico Rovereto, Sez.: Architettura, Storia, Scienze naturali 19 (2003): 71–213.

Melnik V (1997) Distribution and plant communities of *Daphne cneorum* and *Daphne sophia* in Ukraine. Thaiszia, 6 (1996): 49–66.

Niklfeld H, Schratt-Ehrendorfer L (1999) Rote Liste gefährdeter Farn- und Blütenpflanzen (Pteridophyta und Spermatophyta) Österreichs. 2. Fassung. In: Niklfeld, H. (Hrsg.): Rote Liste gefährdeter Pflanzen Österreichs. Grüne Reihe des Bundesministeriums für Umwelt, Jugend und Familie, 10.

Peruzzi L, Pierini B, Magrini S, Andreucci A, Marchetti D, Viane R (2015) Three new hybrids of *Ophioglossum* (Ophioglossaceae) from Monte Pisano, Tuscany (Central Italy). Plant Biosystems 149(4): 737–746. https://doi.org/10.1080/11263504.2015.1057264

Plazibat M (2009) A short synopsis of the Tribe *Alysseae* (Brassicaceae) in Croatia with some taxonomic novelties. Natura Croatica 18(2): 401–426.

Poldini L. (2002) Nuovo atlante corologico delle piante vascolari nel Friuli Venezia Giulia. Regione Auton. Friuli Venezia Giulia – Azienda Parchi e Foreste regionali, Università degli Studi di Trieste – Dipartimento di Biologia, Udine.

Prosser F (2017) Il regresso di *Chondrilla chondrilloides* (Asteraceae) in Trentino. Annali del Museo Civico di Rovereto, Sezione Architettura, Storia, Scienze Naturali 31 (2015): 33–46.

Selvaggi A (2009) La flora di Givoletto. In AA.VV. – Givoletto e i suoi protagonisti. Editoriale Aghepos.

Sun Y, Tan DY, Baskin CC, Baskin JM (2012) Role of mucilage in seed dispersal and germination of the annual ephemeral *Alyssum minus* (Brassicaceae). Australian Journal of Botany 60: 439–449. https://doi.org/10.1071/BT11314

Tornadore N (1981) Numeri cromosomi per la Flora Italiana: 806–813. Informatore Botanico Italiano 13: 151–157.

Trinajstić I (1982) Taxa nova et combinationes novae in Flora Jugoslaviae 8. Supplementum ad Floram Analyticam Jugoslaviae 8: 3–11.

Wagensommer RP, Medagli P, Perrino EV (2013) Piante vascolari minacciate e Liste Rosse: aggiornamento delle conoscenze in Puglia. Informatore Botanico Italiano 45(2): 422–428.

Wiszniewska A, Hanus-Fajerska E, Grabski K, Tukaj Z (2013) Promoting effects of organic medium supplements on the micropropagation of promising ornamental *Daphne* species (Thymelaeaceae). In Vitro Cellular & Developmental Biology-Plant 49(1): 51–59. https://doi.org/10.1007/s11627-012-9480-x

Yang X, Baskin JM, Baskin CC, Huang Z (2012) More than just a coating: Ecological importance, taxonomic occurrence and phylogenetic relationships of seed coat mucilage. Perspectives in Plant Ecology, Evolution and Systematics 14(6): 434–442. https://doi.org/10.1016/j.ppees.2012.09.002

Italian Botanist 7: 125–148 (2019)
doi: 10.3897/italianbotanist.7.36148
http://italianbotanist.pensoft.net

RESEARCH ARTICLE

Italian Botanist
Published by Società Botanica Italiana

Notulae to the Italian native vascular flora: 7

Fabrizio Bartolucci[1], Gianniantonio Domina[2], Alessandro Alessandrini[3], Claudia Angiolini[4], Nicola M.G. Ardenghi[5], Gianluigi Bacchetta[6], Enrico Banfi[7], Rossano Bolpagni[8], Gianmaria Bonari[9], Christian Bräuchler[10], Giacomo Calvia[6], Laura Cancellieri[11], Silvia Cannucci[4], Francesca Carruggio[12], Fabio Conti[1], Viviana Cavallaro[12], Emanuele Fanfarillo[13], Giulio Ferretti[14], Francesco Festi[15], Tiberio Fiaschi[3], Bruno Foggi[14], Luigi Forte[12], Sigurd E. Fröhner[16], Gabriele Galasso[7], Giovanni Gestri[17], Günter Gottschlich[18], Rocco Labadessa[19], Lorenzo Lastrucci[20], Lorenzo Lazzaro[14], Giuliano Mereu[21], Antonio Morabito[22], Michele Mugnai[14], Carmelo M. Musarella[22], Simone Orsenigo[23], Gaetano Pazienza[12], Riccardo Pennesi[24], Lorenzo Peruzzi[25], Brunello Pierini[26], Lina Podda[27], Filippo Prosser[15], Graziano Rossi[5], Anna Scoppola[11], Giovanni Spampinato[22], Adriano Stinca[28], Valeria Tomaselli[29], Giulio Zangari[11], Chiara Nepi[20]

1 *Centro Ricerche Floristiche dell'Appennino (Università di Camerino - Parco Nazionale del Gran Sasso e Monti della Laga), San Colombo, 67021 Barisciano (L'Aquila), Italy* **2** *Dipartimento di Scienze Agrarie, Alimentari e Forestali, Università di Palermo, Viale delle Scienze, ed. 4, 90128 Palermo, Italy* **3** *Istituto Beni Culturali Regione Emilia-Romagna, via Galliera 21, 40121 Bologna, Italy* **4** *Dipartimento di Scienze della Vita, Università di Siena, Via P.A. Mattioli 4, 53100 Siena, Italy* **5** *Dipartimento di Scienze della Terra e dell'Ambiente, Università di Pavia, Via Sant'Epifanio 14, 27100 Pavia, Italy* **6** *Dipartimento di Scienze della Vita e dell'Ambiente, Università degli Studi di Cagliari, viale Sant'Ignazio da Laconi 13, 09123 Cagliari, Italy* **7** *Sezione di Botanica, Museo di Storia Naturale di Milano, Corso Venezia 55, 20121 Milano, Italy* **8** *CNR IREA, Sede di Milano, Via Bassini 15, 20133 Milano, Italy* **9** *Department of Botany and Zoology, Masaryk University, Kotlářská 2, CZ-611 37 Brno, Czech Republic* **10** *Naturhistorisches Museum Wien, Botanische Abteilung (W), Burgring 7, 1010 Wien, Austria* **11** *Dipartimento di Scienze Agrarie e Forestali, Università della Tuscia, Via San Camillo de Lellis snc 01100 Viterbo, Italy* **12** *Dipartimento di Biologia e Museo Orto Botanico – Campus Universitario "E. Quagliariello", Università degli Studi di Bari "Aldo Moro", Via Orabona 4, 70125 Bari, Italy* **13** *Dipartimento di Biologia Ambientale, Sapienza Università di Roma, Piazzale A. Moro 5, 00185 Roma, Italy* **14** *Dipartimento di Biologia, Università di Firenze, Via G. La Pira 4, 50121 Firenze, Italy* **15** *Fondazione Museo Civico di Rovereto, Borgo S. Caterina 41, 38068 Rovereto (Trento), Italy* **16** *Gmünder Strasse 6, 01279 Dresden, Germany* **17** *Via Bonfiglioli 30, 59100 Prato, Italy* **18** *Hermann-Kurz Strasse 35, D-72074 Tübingen, Germany* **19** *Associazione Centro Studi de Romita, Via G. Postiglione 9, 70126 Bari, Italy* **20** *Museo di Storia Naturale, Università di Firenze, Via G. La Pira 4, 50121 Firenze, Italy* **21** *Via Alghero 17, 08042 Bari Sardo (Ogliastra), Italy* **22** *Dipartimento di AGRARIA,*

Università "Mediterranea" di Reggio Calabria, Loc. Feo di Vito, 89122 Reggio Calabria, Italy **23** *Dipartimento di Scienze Agrarie e Ambientali – Produzione, Territorio, Agroenergia, Università degli Studi di Milano, Via Celoria, 2 20133 Milano* **24** *Scuola di Bioscienze e Medicina Veterinaria, Università di Camerino, Via Pontoni 5, 62032 Camerino (Macerata), Italy* **25** *Dipartimento di Biologia, Università di Pisa, Via Derna 1, 56126 Pisa, Italy* **26** *Via Zamenhof 2, 56127 Pisa, Italy* **27** *Dipartimento di Agraria, Università degli Studi di Sassari, viale Italia 39, 07100 Sassari, Italy* **28** *Dipartimento di Scienze e Tecnologie Ambientali, Biologiche e Farmaceutiche, Università della Campania Luigi Vanvitelli, Via Vivaldi 43, 81100 Caserta, Italy* **29** *C.N.R., Istituto di Bioscienze e Biorisorse, via G. Amendola 165/A, 70126 Bari, Italy*

Corresponding author: *Fabrizio Bartolucci* (fabrizio.bartolucci@gmail.com)

Academic editor: *S. Biondi* | Received 13 May 2019 | Accepted 24 May 2019 | Published 11 June 2019

Citation: 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

Abstract

In this contribution, new data concerning the distribution of native vascular flora in Italy are presented. It includes new records, confirmations and status changes to the Italian administrative regions for taxa in the genera *Acer*, *Alchemilla*, *Andrachne*, *Bromus*, *Clinopodium*, *Colchicum*, *Damasonium*, *Erodium*, *Festuca*, *Hieracium*, *Hyparrhenia*, *Ipomoea*, *Linaria*, *Lolium*, *Narcissus*, *Ranunculus*, *Sisymbrium*, *Stipa*, *Valerianella*, *Vicia*, and *Zannichellia*. New combinations in the genus *Ziziphora* (*Z. sardoa* and *Z. corsica*) and the new subspecies *Ulmus minor* susbp. *canescens* are proposed. Furthermore, the name *Calamintha alpina* var. *sardoa* is here lectotypified. Nomenclatural and distribution updates, published elsewhere, and corrigenda are provided as Suppl. material 1.

Keywords

Floristic data, Italy, new combination, new subspecies, nomenclature, typification

How to contribute

The text for the new records should be submitted electronically to Chiara Nepi (chiara.nepi@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 2,000 characters (spaces included).

Floristic records

Acer pseudoplatanus L. (Sapindaceae)

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

This species has a European-Caucasian distribution (Pignatti 2017b). It is native to Italy and is common in all Administrative Regions, with the exception of Sardegna (Bartolucci et al. 2018a), where it has been reported as casual alien. It was introduced in reforestations since the first half of the 20th century. This species was first reported in the island by Veri and Bruno (1974) for the Limbara massif (NE Sardegna). They reported it both as native and cultivated. Later, this species has been considered only as a cultivated casual alien. In some mountain areas of central and northern Sardegna, it is widespread and locally colonizes woodlands and reforestation sites. It is common on the Limbara and Gennargentu massifs where it occurs in garrigues, heaths, clearings, rocky places, and reforestations, with trees of different ages, while in the Marghine-Goceano it is mainly represented by saplings and seedlings, which locally invade some sites such as the old yew forest, a Regional Natural Monument, known as Sos Nibberos.

G. Bacchetta, G. Calvia

Alchemilla alpigena Buser ex Hegi (Rosaceae)

+ **TOS:** da M. Lancino verso il Libro Aperto (Pistoia), crinale, 3° poggio (WGS84: 44.154167N, 10.711944E), rupi, 1820 m, 19 July 2016, Leg. *G. Gestri*, Det. *F. Festi* (PI No. 008786); Doganaccia-Passo Calanca (Pistoia), incrocio strada-sentiero (WGS84: 44.120000N, 10.774722E), 1670 m, 18 August 2016, Leg. *G. Gestri*, Det. *F. Festi* (PI No. 008788). – Species confirmed for the flora of Toscana.

This species was considered as doubtful for the Region (Bartolucci et al. 2018a), despite a recent record published by Buccomino and Tondi (2010) for Monte La Nuda, about 40 km NW of the present records.

G. Gestri, B. Pierini, L. Peruzzi, S.E. Fröhner, F. Festi

Alchemilla incisa Buser (Rosaceae)

+ **EMR:** Appennino tosco-emiliano, a N di Fonte Uccelliera (WGS84: 44.101389N, 10.848611E), fra i mirtilli, ca. 1780 m, 20 July 2016, Leg. *G. Gestri*, Det. *F. Festi* (PI No. 010386). – Species new for the flora of Emilia-Romagna.

This species was recorded for the same area (but in Tuscan territory) by Arrigoni (2018b).

G. Gestri, B. Pierini, L. Peruzzi, S.E. Fröhner, F. Festi

Alchemilla pallens Buser (Rosaceae)

+ **EMR:** dallo Scaffaiolo verso il Passo dello Strofinatoio (WGS84: 44.114756N, 10.816248E), 1650 m, 18 June 2016, Leg. *G. Gestri et C. Gavazzi*, Det. *S.E. Fröhner* (PI No. 008804). – Species confirmed for the flora of Emilia-Romagna.

This species was doubtfully recorded for the Region (Bartolucci et al. 2018a).

G. Gestri, B. Pierini, L. Peruzzi, S.E. Fröhner, F. Festi

Alchemilla strigosula Buser (Rosaceae)

+ **TOS:** Monte Falterona (Firenze), Passo della Calla (WGS84: 43.833611N, 11.733611E), prato, ca. 1290 m, 29 May 2016, Leg. *G. Gestri et C. Gavazzi*, Det. *F. Festi* (PI No. 010472). – Species confirmed for the flora of Toscana.

This species was doubtfully recorded for the Region (Arrigoni 2018b, Bartolucci et al. 2018b), although it is generically reported as very common for the central and southern Apennines by Festi (2017).

G. Gestri, B. Pierini, L. Peruzzi, S.E. Fröhner, F. Festi

Alchemilla subcrenata Buser (Rosaceae)

+ **TOS:** Alpi Apuane, Minucciano (Lucca), tra Carcaraia e Passo della Focolaccia (WGS84: 44.168333N, 10.204167E), 1200–1600 m, 19 July 2016, Leg. *L. Peruzzi, G. Bedini, J. Muller et G. Trombetti*, Det. *S.E. Fröhner* (PI No. 011182). – Species new for the flora of Toscana.

This species is only generically reported as very common for the central and southern Apennines by Festi (2017).

G. Gestri, B. Pierini, L. Peruzzi, S.E. Fröhner, F. Festi

Alchemilla tenerrima S.E.Fröhner (Rosaceae)

+ **EMR:** da M. Lancino a Libro Aperto, 2° poggio (WGS84: 44.156667N, 10.730278E), crinale, 19 July 2016, Leg. *G. Gestri*, Det. *F. Festi* (PI No. 008822). – Species new for the flora of Emilia-Romagna.

This species is only generically reported for the "Appennino pistoiese" (Apennines in the area of Pistoia, Toscana) by Festi (2017).

G. Gestri, B. Pierini, L. Peruzzi, S.E. Fröhner, F. Festi

Alchemilla venosula Buser (Rosaceae)

+ **TOS:** Pratomagno (Arezzo), cima M. Secchieta (WGS84: 43.716944N, 11.589167E), prato, ca. 1440 m, 21 June 2016, Leg. *C. Gavazzi, G. Gestri, B. Pierini*, Det. *S.E. Fröhner* (PI No. 011178); Pratomagno (Arezzo), fra Varco di Reggello e M. Secchieta (WGS84: 43.697778N, 11.607778E), fosso, 1400 m, 21 June 2016, Leg. *C. Gavazzi, G. Gestri, B. Pierini*, Det. *S.E. Fröhner* (PI No. 011177); Pratomagno (Arezzo), lungo la strada di Secchieta (WGS84: 43.732222N, 11.575278E), 1400 m, 22 June 2016, Leg. *B. Pierini et G. Gestri* Det. *S.E. Fröhner* (PI No. 011180); Appenino pistoiese, Cutigliano (Pistoia), NW Passo Calanca (WGS84: 44.123056N, 10.800278E), ca. 1650 m, 16 August 2016, *G. Gestri*, Det. *S.E. Fröhner* (PI No. 011171). – Species new for the flora of Toscana.

This is the second record of this rare species for peninsular Italy, where it was so far known only for Lazio, in the sector of Monti della Laga (Di Pietro et al. 2016; Festi 2017).

G. Gestri, B. Pierini, L. Peruzzi, S.E. Fröhner, F. Festi

Andrachne telephioides L. (Phyllanthaceae)

+ C **TOS:** Grosseto (Grosseto), stazione ferroviaria di Grosseto (WGS84: 42.767200N, 11.106615E), massicciata di un binario morto, 11 m, 28 September 2018, *G. Ferretti, M. Mugnai* (FI). – Cryptogenic species new for the flora of Toscana.

This species shows a wide Mediterranean distribution, but it is considered alien to France (Tison and de Foucault 2014). It has been recorded as native mostly in central and southern Italy and as extinct in Liguria, but until now it has never been reported for Toscana (Bartolucci et al. 2018a). The records for Liguria seemingly derive from individuals collected in natural environments and date back to the end of the 1800s (Tammaro and Pogliani 1977). We retrieved an abundant population at Grosseto railway station, showing mature fruits and clear signs of seed dispersal. Notwithstanding these evidences and its native status in Italy, we opted for a cryptogenic status for Toscana, considering that there are no previous records for this Region and that the context in which the plants have been collected is far from being a natural environment. Indeed, this population may be the result of an accidental introduction along the railways, from natural populations in Lazio. Accordingly, further studies are necessary to assess the native status of this species also in Toscana.

M. Mugnai, L. Lazzaro, G. Ferretti

Bromus hordeaceus L. subsp. *thominei* (Hardouin) Braun-Blanq. (Poaceae)

+ **TOS:** San Rossore (Pisa), pineta di *Pinus pinea* L. su suolo sabbioso (WGS84: 43.720294N, 10.321115E), 0–5 m s.l.m., 5 May 2015, *G. Bonari* (FI); Parco della

Maremma (Grosseto), pineta di *Pinus pinea* L. su suolo sabbioso (WGS84: 42.649897N, 11.060141E), 0–5 m s.l.m., 18 May 2015, *G. Bonari* (FI); Parco della Maremma (Grosseto), pineta di *Pinus pinea* L. su suolo sabbioso (WGS84: 42.651296N, 11.059456E), 0–5 m s.l.m., 20 May 2015, *G. Bonari* (FI). – Subspecies new for the flora of Toscana.

Scholz (2008), unlike Smith (1980) and Tison and de Foucault (2014), reported the base of the awn as flattened and rather stout for this subspecies (similarly to *B. hordeaceus* subsp. *molliformis* (J.Lloyd ex Billot) Maire & Weiller). This deviant information may have created some confusion, leading to an underestimation of the distribution of *B. hordeaceus* subsp. *thominei* in Italy.

E. Banfi, G. Bonari

Clinopodium nepeta (L.) Kuntze subsp. *nepeta* (Lamiaceae)

+ **SAR:** Burcei (Cagliari), Cantoniera Ovile Cannas, ambiente ruderale e area circostante (WGS84: 39.332100N, 9.429200E ± 50 m), 208 m, 29 August 2018, *G. Mereu* (FI). – Subspecies confirmed for the flora of Sardegna.

The occurrence of this taxon in Sardegna had been generically indicated by Arrigoni (2013), but regarded as doubtful in Bartolucci et al. (2018a).

G. Mereu

Colchicum corsicum Baker (Colchicaceae)

+ **ITALIA (SAR):** Bultei (Sassari), località Sa Fraigada, schiarite boschive in ambiente fresco, esposizione a nord (WGS84: 40.516400N, 9.067900E ± 150 m), 935 m, 3 June 2018 (bulb and leaves); *ibidem*, 30 September 2018 (flowers), *G. Mereu* (FI). – Species confirmed for the flora of Italy (Sardegna).

The previous reports of this species in Sardegna (e.g., Camarda 1990) correspond to *Colchicum verlaqueae* Fridl. (Fridlender 2009), a littoral Sardinian endemic (Maddalena archipelago, Spargi, San Pietro, Pirastru-Vignola). The identification of the samples of *C. corsicum* was based on the descriptions by Baker (1879) and Fridlender (2009, 2014a) and also by comparison with the lectotype at K (K barcode K000464097!). *Colchicum corsicum* is thus added to the rather long list of Sardinian-Corsican endemic species, confirming the ancient link between the two islands.

G. Mereu

Colchicum longifolium Castagne (Colchicaceae)

+ **LOM:** Cecima (Pavia), Cascina Monte, davanti all'"Agriturismo Ca' del Monte" (WGS84: 44.81659N, 9.07412E), 689 m, prateria xerofila, su arenaria, 20 April 2017, Leg. *F. Polani*, Det. *N.M.G. Ardenghi* (*Herb. N. Ardenghi*); *ibidem*, 9 September 2017,

diffuso anche sul lato E del "Planetario e Osservatorio Astronomico Ca' del Monte" (WGS84: 44.81440N, 9.07933E), Leg. *F. Polani*, Det. *N.M.G. Ardenghi* (FI, *Herb. N. Ardenghi*); *ibidem*, 17 September 2017, Leg. *F. Polani*, Det. *N.M.G. Ardenghi* (*Herb. N. Ardenghi*). – Species new for the flora of Lombardia.
+ **PIE:** Gremiasco (Alessandria), ca. all'altezza di Cascina Monte di Cecima (Pavia) (WGS84: 44.81657N, 9.07320E), 690 m, prateria xerofila, su arenaria, 9 September 2017, diffuso anche sul lato S del "Planetario e Osservatorio Astronomico Ca' del Monte" di Cecima (WGS84: 44.81440N, 9.07812E), Leg. *F. Polani*, Det. *N.M.G. Ardenghi* (FI). – Species confirmed for the flora of Piemonte.

This species was recently reported from different localities of the Ligurian Alps and the Ligurian Apennines in western Liguria (Persson 2009; Pignatti 2017a), and it is here recorded for the northeastern portion of the latter mountain range in Lombardia and Piemonte. A large population (characterized by tepals with white apex and dark brown tunics, the main morphological features separating *C. longifolium* from *C. neapolitanum* (Ten.) Ten., see Selvi 2009) has been detected along the crest between the Staffora and Curone valleys, growing mainly in dry grasslands and on the fringe of mixed *Quercus pubescens* Willd. subsp. *pubescens* woodlands.

F. Polani, N.M.G. Ardenghi

Damasonium bourgaei Coss.

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

This taxon is native to Basilicata, Puglia, and Sicilia (Bartolucci et al. 2018a). In Sardegna, Martinoli (1950) reported this species from Capo S. Elia (Cagliari), and recently Rich and Nicholls-Vuille (2001) confirmed its presence for the island, especially in the southern part. Our research in the Herbarium of Cagliari (CAG) demonstrated its presence in 2009 at Cava Monte Pira, Bolotana (Nuoro) (Leg. *F. Mascia*) and at Badde Pirastu in 2014, Teulada (southern Sardegna) (Leg. *G. Bacchetta, M. Fois*). Bartolucci et al. (2018a) evaluated the status of this species in Sardegna as naturalized alien, possibly due to a misprint.

G. Bacchetta, G. Calvia, L. Podda

Erodium alnifolium Guss. (Geraniaceae)

+ **LAZ:** Santa Marinella (Roma), Loc. Prato Cipolloso (WGS84: 42.073220N, 11.870662E), 232 m s.l.m., prateria sovrappascolata su suolo argilloso superficiale, su versante esposto ad Est. 19 May 2018, *G. Zangari* (FI); Civitavecchia (Roma), Loc. Fontanile della Vecchia (WGS84: 42.092250N, 11.844583E), 219 m s.l.m., prateria a cotico eterogeneo su suolo argilloso superficiale, su versante esposto ad Ovest, 24 May 2018, *G. Zangari* (UTV No. 37307); Barbarano Romano (Viterbo), Loc. Banditella (WGS84: 42.249242N, 12.059044E), 390 m s.l.m., pascolo al margine di boscaglia,

16 May 2003, *F. Mazzenga* (UTV No. 22242, sub *E. malacoides* (L.) L'Hér.); Università Agraria di Tolfa (Roma), Loc. Trocione (WGS84: 42.060720N, 11.992200E), 277 m s.l.m., pascolo arido, 1 June 1988, *A. Scoppola* (UTV No. 12396, sub *E. malacoides* (L.) L'Hér.). – Species new for the flora of Lazio.

Erodium alnifolium is a western Mediterranean species, similar to *E. malacoides* (L.) L'Hér. and *E. chium* (L.) Willd., with which it is often confused (Pignatti 2017b). According to Bartolucci et al. (2018a), this species occurs in Emilia-Romagna, Toscana, Abruzzo, Molise, Puglia, Basilicata, Sicilia, and Sardegna, while it is no longer recorded in Campania and doubtfully occurring in Calabria. All the records, both from the field and from UTV herbarium, were collected within the "Tolfetano-Cerite-Manziate" Natura 2000 SPA. There, *E. alnifolium* was found in intensely grazed grasslands on dry clay soils.

G. Zangari, L. Cancellieri, A. Scoppola

Festuca rubra L. subsp. *juncea* (Hack.) K.Richt. (Poaceae)

+ (NAT) **SAR:** Tempio Pausania (Sassari), Monte Limbara, zona sommitale sotto il tornante del sambuco, gariga, nel ciglio stradale, 1300 m (WGS84: 40.511140N, 09.102044E), 17 July 2010, *G. Calvia* (Herb. Calvia, Berchidda); Tempio Pausania (Sassari), Monte Limbara, zona antenne RAI, scarpate, cigli stradali, 1300 m (WGS84: 40.511160N, 09.102385E), 6 July 2013, *G. Calvia* (Herb. Calvia, Berchidda); Tempio Pausania (Sassari), Vallicciola, graniti. Prati, radure, cigli stradali (WGS84: 40.849839N, 09.152562E) 1050 m, 24 June 2017, *G. Calvia* (FI; Herb. Calvia, Berchidda). – Naturalized regional alien species new for the flora of Sardegna.

This is a European taxon, typical of mountain areas (Pignatti 2017a). It is native to Italy, where it is widespread in many Regions (Bartolucci et al. 2018a). In Sardegna, it was first collected in 2010 close to the communication station of P. Balistreri, on the top of Mt. Limbara (NE Sardegna), in a far from natural environment. Recently, it has been spreading in other areas of the massif, and is now sparsely diffuse between 1,000 and 1,330 m a.s.l., along roads, slopes, garrigues, and meadows, normally growing close to disturbed places.

G. Calvia

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

+ **BAS:** Fardella (Potenza), tra Fosso Carceri e Piano di Iannace (WGS84: 39.943725N, 16.188962E), faggeta, 1591 m, 23 June 2016, Leg. *A. Stinca et R. Pennesi*, Det. *G. Gottschlich* (FI, PORUN-Herb. Stinca, CAME); Terranova di Pollino (Potenza), tra Piano di Iannace e Serra di Crispo (WGS84: 39.936568N, 16.201584E), faggeta, 1773 m, 23 June 2016, Leg. *A. Stinca et R. Pennesi*, Det. *G. Gottschlich* (PORUN-Herb. Stinca, CAME). – Subspecies new for the flora of Basilicata.

Hieracium pseudogrovesianum subsp. *opertum* is endemic to Italy and recorded so far only for Abruzzo (Gottschlich 2009). Therefore, our finding represents an important extension of its distribution range in Italy.

A. Stinca, R. Pennesi, G. Gottschlich

Hieracium tolstoii Fen. & Zahn (Asteraceae)

– **TAA.** Species to be excluded from the flora of Trentino-Alto Adige.

Hieracium tolstoii was described by Fenaroli and Zahn (1927) on specimens collected on the walls of the Sforza castle in Milan. Its presence in Trentino-Alto Adige was reported by Gottschlich and Pujatti (2000) for the Santa Barbara castle (Lodrone), based on a sample collected by Luzzani in 1931. We revised the only specimen collected by Luzzani and stored at Collegio Arcivescovile in Trento, and we attributed it to *Hieracium sabaudum* L. Accordingly, *Hieracium tolstoii* should be excluded from the flora of Trentino-Alto Adige. These two species look similar, but they can be distinguished by stem leaves bluish-green and involucral bracts with dense stellate hairs in *H. tolstoii* vs. stem leaves dark green and involucral bracts lacking stellate hairs in *H. sabaudum* (Orsenigo et al. 2019).

EX **ITALIA (LOM):** Species extinct in Lombardia and Italy.

Hieracium tolstoii is endemic to Italy (Peruzzi et al. 2014, 2015; Orsenigo et al. 2018), where it was reported only for Lombardia and Trentino-Alto Adige (see above). Field research carried out in its *locus classicus* (the walls of the Sforza castle in Milan; Fenaroli and Zahn 1927), allowed us to exclude the current presence of this species in Lombardia and to consider it as extinct at global level.

S. Orsenigo, G. Gottschlich, F. Prosser, G. Galasso

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

+ **UMB:** Arrone (Terni), su calcare (ca. WGS84: 42.584881N, 12.769024E), 250 m s.l.m., Esp. S., 5 June 1989, *I. Bonini, G. Fontana* (SIENA sub *Bothriochloa ischaemum* (L.) Keng.). – Species new for the flora of Umbria.

E. Banfi, T. Fiaschi, G. Bonari

Ipomoea imperati (Vahl) Griseb. (Convolvulaceae)

+ **CAL:** Gizzeria (Catanzaro), ZSC "LAGHI LA VOTA" (WGS84: 38.94124N, 16.18061E), 1 m s.l.m., dune sabbiose, 29 June 2018, Leg. *Morabito, Musarella, Prigoliti, Settineri, Spampinato,* Det. *Musarella et Spampinato* (FI, REGGIO). – Species new for the flora of Calabria.

Ipomoea imperati is a thermo-cosmopolite species widespread in temperate and tropical areas of Central and North America, Asia, Pacific Islands, Australia, Canary

Islands, the Azores, and in the Mediterranean (Silvestre 2012, Cennamo et al. 2013). Recent molecular investigations suggest that *I. imperati* is a native species in the Mediterranean (Cennamo et al. 2013). In Italy, it is present only in Sicilia, while in Campania (i.e., the *locus classicus* of this species) is considered Extinct (Turrisi 2001, 2005; Bartolucci et al. 2018a, as *I. stolonifera*, see Suppl. material 1). A few individuals were found among patches of *Convolvulus soldanella* L.

C.M. Musarella, A. Morabito, G. Spampinato

Linaria dalmatica (L.) Mill. (Plantaginaceae)

+ **PUG:** Gravina in Puglia (Bari), Lame Maiorani (WGS84: 40.920284N, 16.332436E), 625 m s.l.m., pascolo roccioso, 23 September 2018, Leg. et Det. *G. Pazienza* (BI Nos. 42058, 42059, 42060). – Species confirmed for the flora of Puglia.

Linaria dalmatica was discovered in Puglia during the 19th century (Palanza 1900), exclusively at Gravina (Bari). It was reported by Bartolucci et al. (2018a) as no longer recorded for the Region.

G. Pazienza, F. Carruggio, V. Cavallaro

Lolium apenninum (De Not.) Ardenghi & Foggi (Poaceae)

+ **LOM:** Piazzale della 1a cantoniera dello Stelvio, 1800 m, suolo calcareo, 7 July 1920, Leg. M. Longa, Rev. *N.M.G. Ardenghi* (PAV sub *Festuca pratensis* Huds.); Prati di Gobetta e piazzale 1ª Cant.ra Stelvio, 1200–1800, *sine data*, Leg. *M. Longa*, Rev. *N.M.G. Ardenghi* (PAV sub *Festuca pratensis* Huds. Massara sub nom. *F. elatior*); Alpe Lago in Valmalenco (Sondrio), 1600 m, rive torbose del lago, 22 August 1984, Leg. *A. Pirola, V. Credaro*, Rev. *N.M.G. Ardenghi* (PAV sub *Festuca pratensis* Hudson); Madesimo (Sondrio), Valcava, presso il càrden del Giardino Alpino Valcava (WGS84: 46.45415N, 9.35437E), 1860 m, margine tra prateria e campetto di patate, 26 July 2018, Leg. *G. Rossi*, Det. *N.M.G. Ardenghi* (FI). – Species confirmed for the flora of Lombardia.

Up to now, the presence of *Lolium apenninum* in Lombardia was regarded as doubtful (Bartolucci et al. 2018a), based on a record by Chenevard (1915; see also Martini et al. 2012) from Bergamo. The linked herbarium voucher, stored at BER-Rota ("Selve ombrose e prati = umidi presso Bergamo", *sine data*, *L. Rota* sub *Festuca pratensis* Huds.?), has recently been verified and it actually pertains to *L. pratense* (Huds.) Darbysh. Yet, historical specimens of genuine *L. apenninum* from Valtellina were discovered in PAV-Lombardo and a population from Valchiavenna was sampled in 2017 and 2018, thus confirming the regional presence of this species, already recorded from nearby Switzerland (Tyler et al. 1978; Kopecký et al. 2016). Further research in this part of the Alps may improve our knowledge of the distribution of *L. apenninum*, traditionally confused, or even merged, with *L. pratense* (Huds.) Darbysh. (Ardenghi and Foggi 2015).

N.M.G. Ardenghi, G. Rossi

Narcissus tazetta L. subsp. *aureus* (Loisel.) Baker (Amaryllidaceae)

+ (CAS) **LAZ:** Ferentino (Frosinone) (WGS84: 41.66242N, 13.25104E), bordo strada, 190 m, 09 March 2018, *E. Fanfarillo* (FI). – Casual regional alien species new for the flora of Lazio.

The presence of this taxon in Lazio was doubtful, while it is considered native to Toscana and Campania, and a casual alien in Marche (Bartolucci et al. 2018a). The present record refers to individuals escaped from cultivation, as this species is frequently cultivated in flowerbeds.

E. Fanfarillo

Nuphar lutea (L.) Sm. (Nymphaeaceae)

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

Nuphar lutea is a Eurasian hydrophyte, which is typical of oligotrophic and still waters. It is common in many regions of northern and central Italy, while it is rare in southern Italy and islands (Pignatti 2017a). According to Conti et al. (2005) and Arrigoni (2006), this species was considered native for Sardegna, but it has been recently reported as casual alien (Bartolucci et al. 2018a), probably due to a misprint.

G. Bacchetta, G. Calvia

Ranunculus peltatus Schrank (Ranunculaceae)

+ **TOS:** Padule di Fucecchio, La Cavallaia (Firenze), loc. Giardino (WGS84: 43.779482N, 10.814862E), 5 May 2018, *L. Lastrucci, V. Macchi, G. Riccioni* (FI No. FI052890); Fucecchio (Toscana), June 1939, *R. Pichi Sermolli* (FI). – Species confirmed for the flora of Toscana.

This species has been reported as doubtfully present for Toscana (Bartolucci et al. 2018a), although several ancient and recent records for this Region are known both on the basis of the presence of herbarium samples and bibliographic information (Baroni 1897; Lastrucci et al. 2007; Arrigoni 2018a; Peruzzi and Bedini 2018). It should be noted that several records for the Fucecchio Marsh have been reported in the past as *Ranunculus aquatilis* L. (see Tomei and Guazzi 1995; Arrigoni 2018a). In FI, two specimens from the Fucecchio Marsh stored as *R. aquatilis* were found. The first one, collected by U. Martelli in the second half of the 19th century, is incomplete and impossible to identify. The second one, collected by R.E.G. Pichi Sermolli in June 1939 and not originally identified by the collector, can be attributed to *R. peltatus* based on the length of the peduncles.

L. Lastrucci

Ranunculus rionii Lagger (Ranunculaceae)

+ **LOM:** Lombardia, Menaggio (Como), Lago di Como (WGS84: 46.026107N, 9.238882E), August 2018, *R. Bolpagni* (FI No. FI055105). – Species new for the flora of Lombardia.
+ **TOS:** Toscana, prov. di Grosseto, comprensorio di Capalbio. Piccolo stagno adiacente al Lago Acquato (WGS84: 42.485861N, 11.453187E), 20 June 2018, *L. Lastrucci, G. Ferretti* (FI No. FI053668). – Species new for the flora of Toscana.

For Italy, this species can be found in Trentino-Alto Adige, considered doubtful for Veneto, and recorded by mistake for Valle d'Aosta (Bartolucci et al. 2018a). Concerning the ancient record from Torri del Benaco (Garda Lake), Pignatti (1982) hypothesized the possible disappearance of this species from the site. In the site from Lombardia, this species is quite rare, recorded along the littorals of Menaggio (Como Province), where it sparsely grows in areas dominated by *Potamogeton perfoliatus* L. and *P. gramineus* L. at depths ranging from 2 to 5 m. In the site from Toscana, this species is rather abundant in the shallow waters of the few open water bodies of the Lake Acquato, a wetland almost completely occupied by marsh vegetation, and near the shore of a small pond close to the lake.

L. Lastrucci, B. Foggi, G. Ferretti, R. Bolpagni

Sisymbrium polyceratium L. (Brassicaceae)

+ **PUG:** Bari (Bari), Lungomare San Girolamo (WGS84: 41.137720N, 16.823124E), vegetazione sinantropica nei pressi del mare, 1 m, 26 April 2018, *R. Labadessa* (BI Nos. 40486, 42063). – Species confirmed for the flora of Puglia.

Sisymbrium polyceratium is distributed in southern Europe and it is known for the majority of Italian Regions, with the exception of the northernmost ones, while it has no longer been recorded in Liguria, Emilia-Romagna, Calabria, and Puglia (Bartolucci et al. 2018a). In particular, this species has not been found in Puglia since the second half of the 19th century, when it was indicated for the area of Barletta (Bruni 1857).

R. Labadessa, L. Forte

Stipa capillata L. (Poaceae)

+ **BAS:** Matera (Matera), Murgia Timone (WGS84 40.673616N, 16.629670E), 420 m s.l.m., prateria xerica submediterranea a *Stipa austroitalica*, 13 October 2018, *L. Forte* (FI). – Species new for the flora of Basilicata.

Stipa capillata is one of the most widely distributed species of the genus, being present from Spain to eastern Siberia (Freitag 1985), with a central range extending from eastern Romania to eastern Kazakhstan (Wagner et al. 2011). In Italy, this species is reported from Piemonte to Trentino-Alto Adige in the north, and in Umbria, Lazio, Abruzzo, Molise, and Puglia in the centre and south (Bartolucci et al. 2018a).

L. Forte, R. Labadessa, V. Tomaselli

Valerianella discoidea (L.) Loisel. (Valerianaceae)

+ **TOS:** Galenda, Gaiole in Chianti (Siena), su un muretto a secco a bordo di un bosco di roverella (WGS84: 43.450239N, 11.37004E), 505 m s.l.m., 29 May 2018 *C. Angiolini* (FI). – Species confirmed for the flora of Toscana.

C. Angiolini, S. Cannucci

Vicia johannis Tamamsch. (Fabaceae)

+ **ABR:** Lama dei Peligni (Chieti), vicino all'Orto Botanico, pascoli aridi, 600 m, 18 May 1996, *A. Manzi* (APP no. 12659); Barisciano (L'Aquila), San Colombo, pascolo, 1088 m, 26 April 2002, *F. Conti* (APP no. 27783); Capestrano (L'Aquila), Fiume Tirino, incolti, 21 April 1998, *A. Manzi* (APP no. 28078); Carapelle Calvisio (L'Aquila), pascoli, 870 m, 15 May 2004, *A. Manzi* (APP no. 32209); Barisciano (L'Aquila), San Colombo, margine boschivo, 2011, *F. Conti* (APP no. 56097); Acciano (L'Aquila), M. Offermo, incolti aridi, 30 May 2018, *F. Conti, F. Bartolucci* (APP no. 59830). – Species new for the flora of Abruzzo.
+ **LAZ:** Campoli Appennino (Frosinone), ex coltivi, esp. S, 850 m, 25 May 1997, *F. Minutillo* (APP No. 39929). – Species confirmed for the flora of Lazio.
+ **MOL:** Scapoli (Iserna), M. Falconara, versante settentrionale, siepi, 600 m, 25 April 1998, *F. Conti, F. Minutillo* (APP no. 33753). – Species new for the flora of Molise.

This species was so far known in Italy only for Veneto and Emilia-Romagna (Bartolucci et al. 2018a), and generically reported from Lazio and Sardegna (Schäfer 1973; Bennett and Maxted 1997). *Vicia johannis* was confused in central Italy with *V. narbonensis* L., from which it is easily distinguished for the background colour of the standard (cream to yellow vs. violet to deep purple), for the wings showing violet or brown veins and wing spots (vs. ± concolorous corollas, lacking distinct spots on wings), and for the upper leaves showing leaflets usually 2-paired (vs. usually 3-paired) (Birch et al. 1985; Schäfer 1973; Tison and de Focault 2014).

F. Bartolucci, F. Conti

Zannichellia pedunculata Rchb. (Potamogetonaceae)

0 **PUG:** In Apulia, s.d., *G. Gasparrini*, Rev. *S. Pignatti*, 1953 as *Z. palustris* L. subsp. *pedicellata* (Wahl. et Rosen) Hegi (PAV-Gasparrini, under the name *Ruppia maritima Zannichella* [*sic*] *palustris*). – Species not recently confirmed for the flora of Puglia.

Zannichellia pedunculata is a subcosmopolitan species, reported for most of the Italian territory, with the exception of north-western and south-eastern Regions (Bartolucci et al. 2018a). A single herbarium specimen from "Apulia" was found in PAV-Gasparrini, collected by Guglielmo Gasparrini (1804–1866) probably around 1830, before becoming professor of botany in Pavia in 1857, where he transferred most of his

collections (Alippi Cappelletti 1999). The specimen was later revised as *Z. palustris* L. subsp. *pedicellata* (Wahlenb. & Rosén) Arcang. by Sandro Pignatti, who indexed the Gasparrini herbarium in Pavia in the early 1950s.

N.M.G. Ardenghi, G. Rossi

Zannichellia peltata Bertol. (Potamogetonaceae)

+ **EMR:** Bologna, periferia nord-ovest, Lungo il Canale Ghisiliera; 50 m, noexp (WGS84: 44.5068N, 11.3193E), 31 August 2018, Leg. et Det. *A. Alessandrini*, Confirm. *L. Lastrucci* (FI). – Species new for the flora of Emilia-Romagna.

This species is known (Bartolucci et al. 2018a) for southern Italy (ascertained in Basilicata and Sicilia, to be confirmed in Lazio and Calabria). In the collection site, *Z. peltata* grows abundantly along the running shallow waters of a canal about 2-m wide. The collected specimens were identified mainly using the key published by Talavera and Garcia-Murillo (2010). We paid particular attention to the length of stamen filaments in the male flower and to the separation of female and male flowers in different nodes along the stem. A broad revision of herbarium materials belonging to *Z. palustris* s.l. is advisable, in order to check the possible presence of further samples of *Z. peltata* in other Italian localities.

A. Alessandrini, L. Lastrucci

Nomenclatural novelties

Ulmus minor L. subsp. *canescens* Bartolucci & Galasso, subsp. nov.
urn:lsid:ipni.org:names:60478977-2

–*Ulmus canescens* Melville, Kew Bull. 12(3): 499(–502, figs. 1–2). 1958 (1957 publ. 17 January 1958), *nom. inval.*
–*Ulmus minor* Mill. subsp. *canescens* Browicz & Ziel., Fragm. Florist. Geobot. 23(2): 145. 1977. [end of August 1977], *nom. inval.*
–*Ulmus minor* Mill. subsp. *canescens* Browicz & Ziel., Arbor. Kórnickie 22: 320. 1978. [1977 publ. January 1978], *nom. inval.*

Holotype: [Greece]. Thrace, Karakeuy, 17 May 1932, *H.G.Tedd 806* (K barcode K000852646!).

Description: Melville in Kew Bull. 12(3): 499. 1958.

The name "*Ulmus canescens*" was not validly published by Melville (1958), because three gatherings, from the same place but on different dates, were cited as "holotype" (Arts. 8 and 40 of the ICN, Turland et al. 2018). Currently, *Ulmus canescens* is treated at subspecific rank (e.g., Browicz and Zieliński 1982; Christensen 1997; Uotila 2011; Dimopoulos et al. 2013; Barina et al. 2018; Bartolucci et al. 2018a) under the invalid combination "*U. minor* subsp. *canescens* (Melville) Browicz & Ziel.". We propose

a new subspecies based on Melville's description and designating a single specimen, within the original material "*H.G.Tedd 806*" cited by Melville (traced at K, barcodes K000852646!, K001328097!, K001328098!, K001328099!, K001328100!), as the holotype (see also Art 46.4 of the ICN).

F. Bartolucci, G. Galasso

Ziziphora sardoa (Asch. & Levier) Bartolucci, Galasso & Bräuchler, comb. nov.
urn:lsid:ipni.org:names:60478978-2

≡ *Calamintha alpina* (L.) Lam. var. *sardoa* Asch. & Levier, Fl. Sard. Comp.: 234. 1884–1885 ≡ *Acinos sardous* (Asch. & Levier) Arrigoni, Boll. Soc. Sarda Sci. Nat. 22: 288. 1983 [31 October 1983] ≡ *Satureja sardoa* (Asch. & Levier) Greuter & Burdet, Med-Checkl. 3: 325 1986. [1 September 1986] ≡ *Clinopodium alpinum* (L.) Kuntze subsp. *sardoum* (Asch. & Levier) Govaerts, World Checkl. Seed Pl. 3(1): 16. 1999 ≡ *Clinopodium sardoum* (Asch. & Levier) Peruzzi & F.Conti, Inform. Bot. Ital. 40(2): 264. 2008 [31 December 2008]

Lectotype (designated here): [ITALY]. Sardegna: S'Atha e Bidda, 16 May 1884, *Forsyth Major 52* (FI barcode FI055680!).

Acinos Mill. and *Ziziphora* L. form a group separate from *Clinopodium* s.str. in the phylogenetic trees reconstructed from plastid and nuclear ribosomal markers (Bräuchler et al. 2010). A close morphological relationship between the two genera (López and Bayer 1988) and lack of a clear separation in their phylogeny suggests that the two genera should be merged. As a consequence, we here include *Acinos* in *Ziziphora*, while they were regarded as part of *Clinopodium* L. by Bartolucci et al. (2018a). The taxa belonging to the genus *Ziziphora* occurring in Italy (Bartolucci et al. 2018a; Galasso et al. 2018) are: *Z. acinos* (L.) Melnikov subsp. *acinos* [≡ *Clinopodium acinos* (L.) Kuntze subsp. *acinos*], *Z. granatensis* (Boiss. & Reut.) Melnikov subsp. *granatensis* [= *Clinopodium alpinum* (L.) Kuntze subsp. *meridionale* (Nyman) Govaerts], *Z. granatensis* subsp. *alpina* (L.) Bräuchler & Gutermann [≡ *C. alpinum* (L.) Kuntze subsp. *alpinum*], *Z. graveolens* (M. Bieb.) Melnikov [≡ *C. graveolens* (M.Bieb.) Kuntze], *Z. suaveolens* (Sm.) Melnikov [≡ *Clinopodium suaveolens* (Sm.) Kuntze], *Ziziphora villosa* (Pers.) Melnikov [*Clinopodium acinos* (L.) Kuntze subsp. *villosum* (Pers.) Peruzzi & F.Conti] and the alien taxon *Z. capitata* L. subsp. *capitata*. *Clinopodium alpinum* (L.) Kuntze subsp. *nebrodense* (A.Kern. & Strobl) Bartolucci & F.Conti [≡ *Calamintha nebrodensis* A.Kern. & Strobl] and *C. minae* (Lojac.) Peruzzi & F.Conti [≡ *Calamintha minae* Lojac.] are taxa of doubtful taxonomic value, and they are regarded here as synonyms of *Z. granatensis* (Boiss. & Reut.) Melnikov subsp. *granatensis*, pending further studies. A new combination for the Corsican endemic *Clinopodium corsicum* (Pers.) Govaerts under *Ziziphora* is proposed: *Ziziphora corsica* (Pers.) Bräuchler, comb. nov. (urn:lsid:ipni.org:names:77197998-1) (≡ *Thymus corsicus* Pers., Syn. Pl. [Persoon] 2(1): 131. 1806 [November 1806])

F. Bartolucci, G. Galasso, C. Bräuchler

Nomenclatural and distribution updates from other literature sources, and corrigenda

Nomenclatural and distribution updates according to Caruel (1860), Zahn (1916), Zangheri (1966), Caputo (1967), La Valva and Sabato (1983), Moraldo et al. (1988), López González (1992, 1994), Vergari et al. (1996), Rich and Nicholls-Vuille (2001), Arrigoni (2003, 2016, 2017, 2018a, 2019), Viciani et al. (2008, 2013), Anzalone et al. (2010), Carine and Robba (2010), Lastrucci et al. (2007, 2010, 2016, 2017), Selvi (2010), Aghababyan (2011), Kurtto et al. (2013), Talavera et al. (2013), Fridlender (2014b), Tison and de Foucault (2014), Iamonico and Managlia (2015), Ali et al. (2016a, 2016b), Arrigoni et al. (2016), Hauenschild et al. (2016), Roccia et al. (2016), Pignatti (2017b), Uhlemann (2017), Bamonte (2018), Bellone et al. (2018), Bergfeld (2018), Bottinelli et al. (2018), Bovio (2018), Bräuchler (2018), De Santis (2018a, 2018b), Ellmouni et al. (2018), Lazzeri et al. (2018), Oberprieler et al. (2018), Ottonello and Longo (2018), Perrino et al. (2018), Peruzzi et al. (2018), Polidori et al. (2018), Rosati et al. (2018), Secchi and Longo (2018), Troia et al. (2018), Bartolucci et al. (2019), Benedí (2019), Bonali (2019), Conti et al. (2019), Cresti et al. (2019), Govaerts (2019), Groom et al. (2019), Gutermann (2019), Gutiérrez-Larruscain et al. (2019), Maggioni and Alessandrini (2019), Ramírez et al. (2019), Thiv et al. (2019), Wahlsteen and Tyler (2019) and corrigenda to Bartolucci et al. (2018a) are provided in Suppl. material 1.

F. Bartolucci, G. Galasso

Acknowledgements

We gratefully acknowledge colleagues who provided distribution, nomenclatural, and taxonomic suggestions: Liliana Bernardo, Giampiero Ciaschetti, Emanuele Del Guacchio, Alain Fridlender, Lorenzo Gallo, Dario Macaluso, Daniela Longo, Domenico Puntillo, Francesco Roma-Marzio, Annalisa Santangelo, Ingo Uhlemann, Robert P. Wagensommer. Many thanks are due to Stefano Armiraglio (Museo di Scienze Naturali, Brescia), who provided a scan of Chenevard (1915), Francesco Zonca (Orto Botanico di Bergamo "Lorenzo Rota"), who sent digital images of the specimens in BER-Rota, and to the curators of the herbaria FI and K.

References

Aghababyan MV (2011) A revision of *Papaver* sect. *Argemonidium* Spach (Papaveraceae). Takhtajania 1: 38–42.

Ali T, Runge F, Dutbayev A, Schmuker A, Solovyeva I, Nigrelli L, Buch A-K, Xia X, Ploch S, Orren O, Kummer V, Paule J, Çelik A, Vakhrusheva L, Gabrielyan I, Thines M (2016a) *Microthlaspi erraticum* (Jord.) T. Ali et Thines has a wide distribution, ranging from the Alps to the Tien Shan. Flora 225: 76–81. https://doi.org/10.1016/j.flora.2016.09.008

Ali T, Schmuker A, Runge F, Solovyeva I, Nigrelli LJP, Buch A, Xia X, Ploch S, Orren O, Kummer V, Linde-Laursen I, Ørgaard M, Hauser TP, Çelik A, Thines M (2016b) Morphology, phylogeny, and taxonomy of *Microthlaspi* (Brassicaceae, Coluteocarpeae) and related genera. Taxon 65(1): 79–98. https://doi.org/10.12705/651.6

Alippi Cappelletti M (1999) Gasparrini, Guglielmo. Dizionario Biografico degli Italiani. Treccani. http://www.treccani.it/enciclopedia/guglielmo-gasparrini_(Dizionario-Biografico)/ [accessed: 8 March 2019]

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

Ardenghi NMG, Foggi B (2015) Lectotypification and combination of *Festuca apennina* (Poaceae). Taxon 64(5): 1038–1041. https://doi.org/10.12705/645.14

Arrigoni PV (2003) La flora vascolare del Parco della Maremma (Toscana, Italia centrale). Webbia 58(1): 151–240. https://doi.org/10.1080/00837792.2003.10670750

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.

Arrigoni PV (2016) Flora analitica della Toscana, Vol, 1. Edizioni Polistampa, Firenze, 403 pp.

Arrigoni PV (2017) Flora analitica della Toscana, Vol. 2. Edizioni Polistampa, Firenze, 335 pp.

Arrigoni PV (2018a) Flora analitica della Toscana, Vol. 3. Edizioni Polistampa, Firenze, 533 pp.

Arrigoni PV (2018b) Flora analitica della Toscana, Vol. 4. Edizioni Polistampa, Firenze, 510 pp.

Arrigoni PV (2019) Flora analitica della Toscana,Vol. 5. Edizioni Polistampa, Firenze, 544 pp.

Arrigoni PV, Ferretti G, Nepi C (2016) Flora del Prato Fiorito (Bagni di Lucca, Toscana). Annali dei Musei Civici-Rovereto. Sezione Archeologia, Storia, Scienze Naturali 31 (2015): 169–245.

Baker JG (1879) A synopsis of Colchicaceae and the aberrant tribes of Liliaceae. Journal of the Linnean Society. Botany 17: 405–510. https://doi.org/10.1111/j.1095-8339.1879.tb01238.x

Bamonte R (2018) Noterelle: 204. Acta Plantarum Notes 6: 150.

Barina Z, Somogyi G, Pifkó D, Rakaj M (2018) Checklist of vascular plants of Albania. Phytotaxa 378(1): 1–339. https://doi.org/10.11646/phytotaxa.378.1.1

Baroni E (1897) Supplemento generale al Prodromo della Flora Toscana di T. Caruel. Fasc. I. Società Botanica Italiana, Firenze.

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

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 (2018b) Notulae to the Italian native vascular flora: 6. Italian Botanist 6: 45–64. https://doi.org/10.3897/italianbotanist.6.30575

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 (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

Bellone G, Longo D, Tison J-M (2018) Noterelle: 230–234, 236. Acta Plantarum Notes 6: 176–182.

Benedí C (2019) *Artemisia* L. In: Benedí C, Buira A, Rico E, Crespo MB, Quintanar A, Aedo C (Eds) Flora Iberica, Vol. XVI(III). Real Jardín Botánico, CSIC, Madrid, 1717–1752.

Bennett SJ, Maxted N (1997) An ecogeographic analysis of the *Vicia narbonensis* complex. Genetic Resources and Crop Evolution 44(5): 411–428.

Bergfeld D (2018) Ergänzungen zur Orchideenflora der italienischen Regionen Abruzzen und Molise. Journal Europäischer Orchideen 50(2–4): 273–298.

Birch ANE, Tithecott MT, Bisby FA (1985) *Vicia johannis* and wild relatives of the faba bean: a taxonomic study. Economic Botany 39(2): 177–190. https://doi.org/10.1007/bf02907843

Bonali F (2019) Segnalazioni floristiche per la provincia di Cremona: 89–94. In: Bonali F (Ed.) Segnalazioni floristiche per la provincia di Cremona: 86–165. Pianura 38: 5–8.

Bottinelli R, Longo D, Banfi E (2018) Noterelle: 229. Acta Plantarum Notes 6: 175.

Bovio M (2018) Note di aggiornamento al volume Flora vascolare della Valle d'Aosta 5. Revue Valdotaine d'Histoire Naturelle 72: 97–121.

Bräuchler C (2018) And now for something completely different – new names in *Clinopodium* with comments on some types. Phytotaxa 356(1): 71–80. https://doi.org/10.11646/phytotaxa.356.1.6

Bräuchler C, Meimberg H, Heubl G (2010) Molecular phylogeny of Menthinae (Lamiaceae, Nepetoideae, Mentheae) – taxonomy, biogeography and conflicts. Molecular Phylogenetics and Evolution 55(2): 501–523. https://doi.org/10.1016/j.ympev.2010.01.016

Browicz K, Zieliński J (1982) *Ulmus* L. In: Davis PH (Ed.) Flora of Turkey and East Aegean Islands, Vol. 7. Edinburgh University Press, Edinburgh, 645–648.

Bruni A (1857) Descrizione botanica delle campagne di Barletta. Stamp. del Fibreno, Napoli, 212 pp. https://doi.org/10.5962/bhl.title.9655

Buccomino G, Tondi G (2010) Notulae alla checklist della Flora vascolare Italiana, 9: 1647. Informatore Botanico Italiano 42(1): 376.

Camarda I (1990) Le piante endemiche délia Sardegna: 198 *Colchicum corsicum* Baker (1879). Bolletino délia Società Sarda di Scienze Naturali 27 : 283–287.

Caputo G (1967) Flora e vegetazione delle isole di Procida e Vivara (Golfo di Napoli). Delpinoa, n.s., 6–7 (1964–1965): 191–27.

Carine MA, Robba L (2010) Taxonomy and evolution of the *Convolvulus sabatius* complex (Convolvulaceae). Phytotaxa 14: 1–21. https://doi.org/10.11646/phytotaxa.14.1.1

Caruel T (1860–1864) Prodromo della Flora Toscana. Firenze.

Cennamo P, Del Guacchio E, Paino L, De Castro O, Menale B, Vasquez-Torres M, Caputo P (2013) Genetic structure of *Ipomoea imperati* (Convolvulaceae) in the Mediterranean region and implications for its conservation. Phytotaxa 141(1): 40–54. https://doi.org/10.11646/phytotaxa.141.1.3

Chenevard P (1915) [Flora delle Prealpi bergamasche]. Unpublished manuscript stored at the library of the Conservatoire et Jardin botanique de la Ville de Genève.

Christensen KI (1997) *Ulmus* L. In: Strid A, Tan K (Eds) Flora Hellenica, Vol. 1. Koeltz Scientific Books, Königstein, 50–52.

Conti F, Bracchetti L, Uzunov D, Bartolucci F (2019) A new subspecies of *Corydalis densiflora* (Papaveraceae) from the Apennines (Italy). Willdenowia 49(1): 53–64. https://doi.org/10.3372/wi.49.49107

Cresti L, Schönswetter P, Peruzzi L, Barfuss MHJ, Frajman B (2019) Pleistocene survival in three Mediterranean refugia: origin and diversification of the Italian endemic *Euphorbia gasparrinii* from the *E. verrucosa* alliance (Euphorbiaceae). Botanical Journal of the Linnean Society 189(3): 262–280. https://doi.org/10.1093/botlinnean/boy082

De Santis E (2018a) Contributo alla conoscenza della Flora vascolare dei Monti della Tolfa (Lazio): La flora lungo il fiume Mignone nei pressi di Rota (Tolfa, RM). Acta Plantarum Notes 6: 58–72.

De Santis E (2018b) Noterelle: 210. Acta Plantarum Notes 6: 156.

Dimopoulos P, Raus Th, Bergmeier E, Constantinidis Th, Iatrou G, Kokkini S, Strid A, Tzanoudakis D (2013) Vascular plants of Greece: an annotated checklist. Berlin; Athens: Botanic Garden and Botanical Museum Berlin-Dahlem; Hellenic Botanical Society.

Di Pietro R, Fröhner SE, Gottschlich G, Minutillo F, Fortini P, Tondi G (2016) New floristic records for the apennines with some biogeographical and phytosociological considerations. Atti Società Toscana di Scienze naturali, Memorie, serie B 122 (2015): 43–60. https://doi.org/10.2424/ASTSN.M.2015.06

Ellmouni FY, Karam MA, Ali1 RM, Albach DC (2018) Systematic treatment of *Veronica* L. Section *Beccabunga* (Hill) Dumort (Plantaginaceae). Taeckholmia 38(1): 168–183. https://doi.org/10.21608/TAEC.2018.5481.1000

Fenaroli L, Zahn KH (1927) Hieracia nova Italiae borealis (avec remarques sur *H. australe* Fr.). Botanische Jahrbücher fur Systematik 61 (2–3, Beibl. 138): 22–30.

Festi F (2017) *Alchemilla* L. In: Pignatti S (Ed.) Flora d'Italia 2, ed. 2. Edagricole-New Business Media, Milano, 768–799.

Freitag H (1985) The genus *Stipa* (*Gramineae*) in Southwest and South Asia. Notes Roy. Bot. Gard. Edinburgh 42(3): 355–489.

Fridlender A (2009) *Colchicum verlaqueae* Fridlender: un colchique nouveau endémique du littoral sarde. Bulletin Mensuel de la Société Linnéenne de Lyon 78(5–6): 111–117. https://doi.org/10.3406/linly.2009.13719

Fridlender A (2014a) Les colchiques de la flore française. Digitalis 10: 5–17.

Fridlender A (2014b) Combinaisons nouvelles concernant 3 colchiques du sud-ouest méditerranéen. Bulletin Mensuel de la Société Linnéenne de Lyon 83(5–6): 137–141. https://doi.org/10.3406/linly.2014.13910 [In French]

Gottschlich G (2009) Die Gattung *Hieracium* L. (Compositae) in der Region Abruzzen (Italien). Stapfia 89: 1–328.

Gottschlich G, Pujatti D (2000) Il genere *Hieracium* (Compositae) in provincia di Trento (nord Italia): chiave di determinazione, descrizione morfologica e distribuzione locale delle specie. Annali dei Musei Civici-Rovereto. Sezione Archeologia, Storia, Scienze Naturali 16: 273–351.

Govaerts R (2019) World Checklist of Lamiaceae. Facilitated by the Royal Botanic Gardens, Kew. Published on the Internet; http://wcsp.science.kew.org [accessed: 30 April 2019]

Groom QJ, Van Der Straeten J, Hoste I (2019) The origin of *Oxalis corniculata* L. PeerJ 7: e6384. https://doi.org/10.7717/peerj.6384

Gutermann W (2019) Notulae nomenclaturales 46–59. Neilreichia 10:135–154. https://doi.org/10.5281/zenodo.2630535

Gutiérrez-Larruscain D, Santos-Vicente M, Montserrat Martínez-Ortega M, Rico E (2019) Typification of 25 names in Inula (Inuleae, Asteraceae), and a new combination in *Pentanema*. Phytotaxa 395(1): 17–026. https://doi.org/10.11646/phytotaxa.395.1.2

Hauenschild F, Favre A, Salazar GA, Muellner-Riehl AN (2016) Corrigendum to Hauenschild F et al., Analysis of the cosmopolitan buckthorn genera *Frangula* and *Rhamnus* s.l. supports the description of a new genus, *Ventia*. Taxon 65(4): 926–927. https://doi.org/10.12705/654.49

Iamonico D, Managlia A (2015) Lectotypification of the Bertoloni's names in the genus *Senecio* L. (Asteraceae). Plant Biosystems 149(1): 48–53. https://doi.org/10.1080/11263504.2013.809816

Kopecký D, Harper J, Bartoš J, Gasior D, Vrána J, Hřibová E, Boller B, Ardenghi NMG, Šimoníková D, Doležel J, Humphreys MW (2016) An Increasing Need for Productive and Stress Resilient *Festulolium* Amphiploids: What Can Be Learnt from the Stable Genomic Composition of *Festuca pratensis* subsp. *apennina* (De Not.) Hegi? Frontiers in Environmental Science 4: 66. https://doi.org/10.3389/fenvs.2016.00066

Kurtto A, Sennikov AN, Lampinen R (2013) Atlas Florae Europaeae. Distirbution of vascular plants in Europe, Vol. 16. Helsinki, The Committee for Mapping the Flora of Europea & Societas Biologica Fennica Vanamo, 168 pp.

La Valva V, Sabato S (1983) Nomenclature and Typification of *Ipomoea imperati* (Convolvulaceae). Taxon 32(1): 110–114. https://doi.org/10.2307/1219862

Lastrucci L, Foggi B, Selvi F, Becattini R (2007) Contributo alla conoscenza della vegetazione e della flora delle aree umide nel comprensorio di Capalbio (provincia di Grosseto, Italia centrale). Archivio Geobotanico 10(1–2) (2004): 1–30.

Lastrucci L, Frignani F, Kaplan Z (2010) *Potamogeton schweinfurthii* and similar broad-leaved species in Italy. Webbia 65(1): 147–160. https://doi.org/10.1080/00837792.2010.10670870

Lastrucci L, Dell'Olmo L, Foggi B, Massi L, Nuccio C, Vicenti C, Viciani D (2017) Contribution to the knowledge of the vegetation of the Lake Massaciuccoli (northern Tuscany, Italy). Plant Sociology 54(1): 67–87.

Lastrucci L, Valentini E, Dell'Olmo L, Vietina B, Foggi B (2016) Hygrophilous vegetation and habitats of conservation interest in the area of the Lake Porta (Tuscany, Central Italy). Atti della Società Toscana di Scienze Naturali, Memorie, Serie B, 122 (2015): 131–146.

Lazzeri V, Gestri G, Borzatti von Löwenstern A, Mannocci M, Barsotti G, Campus G, Caramante P (2018) Note floristiche tosco-sarde IV: novità regionali e locali per le regioni Toscana e Sardegna. Annali del Museo Civico di Rovereto, sezione Archeologia, Storia e Scienze Naturali 33 (2017): 79–110.

López González G (1992) Apuntes para justificar el tratamiento del género "*Helianthemum*" Miller, s.l. ("Cistaceae"), en "Flora Ibérica" Anales del Jardín Botánico de Madrid 50(1): 35–63.

López González G (1994) ¿*Rorippa pyrenaica* (All.) Rchb. o *R. stylosa* (Pers.) Mansf. & Rothm.? (Cruciferae). Anales del Jardín Botánico de Madrid 52(1): 98–102.

López González G, Bayer E (1988) El género *Ziziphora* L. (Labiatae) en el Mediterraneo occidental y sus relaciones con *Acinos* Miller ¿parentesco o convergenia? Lagascalia 15(Extra): 49–64.

Maggioni L, Alessandrini A (2019) The occurrence of Brassica montana Pourr. (Brassicaceae) in the Italian regions of Emilia-Romagna and Marche, and in the Republic of San Marino. Italian Botanist 7: 1–16. https://doi.org/10.3897/italianbotanist.7.31727

Martini F, Bona E, Federici G, Fenaroli F, Perico G (2012) Flora vascolare della Lombardia centro-orientale, 1: Parte generale. LINT, Trieste.

Martinoli G (1950) La flora e la vegetazione del Capo S. Elia (Sardegna meridionale). Pubblicazioni Centro per lo Studio della Flora e della Vegetazione Italiana 17: 57–148. https://doi.org/10.1080/11263505009430782

Melville R (1958) *Ulmus canescens*: An Eastern Mediterranean Elm. Kew Bulletin 12(3): 499–502. http://www.jstor.org/stable/4113729

Moraldo B, La Valva V, Ricciardi M, Caputo G (1988) La Flora dei Monti Picentini (Campania). Pars altera: Pyrolaceae - Orchidaceae. Delpinoa, n.s., 27–28 (1985–1986): 59–148.

Moris JJ (1827) Stirpium sardoarum elenchus. Ex Typiis Regiis, Carali.

Oberprieler C, Konowalik K, Fackelmann A, Vogt R (2018) Polyploid speciation across a suture zone: phylogeography and species delimitation in S French *Leucanthemum* Mill. representatives (Compositae-Anthemideae). Plant Systematics and Evolution 304: 1141–1155. https://doi.org/10.1007/s00606-018-1537-9

Orsenigo S, Gottschlich G, Galasso G (2019) The typification and identity of *Hieracium australe* Fr. (Asteraceae). Phytotaxa 388(2): 207–211. https://doi.org/10.11646/phytotaxa.388.2.8

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 MC, Wagensommer RP, Wilhalm T, Tartaglini N, Duprè E, Blasi C, Rossi G (2018) Red Listing plants under full national responsibility: extinction risks and threats in the vascular flora endemic to Italy. Biological Conservation 224: 213–222. https://doi.org/10.1016/j.biocon.2018.05.030

Ottonello M, Longo D (2018) Noterelle: 215, 217–220, 224–227. Acta Plantarum Notes 6: 161–173.

Palanza A (1900) Flora della Terra di Bari. In: Jatta A (a cura di) La Terra di Bari. Tipografia dell'Editore V. Vecchi, Trani, 3: 1–90.

Persson K (2009) *Colchicum longifolium* Castagne. In: Marhold K (Ed.) IAPT/IOPB chromosome data 7. Taxon 58(1): E6.

Perrino EV, Silletti GN, Erben M, Wagensommer RP (2018) *Viola cassinensis* subsp. *lucana* (Violaceae), a new subspecies from the Lucanian Apennine, southern Italy. Phyton (Horn) 58(2): 109–115. https://doi.org/10.12905/0380.phyton58(2)-2018-0109

Peruzzi L, Bedini G (2018) Wikiplantbase #Toscana. Verso un catalogo collaborativo, online e gratuito delle piante vascolari di Toscana. http://bot.biologia.unipi.it/wpb/toscana [accessed: 11 June 2018]

Peruzzi L, Conti F, Bartolucci F (2014) An inventory of vascular plants endemic to Italy. Phytotaxa 168(1): 1–75. https://doi.org/10.11646/phytotaxa.168.1.1

Peruzzi L, Astuti G, Cambria S, Cresti L, Franzoni J, Roma-Marzio F, Spezia M (2018) Chromosome numbers for the Italian flora: 6. Italian Botanist 6: 91–96. https://doi.org/10.3897/italianbotanist.6.30975

Peruzzi L, Domina G, Bartolucci F, Galasso G, Peccenini S, Raimondo FM, Albano A, Alessandrini A, Banfi E, Barberis G, Bernardo L, Bovio M, Brullo S, Brundu G, Brunu A, Camarda I, Carta L, Conti F, Croce A, Iamonico D, Iberite M, Iiriti G, Longo D, Marsili S, Medagli P, Pistarino A, Salmeri C, Santangelo A, Scassellati E, Selvi F, Soldano A, Stinca A, Villani M, Wagensommer RP, Passalacqua NG (2015) An inventory of the names of vascular plants endemic to Italy, their loci classici and types. Phytotaxa 196(1): 1–217. https://doi.org/10.11646/phytotaxa.196.1.1

Pignatti S (2017a) Flora d'Italia, Vol. 1, ed. 2. Edagricole-New Business Media, Milano, 1064 pp.

Pignatti S (2017b) Flora d'Italia, Vol. 2, ed. 2. Edagricole-New Business Media, Milano, 1178 pp.

Polidori J-L, Arnoux J-C, Bellone C (2018) *Sempervivum adenotrichum* Burnat ou joubarbe à poils glanduleux, taxon méconnu des Alpes occidentales, observé dans les Alpes maritimes. Riviera Scientifique 102: 3–32.

Ramírez E, Rufo L, Sánchez-Mata D, de la Fuente V (2019) *Arthrocaulon meridionalis* (Chenopodiaceae), a new species of Mediterranean flora. Mediterranean Botany 40(1): 33–41. https://doi.org/10.5209/MBOT.59820

Rich TCG, Nicholls-Vuille F-L (2001) Taxonomy and distribution of European *Damasonium* (Alismataceae). Edinbourg Journal of Botany 58: 45–55. https://doi.org/10.1017/S0960428601000464

Roccia A, Gluch O, Lampard S, Robinson A, Fleischmann A, McPherson S, Legendre L, Partrat E, Temple P (2016) *Pinguicula* of the temperate north. Redfern Natural History Productions, Dorset, 349 pp.

Rosati L, Coppi A, Farris F, Fascetti S, Becca G, Peregrym M, Tan K, Selvi F (2018) The genus *Gymnospermium* (Berberidaceae) in Italy: identity and relationships of the populations at the western limit of the genus range. Plant Biosystems. https://doi.org/10.1080/11263504.2018.1549613 [e-published: 31 Dec 2018]

Schäfer HI (1973) Zur Taxonomie der *Vicia narbonensis* Gruppe. Kulturpflanze 21: 211–273. https://doi.org/10.1007/BF02103161

Scholz H (2008) Some comments on the genus *Bromus* (Poaceae) and three new species. Willdenowia 38(2): 411–422. https://doi.org/10.3372/wi.38.38203

Secchi F, Longo D (2018) Noterelle: 2238. Acta Plantarum Notes 6: 184.

Selvi F (2009) Notulae: 1540–1541. In: Conti F, Nepi C, Scoppola A (Eds) Notulae alla checklist della flora vascolare italiana 7 (1530–1567). Informatore Botanico Italiano 41(1): 131–132.

Selvi F (2010) A critical checklist of the vascular flora of Tuscan Maremma (Grosseto province, Italy). Flora Mediterranea 20: 47–139.

Silvestre S (2012) *Ipomoea* L. In: Castroviejo S, Aedo C, Laínz M, Muñoz Garmendia F, Nieto Feliner G, Paiva J, Benedí C (Eds) Flora iberica, Vol. 11: Real Jardín Botánico, CSIC, Madrid, 279–286.

Smith PM (1980) *Bromus* L. In: Tutin TG, Heywood VH, Burges NA, Moore DM, Valentine DH, Walters SM, Webb DA (Eds) Flora Europaea, Vol. 5 (Alismataceae-Orchidaceae). Cambridge University Press, Cambridge, 182–190.

Talavera S, Garcia-Murillo P (2010) *Zannichellia* L. In: Talavera S, Gallego MJ, Romero Zarco C, Herrero A (Eds) Flora Iberica, Vol. 17. Real Giardín Botánico, C.S.I.C., Madrid, 94–101.

Talavera M, Sánchez Casimiro-Soriguer C, Talavera-Lozano S (2013) *Crepis* Sect. *Lepidoseris* sensu Babcock en la Península Ibérica y Baleares. Acta Botanica Malacitana 38: 231–240.

Tammaro F, Pogliani M (1977) «*Andrachne telephioides*» L. nella Valle dell'Aterno, nuovo reperto per la Flora Abruzzese. Webbia 32(1): 135–145. https://doi.org/10.1080/00837792.1977.10670087

Thiv M, Reyes-Betancort JA, Fragman-Sapir O (2019) Lifeforms as criterion for species delimitation: Are *Aristida adscensionis* and *A. coerulescens* (Aristidoideae, Poaceae) two species? Phytotaxa 393(1): 67–74. https://doi.org/10.11646/phytotaxa.393.1.6

Tison J-M, De Foucault B (2014) Flora Gallica – Flore de France. Biotopes, Mèze, 1216 pp.

Tomei PE, Guazzi E (1995) Le zone umide della Toscana. Lista generale delle entità vegetali. Atti del Museo Civico di Storia Naturale di Grosseto 15(1993): 107–152.

Troia A, Schicchi R, Geraci A (2018) Typification of the Linnaean name *Ambrosinia bassii* and other nomenclatural remarks in the genus *Ambrosinia* (Araceae). Taxon 67(6): 1183–1186. https://doi.org/10.12705/676.15

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

Turrisi RE (2001) *Ipomoea imperati* (Vahl) Griseb. (Convolvulaceae), nouvelle entité pour la flore sicilienne. Flora Mediterranea 11: 373–378.

Turrisi RE (2005) Inquadramento fitosociologico dei popolamenti ad *Ipomoea imperati* (Convolvulaceae) della Sicilia. Quaderni di Botanica Ambientale e Applicata 16: 87–92.

Tyler B, Borrill M, Chorlton K (1978) Studies in *Festuca*. X. Observations on germination and seedling cold tolerance in diploid *Festuca pratensis* and tetraploid *F. pratensis* var. *apennina* in relation to their altitudinal distribution. Journal of Applied Ecology 15(1): 219–226. https://doi.org/10.2307/2402932

Uhlemann I (2017) The genus *Taraxacum* (Asteraceae, Cichorieae) sect. Erythrosperma in the northern coastal part of Croatia. Schlechtendalia 32: 1–24.

Uotila P (2011) Ulmaceae. In: Euro+Med Plantbase – the information resource for Euro-Mediterranean plant diversity. http://ww2.bgbm.org/EuroPlusMed/ [accessed: 10 April 2019].

Vergari S, Dondini G, Biagioli M (1996) Primo contributo alla conoscenza delle Orchidaceae sull'Appennino Pistoiese. Atti della Società Toscana di Scienze Naturali, Memorie, Serie B, 103 (1995): 129–133.

Viciani D, Baroni S, Nardi E (2008) Contribution to the knowledge of the vascular flora of Monte Beni and Sasso di Castro, two ultramafic mountains in Upper Mugello (Northern Tuscany). Webbia 63(2): 187–214. https://doi.org/10.1080/00837792.2008.10670842

Viciani D, Gonnelli V, Gottschlich G (2013) Notulae sulla flora del Parco Nazionale delle Foreste Casentinesi, Monte Falterona e Campigna (Appennino Tosco-Romagnolo) 2: revisione di alcuni campioni critici di *Hieracium* subgen. *Hieracium* (Asteraceae) dell'Erbario Zangheri. Quaderno di Studi e Notizie di Storia Naturale della Romagna 37: 29–34.

Wagner V, Durka W, Hensen I (2011) Increased genetic differentiation but no reduced genetic diversity in peripheral vs. central populations of a steppe grass. American Journal of Botany 98: 1173–1179. https://doi.org/10.3732/ajb.1000385

Wahlsteen E, Tyler T (2019) Morphometric analyses and species delimitation in *Legousia* (Campanulaceae). Willdenowia 49(1): 21–33. https://doi.org/10.3372/wi.49.49104

Zahn KH (1916) Les *Hieracium* des Alpes Maritimes. Georg & Cie, Libraires-editeurs, Genève, Bale, 404 pp.

Zangheri P (1966) Romagna Fitogeografica (5). Flora e vegetazione del medio e alto Appennino Romagnolo. Webbia 21(1): 1–450. https://doi.org/10.1080/00837792.1966.10669838

Supplementary material 1

Supplementary material

Authors: Fabrizio Bartolucci, Gabriele Galasso

Data type: species data

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

Link: https://doi.org/10.3897/italianbotanist.7.36148.suppl1

Italian Botanist 7: 149–156 (2019)
doi: 10.3897/italianbotanist.7.34639
http://italianbotanist.pensoft.net

RESEARCH ARTICLE

Italian Botanist
Published by Società Botanica Italiana

Epiphytic lichens of the sacred natural site "Bosco di Sant'Antonio" (Majella National Park – Abruzzo)

Juri Nascimbene[1], Valter Di Cecco[2], Luciano Di Martino[2], Fabrizio Frascaroli[1], Paolo Giordani[3], Chiara Lelli[1], Chiara Vallese[1], Piero Zannini[1], Alessandro Chiarucci[1]

1 *Department of Biological Geological and Enviromental Sciences, University of Bologna, via Irnerio 42, 40126 Bologna, Italy* **2** *Majella National Park, Botanical Office, Via Badia 28, 67039 – Sulmona (L'Aquila), Italy* **3** *DIFAR, University of Genova, Viale Cembrano 4, 16148 Genova, Italy*

Corresponding author: *Juri Nascimbene* (juri.nascimbene@unibo.it)

Academic editor: *Sonia Ravera* | Received 18 March 2019 | Accepted 22 May 2019 | Published 11 June 2019

Citation: Nascimbene J, Di Cecco V, Di Martino L, Frascaroli F, Giordani P, Lelli C, Vallese C, Zannini P, Chiarucci A (2019) Epiphytic lichens of the sacred natural site "Bosco di Sant'Antonio" (Majella National Park – Abruzzo). Italian Botanist 7: 149–156. https://doi.org/10.3897/italianbotanist.7.34639

Abstract

Sacred Natural Sites are relevant for biodiversity conservation, as in the case of forest sites that, across centuries, developed old growth structures and are now crucial for the conservation of epiphytic lichens and other specialized forest organisms. In this study, we investigated the epiphytic lichen flora of a small forest patch included in the Majella National Park (Abruzzo), whose old growth features and naturalness reflect its long lasting spiritual role that perfectly fits with the concept of Sacred Natural Site. Results revealed that the "Bosco di Sant'Antonio" hosts a rich and interesting epiphytic lichen flora, thus indicating the potential of this Sacred Natural Site for lichen conservation. Fifty-six species were found including two species newly recorded in Abruzzo, two red-listed species, and the sensitive species *Lobaria pulmonaria*. This study corroborates the hypothesis that sacred forest sites are relevant for the conservation of specialized epiphytic lichens. In particular, in the Italian forest landscape where old-growth stands are practically absent, sacred forest sites may provide unique old-growth structures and buffer anthropogenic disturbance.

Keywords

conservation, forest lichens, lichen red-list, *Lobaria pulmonaria*, old-growth stands

Introduction

Sacred Natural Sites are relevant for biodiversity conservation (Avtzis et al. 2018; Frascaroli et al. 2016) since their spiritual value is intrinsically associated with the maintenance of inspiring natural habitats by non-intervention or non-intensive management. This is, for example, the case of several forest sites that are not exploited for timber production due to the presence of a small church, a shrine, or a crucifix. Across centuries, these forests are allowed to develop old-growth structures that are crucial for the conservation of several forest organisms, such as epiphytic lichens (Nascimbene et al. 2013a).

Epiphytic lichens are a species-rich component of the forest biota playing several ecological roles, thus contributing to forest functioning and underpinning relevant ecosystem services (Zedda and Rambold 2015). Their diversity patterns are strongly influenced by forest structure and dynamics that, in turn, are affected by forest management. In particular, forestry is among the main causes of species loss across European forests (Nascimbene et al. 2013b) due to the exploitation of old trees, short rotation cycles, excessive canopy cover, or excessive exposure to direct light in the final part of the rotation cycle. In contrast, their diversity is enhanced by increasing tree age, which especially benefits rare, threatened (red-listed), and late successional species (Ellis 2012). Old trees provide different and highly variable bark structure as well as other microhabitats such as rot holes, growth anomalies, and moss cover (e.g. Fritz and Heilmann-Clausen 2010). Large old trees also enhance the establishment of dispersal-limited species that have more time for colonization, higher surface availability, and more stable substrate conditions (Nascimbene et al. 2013b).

In this study, we investigated the epiphytic lichen flora of a small forest patch included in the Majella National Park, whose old-growth features (i.e., occurrence of old trees) and naturalness reflect its age-old spiritual role that perfectly fits with the concept of Sacred Natural Site.

Methods

2.1 Study area

The study area, “Bosco di Sant’Antonio”, is located in the “Altipiani Maggiori” of the Abruzzo Administrative Region (41°56.745'N, 14°1.648'E), with an elevation that varies between 1290 and 1360 m a.s.l. This forest, covering a surface of 450 ha, was the first Natural Reserve established in Abruzzo, back in 1985. Since 1991, it has been included in the Majella National Park. Furthermore, the forest has become part of the Natura 2000 network, being included in the SCI IT7110204 “Majella sud-ovest”.

Based on information retrieved from the meteorological station of Pescocostanzo (1395 m a.s.l.), the climate of the forest is temperate-cold with moderate continentality. The annual precipitation exceeds 900 mm, with maximum in November-December

and minimum in July-August. The mean annual temperature is 8.1°C, with a maximum mean in August (18.1°C) and a minimum mean in January (0.1°C).

The forest is dominated by beech (*Fagus sylvatica* L.), mixed with *Acer campestre* L., *Acer pseudoplatanus* L., *Prunus avium* (L.) L., *Quercus cerris* L., *Ilex aquifolium* L., and *Pyrus communis* L. subsp. *pyraster* (L.) Ehrh. (Pirone et al. 2004). The current physiognomy of the Sant'Antonio forest is characterized by the presence of monumental trees that have a typical "candlestick" posture, conferred by pollarding practice. This technique can be associated to the ancient traditional forms of pasture in forests (Manzi 1997). The sacredness of the site is clearly emphasized by the name of the forest, dedicated to St. Anthony of Padua, and by the presence of a church, founded by a religious congregation.

2.2 Data collection, species traits and nomenclature

In summer 2018, we carried out a floristic survey aiming at maximizing species capture. In particular, two skilled lichenologists and four collaborators were engaged in six hours of field work. This floristic survey was focused exclusively on epiphytic lichens and the four main tree substrates (*Acer campestre*, *A. pseudoplatanus*, *Fagus sylvatica* and, *Quercus cerris*) were explored in detail. For each species, at least one specimen was collected for identification and stored in the personal herbarium of JN.

The species' ecological traits were evaluated using the ecological indicator factors retrieved from Nimis and Martellos (2017). These factors indicate, on a 5-class ordinal scale, the ecological requirements of each species for (a) pH of the substrate (1 = on very acid substrata; 2 = on acid substrata; 3 = on sub-acid to sub-neutral substrata; 4 = on slightly basic substrata; 5 = on basic substrata); (b) light (1 = in very shaded situations; 2 = in shaded situations; 3 = in sites with plenty of diffuse light but scarce direct solar irradiation; 4 = in sun-exposed sites, but avoiding extreme solar irradiation; 5 = in sites with very high direct solar irradiation); (c) moisture (1 = hygrophytic species; 2 = rather hygrophytic species; 3 = mesophytic species; 4 = xerophytic species living in dry situations, but absent from extremely arid stands; 5 = very xerophytic species); (d) eutrophication (1 = no eutrophication; 2 = very weak eutrophication; 3 = weak eutrophication; 4 = rather high eutrophication; 5 = very high eutrophication).

Species biological traits (growth forms, reproductive strategies, and photobiont) were also retrieved from Nimis and Martellos (2017). Foliose lichens include both those with narrow (*Physcia*-like) and large (*Parmelia*-like) lobes; fruticose lichens; crustose lichens include true crustose, leprose and squamulose species. Reproductive strategies were classified as: (a) mainly sexual reproduction by ascospores, mainly asexual reproduction by (b) isidia, (c) soredia, and (d) thallus fragmentation. The photobiont can be a chlorococcoid green alga other than *Trentepohlia* (Ch), a Trentepohlioid green alga (Tr) or a cyanobacterium (Cy).

Nomenclature follows Nimis (2016), while the conservation importance of the species is based on their inclusion in the red list of the Italian epiphytic lichens (Nascimbene et al. 2013c).

Results

Fifty-six species were found (Table 1), representing 17% of the known epiphytic lichen flora of Abruzzo. They include two species that were new records for this Region, namely *Arthonia mediella* and *Gyalecta ulmi*, the second of which is also a red-listed species together with *Sclerophora pallida*. An additional interesting species is *Lobaria pulmonaria*, occurring with a well-established, but clustered, population including several fertile thalli.

The checklist mainly includes crustose and large-lobed foliose lichens with chlorococcoid green algae as photobiont and sexually reproducing by ascospores. However, we found a high percentage of cyanolichens (17.9%) and vegetatively reproducing species (42.8%), representing about 28% and 20%, respectively of the species occurring at the Regional level.

The analysis of the ecological indicator values (Table 2) revealed that the epiphytic lichen flora of the "Bosco di Sant'Antonio" mainly includes sub-acidophytic-neutrophytic species related to mesic-shaded and humid-mesic conditions, and avoiding or tolerating moderate eutrophication.

Discussion

Results reveal that the "Bosco di Sant'Antonio" hosts a rich and interesting epiphytic lichen flora, thus indicating the potential of this sacred natural site for lichen conservation. Actually, our field observations in several forest sites of the Majella National Park support the view that this small forest patch may represent a refuge for several lichen species that are virtually missing in the surrounding forest landscape. While for small-sized species (e.g. *Sclerophora pallida*) there could be a bias related to intrinsic species detectability, for large-sized species this observation could be reliable, as in the case of the large foliose lichen *Lobaria pulmonaria* whose population in the "Bosco di Sant'Antonio" seems to be unique to the Majella National Park. This species has suffered a general decline throughout Europe as a consequence of air pollution and intensive forest management and is currently red-listed in several European countries (Benesperi et al. 2018). In Italy, it is expected to strongly decline in the next decades due to reduced climatic suitability related to climate change that may exacerbate the effect of local impacts (Nascimbene et al. 2016). In the Majella National Park, the studied sacred forest site is crucial for the conservation of this sensitive and charismatic species, also able to ensure the conservation of co-occurring red-listed species (Nascimbene et al. 2013b).

The conservation importance of this site is further corroborated by 1) the high percentage of cyanolichens, and 2) vegetatively reproducing species that compose its lichen flora. Cyanolichens are a group of functionally relevant species (i.e., they are involved in atmospheric nitrogen fixation) sensitive to climate change and local anthropogenic disturbance that are dramatically declining across Europe, including Italy (Nascimbene et al. 2016). In many Italian regions, the occurrence of most species

Table 1. Checklist of the epiphytic lichens recorded in the "Bosco di Sant'Antonio". Species' biological traits (growth forms and reproductive strategies) were retrieved from Nimis and Martellos (2017). Foliose lichens include both those with narrow (*Physcia*-like; Fol.n) and large (*Parmelia*-like; Fol.l) lobes; fruticose lichens (Frut); crustose lichens include true crustose (Cr), and squamulose (Sq) species. Reproductive strategies are classified as: (a) mainly sexual reproduction by ascospores (S), mainly asexual reproduction by (b) isidia (A.i), and (c) soredia (A.s). The photobiont can be a chlorococcoid green alga other than *Trentepohlia* (Ch), a Trentepohlioid green alga (Tr) or a cyanobaterium (Cy). Tree species: AC = *Acer campestre*; AP = *Acer pseudoplatanus*; FS = *Fagus sylvatica*; QC = *Quercus cerris*. Nomenclature follows Nimis (2016), while the conservation importance of the species follows the Italian red list (Nascimbene et al. 2013c).

Species	Red List	New to Abruzzo	Growth form	Reproductive strategy	Photobiont	Tree species
Alyxoria varia (Pers.) Ertz & Tehler			Cr	S	Tr	AC; FS
Anaptychia ciliaris (L.) A. Massal.			Frut	S	Ch	AC; AP; FS
Arthonia atra (Pers.) A. Schneid.			Cr	S	Tr	FS
Arthonia mediella Nyl.		+	Cr	S	Tr	AC; FS
Arthonia radiata (Pers.) Ach.			Cr	S	Tr	FS
Athallia pyracea (Ach.) Arup, Frödén & Søchting			Cr	S	Ch	FS
Bacidia rubella (Hoffm.) A. Massal.			Cr	S	Ch	AC; FS
Calicium salicinum Pers.			Cr	S	Ch	FS
Caloplaca cerina (Hedw.) Th. Fr. s.lat.			Cr	S	Ch	FS
Candelariella faginea Nimis, Poelt & Puntillo			Cr	S	Ch	FS
Cladonia chlorophaea (Sommerf.) Spreng.			Frut	A.s	Ch	FS
Collema flaccidum (Ach.) Ach.			Fol.b	A.i	Cy	AC; FS
Collema furfuraceum Du Rietz			Fol.b	A.i	Cy	AC; AP; FS
Collema subflaccidum Degel.			Fol.b	A.i	Cy	AC; FS
Collema subnigrescens Degel.			Fol.b	S	Cy	AC; FS
Diplotomma alboatrum (Hoffm.) Flot.			Cr	S	Ch	AC
Evernia prunastri (L.) Ach.			Frut	A.s	Ch	AC; FS
Gyalecta ulmi (Sw.) Zahlbr.	NT	+	Cr	S	Tr	AC; AP
Lecanora allophana (Ach.) Nyl. f. *allophana*			Cr	S	Ch	AC
Lecanora chlarotera Nyl. subsp. *chlarotera*			Cr	S	Ch	FS
Lecanora horiza (Ach.) Linds.			Cr	S	Ch	FS
Lecanora subcarpinea Szatala			Cr	S	Ch	FS
Lecidella elaeochroma (Ach.) M. Choisy var. *elaeochroma* f. *elaeochroma*			Cr	S	Ch	FS
Lepra albescens (Huds.) Hafellner			Cr	A.s	Ch	FS; QC
Leptogium saturninum (Dicks.) Nyl.			Fol.b	A.i	Cy	FS
Lobaria pulmonaria (L.) Hoffm.			Fol.b	A.s	Ch	FS; QC
Melanelixia glabra (Schaer.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch			Fol.b	S	Ch	AC; FS
Melanelixia glabratula (Lamy) Sandler & Arup			Fol.b	A.i	Ch	AC; FS
Melanelixia subargentifera (Nyl.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch			Fol.b	A.s	Ch	AC; FS
Melanohalea elegantula (Zahlbr.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch			Fol.b	A.i	Ch	AC; FS
Myriolecis hagenii (Ach.) Sliwa, Zhao Xin & Lumbsch			Cr	S	Ch	AC; FS
Nephroma resupinatum (L.) Ach.			Fol.b	A.i	Cy	FS
Ochrolechia pallescens (L.) A. Massal.			Cr	S	Ch	FS; QC
Parmelia sulcata Taylor			Fol.b	A.s	Ch	AC; AP; FS; QC
Parmelina tiliacea (Hoffm.) Hale			Fol.b	A.i	Ch	AC; AP; FS; QC
Peltigera collina (Ach.) Schrad.			Fol.b	A.s	Cy	FS
Peltigera horizontalis (Huds.) Baumg.			Fol.b	S	Cy	FS
Peltigera praetextata (Sommerf.) Zopf			Fol.b	A.i	Cy	FS
Pertusaria coronata (Ach.) Th. Fr.			Cr	A.i	Ch	FS
Phaeophyscia orbicularis (Neck.) Moberg			Fol.n	A.s	Ch	AP; FS

Species	Red List	New to Abruzzo	Growth form	Reproductive strategy	Photobiont	Tree species
Phlyctis argena (Spreng.) Flot.			Cr	A.s	Ch	AC; AP; FS; QC
Physcia adscendens H. Olivier			Fol.n	A.s	Ch	AC; AP; FS
Physcia aipolia (Humb.) Fürnr.			Fol.n	S	Ch	AC; FS
Physconia detersa (Nyl.) Poelt			Fol.n	A.s	Ch	FS
Physconia distorta (With.) J.R. Laundon			Fol.n	S	Ch	AC; AP; FS
Physconia enteroxantha (Nyl.) Poelt			Fol.n	A.s	Ch	AC; FS
Physconia perisidiosa (Erichsen) Moberg			Fol.n	A.s	Ch	AC; FS
Physconia venusta (Ach.) Poelt			Fol.n	S	Ch	FS; QC
Placynthiella icmalea (Ach.) Coppins & P. James			Cr	A.i	Ch	FS
Pleurosticta acetabulum (Neck.) Elix & Lumbsch			Fol.b	S	Ch	AC; AP; FS; QC
Ramalina fastigiata (Pers.) Ach.			Frut	S	Ch	FS
Ramalina fraxinea (L.) Ach.			Frut	S	Ch	FS; QC
Rinodina sophodes (Ach.) A. Massal.			Cr	S	Ch	FS
Sclerophora pallida (Pers.) Y.J. Yao & Spooner	VU		Cr	S	Tr	AC; FS
Scytinium lichenoides (L.) Otálora, P.M. Jørg. & Wedin			Sq	S	Cy	FS
Xanthoria parietina (L.) Th. Fr.			Fol.b	S	Ch	AC; AP; FS

Table 2. Ecological requirements of the species represented by 4 indicator factors ranging on a five-level ordinal scale. Values in the table are percentages of species referred to the total for each of the five-levels of the ordinal scale (each species may have a range of values for each indicator factor).

Class	Substrate pH	Light	Moisture	Eutrophication
1	16.1	0.0	8.9	50.0
2	80.4	10.7	57.1	75.0
3	87.5	66.1	78.6	62.5
4	23.2	82.1	32.1	21.4
5	7.1	46.4	5.4	5.4

is only documented by records dating back more than a century ago (Nimis 2016; Nimis and Martellos 2017). Vegetative reproduction is a strategy that characterizes late successional communities (Nascimbene et al. 2017). This may reflect the fact that vegetative propagules are probably poorly adapted to bear harsh conditions typical of pioneer stages, while they meet more favorable conditions in old, more stable sites. The production of vegetative propagules enhances the local competitiveness of the species due to a rapid recruitment of new thalli. This is likely to result in a species-rich community that effectively saturates the available ecological niches.

The ecology of the species, as indicated by the values of the ecological indicators, reflects the main substrate and habitat features, with a high incidence of subacidophytic-neutrophytic species growing on beech bark in mesic-shaded and humid conditions. Interestingly, only a few species moderately tolerate eutrophication, probably reflecting a sporadic grazing activity. Our field observations in some forest patches nearby the sacred site revealed an intensive grazing activity that resulted in the establishment of a nitrogen-tolerant lichen flora, while most of the species inventoried in the "Bosco di Sant'Antonio" were almost absent. This situation further supports its important conservation status, likely related to its spiritual value.

Conclusions

This study corroborates the hypothesis that sacred forest sites may be relevant for epiphytic lichen conservation. In particular, in the Italian forest landscape where old-growth stands are scarce, such sites may provide unique old-growth structures and buffer anthropogenic disturbance. This would fit with the concept of 'shadow network' (Dudley et al. 2009) that considers Sacred Natural Sites as nodes of a non-official conservation network that may integrate the one based on protected areas. In this perspective, further sampling-based studies are required to confirm these promising speculations.

Acknowledgements

This floristic survey was financed by the Project "Indagine sulla biodiversita' lichenica nel territorio del Parco Nazionale della Majella" (scientific collaboration between UNIBO-BiGeA and the administration of the Majella National Park) and by the project "Biodiversity and ecosystem services in Sacred Natural Sites (BIOESSaNS)" (PRIN 2015 2015P8524C, project coordinator Prof. A. Chiarucci; https://site.unibo.it/bioessans/it).

JN and AC conceived the idea; JN, VDC, LDM, PG, CL, CV performed the field work and species identification; FF, PZ, AC contributed expertise in the field of Sacred Natural Sites; JN prepared the first draft of the ms and all the authors contributed to the final version.

References

Avtzis DN, Stara K, Sgardeli V, Betsis A, Diamandis S, Healey JR, Kapsalis E, Kati V, Korakis G, Marini Govigli V, Monokrousos N, Muggia L, Nitsiakos V, Papadatou E, Papaioannou H, Rohrer A, Tsiakiris R, Van Houtan KS, Vokou D, Wong JLG, Halley JM (2018) Quantifying the conservation value of Sacred Natural Sites. Biological Conservation 222: 95–103. https://doi.org/10.1016/j.biocon.2018.03.035

Benesperi R, Nascimbene J, Lazzaro L, Bianchi E, Tepsich A, Longinotti S, Giordani P (2018) Successful conservation of the endangered forest lichen *Lobaria pulmonaria* requires knowledge of fine-scale population structure. Fungal Ecology 33: 65–71. https://doi.org/10.1016/j.funeco.2018.01.006

Dudley N, Higgins-Zogib L, Mansourian S (2009) The Links between Protected Areas, Faiths, and Sacred Natural Sites. Conservation Biology 23: 568–577. https://doi.org/10.1111/j.1523-1739.2009.01201.x

Ellis CJ (2012) Lichen epiphyte diversity: a species, community and trait-based review. Perspectives in Plant Ecology, Evolution and Systematics 14: 131–152. https://doi.org/10.1016/j.ppees.2011.10.001

Frascaroli F, Bhagwat S, Guarino R, Chiarucci A, Schmid B (2016) Shrines in Central Italy conserve plant diversity and large trees. Ambio 45: 468–479. https://doi.org/10.1007/s13280-015-0738-5

Fritz Ö, Heilmann-Clausen J (2010) Rot holes create key microhabitats for epiphytic lichens and bryophytes on beech (*Fagus sylvatica*). Biologica Conservation 143: 1008–1016. https://doi.org/10.1016/j.biocon.2010.01.016

Manzi A (1997) Gli alberi e gli dei, I luoghi degli dei. Sacro e natura nell'Abruzzo italico, Carsa Edizioni Pescara, 184 pp.

Nascimbene J, Dainese M, Sitzia T (2013a) Contrasting responses of epiphytic and dead wood-dwelling lichen diversity to forest management abandonment in silver fir mature woodlands. Forest Ecology and Management 289: 325–332. https://doi.org/10.1016/j.foreco.2012.10.052

Nascimbene J, Thor G, Nimis PL (2013b) Effects of forest management on epiphytic lichens in temperate deciduous forests of Europe – a review. Forest Ecology and Management 298: 27–38. https://doi.org/10.1016/j.foreco.2013.03.008

Nascimbene J, Nimis PL, Ravera S (2013c) 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, Casazza G, Benesperi R, Catalano I, Cataldo D, Grillo M, Isocrono D, Matteucci E, Ongaro S, Potenza G, Puntillo D, Ravera S, Zedda L, Giordani P (2016) Climate change fosters the decline of epiphytic *Lobaria* species in Italy. Biological Conservation 201: 377–384. https://doi.org/10.1016/j.biocon.2016.08.003

Nascimbene J, Mayrhofer H, Dainese M, Bilovitz PO (2017) Assembly patterns of soil-dwelling lichens after glacier retreat in the European Alps. Journal of Biogeography 44: 1393–1404. https://doi.org/10.1111/jbi.12970

Nimis PL, Martellos S (2017) ITALIC – The Information System on Italian Lichens. Version 5.0. University of Trieste, Trieste. http://dryades.units.it/italic

Nimis PL (2016) The Lichens of Italy – A Second Annotated Catalogue. EUT, Trieste, 739 pp.

Pirone G, Ciaschetti G, Frattaroli AR (2004) La vegetazione del Bosco di Sant'Antonio (Pescocostanzo, Abruzzo). Micologia e Vegetazione Mediterranea 19: 163–176.

Zedda L, Rambold G (2015) The diversity of lichenised fungi: ecosystem functions and ecosystem services. In: Upreti DK, Divakar PK, Shukla V, Bajpai R (Eds) Recent Advances in Lichenology, New Delhi, 121–145. https://doi.org/10.1007/978-81-322-2235-4_7

Italian Botanist 7: 157–182 (2019)
doi: 10.3897/italianbotanist.7.36386
http://italianbotanist.pensoft.net

RESEARCH ARTICLE

Italian Botanist
Published by Società Botanica Italiana

Notulae to the Italian alien vascular flora: 7

Gabriele Galasso[1], Gianniantonio Domina[2], Nicola M.G. Ardenghi[3], Claudio Aristarchi[4], Gianluigi Bacchetta[5], Fabrizio Bartolucci[6], Gianmaria Bonari[7], Daniela Bouvet[8], Giuseppe Brundu[9], Sergio Buono[10], Orazio Caldarella[11], Giacomo Calvia[5], Ana Cano-Ortiz[12], Emilio Corti[13], Francesco S. D'Amico[14], Marco D'Antraccoli[15], Alessandra Di Turi[4], Moreno Dutto[16], Emanuele Fanfarillo[17], Giulio Ferretti[13], Tiberio Fiaschi[18], Claudia Ganz[19], Riccardo Guarino[20], Mauro Iberite[17], Valentina L.A. Laface[21], Alfonso La Rosa[22], Lorenzo Lastrucci[23], Marta Latini[17], Lorenzo Lazzaro[13], Michele Lonati[24], Vanessa Lozano[9], Fabio Luchino[25], Sara Magrini[26], Andrea Mainetti[24], Manuela Manca[27], Michele Mugnai[13], Carmelo M. Musarella[21], Gianluca Nicolella[28], Nicola Olivieri[29], Ines Orrù[5], Gaetano Pazienza[14], Lorenzo Peruzzi[15], Lina Podda[9], Filippo Prosser[30], Simone Ravetto Enri[24], Silvana Restivo[31], Francesco Roma-Marzio[32], Alessandro Ruggero[33], Anna Scoppola[34], Federico Selvi[35], Giovanni Spampinato[21], Adriano Stinca[36], Massimo Terzi[37], Manuel Tiburtini[38], Emilia Tornatore[39], Roberto Vetromile[40], Chiara Nepi[23]

1 *Sezione di Botanica, Museo di Storia Naturale di Milano, Corso Venezia 55, 20121 Milano, Italy* **2** *Dipartimento di Scienze Agrarie, Alimentari e Forestali (SAAF), Università di Palermo, Viale delle Scienze, ed. 4, 90128 Palermo, Italy* **3** *Dipartimento di Scienze della Terra e dell'Ambiente, Università di Pavia, Via Sant'Epifanio 14, 27100 Pavia, Italy* **4** *Via Crocetta di Apparizione 32, 16133 Genova, Italy* **5** *Dipartimento di Scienze della Vita e dell'Ambiente, Università di Cagliari, Viale Sant'Ignazio da Laconi 13, 09123 Cagliari, Italy* **6** *Centro Ricerche Floristiche dell'Appennino (Università di Camerino – Parco Nazionale del Gran Sasso e Monti della Laga), San Colombo, 67021 Barisciano (L'Aquila), Italy* **7** *Department of Botany and Zoology, Masaryk University, Kotlářská 2, CZ-611 37 Brno, Czech Republic* **8** *Dipartimento di Scienze della Vita e Biologia dei Sistemi, Università di Torino, Viale P.A. Mattioli 25, 10125 Torino, Italy* **9** *Dipartimento di Agraria, Università di Sassari, Viale Italia 39, 07100 Sassari, Italy* **10** *Via XXV Aprile 6, 01010 Oriolo Romano (Viterbo), Italy* **11** *Viale Maria Santissima Mediatrice 38, 90129 Palermo, Italy* **12** *Departamento de Biología Animal, Biología Vegetal y Ecología, Universidad de Jaén, Paraje las Lagunillas s/n, 23071 Jaén, Spain* **13** *Dipartimento di Biologia, Università di Firenze, Via G. La Pira 4, 50121 Firenze, Italy* **14** *Dipartimento di Biologia e Museo Orto Botanico, Università di Bari Aldo Moro, Via E. Orabona 4, 70125 Bari, Italy* **15** *Dipartimento di Biologia, Università di Pisa, Via Derna 1, 56126 Pisa, Italy* **16** *Via Papò 4, 12039 Verzuolo (Cuneo), Italy* **17** *Dipartimento di Biologia Ambientale, Sapienza Università di Roma, Piazzale A. Moro 5, 00185 Roma, Italy* **18** *Dipartimento di Scienze della Vita, Università di Siena, Via P.A. Mattioli 4, 53100 Siena, Italy* **19** *Fraz. Perrière 78, 11027 Saint-Vincent (Aosta), Italy* **20** *Dipartimento di Scienze e Tecnologie Biologiche, Chimiche e Farmaceutiche (STEBICEF), Università di Palermo, Via Archirafi 20, 90123 Palermo, Italy* **21** *Dipartimento di Agraria, Università Mediterranea di Reggio Calabria, Feo di Vito*

snc, 89122 Reggio Calabria, Italy **22** *Coop Silene a r.l., Via V. D'Ondes Reggio Vito 8/a, 90127 Palermo, Italy* **23** *Sistema Museale di Ateneo, Università di Firenze, Via G. La Pira 4, 50121 Firenze, Italy* **24** *Dipartimento di Scienze Agrarie, Forestali e Alimentari (DISAFA), Università di Torino, Largo P. Braccini 1, 10095 Grugliasco (Torino), Italy* **25** *Via Torrente Allume 6/a, 98027 Roccalumera (Messina), Italy* **26** *Banca del Germoplasma della Tuscia, Università della Tuscia, Largo dell'Università snc, blocco c, 01100 Viterbo, Italy* **27** *Servizio Territoriale di Nuoro, Agenzia Fo.Re.S.T.A.S., Via A. Deffenu 7, 08100 Nuoro, Italy* **28** *Via di Valle Melaina 61, 00139 Roma, Italy* **29** *Via Maestri del Lavoro 40, 64100 Teramo, Italy* **30** *Fondazione Museo Civico di Rovereto, Largo Santa Caterina 41, 38068 Rovereto (Trento), Italy* **31** *Via J. Palach 63, 92025 Casteltermini (Agrigento), Italy* **32** *Sistema Museale di Ateneo, Università di Pisa, Via L. Ghini 13, 56126 Pisa, Italy* **33** *Loc. Parapinta, 07029 Tempio Pausania (Sassari), Italy* **34** *Dipartimento di Scienze Agrarie e Forestali (DAFNE), Università della Tuscia, Via San Camillo de Lellis snc, 01100 Viterbo, Italy* **35** *Dipartimento di Scienze delle Produzioni Agroalimentari e dell'Ambiente, Università di Firenze, Piazzale delle Cascine 28, 50144 Firenze, Italy* **36** *Dipartimento di Scienze e Tecnologie Ambientali, Biologiche e Farmaceutiche, Università della Campania Luigi Vanvitelli, Via A. Vivaldi 43, 81100 Caserta, Italy* **37** *Istituto di Bioscienze e Biorisorse, Consiglio Nazionale delle Ricerche (CNR-IBBR), Via G. Amendola 165/a, 70126 Bari, Italy* **38** *Via Madonna d'Ete 40, 63900 Fermo, Italy* **39** *Via Leo Longanesi 6, 90146 Palermo, Italy* **40** *Via Boccaccio 5, 80048 Sant'Anastasia (Napoli), Italy*

Corresponding author: *Gabriele Galasso* (gabriele.galasso@comune.milano.it)

Academic editor: *Stefania Biondi* | Received 21 May 2019 | Accepted 27 May 2019 | Published 11 June 2019

Citation: Galasso G, Domina G, Ardenghi NMG, Aristarchi C, Bacchetta G, Bartolucci F, Bonari G, Bouvet D, Brundu G, Buono S, Caldarella O, Calvia G, Cano-Ortiz A, Corti E, D'Amico FS, D'Antraccoli M, Di Turi A, Dutto M, Fanfarillo E, Ferretti G, Fiaschi T, Ganz C, Guarino R, Iberite M, Laface VLA, La Rosa A, Lastrucci L, Latini M, Lazzaro L, Lonati M, Lozano V, Luchino F, Magrini S, Mainetti A, Manca M, Mugnai M, Musarella CM, Nicolella G, Olivieri N, Orrù I, Pazienza G, Peruzzi L, Podda L, Prosser F, Ravetto Enri S, Restivo S, Roma-Marzio F, Ruggero A, Scoppola A, Selvi F, Spampinato G, Stinca A, Terzi M, Tiburtini M, Tornatore E, Vetromile R, Nepi C (2019) Notulae to the Italian alien vascular flora: 7. Italian Botanist 7: 157–182. https://doi.org/10.3897/italianbotanist.7.36386

Abstract

In this contribution, new data concerning the distribution of vascular flora alien to Italy are presented. It includes new records, confirmations, and status changes for Italy or for Italian administrative regions of taxa in the genera *Abies*, *Actinidia*, *Alooe*, *Amaryllis*, *Anredera*, *Arctotheca*, *Bidens*, *Cardiospermum*, *Celosia*, *Commelina*, *Cotoneaster*, *Cyclamen*, *Eclipta*, *Euphorbia*, *Grevillea*, *Hedera*, *Hibiscus*, *Impatiens*, *Juglans*, *Kalanchoe*, *Koelreuteria*, *Lindernia*, *Melinis*, *Myriophyllum*, *Nandina*, *Nicotiana*, *Oenothera*, *Oxalis*, *Parthenocissus*, *Phoenix*, *Phyllanthus*, *Physalis*, *Plumbago*, *Pteris*, *Quercus*, *Setaria*, *Symphytum*, *Tagetes*, and *Washingtonia*. Nomenclatural and distribution updates, published elsewhere are provided as Suppl. material 1.

Keywords

Alien species, floristic data, Italy

How to contribute

The text for the new records should be submitted electronically to Chiara Nepi (chiara.nepi@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 2,000 characters (spaces included).

Floristic records

Abies cephalonica Loudon (Pinaceae)

+ (NAT) **SAR**: Tempio Pausania (Sassari), Cime del Limbara, abetaia Madonna della Neve (WGS84: 40.51057N; 9.10121E), abetaia, 30 January 1994, *A. Ruggero* (*Herb. A. Ruggero*); Tempio Pausania (Sassari), Monte Limbara, Punta Balestrieri (WGS84: 40.51035N; 9.10816E), graniti ercinici, 1240–1260 m, 19 January 2008, *G. Bacchetta, A. Congiu* (CAG); Berchidda (Sassari), Valle di Suprappare (WGS84: 40.841674N; 9.167793E), graniti, garighe, ericeti, rocce, 1132 m, 21 May 2018, *G. Calvia* (FI, *Herb. G. Calvia*). – Naturalized alien species new for the flora of Sardegna.

This species is endemic to Greece, but it was introduced in other countries for reforestations (Farjon 2017). Recently it has been considered as naturalized in Friuli Venezia Giulia, Marche, Umbria, and casual in Abruzzo and Sicilia (Galasso et al. 2018a). In Sardegna, it was planted in several mountain areas starting from 1933 (Pavari and De Philippis 1941). In the Limbara massif (NE Sardegna), where many sparse patches of reforestations occur, this species is now naturalized, being found in garrigues, heaths and rocky places as far as 1 km far from plantation sites. Abundant presence of seedlings and saplings is observable nearby and inside the reforestations, and adult trees reach heights of 8–10 m. In the locality Badde Salighes (near Villa Piercy, Bolotana, Nuoro), this species was introduced for ornamental purposes.

G. Bacchetta, G. Calvia, A. Ruggero

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

+ (CAS) **LIG**: Castiglione Chiavarese (Genova), impluvio sotto la cresta del Monte Merelle, versante N (WGS84: 44.25705N; 9.53501E), boscaglia igrofila, 424 m, 17 June 2018, *A. Di Turi, C. Aristarchi* (FI, GDOR, GE). – Casual alien species new for the flora of Liguria.

It is a widely cultivated plant, native to East Asia, recorded in Italy as casual for Lombardia, Trentino-Alto Adige, Veneto, Emilia-Romagna, and Lazio (Galasso et al. 2018a). Well developed specimens have been found in two sites a few hundred metres away: in both cases they grow in hygrophilous stands with *Alnus glutinosa* (L.) Gaertn., *Acer pseudoplatanus* L., and *Frangula alnus* Mill. susbp *alnus*. The recorded area is located within the SAC IT1343412 “Deiva – Bracco – Pietra di Vasca – Mola”.

A. Di Turi, C. Aristarchi

Alooe arborescens Mill. (Asphodelaceae)

+ (CAS) **PUG**: Isole Tremiti (Foggia), Isola di San Domino, loc. Cameroni (WGS84: 42.116391N; 15.493383E), dirupo costiero colonizzato da *Pinus halepensis*, ca. 30 m, 27 July 2018, *N. Olivieri* (FI). – Casual alien species new for the flora of Puglia.

Some individuals of this species grow under *Pinus halepensis* Mill. subsp. *halepensis* trees on a carbonate steep coastal cliff. The plants grow along with *Mesembryanthemum cordifolium* L.f. and *Phagnalon rupestre* (L.) DC. subsp. *illyricum* (H.Lindb.) Ginzb., on a little compact rock face exposed to East and partially shaded, not far from the sea. They may have originated by vegetative propagation from cultivated plants, used as ornamental in some surrounding private gardens. This species is frequently cultivated in the Mediterranean Italy and it is known as a casual alien in Liguria, Toscana, Lazio, Campania, and Basilicata, while it is naturalized in Sardegna (Galasso et al. 2018a).

N. Olivieri

Amaryllis belladonna L. (Amaryllidaceae)

+ (NAT) **SIC**: Savoca (Messina), loc. Pineta di Savoca (WGS84: 37.957310N; 15.338410E), sottobosco di un impianto forestale a *Pinus pinea* e *Robinia pseudoacacia*, 25 October 2018, *F. Luchino* (FI). – Naturalized alien species new for the flora of Sicilia.

Amaryllis belladonna is native to South Africa, but it is now distributed in several tropical, subtropical, and temperate regions of the world (Govaerts et al. 2018). According to Galasso et al. (2018a), in southern Italy this species occurs in Campania, Puglia, and Calabria. Many individuals grow in a shady habitat in a reforestation with codominance of *Pinus pinea* L. and *Robinia pseudoacacia* L., near Savoca (Messina), possibly escaped from neighboring gardens or flowerbeds where this species is widely cultivated as ornamental. The population recorded here has been known for about 15 years and is constantly expanding. In Sicilia, this species occours also in Gibilmanna (Cefalù, Palermo: *M. Barone*, pers. obs.), Rabotano (Piazza Armerina, Enna: *G. Messina*, pers. obs.), Antillo (Messina: *G. Coslovi*, pers. obs.), Pizzo Castellana C.da San Guglielmo and along SS286 approximately at Km 1–2 (Castelbuono, Palermo: *A. La Rosa*, pers. obs.).

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

Anredera cordifolia (Ten.) Steenis (Basellaceae)

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

Anredera cordifolia, originating from South America, is reported as invasive in Italy where, in the last 20 years, it became naturalized in many coastal areas (Pasta et al. 2016). This species was reported so far only as casual in Sardegna (Galasso et al. 2018a). Additional records are reported by Campus and De Pascali (2017) for Santa

Teresa di Gallura, and for Sant'Antioco island in an abandoned field. During 2018, it was recorded as naturalized in three new sites: in the town of Nuoro, escaped from cultivation and covering about 50 square metres; along the shores of River Cedrino (Orosei); along roadsides in the locality San Giovanni (Posada).

M. Manca, G. Brundu

Arctotheca prostrata (Salisb.) Britten (Asteraceae)

+ (CAS) **ITALIA** (**CAM**): Napoli (Napoli), Parco Virgiliano (WGS84: 40.799727N; 14.180829E), sito erboso al margine del bosco di latifoglie, 142 m, 14 August 2018, *A. Stinca, R. Vetromile* (FI, PORUN–Herb. Stinca). – Casual alien species new for the flora of Italy (Campania).

Arctotheca prostrata is a South African perennial herb, showing long stolons rooting at nodes. This species has been introduced in other parts of the world, such as USA, Mexico, and Australia (Hinojosa-Espinosa and Villaseñor 2015), but it was not reported for Europe so far. The population recorded here covers an area of approximately 5 m^2. *A. prostrata* is found in very disturbed grassland at a wood margin. This alien species was probably introduced via stolons in soil transportation. Specimens were identified according to Mahoney and McKenzie (2012).

A. Stinca, R. Vetromile

Bidens subalternans DC. (Asteraceae)

+ (NAT) **TOS**: Firenze (Firenze), stazione ferroviaria dello Statuto, binari (WGS84: 43.787222N; 11.250833E), abbondante negli erbai ruderali fra i binari della ferrovia, 2 November 2018, *F. Selvi* (FI). – Naturalized alien species new for the flora of Toscana.

This Central-South American species occurs as an invasive neophyte in most Italian regions, from Friuli Venezia Giulia and Lombardia in the North to Sicilia in the South (Galasso et al. 2018a). It is part of ruderal communities in warm and xeric habitats close to urban areas, most commonly road margins, escarpments and railways, most often in sites showing Mediterranean or sub-Mediterranean climate. In Firenze, it grows abundantly along a relatively long stretch of the main national railway, from the station "Statuto" towards the eastern and southeastern outskirts of the town. It was still in flower and abundantly in fruit in October 2018.

F. Selvi

Cardiospermum halicacabum L. (Sapindaceae)

+ (CAS) **PIE**: Saluzzo (Cuneo), loc. Terre Rosse (WGS84: 44.641560N; 7.472558E), area collinare incolta vicino ad area boschiva, 369 m, 4 October 2017, *M. Dutto, G. Malfi* (FI). – Casual alien species new for the flora of Piemonte.

Cardiospermum halicacabum is a herbaceous perennial climbing plant native to the northern and tropical America. It is cultivated as an ornamental and may be found as naturalized in the warmer regions of southern Europe. In Italy it has been reported for the first time as a naturalized alien for Calabria and Sicilia, and as a casual for Sardegna (Galasso et al. 2018a). The cultivation in Piemonte is attested since the nineteenth century by some specimens preserved in TO: three specimens collected in the Turin Botanical Garden (from 1806 to 1921), a specimen cultivated in Alba (Cuneo), and four specimens without indication of the collecting site. In the recorded site five plants occur, in a second locality in Saluzzo [Saluzzo (Cuneo), loc. Terre Rosse (WGS84: 44.642030N; 7.472003E), orto famigliare vicino a vecchio frutteto, 352 m, 4 October 2017, *M. Dutto*], nine plants were observed. Flowering period goes from June to October and individuals produce an average of 3–4 fruits each. A thorough investigation was conducted between the fund owners and the residents in neighboring areas: the present or past cultivation of the species for ornamental purposes has not emerged and the people did not know it. Since studies based on bioclimatic modeling show a high potential for expansion (Gildenhuys et al. 2013), at the end of the growing season the specimens have been eradicated and the site will be monitored in the years to come.

M. Dutto, D. Bouvet

Celosia argentea L. (Amaranthaceae)

+ (CAS) **PUG**: Ugento (Lecce), fraz. Torre San Giovanni (WGS84: 39.875000N; 18.146813E), vegetazione disturbata al margine di una strada interpoderale presso la costa ionica, ca. 3 m, 21 August 2018, *N. Olivieri* (FI). – Casual alien species new for the flora of Puglia.

This species appears with some individuals in a disturbed vegetation, dominated by *Phragmites australis* (Cav.) Trin. ex Steud. subsp. *australis*, at the edge of a country road. The plants grow in a flat coastal area, on red soil with good water availability.

N. Olivieri

Commelina erecta L. (Commelinaceae)

+ (CAS) **ITALIA** (**SIC**): Palermo (Palermo), centro urbano, all'angolo tra Via M. Rapisardi e Via N. Morello (WGS84: 38.134187N; 13.343394E), marciapiede, 8 October 2018, *O. Caldarella* (FI). – Casual alien species new for the flora of Italy (Sicilia).

Commelina erecta is native to Central America (Faden 2000) and according to Kumar (2011) is currently distributed in Americas, tropical Africa, West Indies, Australia, and Asia. Israel is the only known place in the Mediterranean basin for this species, so far (Danin 2015). A few individuals grow in a sidewalk near a manhole, inside the fissure of lithic material of the gutter, probably originating from the glass or garden cultivation in the nearby dwellings.

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

Cotoneaster pannosus Franch. (Rosaceae)

+ (CAS) **TOS**: Bagno a Ripoli (Firenze), 2 km a E di Villamagna, lungo la strada sterrata che porta in loc. Torrino (WGS84: 43.76330N; 11.36026E), gariga e boscaglia meso-xerofila, 250 m, 21 July 2018, *F. Roma-Marzio, L. Peruzzi* (FI). – Casual alien species new for the flora of Toscana.

Cotoneaster pannosus is a popular ornamental evergreen shrub, native to China (Lu and Brach 2003). It was introduced and escaped from cultivation in United States, Europe, South Africa, Pacific Islands (Hawaii and New Zealand), and Australia (Fryer et al. 2014). In Italy, *C. pannosus* was recorded as naturalized in Lombardia, and as casual in Trentino-Alto Adige, Liguria, and Puglia (Galasso et al. 2018a). We found one fruiting adult individual and two small plants along a pathway at the edge of a wood. Possibly, the plants originated from seeds of individuals cultivated in a country house placed in close proximity.

F. Roma-Marzio, L. Peruzzi

Cyclamen persicum Mill. (Primulaceae)

+ (CAS) **ABR**: Lanciano (Chieti), Via A. Cacciaguerra (WGS84: 42.229116N; 14.392751E), base del muro perimetrale di un edificio, ca. 285 m, 8 August 2018, *N. Olivieri* (FI). – Casual alien species new for the flora of Abruzzo.

A young individual of this species developed into a crevice at the base of the perimeter wall of a building, near a rain gutter downspout in a shaded site in the town. The plant may have originated from seeds produced by individuals grown as ornamental in neighboring buildings. *Cyclamen persicum* is a species native to South-Central Turkey, Syria, Lebanon, Israel, Jordan, the Greek islands of Crete, Rhodes and Karpathos, as well as to Algeria and Tunisia, now widely cultivated for ornamental purpose. In Italy, this species is reported as casual alien in Lombardia and Sardegna (Galasso et al. 2018a).

N. Olivieri

Eclipta prostrata (L.) L. (Asteraceae)

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

This species, native to Asia, is a widely distributed and a common weed in warm temperate to tropical areas worldwide, where it grows commonly in moist places (Holm et al. 1977). It is considered casual alien in Lazio (Galasso et al. 2018a), distributed mainly along the Tyrrhenian coast from the municipality of Santa Marinella (Roma) to Formia (Latina) (Anzalone et al. 2010; Lucchese 2017). Based on recent observations, the species results naturalized on sandy soil along the coast of the Lake Bracciano (Roma), from the municipality of Anguillara Sabazia to Bracciano, and Trevignano Romano. In these sites, large populations occur with an important renewal.

S. Buono, A. Scoppola, S. Magrini

Euphorbia davidii Subils (Euphorbiaceae)

+ (NAT) **TOS**: Pontedera (Pisa), stazione ferroviaria di Pontedera-Casciana Terme (WGS84: 43.662113N; 10.629512E), tra i binari nella massicciata ferroviaria, 13 m, 4 October 2018, *G. Ferretti, M. Mugnai, E. Corti* (FI); Grosseto (Grosseto), fraz. Alberese, stazione ferroviaria di Alberese Scalo (WGS84: 42.640182N; 11.134348E), nella massicciata ferroviaria in prossimità dei binari e nelle aree marginali, assieme a *Euphorbia nutans*, 23 m, 17 November 2018, *M. Mugnai, S. Di Natale, L. Lazzaro, G. Ferretti* (FI). – Naturalized alien species new for the flora of Toscana.

Euphorbia davidii is an alien species native to North America, usually retrieved along railways or in agricultural land (Viggiani 2015) and previously recorded only for northern Italy (Galasso et al. 2018a). We found two abundant populations in Pontedera and Alberese Scalo railway stations, located in the North and South of Tuscany, respectively. This distribution suggests the possible presence of other populations within the region and underlie the status of naturalized for the region.

M. Mugnai, E. Corti, L. Lazzaro, G. Ferretti

+ (NAT) **LAZ**: Ferentino (Frosinone), stazione ferroviaria (WGS84: 41.657718N; 13.245576E), tra i binari, 160 m, 16 October 2017, *E. Fanfarillo* (RO); *ibidem* (WGS84: 41.65695N; 13.24635E), tra i binari, 160 m, 12 September 2018, *E. Fanfarillo* (FI, RO); Morolo (Frosinone), stazione ferroviaria (WGS84: 41.667064N; 13,194339E), abbondante tra i binari e sulle banchine, 160 m, 10 July 2018, *E. Fanfarillo* (FI, RO). – Naturalized alien species new for the flora of Lazio.

The population recorded in Ferentino was observed for the first time in October 2017; it appeared again, more conspicuous, in September 2018. In Morolo, this species was discovered in July 2018; it looks more abundant than in Ferentino and colonizes both the railways and the platforms. The invasive potential of this taxon (Marchessi et al. 2011) suggests that it needs to be constantly monitored.

E. Fanfarillo, G. Nicolella

Grevillea robusta A.Cunn. ex R.Br. (Proteaceae)

+ (CAS) **LAZ**: Roma (Roma), Via C. De Lollis (WGS84: 41.900975N; 12.515406E), interstizi tra muro e marciapiede, 47 m, 11 June 2018, *E. Fanfarillo* (FI). – Casual alien species new for the flora of Lazio.

This species is cultivated as an ornamental tree along Via Cesare De Lollis, where every year it produces abundant flowers and fruits. Juveniles grow in the interstices between a wall and a sidewalk; rare seedlings were also observed in wall cracks.

E. Fanfarillo

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

+ (NAT) **PIE**: Torino (Torino), Mirafiori Sud, bosco di ripa del Fiume Sangone, a valle della ciclopista del Sangone situata su Via Fratelli Bandiera (WGS84: 45.006917N; 7.655493E), bosco di ripa, ca. 230 m, 21 October 2018, *M. Lonati, S. Ravetto Enri* (FI); Grugliasco (Torino), area industriale di Strada del Portone, scarpate del sovrappasso ferroviario di Via Maserati, su entrambi i lati della ferrovia (WGS84: 45.046235N; 7.594065E), scarpata, ca. 275 m, 26 November 2018, *M. Lonati, A. Mainetti* (FI). – Naturalized alien species new for the flora of Piemonte.

This is a ground cover plant frequently escaping from cultivation (McAllister and Rutherford 1990), reported in Italy for Lombardia, Trentino-Alto Adige, and Toscana (Galasso et al. 2018a). Both the above-mentioned populations form dense stands in the underwood of disturbed woodlands, already invaded by other alien species. The first one has colonized more than 300 m^2 close to an illegal landfill of plant material from private gardens; the second one is about 100 m^2, and originates from cut branches of a private hedge flowed on the Sangone river.

M. Lonati, S. Ravetto Enri, A. Mainetti

Hibiscus syriacus L. (Malvaceae)

+ (CAS) **PUG**: Brindisi (Brindisi), loc. Casale, presso Via Santa Maria del Casale (WGS84: 40.644697N; 17.941041E), base di muro ombroso, ca. 5 m, 23 August 2018, *N. Olivieri* (FI). – Casual alien species new for the flora of Puglia.

Some young plants grow together with ruderal vegetation at the base of a wall built with blocks of limestone and concrete, in a shady and rather humid area near the port of Brindisi. Nearby there are some enclosed gardens where the species could be cultivated and from which the seeds may have come. *Hybiscus syriacus* is known as a casual alien in Piemonte, Lombardia, Veneto, Emilia-Romagna, Trentino-Alto Adige, Friuli Venezia Giulia, Toscana, Marche, Umbria, Lazio, Abruzzo, Campania, and Sardegna (Galasso et al 2018a).

N. Olivieri

Impatiens balsamina L. (Balsaminaceae)

+ (CAS) **LAZ**: Alatri (Frosinone), Via Castagneto (WGS84: 41.735549N; 13.301030E), cunetta stradale, un solo individuo, 450 m, 24 July 2018, *E. Fanfarillo* (FI). – Casual alien species new for the flora of Lazio.

A single flowering individual was found growing in a grassy road ditch.

E. Fanfarillo

Juglans nigra L. (Juglandaceae)

+ (CAS) **ABR**: Rocca di Mezzo (L'Aquila), loc. Colle del Morricone, ai margini dell'abitato (WGS84: 42.208438N; 13.511394E), incolto presso il bordo stradale, ca. 1290 m, 2 August 2018, *N. Olivieri* (FI). – Casual alien species new for the flora of Abruzzo.

Some young individuals grow near the roadside on a rather deep calcareous soil in an uncultivated area occupied by disturbed vegetation dominated by shrubs such as *Acer campestre* L., *A. pseudoplatanus* L., *Crataegus monogyna* Jacq., and *Prunus spinosa* L. subsp. *spinosa*. *Juglans nigra* is cultivated as ornamental in private gardens located in the area and the young plants probably originate from seeds dispersed by zoochory. This species is native to the eastern regions of North America and was introduced in Italy in 1760 (Maniero 2015), where it is currently cultivated for the production of wood and for ornamental purposes in parks and along roads. It is known as a casual alien in Piemonte, Trentino-Alto Adige, Emilia-Romagna, Umbria, Lazio, Campania, and Sicilia, while it is naturalized in Lombardia and invasive in Veneto (Galasso et al 2018a).

N. Olivieri

Kalanchooe ×houghtonii D.B.Ward (Crassulaceae)

+ (NAT) **LAZ**: Roma (Roma), Municipio II, Via C. De Lollis, lato N, a fianco della fermata dell'autobus "de Lollis/Irpini" (WGS84: 41.901187N; 12.515989E), interstizio tra muro e marciapiede, 43 m, 10 September 2018, *E. Fanfarillo* (FI); *ibidem*, crepe nel cemento e fessure tra tubature, 43 m, 7 December 2018, *N.M.G. Ardenghi* (FI). – Naturalized alien nothospecies new for the flora of Lazio.

This ornamental nothotaxon is frequently cultivated in gardens and balconies and can easily escape into the wild by producing abundant, promptly radicating vegetative propagules (leaf-bulbils), so that it became invasive in some areas of the world (Ward 2008; Wang et al. 2016). Several young plants were observed growing in the interstices between a wall and a sidewalk, some of them emerging even from old infructescences of *Casuarina equisetifolia* L. spread on the ground. A group of larger, vigorous and uneven-aged flowering individuals is present, at least since 2011 (as can be seen in pictures from Google Street View), at the top of the wall, growing within its cracks and nearby pipes.

E. Fanfarillo, N.M.G. Ardenghi

Koelreuteria paniculata Laxm. (Sapindaceae)

+ (CAS) **TOS**: Campiglia Marittima (Livorno), fraz. Venturina Terme (WGS84: 42.998797N; 10.516870E), tra la strada e un campo abbandonato, 18 m, 21 October 2017, *T. Fiaschi* (FI). – Casual alien species new to the flora of Toscana.

In our finding, the occurrence of this species is probably due to seed dispersed from private gardens. The escaped specimens currently found are about ten. Some of

them reach two metres in height. Since the cultivation of *Koelreuteria paniculata* in the nearby garden of Villa Boldrini, where it fructifies regularly, dates back to the end of the Nineties (C. Bertozzi, *in verbis*), the number of seeds in the soil could be much higher than the observed developed individuals, due to the very efficient exogenous and endogenous dormancy of this (Rehman and Park 2000).

G. Bonari, T. Fiaschi, R. Guarino

Lindernia dubia (L.) Pennell (Linderniaceae)

+ (NAT) **TAA**: Bondone (Trento), sponda N del Lago d'Idro a W di Baitoni inferiore, loc. Rionda, 70 m a WSW della torretta di avvistamento (WGS84: 45.8048N; 10.5307E), sponda fangosa, 370 m, 27 September 2018, *F. Prosser, R. Vicentini, F. Valentini, R. Fedrizzi, M. Merli*, det. *F. Prosser* (FI, ROV 74196). – Naturalized alien species new for the flora of Trentino-Alto Adige.

In locality of Rionda, this species forms a dense colony along about fifty metres of the shore, which can be estimated in some tens of thousands of specimens that at the observation date were in bloom and at the beginning of the fruiting. A second group of about fifty individuals was found 30 m NE from the first record (ROV 74195). Both populations fall within the Nature 2000 "Lago d'Idro" area (IT3120065), where they could compete with the rare native *Eleocharis acicularis* (L.) Roem. & Schult. *Lindernia dubia* is a species of North American origin reported in northern Italy as invasive in Piemonte and Lombardia, and naturalized in Veneto and Emilia-Romagna (Galasso et al. 2018a), where it occupies low altitude localities (Banfi and Galasso 2010). This observation confirms the ability of *L. dubia* to settle even within the Alpine chain, as already observed in Switzerland (Schoenenberger et al. 2014).

F. Prosser

Melinis repens (Willd.) Zizka subsp. *repens* (Poaceae)

+ (NAT) **SAR**: Pula (Cagliari), fraz. Santa Margherita di Pula, strada SS195 dal km 36,700 (WGS84: 39.950773N; 8.945784E), margini stradali su alluvioni quaternarie, 27 m, 14 November 2018, *G. Bacchetta, G. Calvia, I. Orrù, L. Podda* (FI, CAG). – Naturalized alien subspecies new for the flora of Sardegna. Status change from casual to naturalized alien for the flora of Italy.

Melinis repens is a grass native to South Africa (Gibbs Russell et al. 1990), that has become a problematic weed in many tropical and subtropical regions around the world (Stokes et al. 2011), especially in South America, West Indies, and western Asia (Fish et al. 2015). Currently, it has been reported in Italy as a casual alien only for Campania (Galasso et al. 2018a). In Sardegna, it has been found along roadsides, probably escaped from cultivation due to the presence of ornamental plant nurseries.

G. Bacchetta, G. Calvia, I. Orrù, L. Podda

Myriophyllum aquaticum (Vell.) Verdc. (Haloragaceae)

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

Myriophyllum aquaticum (Parrot's feather) is a species native to tropical and subtropical America, widespread in many parts of the world (Lastrucci et al. 2017b). Due to its detrimental effects on invaded ecosystems this species is considered of Union concern according to the regulation (EU) No. 1143/2014 (European Commission 2014) and it is one of the 14 species enlisted in the list of invasive alien species (IAS) of Union concern occurring in Italy (and one of the 8 recorded for Toscana, Galasso et al. 2018a). Currently *M. aquaticum* is considered invasive for Piemonte and Veneto, and naturalized for other six Italian regions, including Toscana (Galasso et al. 2018a). It was recorded for the first time in this region by Lastrucci et al. (2006) at Lake Porta (Massa-Carrara province), where it was observed spreading across the network of canals around the lake, forming dense monophytic mats or penetrating in the autochtonous coenoses (Lastrucci et al. 2016). In this area, it has been showing a clear invasive behavior spreading in spite of the control actions adopted and exerting strong impacts on native vegetation due to competition (Lastrucci et al. 2017b). Furthermore, recently *M. aquaticum* has been recorded also in the provinces of Lucca and Pisa close to Lake Massaciuccoli (Peruzzi et al. 2016; Lastrucci et al. 2017a), and it was observed in October 2018 also close to Località Montuolo (Lucca province, WGS84: 43.838378N; 10.442848E). Considering the spread of this species in the regional range, but above all the impacts documented for Lake Porta in Lastrucci et al. (2017b), we retain most appropriate the status of invasive alien in Toscana for *M. aquaticum*.

L. Lazzaro, G. Ferretti, M. Mugnai, L. Lastrucci

Nandina domestica Thunb. (Berberidaceae)

+ (CAS) **PUG**: Lecce (Lecce), aiuola nella Villa Comunale "G. Garibaldi", nei pressi di Via XXV Luglio (WGS84: 40.354586N; 18.175833E), aiuola, ca. 49 m, 23 August 2018, *N. Olivieri* (FI). – Casual alien species new for the flora of Puglia.

Some young individuals of this species have developed in a flowerbed among the branches of *Rhaphiolepis umbellata* (Thunb.) Makino, in a semi-shaded position. These individuals are located in a site characterized by a microclimate cooler than the surrounding areas, due to the presence of numerous evergreen trees, including *Quercus ilex* L. subsp. *ilex* and *Ficus elastica* Roxb. ex Hornem. The young individuals of *Nandina domestica* originated from the fruits produced by some adult plants grown in another nearby flowerbed. This species is native to China and Japan and was introduced in Italy in 1821 (Maniero 2015), where it is currently widely cultivated as ornamental, due to the bright color of the foliage and berries.

N. Olivieri

Nicotiana glauca Graham (Solanaceae)

+ (NAT) **MAR**: Fermo (Fermo), Viale XX Settembre, ai lati della strada (WGS84: 43.159477N; 13.715754E), margine stradale, argilla, in pieno suolo, ca. 230 m, 20 August 2018, *M. Tiburtini* (PI 014835). – Naturalized alien species confirmed for the flora of Marche.

This species is recorded as invasive alien in Italy, known only for historical records in Marche (Galasso et al. 2018a). The plants are randomly distributed in the old town centre, where they grow in different places, either in soil or in cracks on the old walls of the town.

M. Tiburtini

Oenothera lindheimeri (Engelm. & A.Gray) W.L.Wagner & Hoch (Onagraceae)

+ (CAS) **SIC**: Casteltermini (Agrigento), Viale Santa Elisabetta (WGS84: 37.537778N; 13.652778E), avventizia in incolti, 515 m, 11 October 2018, *S. Restivo*, det. *R. Guarino* (FI). – Casual alien species new for the flora of Sicilia.

Oenothera lindheimeri is a rhizomatous, vigorously growing herbaceous species native to southern Louisiana and Texas. So far, it has been recorded as invasive in California (Calflora 2018), Florida, Mississippi, Alabama (Darst and Gholson 2004), South Africa (McLean et al. 2018), Japan (Mito and Uesugi 2004), and China (Yan et al. 2014). In Europe, it has been recorded as casual alien in Portugal (Verloove and Sánchez Gullón 2012), Corsica (Tison 2012), Belgium (Rostański and Verloove 2015), Spain (Sánchez Gullón and Verloove 2015), Austria (Pflugbeil and Moosbrugger 2016), Greece (Raabe and Raus 2016), and Croatia (Pandža 2017). In Italy, it is recorded as a casual alien in Lombardia, Veneto, Campania, Puglia (Galasso et al. 2018a), Toscana (Galasso et al. 2018b), and Liguria (Ottonello and Longo 2018d). In our finding, the occurrence of this species is probably due to seed dispersal from private gardens nearby. It has been observed as adventitious also in eastern Sicilia, along roadsides in Fiumefreddo di Sicilia (Catania province, *R. Guarino*, pers. obs.).

S. Restivo, R. Guarino

Oxalis debilis Kunth (Oxalidaceae)

+ (CAS) **LAZ**: Roma (Roma), Municipio II, Piazza dei Siculi 2, scalinata davanti alla "Cooperativa la Risorgente" (WGS84: 41.899508N; 12.511471E), fessura alla base di gradini in marmo, 51 m, 7 December 2018, *N.M.G. Ardenghi* (FI). – Casual alien species confirmed for the flora of Lazio.

A single individual was found in Rome, within a crack at the base of marble steps. The presence of *Oxalis debilis* in Lazio was regarded as doubtful by Galasso et al. (2018a).

N.M.G. Ardenghi

Parthenocissus tricuspidata (Siebold & Zucc.) Planch. (Vitaceae)

+ (NAT) **BAS**: Matera (Matera), Sasso Barisano, lungo una scalinata (WGS84: 40.666779N; 16.609984E), mura, ca. 400 m, 25 August 2018, *L. Peruzzi, M. D'Antraccoli* (FI). – Naturalized alien species new for the flora of Basilicata.

+ (NAT) **PUG**: Monopoli (Bari), c.da Gorgofreddo, Murgia barese, lungo la SP113, 250 m a N di Monte San Nicola (WGS84: 40.89721N; 17.28361E), costone roccioso calcareo a bordo strada, 190 m, 30 August 2018, *F. Roma-Marzio, P. Liguori* (FI, *Herb. F. Roma-Marzio*). – Naturalized alien species new for the flora of Puglia.

Parthenocissus tricuspidata is a vine commonly cultivated as ornamental, almost exclusively for wall cover (Verloove 2019) native to China, Japan, and Korea (Chen and Wen 2007). In Italy, it was reported as casual or naturalized in almost all the administrative regions except for Valle d'Aosta, Marche, Molise, Puglia, Basilicata, and Calabria (Galasso et al. 2018a). In Puglia, we found fruiting plants completely covering a limestone rocky ridge for about 200 meters. In Basilicata, we observed this species also growing abundantly along a road and above overpasses in the North edge of Matera (WGS84: 40.680404N; 16.587295E).

L. Peruzzi, M. D'Antraccoli, F. Roma-Marzio

Phoenix roebelenii O'Brien (Arecaceae)

+ (CAS) **ITALIA** (**PUG**): Brindisi (Brindisi), giardini pubblici di Piazza Vittorio Emanuele II (WGS84: 40.639861N; 17.948005E), giovani piante epifite sul tronco di piante adulte coltivate, ca. 2 m, 23 August 2018, *N. Olivieri* (FI). – Casual alien species new for the flora of Italy (Puglia).

Some very young individuals have grown as epiphytes on the trunk of some adult plants of the same species, over 1.5 m tall, among which there is a female specimen. The young plants have developed among the residues of the leaf rachides, in the upper part of the stems. *Phoenix roebelenii* ripens the fruit and the young plants have developed from the seeds produced by the adult female individual. The species is native to southeastern Asia, from southwestern China to northern Laos and northern Vietnam, and now is a popular ornamental plant in the warm areas of the Mediterranean region, in the subtropical and tropical areas. The species has been identified according to Squire (2007) and Cullen et al. (2011).

N. Olivieri

Phyllanthus tenellus Roxb. (Phyllanthaceae)

+ (CAS) **CAL**: Villa San Giovanni (Reggio Calabria), fraz. Cannitello, in numerose fioriere con piante acquistate in vivaio, all'interno di una proprietà privata (WGS84:

38.235556N; 15.660556E), fioriere, 11 m, 19 September 2013, *C.M. Musarella*, det. *C.M. Musarella, G. Spampinato* (FI, REGGIO); Reggio Calabria (Reggio Calabria), Pellaro, proprietà privata (WGS84: 38.020000N; 15.643889E), dentro una fioriera, 11 m, 14 August 2014, *C.M. Musarella* (REGGIO); *ibidem*, in un'aiuola e diffuso in un terreno incolto, 11 m, 6 October 2018, *C.M. Musarella* (REGGIO); Reggio Calabria (Reggio Calabria), Arangea, vivaio, dentro vasi di alberi di mimosa provenienti dalla Sicilia (WGS84: 38.078056N; 15.663333E), vasi, 53 m, 23 August 2014, *C.M. Musarella* (REGGIO); Reggio Calabria (Reggio Calabria), Via Cardinale G. Portanova traversa Privata (WGS84: 38.115259N; 15.659431E), bordo strada, 63 m, 14 September 2017, *C.M. Musarella* (REGGIO); Reggio Calabria (Reggio Calabria), Gallico Marina, lungo un muro di cinta all'interno di una proprietà privata (WGS84: 38.190833N; 15.646389E), base di muro, 24 m, 12 October 2018, *V.L.A. Laface*, det. *V.L.A. Laface, C.M. Musarella, G. Spampinato* (REGGIO). – Casual alien species new for the flora of Calabria.

Initially present as weed in nurseries and vases, this species first spread inside private properties and later along the city streets. *Phyllanthus tenellus* is native to Madagascar and Mauritius's Island, and it was found naturalized in Italy firstly in several localities of Messina (Crisafulli et al. 2011). Then, Galasso et al. (2016) reported it for Genova, and more recently Spadaro and Raimondo (2017) recorded some specimens in Palermo.

C.M. Musarella, V.L.A. Laface, A. Cano-Ortiz, G. Spampinato

Physalis philadelphica Lam. (Solanaceae)

+ (CAS) **ITALIA** (**LAZ**): Ferentino (Frosinone), loc. Fresine (WGS84: 41.663546N; 13.254221E), bordo strada, 205 m, 18 July 2018, *E. Fanfarillo* (FI, RO). – Casual alien species new for the flora of Italy (Lazio).

This species is an anciently cultivated plant from Mexico and Guatemala, so far reported in Europe for Austria, Belgium, Czech Republic, France, Lithuania, and Spain (DAISIE 2018). Some individuals, possibly escaped from nearby orchards, were found growing on a roadside. The risk of confusion with the closely related *Physalis ixocarpa* Brot. ex Hornem. is high in the determination of this taxon; the attribution of the collected specimens to *P. philadelphica* was especially based on the observation of a corolla longer than 10 mm and of twisted anthers about 4 mm long (Flora Zambesiaca 2018; New England Wild Flower Society 2018).

E. Fanfarillo

Physalis viscosa L. (Solanaceae)

+ (CAS) **PUG**: Bari (Bari), loc. Canale Lamasinata (WGS84: 41.090325N; 16.845230E), bordo strada, 40 m, 20 September 2018, *G. Signorile*, det. *F.S. D'Amico* (FI). – Casual alien species new for the flora of Puglia.

Physalis viscosa is a South American species (Pignatti 2018) reported as a casual alien on the hills of Biella, in Piemonte (Soldano and Verloove 2013), and in the lower part of the River Biferno in Molise (Lucchese 2010). We observed some individuals of *P. viscosa* at the periphery of Bari, along the edge between a secondary road and the water drainage channel (i.e., Canale Lamasinata, locally called 'Canalone').

F.S. D'Amico, G. Pazienza, M. Terzi

Plumbago auriculata Lam. (Plumbaginaceae)

+ (CAS) **PUG**: Lecce (Lecce), Viale Gallipoli (WGS84: 40.348383N; 18.166944E), bordo di marciapiede, ca. 51 m, 23 August 2018, *N. Olivieri* (FI). – Casual alien species new for the flora of Puglia.

Some young individuals of the species have developed among the inner edge of the sidewalks and the perimeter wall of a private garden. Individuals have developed into interstices between sidewalk cement and vertical masonry in a rather bright area exposed to the Northeast. *Plumbago auriculata* is cultivated as ornamental in the nearby gardens and individuals have developed from the seeds produced by cultivated plants.

N. Olivieri

Pteris multifida Poir. (Pteridaceae)

+ (CAS) **LAZ**: Roma (Roma), Villa Borghese, Giardino del Lago (WGS84: 41.914N; 12.484E ± 200 m), muro umido, November 1949, *A. Cacciato*, rev. *D. Marchetti* (RO, scan in FI). – Casual alien species new for the flora of Lazio.

This pantropical species is cultivated as ornamental outside its native range and occurs as alien in northern Italy (Galasso et al. 2018a). The specimen, initially tentatively identified as *Pteris cretica* L., then revised by D. Marchetti in 1991, is the only record for peninsular Italy. According to B. Anzalone's personal notes, this specimen is to be surely referred to a population growing spontaneously that escaped from cultivation and colonized a humid wall. The growing site was recently surveyed again, but *P. multifida* has not been found.

G. Nicolella, M. Latini, M. Iberite

Quercus rubra L. (Fagaceae)

+ (CAS) **LAZ**: Roma (Roma), Villa Borghese, presso Viale dell'Uccelliera (WGS84: 41.913552N; 12.492622E), siepe di *Laurus nobilis*, ca. 50 m, 14 September 2018, *N. Olivieri* (FI). – Casual alien species new for the flora of Lazio.

Some very young individuals of this species have developed near a hedge of *Laurus nobilis* L., on soil formed by ancient pyroclastic deposits. In the area, there are several adult specimens of *Quercus ilex* L. subsp. *ilex* and *Q. rubra* L.. The latter species is

native to the eastern regions of North America and was introduced in Italy in 1803 (Maniero 2015), as a forest species and as an ornamental, especially in the northern regions. This species is known as a casual alien in Liguria, Emilia-Romagna, Trentino-Alto Adige, Friuli Venezia Giulia, and Campania, while it is naturalized in Veneto and Puglia, and is invasive in Piemonte and Lombardia (Galasso et al. 2018a).

N. Olivieri

Setaria parviflora (Poir.) Kerguélen (Poaceae)

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

In Iscra (Illorai, Sassari), along a country road connecting the SP17 route with SS129, *Setaria parviflora* is found as fully naturalised over a large area in natural and artificial pastures and along the roadside (WGS84: 40.320190N; 9.040872E), since 2016. It is a species originating from South America, recorded as naturalised or casual in Calabria, Campania, Emilia-Romagna, Lazio, Liguria, Lombardia, Marche, Puglia, Sicilia, Toscana, and Veneto. In Sardegna, it was reported as a casual alien (Galasso et al. 2018a).

G. Brundu, V. Lozano

Symphytum asperum Lepech. (Boraginaceae)

+ (NAT) **TOS**: Borgo San Lorenzo (Firenze), Mugello, fra Razzolo e la Colla di Casaglia, presso la locanda (WGS84: 44.040039N; 11.472939E), ca. 800 m, 23 June 1907, *C. Sommier* (FI); Firenze (Firenze), Cascine, inselvatichita a Scienza dell'Orticoltura (WGS84: 43.783903N; 11.220514E ± 100 m), 42 m, 17 May 1929, *A. Fiori* (FIAF 25094); Massa Marittima (Grosseto), fraz. Prata, strada per Gabellino dopo circa 1 km (WGS84: 43.074952N; 10.998783E), erbosi freschi lungo la strada, forse sfuggito a coltura per foraggio, ca. 500 m, 1 May 2017, *F. Selvi 3801* (FI, *Herb. F. Selvi*); *ibidem*, 12 May 2018, *F. Selvi 3898* (FI, *Herb. F. Selvi*). – Naturalized alien species confirmed for the flora of Toscana.

Since long time, this Pontic-Caucasian species has been widely introduced to Europe as ornamental and for forage production. In Italy, it occurs in the northern regions (Piemonte, Lombardia, Veneto, and Friuli Venezia Giulia) and, more southwards, in Marche (Galasso et al. 2018a). It was also collected in Borgo San Lorenzo by Sommier and in Firenze by Fiori (see also Cecchi and Selvi 2017), but here this species has not been observed in more recent times and it has probably disappeared. In the new site here reported, about 20 plants grow in a fresh meadow along the SS441, close to the junction with the SP54 "Cerro Balestro". At the time of collection, the plants were blooming and the pink-violet flowers were visited by bumble bees. Observations in spring 2018 confirmed the presence of this small population, which is therefore assumed to be naturalized. It was probably established from plants previously introduced in some local farm and cultivated for the production of forage.

F. Selvi

Tagetes erecta L. (Asteraceae)

+ (CAS) **VDA**: Châtillon (Aosta), strada di accesso al parcheggio comunale pluripiano di Via R. Pellissier (WGS84: 45.750247N; 7.614914E), bordo strada, ca. 520 m, 16 September 2017, *C. Ganz* (*Herb. C. Ganz*); Pont-Saint-Martin (Aosta), terrazzamento incolto (ex-vigneto) adiacente a Via A. Chenuil (WGS84: 45.601803N; 7.792190E), incolto, ca. 350 m, 29 September 2018, *M. Lonati, A. Mainetti* (FI). – Casual alien species new for the flora of Valle d'Aosta.

This Central and South American species (Everett 1982) is widely cultivated for ornamental purposes all over the world, and it is well known for its wide range of biological activities (Singh et al. 2003). In Italy, it was already known as casual alien for most of the regions, but not yet in Valle d'Aosta (north-western Italy), Marche, Umbria, Puglia, Basilicata, and Calabria (peninsular Italy) (Galasso et al. 2018a). The recorded plants probably originated from those cultivated in nearby private gardens, colonizing roadsides, asphalt cracks, and uncultivated areas. It has also been observed and photographed in the following localities: Saint-Vincent (Aosta), fraz. Moron, parcheggio principale della frazione (WGS84: 45.751497N; 7.666617E), bordo di parcheggio, ca. 805 m, 12 August 2016; Saint-Vincent (Aosta), fraz. Capard, parcheggio principale della frazione (WGS84: 45.756422N; 7.648353E), bordo di parcheggio, ca. 660 m; Aymavilles (Aosta), capoluogo, poco sopra il cimitero comunale (WGS84: 45.700433N; 7.239597E), bordo strada, ca. 645 m, 3 September 2018; Saint-Vincent (Aosta), capoluogo in Via Prof. A. Ferré (WGS84: 45.749781N; 7.650753E), fessurazioni del marciapiede, ca. 565 m, 8 September 2018.

M. Lonati, C. Ganz, A. Mainetti

+ (CAS) **PUG**: Martina Franca (Taranto), Piazza Plebiscito lungo il perimetro della Basilica di San Martino (WGS84: 40.705467N; 17.336823E), marciapiede, 430 m, 26 August 2018, *M. D'Antraccoli, F. Angeli* (FI). – Casual alien species new for the flora of Puglia.

Possibly, the three detected individuals originated from seeds produced by plants cultivated in the centre of Martina Franca for ornamental purposes.

M. D'Antraccoli

Washingtonia filifera (Linden ex André) H.Wendl. ex de Bary (Arecaceae)

+ (CAS) **ABR**: Roseto degli Abruzzi (Teramo), presso il litorale adriatico in Viale Roma (WGS84: 42.680833N; 14.013888E), aiuola, ca. 9 m, E, 8 October 2018, *N. Olivieri* (FI). – Casual alien species new for the flora of Abruzzo.

Washingtonia filifera is a species native to southern California, southwestern Arizona and northern Mexico, cultivated in Italy, and known as a casual alien in Liguria, Campania and Sardegna, while it is naturalized in Sicilia (Galasso et al. 2018a). Some young individuals have developed on sandy soil, at the edge of a flowerbed located in the urban area

near the Adriatic Sea, partially shaded by *Pinus pinea* L. and *P. halepensis* Mill. subsp. *halepensis*. They originate from the seeds produced by a tree growing in a nearby flowerbed.

N. Olivieri

+ (CAS) **PUG**: Lecce (Lecce), Villa Comunale "G. Garibaldi" nei pressi di Via A. Costa (WGS84: 40.354777N; 18.174555E), bordi di aiuole, 49 m, 23 August 2018, *N. Olivieri* (FI). – Casual alien species new for the flora of Puglia.

Some young individuals grow near the edges of flowerbeds and in cracks in the cement paving in an area located inside the Villa Comunale of Lecce. The young plants have grown from seeds produced by a tree found nearby.

N. Olivieri

Nomenclatural and distribution updates from other literature sources

Nomenclatural, status, and distribution updates according to Ross (1899), Chiovenda (1920), Cesca (1972), Viegi and Cela Renzoni (1981), Pedullà and Garbari (2002), Herman (2003), Raimondo et al. (2005), Nordenstam (2007), Domina and Mazzola (2008), Carine and Robba (2010), Arrigoni and Viegi (2011), Wood et al. (2015), Arrigoni (2016, 2017, 2018, 2019), Edwards (2017), Badalamenti and La Mantia (2018), Badalamenti et al. (2018), Cibei (2018a, 2018b), De Santis (2018a, 2018b, 2018c, 2018d), Englmaier and Wilhalm (2018), Lazzeri et al. (2018), Longo (2018), Manni (2018), Martini (2018), Nicolella (2018a, 2018b), Ottonello and Longo (2018a, 2018b, 2018c, 2018d), Pasta and Troia (2018), Pignatti (2018), Roma-Marzio et al. (2018), Stinca et al. (2018), Turland et al. (2018), Wilhalm et al. (2018), Bartolucci et al. (2019), Bovio (2019), Englmaier (2019), Lastrucci et al. (2019), Prosser et al. (2019), Stinca (2019), and corrections to Galasso et al. (2018a) are provided in Suppl. material 1.

G. Galasso, F. Bartolucci

Acknowledgements

We gratefully acknowledge Enrico Banfi and Daniela Longo, who provided distribution, nomenclatural and taxonomic suggestions.

References

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

Arrigoni PV (2016) Flora analitica della Toscana, Vol. 1. Edizioni Polistampa, Firenze.

Arrigoni PV (2017) Flora analitica della Toscana, Vol. 2. Edizioni Polistampa, Firenze.

Arrigoni PV (2018) Flora analitica della Toscana, Vol. 3. Edizioni Polistampa, Firenze.

Arrigoni PV (2019) Flora analitica della Toscana, Vol. 5. Edizioni Polistampa, Firenze.

Arrigoni PV, Viegi L (2011) La flora vascolare esotica spontaneizzata della Toscana. Regione Toscana, Direzione generale Politiche territoriali, ambientali e per la mobilità, Settore Tutela e valorizzazione delle risorse ambientali, Firenze.

Badalamenti E, Cusimano D, La Mantia T, Pasta S, Romano S, Troia A, Ilardi V (2018) The ongoing naturalisation of *Eucalyptus* spp. in the Mediterranean basin: new threats to native species and habitats. Australian Forestry 81(4): 239–249. https://doi.org/10.1080/00049158.2018.1533512

Badalamenti E, La Mantia T (2018) *Handroanthus heptaphyllus* (Bignoniaceae) in Sicily: a new casual alien to Italy and Europe. Flora Mediterranea 28: 331–338. https://doi.org/10.7320/FlMedit28.331

Banfi E, Galasso G (Eds) (2010) La flora esotica lombarda. Museo di Storia Naturale di Milano, Milano, 274 pp. [+ CD-Rom]

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

Bovio M (Ed.) (2019) Note di aggiornamento al volume *Flora vascolare della Valle d'Aosta* – 5. Revue Valdôtaine d'Histoire Naturelle 72(2018): 97–121.

Calflora (2018) Calflora, information on wild California plants. https://www.calflora.org/ [accessed 03.12.2018]

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

Carine MA, Robba L (2010) Taxonomy and evolution of the *Convolvulus sabatius* complex (Convolvulaceae). Phytotaxa 14: 1–21. https://doi.org/10.11646/phytotaxa.14.1.1

Cecchi L, Selvi F (2017) Flora critica d'Italia. Boraginaceae – Boragineae. Fondazione per la Flora Italiana, Firenze. https://doi.org/10.17773/Fl_Ita_Boragineae1.0

Cesca G (1972) Ricerche citologiche ed embriologiche nel genere *Euphorbia*: *Euphorbia oblongata* Griseb. Tipografia dell'Università di Siena, Siena.

Chen Z, Wen J (2007) *Parthenocissus* Planchon. In: Wu ZY, Raven PH (Eds) Flora of China, Vol. 12. Science Press, Beijing, Missouri Botanical Garden Press, St. Louis, 173–177.

Chiovenda E (1920) L'*Eragrostis caroliniana* (Spreng.) Scribner. Bullettino della Società Botanica Italiana 1920(1–3): 11–16.

Cibei C (2018a) Notarella: 0212. Acta Plantarum Notes 6: 158.

Cibei C (2018b) Notarella: 0221. Acta Plantarum Notes 6: 167.

Crisafulli A, Picone RM, Zaccone S (2011) *Phyllanthus tenellus* (Phyllanthaceae) a new alien species naturalized to Sicily, first record for Italy. Flora Mediterranea 21: 293–297.

Cullen J, Knees SG, Cubey HS (2011) Palmae (Arecaceae). In: Cullen J, Knees SG, Cubey HS (Eds) The European garden flora. A manual for the identification of plants cultivated in Europe, both out-of-doors and under glass. Ed. 2, Vol. 1. Cambridge University Press, Cambridge, 361–372.

DAISIE (2018) *Physalis philadelphica*. https://doi.org/10.1002/ejoc.201801400 [accessed 01.10.2018]

Danin A (2015) *Commelina erecta* L. In: Raab-Straube E von, Raus T (Eds) Euro+Med-Checklist Notulae, 4. Willdenowia 45(1): 124. https://doi.org/10.3372/wi.45.45113

Darst M, Gholson AK (2004) Noteworthy Collections. Florida. Castanea 69(4): 328. https://doi.org/10.2179/0008-7475(2004)069<0328:F>2.0.CO;2

De Santis E (2018a) Contributo alla conoscenza della flora vascolare dei Monti della Tolfa (Lazio). La flora lungo il fiume Mignone nei pressi di Rota (Tolfa, RM). Acta Plantarum Notes 6: 58–72.

De Santis E (2018b) Notarella: 0203. Acta Plantarum Notes 6: 149.

De Santis E (2018c) Notarella: 0206. Acta Plantarum Notes 6: 152.

De Santis E (2018d) Notarella: 0209. Acta Plantarum Notes 6: 155.

Domina G, Mazzola P (2008) Flora ornamentale delle isole circumsiciliane. Quaderni di Botanica Ambientale e Applicata 19: 107–119.

Edwards D (2017) A new name for an *Elaeagnus* hybrid. The Plantsman 16(4): 222–223.

Englmaier P (2019) Alien grasses (Poaceae) in the flora of the eastern Alps: first supplement. Neilreichia 10: 185–189. http://doi.org/10.5281/zenodo.2630541

Englmaier P, Wilhalm T (2018) Alien grasses (Poaceae) in the flora of the eastern Alps: contribution to an excursion flora of Austria and the Eastern Alps. Neilreichia 9: 177–245. http://doi.org/10.5281/zenodo.1196285

European Commission (2014) Regulation (EU) No 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species. http://eur-lex.europa.eu/legalcontent/EN/TXT/?qid=1468913651345&uri=CELEX:32014R1143 [accessed 21.02.2019]

Everett TH (1982) The New York botanical garden illustrated encyclopedia of horticulture, Vol. 10: Ste-Zy. Garland Publishing Inc. New York, London.

Faden RB (2000) Commelinaceae. In: Flora of North America Editorial Committee (Ed.) Flora of North America North of Mexico, Vol. 22. Oxford University Press, New York, Oxford, 170–197.

Farjon A (2017) A handbook of the world's conifers. Second, revised edition. Brill, Leiden, Boston. https://doi.org/10.1163/9789004324510

Fish L, Mashau AC, Moeaha MJ, Nembudani MT (2015) Identification guide to southern African grasses. Strelitzia 36: 271–276.

Flora Zambesiaca (2018) Key to *Physalis*. http://apps.kew.org/efloras/key.do?parentkeyid=2368&keyid=2374 [accessed 11.11.2018]

Fryer J, Hylmö B, Zika PF (2014) *Cotoneaster* Medikus. In: Flora of North America Editorial Committee (Ed.) Flora of North America North of Mexico, Vol. 9. Oxford University Press, New York, Oxford, 448–468.

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, Marti-

netto 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, 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, 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 N, Pennesi R, Peruzzi L, Podda L, Probo M, Prosser F, Ravetto Enri S, Roma-Marzio F, Ruggero A, Scafidi F, Stinca A, Nepi C (2018b) Notulae to the Italian alien vascular flora: 6. Italian Botanist 6: 65–90. https://doi.org/10.3897/italianbotanist.6.30560

Gibbs Russell GE, Watson L, Koekemoer M, Smook L, Barker NP, Anderson HM, Dallwitz MJ (1990) Grasses of southern Africa. Memoirs of the Botanical Survey of South Africa 58: 1–437.

Gildenhuys E, Ellis AG, Carroll SP, Le Roux JJ (2013) The ecology, biogeography, history and future of two globally important weeds: *Cardiospermum halicacabum* Linn. and *C. grandiflorum* Sw. NeoBiota 19: 45–65. https://doi.org/10.3897/neobiota.19.5279

Govaerts R, Kington S, Friesen N, Fritsch R, Snijman DA, Marcucci R, Silverstone-Sopkin PA, Brullo S (2018) World checklist of Amaryllidaceae. Facilitated by the Royal Botanic Gardens, Kew. http://wcsp.science.kew.org [accessed 11.11.2018]

Herman PPJ (2003) *Dimorphotheca* Vaill. ex Moench. In: Germishuizen G, Meyer NL (Eds) Plants of southern Africa: an annotated checklist. Strelitzia 14: 211–212.

Hinojosa-Espinosa O, Villaseñor JL (2015) *Arctotheca prostrata* (Asteraceae: Arctotideae), a South African species now present in Mexico. Botanical Sciences 93(4): 1–4. https://doi.org/10.17129/botsci.223

Holm LG, Plucknett DL, Pancho JV, Herberger JP (1977) The world's worst weeds. Distribution and biology. University Press of Hawaii, Honolulu.

Kumar B (2011) *Commelina erecta*. The IUCN red list of threatened species 2011: e.T176972A7342930. [accessed 15.10.2018] https://doi.org/10.2305/IUCN.UK.2011-1.RLTS.T176972A7342930.en

Lastrucci L, Dell'Olmo L, Foggi B, Massi L, Nuccio C, Vicenti C, Viciani D (2017a) Contribution to the knowledge of the vegetation of the Lake Massaciuccoli (northern Tuscany, Italy). Plant Sociology 54(1): 67–87. https://doi.org/10.7338/pls2017541/03

Lastrucci L, Fiorini G, Lunardi L, Viciani D (2019) Herbarium survey on the genus *Azolla* (Salviniaceae) in Italy: distributive and taxonomic implications. Plant Biosystems. https://doi.org/10.1080/11263504.2018.1549601

Lastrucci L, Foggi B, Becattini R (2006) *Myriophyllum aquaticum* (Vell.) Verdc. (Haloragaceae): una nuova specie esotica invasiva per la Toscana. Informatore Botanico Italiano 37(2) [2005]: 1133–1136.

Lastrucci L, Lazzaro L, Dell'Olmo L, Foggi B, Cianferoni F (2017b) Impacts of *Myriophyllum aquaticum* invasion in a Mediterranean wetland on plant and macro-arthropod communities. Plant Biosystems 152(3) [2018]: 427–435. https://doi.org/10.1080/11263504.2017.1303002

Lastrucci L, Valentini E, Dell'Olmo L, Vietina B, Foggi B (2016) Hygrophilous vegetation and habitats of conservation interest in the area of the Lake Porta (Tuscany, Central Italy). Atti della Società Toscana di Scienze Naturali, Memorie, Serie B 122(2015): 131–146. https://doi.org/10.2424/ASTSN.M.2015.12

Lazzeri V, Gestri G, Borzatti von Löwenstern A, Mannocci M, Barsotti G, Campus G, Caramante P (2018) Note floristiche tosco-sarde IV: novità regionali e locali per le regioni Toscana e Sardegna. Annali del Museo Civico di Rovereto. Sezione: Archeologia, Storia Scienze Naturali 33 (2017): 79–110.

Longo D (2018) Notarella: 0216. Acta Plantarum Notes 6: 162.

Lu LT, Brach AR (2003) *Cotoneaster* Linnaeus. In: Wu ZY, Raven PH (Eds) Flora of China, Vol. 9. Science Press, Beijing, Missouri Botanical Garden Press, St. Louis, 85–108.

Lucchese F (2010) Molise. In: Celesti-Grapow L, Pretto F, Carli E, Blasi C (Eds) Flora vascolare alloctona e invasiva delle regioni d'Italia. Casa Editrice Università La Sapienza, Roma, 114–118.

Lucchese F (Ed.) (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.

Mahoney AM, McKenzie RJ (2012) *Arctotheca*. In: Jepson Flora Project (Eds) Jepson eFlora. http://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=77538 [accessed 24.12.2018]

Maniero F (2015) Cronologia della flora esotica italiana. Leo S. Olschki, Firenze.

Manni QG (2018) Notarella: 0237. Acta Plantarum Notes 6: 183.

Marchessi JE, Subils R, Scaramuzzino RL, Crosta HN, Eseiza MF, Saint André HM, Juan VF (2011) Presencia de *Euphorbia davidii* Subils (Euphorbiaceae) en la Provincia de Buenos Aires: morfología y anatomía de la especie. Kurtziana 36(1): 45–53.

Martini F (Ed.) (2018) Aggiornamenti alla flora del Friuli Venezia Giulia (Italia nordorientale). Nuova serie. III (65–84). Gortania. Botanica, Zoologia 37 (2017): 19–28.

McAllister HA, Rutherford A (1990) *Hedera helix* L. and *H. hibernica* (Kirchner) Bean (Araliaceae) in the British Isles. Watsonia 18(1): 7–15.

McLean P, Wilson JRU, Gaertner M, Kritzinger-Klopper S, Richardson DM (2018) The distribution and status of alien plants in a small South African town. South African Journal of Botany 117: 71–78. https://doi.org/10.1016/j.sajb.2018.02.392

Mito T, Uesugi T (2004) Invasive alien species in Japan: the status quo and the new regulation for prevention of their adverse effects. Global Environmental Research 8(2): 171–191.

New England Wild Flower Society (2018) *Physalis*. In: Go Botany. https://gobotany.newenglandwild.org/dkey/physalis/ [accessed 11.11.2018]

Nicolella G (2018a) Notarella: 0205. Acta Plantarum Notes 6: 151.

Nicolella G (2018b) Notarella: 0208. Acta Plantarum Notes 6: 154.

Nordenstam B (2007) Tribe Calenduleae Cass. (1819). In: Kadereit JW, Jeffrey C (Eds) The families and genera of vascular plants, Vol. 8. Springer, Berlin, Heidelberg, 241–245.

Ottonello M, Longo D (2018a) Notarella: 0213. Acta Plantarum Notes 6: 159.

Ottonello M, Longo D (2018b) Notarella: 0214. Acta Plantarum Notes 6: 160.

Ottonello M, Longo D (2018c) Notarella: 0222. Acta Plantarum Notes 6: 168.

Ottonello M, Longo D (2018d) Notarella: 0223. Acta Plantarum Notes 6: 169.

Pandža M (2017) Alien flora of the settlement of Jezera on the island Murter (Dalmatia, Croatia). Agronomsky Glasnik 3: 121–148. https://doi.org/10.33128/ag.79.3.4

Pasta S, La Rosa A, La Mantia T, Badalamenti E (2016) *Anredera cordifolia* (Ten.) Steenis (Basellaceae): status in Italia e sua espansione in Sicilia occidentale. Il Naturalista Siciliano s. 4, 40(1): 145–149.

Pasta S, Troia A (2018) From common and used to rare and forgotten: past and present distribution of the archaeophyte *Euphorbia lathyris* L. (Euphorbiaceae) in southern Italy and Sicily. Atti della Società Toscana di Scienze Naturali, Memorie, Serie B.

Pavari A, De Philippis A (1941) La sperimentazione di specie forestali esotiche in Italia. Risultati del primo ventennio. Annali della Sperimentazione Agraria 38: 1–648.

Pedullà ML, Garbari F (2002) Piante d'interesse biogeograficoecologico nei canali di bonifica della pianura pisana. Atti della Società Toscana di Scienze Naturali, Memorie, Serie B 108 (2001): 113–117.

Peruzzi L, Viciani D, Angiolini C, Astuti G, Avanzi A, Baldanzi C, Benesperi R, Bonari G, Bonini I, D'antraccoli M, Castellani B, Dell'Olmo L, Di Nuzzo L, Domina G, Ercolini P, Ferretti G, Fontana D, Gestri G, Gottschlich G, Grazzini A, Lastrucci L, Lazzaro L, Malfanti F, Marsiaj G, Piazzini S, Pierini B, Roma-Marzio F, Sani A, Selvi F, Vicenti C, Bedini G (2016) Contributi per una flora vascolare di Toscana. VII (357–439). Atti della Società Toscana di Scienze Naturali, Memorie, Serie B 122(2015): 61–72. https://doi.org/10.2424/ASTSN.M.2015.07

Pflugbeil G, Moosbrugger K (2016) Floristische Besonderheiten in der Stadt Salzburg und ihren Umlandgemeinden. Mitteilungen aus dem Haus der Natur 23: 58–71.

Pignatti S (2018) Flora d'Italia. Ed. 2, Vol. 3. Edagricole, Bologna.

Prosser F, Bertolli A, Festi F, Perazza G (2019) Flora del Trentino. Ed. Osiride, Fondazione Museo Civico, Rovereto (Trento).

Raabe U, Raus T (2016) *Oenothera lindheimeri* (Engelm. & A. Gray) W. L. Wagner & Hoch. In: Raab-Straube E von, Raus T (Eds) Euro+Med-Checklist Notulae, 6. Willdenowia 46(3): 430. https://doi.org/10.3372/wi.46.46310

Raimondo FM, Domina G, Spadaro V, Aquila G (2005) Prospetto delle piante avventizie e spontaneizzate in Sicilia. Quaderni di Botanica Ambientale e Applicata 15 (2004): 153–164.

Rehman S, Park I-H (2000) Effect of scarification, GA and chilling on the germination of goldenrain-tree (*Koelreuteria paniculata* Laxm.) seeds. Scientia Horticulturae 85(4): 319–324. https://doi.org/10.1016/S0304-4238(00)00126-6

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.

Ross H (1899) Beitrage zur Flora von Sicilien. 1 Teil. Erläuterungen und kritische Bemerkungen zum Herbarium siculum. Centuria I. Bulletin de l'Herbier Boissier 7(4): 262–299.

Rostański K, Verloove F (2015) The genus *Oenothera* (Onagraceae) in Belgium. Dumortiera 106: 12–42.

Sánchez Gullón E, Verloove F (2015) New records of interesting xenophytes in the Iberian Peninsula. V. Lazaroa 36: 43–50. https://doi.org/10.5209/rev_LAZA.2015.v36.48752

Schoenenberger N, Röthlisberger J, Carraro G (2014) La flora esotica del Cantone Ticino (Svizzera). Bollettino della Società Ticinese di Scienze Naturali 102: 13–30.

Singh G, Singh OP, De Lampasona MP, Catalán CA (2003) Studies on essential oils. Part 35: chemical and biocidal investigations on *Tagetes erecta* leaf volatile oil. Flavour and Fragrance Journal 18(1): 62–65. https://doi.org/10.1002/ffj.1158

Soldano A, Verloove F (2013) Nota floristica piemontese n. 531. *Physalis viscosa* L. (Solanaceae). In: Selvaggi A, Soldano A, Pascale M, Dellavedova R (Eds) Note Floristiche Piemontesi n. 460–544. Rivista Piemontese di Storia Naturale 34: 403.

Spadaro V, Raimondo FM (2017) Stazioni nuove di *Euphorbia hypericifolia* (Euphorbiaceae) e di *Phyllanthus tenellus* (Phyllanthaceae) in Sicilia. Quaderni di Botanica Ambientale e Applicata 26 (2015): 39–42.

Squire D (2007) Palms and Cycads. A complete guide to selecting, growing and propagating. New Holland Publishers Ltd., London.

Stinca A (2019) The genus *Vitis* L. (Vitaceae) in Campania (southern Italy), with emphasis on alien units. Annali di Botanica 9: 107–112. https://doi.org/10.13133/2239-3129/14792

Stinca A, Ravo M, Giacanelli V, Conti F (2018) Additions to the vascular flora of the islands of Procida and Vivara (Campania, southern Italy). Atti della Società Toscana di Scienze Naturali, Memorie, Serie B 125: 87–93. https://doi.org/10.2424/ASTSN.M.2018.14

Stokes CA, MacDonald GE, Adams CR, Langeland KA, Miller DL (2011) Seed biology and ecology of natalgrass (*Melinis repens*). Weed Science 59(4): 527–532. https://doi.org/10.1614/WS-D-11-00028.1

Tison JM (2012) *Oenothera lindheimeri* (Engelm. & A.Gray) W.L.Wagner & Hoch. In: Jeanmonod D, Schlüssel A (Eds) Notes et contributions à la flore de Corse, XXIV. Candollea 67(2): 316. https://doi.org/10.15553/c2012v672a11

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

Verloove F (2019) *Parthenocissus tricuspidata*. In: Manual of the alien plants of Belgium. Botanic Garden Meise, Belgium. http://alienplantsbelgium.be/species-list/parthenocissus-tricuspidata [accessed 05.01.2019]

Verloove F, Sánchez Gullón E (2012) New records of interesting vascular plants (mainly xenophytes) in the Iberian Peninsula. II. Flora Mediterranea 22: 5–24. https://doi.org/10.7320/FlMedit22.005

Viegi L, Cela Renzoni G (1981) Flora esotica d'Italia: le specie presenti in Toscana. Consiglio Nazionale delle Ricerche, Collana «Promozione della qualità dell'ambiente», Pavia, AQ/1/132.

Viggiani P (2015) L'americana *Euphorbia davidii* sulla soia italiana. Terra e Vita 56(46): 58–61.

Wang ZQ, Guillot D, Ren MX, López-Pujol J (2016) *Kalanchoe* (Crassulaceae) as invasive aliens in China – new records, and actual and potential distribution. Nordic Journal of Botany 34(3): 349–354. https://doi.org/10.1111/njb.01052

Ward DB (2008) Keys to the flora of Florida: 18, *Kalanchoe* (Crassulaceae). Phytologia 90(1): 41–46.

Wilhalm T, Aichner G, Argenti C, Bucher E, Egger W, Fink M, Girardi E, Hilpold A, Hofer G, Kiebacher T, Mallaun M, Prosser F, Rinner A, Sölva E, Stockner W, Thalinger M, Tratter W, Unterluggauer P, Winkler J, Zemmer F (2018) Ergänzungen und Korrekturen zum Katalog der Gefäßpflanzen Südtirols (8). Gredleriana 18: 5–16.

Wood JRI, Williams BRM, Mitchell TC, Carine MA, Harris DJ, Scotland RW (2015) A foundation monograph of *Convolvulus* L. (Convolvulaceae). PhytoKeys 51: 1–282. https://doi.org/10.3897/phytokeys.51.7104

Yan XL, Liu QR, Shou HY, Zeng XF, Zhang Y, Chen L, Liu Y, Ma HY, Qi SY, Ma JS (2014) The categorization and analysis on the geographic distribution patterns of Chinese alien invasive plants. Biodiversity Science 22(5): 667–676. https://doi.org/10.3724/SP.J.1003.2014.140699

Supplementary material 1

Supplementary data

Edited by: Gabriele Galasso, Fabrizio Bartolucci

Data type: species data

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

Link: https://doi.org/10.3897/italianbotanist.7.36386.suppl1

Italian Botanist 7: 183–187 (2019)
doi: 10.3897/italianbotanist.7.36004
http://italianbotanist.pensoft.net

RESEARCH ARTICLE

Italian Botanist
Published by Società Botanica Italiana

Chromosome numbers for the Italian flora: 7

Giovanni Astuti[1], Lijuan Liu[1], Lorenzo Peruzzi[1]

1 *Dipartimento di Biologia, Università di Pisa, Via Derna 1, 56126 Pisa, Italy*

Corresponding author: *Giovanni Astuti* (gastuti@biologia.unipi.it)

Academic editor: *G. Domina* | Received 9 May 2019 | Accepted 16 May 2019 | Published 18 June 2019

Citation: Astuti G, Liu L, Peruzzi L (2019) Chromosome numbers for the Italian flora: 7. Italian Botanist 7: 183–187. https://doi.org/10.3897/italianbotanist.7.36004

Abstract

In this contribution, new chromosome data obtained on material collected in Italy are presented. It includes a total of 105 chromosome counts for three populations of *Pulmonaria vallarsae* A.Kern. subsp. *apennina* (Cristof. & Puppi) Cecchi & Selvi and for three populations of *P. hirta* L.

Keywords

cytogeography, cytotaxonomy, *Pulmonaria hirta* complex

How to contribute

Texts concerning new chromosome data should be submitted electronically to Giovanni Astuti (gastuti@biologia.unipi.it), including indications on voucher specimens and methods used.

Chromosome counts

Pulmonaria vallarsae A.Kern. subsp. *apennina* (Cristof. & Puppi) Cecchi & Selvi (Boraginaceae)

Chromosome number. $2n = 22$ (Figs 1, 2)

Voucher specimen. ITALY. Emilia-Romagna. Casalecchio di Reno (Bologna), Parco Talon (WGS84: 44.47278N, 10.28416E), 76 m s.l.m., 23 March 2018, *G. Astuti et L. Liu* (PI n° 021283–021302); **Calabria.** San Fili (Cosenza), Foresta Luta (WGS84: 39.34085N, 16.08722E), margine di bosco a *Fagus sylvatica* (più in basso a

Figure 1. *Pulmonaria vallarsae* A.Kern. subsp. *apennina* (Cristof. & Puppi) Cecchi & Selvi from Parco Talon (Casalecchio di Reno, Bologna), 2*n* = 22. Scale bar: 10 µm.

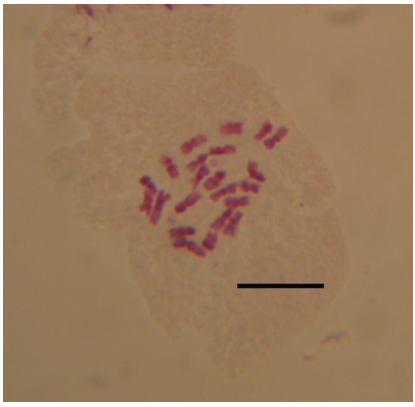

Figure 2. *Pulmonaria vallarsae* A.Kern. subsp. *apennina* (Cristof. & Puppi) Cecchi & Selvi from Foresta Luta (San Fili, Cosenza), 2*n* = 22. Scale bar: 10 µm.

Tilia platyphyllos e *Acer platanoides*), 1030 m s.l.m., 5 April 2018, *G. Astuti, L. Liu, F. Roma-Marzio* (PI n° 021323–021342).

Chromosome number. 2*n* = 26 (Fig. 3)

Voucher specimen. ITALY. Abruzzo. Rocca di Mezzo (L'Aquila), in Via dei Prati Santi (WGS84: 42.2125N, 13.51305E), lungo il fossato insieme a *Salix apennina*, 1289 m s.l.m., 10 April 2018, *G. Astuti, L. Liu, F. Bartolucci* (PI n° 021303–021322).

Method. Squash preparations were made on root-tips obtained from potted plants. 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. Puppi and Cristofolini (1996) collected the holotype of the name *P. apennina* from Parco Talon (Emilia-Romagna). All the 18 plants sampled from this population show the typical chromosome number of *P. apennina*, i.e. 2*n* = 22, without

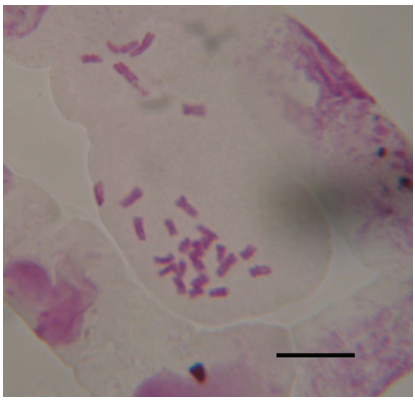

Figure 3. *Pulmonaria vallarsae* A.Kern. subsp. *apennina* (Cristof. & Puppi) Cecchi & Selvi from Rocca di Mezzo (L'Aquila), 2*n* = 26. Scale bar: 10 µm.

any variation. Also the chromosome number found in 18 individuals from Foresta Luta (Calabria) is 2*n* = 22, and it agrees with a single previous count (Peruzzi and Cesca 2003) available from that area. On the contrary, all the 17 individuals sampled from Rocca di Mezzo (Abruzzo) show 2*n* = 26 chromosomes. The identification of these plants was based on morphological features, revised by L. Cecchi on herbarium sheets preserved at APP (F. Bartolucci *in verbis*). Previously, chromosome numbers (2*n* = 25, 26) intermediate between 2*n* = 22, typical of *P. apennina*, and 2*n* = 28, typical of *P. hirta* (Cecchi and Selvi 2015), were reported from populations in northern and central Apennines (Puppi and Cristofolini 1996, Vosa and Pistolesi 2004). However, this is the first case in which an intermediate chromosome number is constantly observed within a single population.

G. Astuti, L. Liu, L. Peruzzi

***Pulmonaria hirta* L. (Boraginaceae)**

Chromosome number. 2*n* = 28 (Figs 4, 5, 6)

Voucher specimen. ITALY. Toscana. Poppi (Arezzo), all'Eremo di Camaldoli (WGS84: 43.80902N, 11.82518E), lungo la SP124 nel tratto che porta dall'eremo al Prato alla Penna, al margine della faggeta, 1150 m s.l.m., 24 April 2018, *G. Astuti et L. Liu* (PI n° 021358–021376); Santa Maria a Monte (Pisa), Valle Lupitana (WGS84: 43.71388N, 10.67218E), nelle schiarite del bosco, 39 m s.l.m., 21 March 2018 *G. Astuti et L. Liu* (PI n° 021343–021357); **Emilia-Romagna.** Grizzana Morandi (Bologna), lungo la SP73 presso la località Favari, (WGS84: 44.22385N, 11.09556E), a margine del querceto, 539 m s.l.m., 19 April 2018, *G. Astuti et L. Liu* (PI n° 021377–021396).

Method. Squash preparations were made on root-tips obtained from potted plants. Root tips were pre-treated with 0.4% colchicine for 3 hours and then fixed in Carnoy

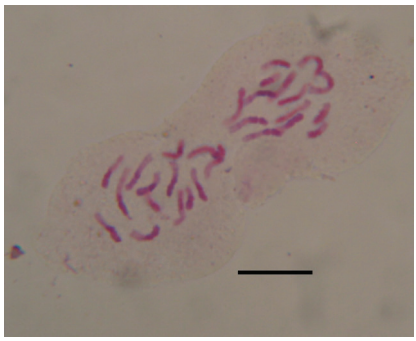

Figure 4. *Pulmonaria hirta* L. from Eremo di Camaldoli (Poppi, Arezzo), 2*n* = 28. Scale bar: 10 μm.

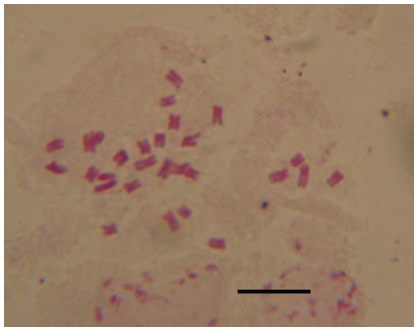

Figure 5. *Pulmonaria hirta* L. from Valle Lupitana (Santa Maria a Monte, Pisa), 2*n* = 28. Scale bar: 10 μm.

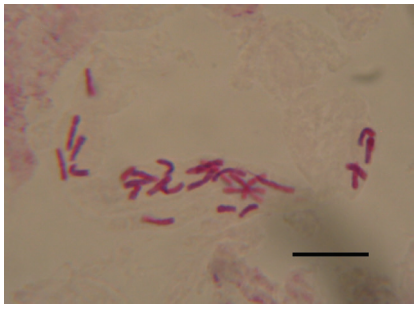

Figure 6. *Pulmonaria hirta* L. from Favari (Grizzana Morandi, Bologna), 2*n* = 28. Scale bar: 10 μm.

fixative solution for 1 hour. After hydrolysis in HCl 1N at 60 °C, the tips were stained in leuco-basic fuchsine.

Observations. A specimen collected in Camaldoli (Toscana) was selected as the epitype for the name *P. hirta* by Selvi in Cafferty and Jarvis (2004). We found 2*n* = 28 chromosomes, the chromosome number typical of this species (Cecchi and Selvi 2015), and no variation among the 16 individuals sampled in this topotypical popula-

tion. A specimen coming from Valle Lupitana (Toscana) was selected by Puppi and Cristofolini (1996) as the neotype for the name *Pulmonaria picta* Rouy, a heterotypic syonym of *P. hirta*. Also for the 18 individuals sampled in this population, we found $2n = 28$ chromosomes, in agreement with other counts from the same geographical area (Vosa and Pistolesi 2004). The identification of the population from Favari (Emilia-Romagna) was based on morphological features of basal leaves, and the 18 individuals sampled, all showing $2n = 28$ chromosomes, confirmed our identification.

G. Astuti, L. Liu, L. Peruzzi

Acknowledgements

The authors are deeply grateful to Fabrizio Bartolucci, Giancarlo Marconi, Francesco Roma-Marzio and Paolo Pupillo for their help during field activities.

References

Cafferty S, Jarvis CE (2004) Typification of linnaean plant names in Boraginaceae. Taxon 53(3): 799–805. https://doi.org/10.2307/4135454

Cecchi L, Selvi F (2015) Boraginaceae in Italy – II. Plant Biosystems 149: 630–677. https://doi.org/10.1080/11263504.2015.1057261

Peruzzi L, Cesca G (2003) Numeri Cromosomici per la Flora Italiana 1421–1433. Informatore Botanico Italiano 35(1): 85–91.

Puppi G, Cristofolini G (1996) Systematics of the complex *Pulmonaria saccharata*, *Pulmonaria vallarsae* and related species (Boraginaceae). Webbia 51: 1–20. https://doi.org/10.1080/00837792.1996.10670611

Vosa CG, Pistolesi G (2004) Chromosome numbers and distribution of the genus *Pulmonaria* (Boraginaceae) in Tuscany and neighbouring areas. Caryologia 57(1): 121–126. https://doi.org/10.1080/00087114.2004.10589380