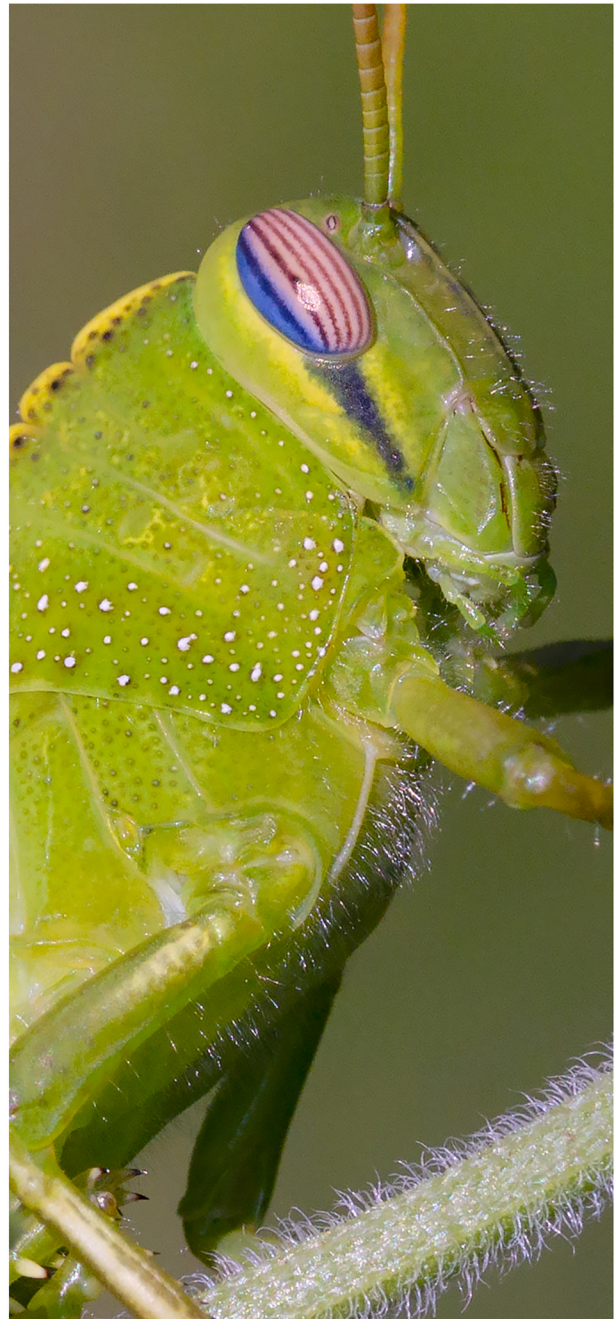


LIFE ON ISLANDS

BIODIVERSITY IN SICILY AND SURROUNDING ISLANDS

Studies dedicated to **Bruno Massa**



edizioni danaus

Tommaso La Mantia, Emilio Badalamenti, Attilio Carapezza,
Pietro Lo Cascio & Angelo Troia (Editors)

LIFE ON ISLANDS. 1

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On the front cover a Sicilian rock partridge, *Alectoris graeca whitakeri* Schiebel, 1934 and an Egyptian locust, *Anacridium aegyptium* (Linnaeus, 1764); on the back cover a summer image of Linosa Island (photos T. Puma).

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BIO-ECOLOGICAL SURVEY ON THE VASCULAR FLORA OF THE SATELLITE ISLETS OF THE AEOLIAN ARCHIPELAGO (SOUTH-EASTERN TYRRHENIAN SEA, ITALY)

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SUMMARY: This work provides an updated checklist of 174 vascular plant taxa recorded for 22 islets of the Aeolian Archipelago. This checklist results from a 15 years-long (1994-2009) survey carried out by the authors but also takes into account the sparse data published by botanists and travelers since 1828. Species richness is strongly correlated to coastal perimeter, number of habitats, islet surface and distance from the nearest island. Therophytes are the most frequent life form, while the percentage of phanerophytes often results very high, a common feature for small islands worldwide. Concerning life strategies, ruderal (R), stress-tolerant (S), mixed S-R and mixed competitive-ruderal (C-S) plants are the most frequent ones. The islets show a remarkable floristic distinctness: 83 taxa (56.8% of the entire islets' flora) occur on one single islet, while only 12 (8.2%) grow on more than 5 islets; furthermore, *Hordeum marinum* subsp. *gussoneanum* and *Parapholis marginata* are new records for the archipelago. Nonetheless, a certain degree of floristic similarity allows to identify two large groups: the first including essentially the satellites of Lipari Island, the second mostly represented by larger islets and the group located east of Panarea Island. *Anthemis aeolica*, a narrow endemic, currently grows only on Lisca Bianca. Following IUCN risk assessment guidelines, this plant should be considered "CR" (critically endangered) following the criteria B1ab (iv, v) + B2ab (iv, v). Despite the moderate impact of alien plants and seagull colonies, more appropriate and effective measures are urgently needed to protect the biological heritage of these tiny islets.

KEY WORDS: species richness, turnover, disturbance, small island specialists, plant traits, endemism.

RIASSUNTO: Indagini bioecologiche sulla flora vascolare degli isolotti satelliti dell'Arcipelago Eoliano (Tirreno sud-orientale, Italia) - Viene presentata una checklist aggiornata di 174 taxa di piante vascolari censiti per 22 isolotti dell'Arcipelago Eoliano, frutto di 15 anni (1994-2009) di indagini condotte dagli autori e comprendente anche i dati sparsi pubblicati da botanici e viaggiatori a partire dal 1828. La ricchezza specifica è strettamente correlata con il perimetro costiero, la diversità di habitat, la superficie degli isolotti e la loro distanza dall'isola maggiore più vicina. Le terofite costituiscono la categoria principale tra le forme di crescita, ma anche le fanerofite raggiungono una percentuale spesso molto alta, una caratteristica piuttosto comune nelle piccole isole su scala globale. Riguardo alle strategie di risposta a fattori di stress e di disturbo, le categorie delle ruderali (R), stress-tolleranti (S), miste S-R e miste competitive-ruderali (C-S) risultano quelle maggiormente rappresentate. Gli isolotti mostrano tra loro una discreta diversità floristica: 83 taxa (pari al 56,8% dell'intera flora censita) risultano presenti solo su un isolotto, mentre soltanto 12 (8,2%) sono stati rinvenuti su più di 5 isolotti; due taxa appartenenti alla famiglia Poaceae, *Hordeum marinum* subsp. *gussoneanum* e *Parapholis marginata*, vengono inoltre segnalati per la prima volta per l'arcipelago. L'analisi della similarità floristica tra gli isolotti ha messo in luce un certo grado di affinità all'interno di due macro-gruppi: il primo include soprattutto i satelliti di Lipari, il secondo quelli a Est di Panarea e, allo stesso tempo, anche gli isolotti di maggiore estensione. *Anthemis aeolica* è un endemismo esclusivo attualmente presente soltanto sull'isolotto di Lisca Bianca. Secondo le indicazioni per la valutazione del rischio proposte dall'IUCN, la specie va riferita alla categoria "CR" (criticamente minacciata) secondo i criteri B1ab (iv, v) + B2ab (iv, v). Nonostante gli isolotti ospitino un modesto contingente di specie aliene e le colonie di gabbiani esercitino un disturbo abbastanza contenuto, si evidenzia la necessità urgente di misure più concrete e appropriate per la conservazione del loro patrimonio biologico.

PAROLE CHIAVE: ricchezza specifica, avvicendamento, disturbo, specialisti di "piccole isole", bio-ecologia vegetale, endemismo.

INTRODUCTION

Islands' fascination has long influenced mythology, literature, poetry, history, psychology, collective imagination and even science, which usually should be far from anything unrelated to objective methods based on theoretical principles or coherent sequences of events. The inordinate fondness for islands that also involves scientists, especially biologists, may perhaps be explained through the

fundamental role played by these territories in the development of revolutionary theories that changed modern science and thought since the 19th century. Darwin, Wallace and a wide plethora of naturalists and biologists as far as modern times are certainly indebted to islands and insularity, constantly proposed as field-labs or key-places to study ecological and evolutionary processes.

No less important is the contribution given by the islands to global biodiversity: although they

represent only a small part of the emerged lands, they host a large fraction of the overall biological richness (Whittaker & Fernández-Palacios 2006); the isolation of these ecosystems has favoured evolutionary divergences and endemism, but also offered refuge to organisms threatened or disappeared elsewhere.

In this perspective, the tiny uninhabited islets offer an exceptional field of study for botanists because they represent both conservative and extremely simplified contexts (see for instance Médail & Vidal 1998b; Bergmeier & Dimopoulos 2003; Panitsa *et al.* 2006; Foggi *et al.* 2009; Lo Cascio & Pasta 2011, 2012; Rita & Bibiloni 2013; Véla *et al.* 2013; Pasta *et al.* 2014b; Fois *et al.* 2016). The Aeolian archipelago represents one of the most complex insular systems of the central Mediterranean Basin: apart from the main seven islands, it includes a hundred islets and stacks, and twenty-four of them currently harbour vascular plants. While the vascular flora of the main islands can be considered well known (Pasta *et al.* 2019 and references therein), satellite islets have been only occasionally studied and for many of them no botanical data were available so far.

The small stack Briantinu, located in the bay of Calajunco near the southern coast of Panarea Island, actually was the only investigated islet of the archipelago (Sciberras & Sciberras 2012). As for other satellites of Panarea (Basiluzzo, Lisca Bianca, Dattilo, Bottaro and Lisca Nera), as well as for Strombolicchio (off Stromboli Island), scattered records have been included in the pioneer works issuing from the first botanical explorations of the archipelago (Gussone 1832-1834, 1842-1845; Lojacono 1878), the reports of occasional visits (De Angelis D'Ossat 1900; Lojacono-Pojero 1902a), and in the ponderous volumes "Die Liparischen Inseln" written by the archduke Luigi Salvatore d'Asburgo Lorena (Habsburg Lothringen 1893b, 1895, 1896), a detailed geographic work that also contains the first information on the flora of Scogli Faraglione (near Salina Island). More recently, new or additional data for these islets have been provided by Ferro & Furnari (1968), Brullo *et al.* (1997, 2016), Pasta *et al.* (1999, 2014a), Brullo & Minissale (2002), Lo Cascio (2004, 2006, 2017), while Di Palma (1980) and Lo Cascio *et al.* (2014a) have given some floristic records for La Canna (near Filicudi Island).

The aim of this paper is to illustrate and analyze the vascular flora of the satellite islets of the Aeolian Archipelago on the basis of the results of investigations started 26 years ago and extended to 23 islets on the whole. Field work was carried out systematically between 1994 and 2009, but further surveys have been also done later.

We decided to sort out from this research Briantinu, already investigated by Sciberras & Sci-

berras (2012), and Dattilo, the second largest islet of the group east of Panarea, because its inaccessibility hindered careful exploration. In contrast, we left the data concerning Lisca Nera, the smallest islet of the same group, although it was recently destroyed by erosion and there are currently no plant populations on its residual fragments (see below).

The floristic composition of islets' plant assemblages, patterns of similarity and species richness were commented under an ecological and phytogeographic perspective.

STUDY AREA

Geographical setting

The Aeolian Archipelago (SE Tyrrhenian Sea) lies between 38°49'-38°22' latitude N and 15°15'-14°20' longitude E Greenwich, and is located 19.5 km far from the northern coasts of Sicily (between Vulcano Island and Capo Calavà) and 54.3 km far from Southern Italy (between Stromboli Island and Capo Vaticano, Calabria). It includes seven main islands (Fig. 1a) and a wide number of islets and stacks, whose surface ranges from 0.0001 to 0.28 km².

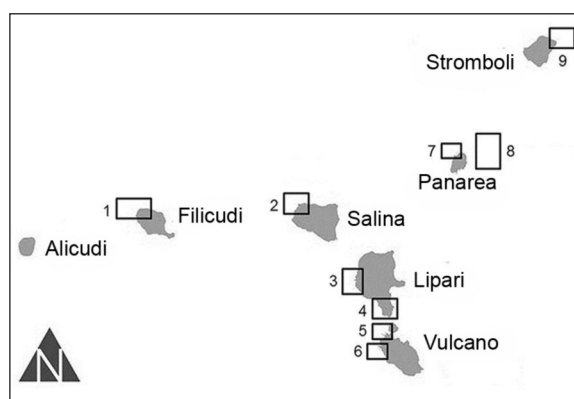


Fig. 1a. The study area in the framework of the Aeolian Archipelago.

The location of the study islets is shown in figure 1b, while information regarding their main geographical features is provided in Table 1. The name of each islet has been abbreviated through a three-letters code, in order to simplify the text (Fig. 1b and Table 1). The place-names were assigned according to the official maps of I.G.M. (Istituto Geografico Militare) and I.I.M.M. (Istituto Idrografico della Marina Militare). However, for some unnamed islets we adopted the vernacular toponyms used in the maps drawn by the Holzel Geographische Institut of Wien in the late 19th century and published by Habsburg Lothringen (1893a, 1894); namely, these islets are: "Faragghiuni d'u Puortu 'i Punenti" (= Faraglione Porto Ponente: FPP), off the NW coast of Vulcano Island;

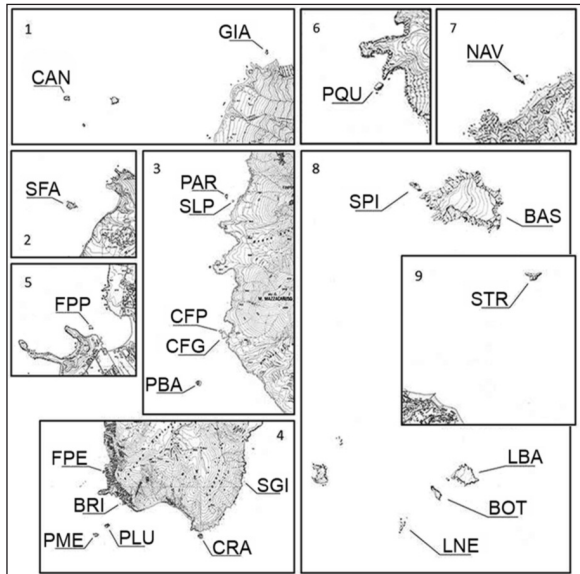


Figure 1b. Location and three-letter codes of the study islets. Box 1: CAN) La Canna, GIA) Gifante; box 2: SFA) Scoglio Faraglione; box 3: CFG) Cala Fico Grande, CFP) Cala Fico Piccolo, PAR) Parmara, PBA) Pietra del Bagno, SLP) Scoglio Lungo del Palmeto; box 4: BRI) Brigghiu, CRA) Crapazza, FPE) Faraglione del Perciato, PLU) Pietra Lunga, PME) Pietra Menalda, SGI) Scoglio di San Giuseppe; box 5: FPP) Faraglione di Porto Ponente; box 6: PQU) Pietra Quaglietto; box 7: NAV) La Nave; box 8: BAS) Basiluzzo, BOT) Bottaro, LBA) Lisca Bianca, LNE) Lisca Nera, SPI) Spinazzola; box 9: STR) Strombolicchio.

“U Brigghiu” (BRI) and “Faragghiuni d’u Pirciatu” (= Faraglione del Perciato: FPE), off the S coast of Lipari Island. According to Habsburg Lothringen (1894), also the vernacular names of Parmara (PAR) (Fig. 2) and Scoglio Lungo del Palmeto (SLP) have been preferred to the recent generic toponym “Torricelle” featuring in the I.G.M. maps to indicate both two islets off the NW coast of Lipari Island, in order to easily distinguish them. Finally,

new toponyms have been coined for some coastal islets of Lipari Island still unnamed in any map: Crapazza (CRA) (Fig. 3), off the homonymous headland in the S coast; San Giuseppe (SGI), off the homonymous headland in the SE coast; Cala Fico Piccolo (CFP) and Cala Fico Grande (CFG), off the homonymous bay in the W coast; this latter is the same named as Faraglione di Terra di Cala Fico by Lo Cascio & Sciberras (*hoc opus*).

Like the entire Aeolian Archipelago, all the study islets have a volcanic origin. However, considering both the geo-chemical characteristics and the age of formation, they are extremely diversified. Most of them (BRI, CFG, CFP, CRA, FPE, FPP, GIA, NAV, PAR, PBA, PLU, PME, PQU, SFA, SGI, SLP) represent remnant fragments of the coast of the nearest main island, being isolated during the last eustatic sea-level variation (since 18,000 yrs BP, see Lambeck *et al.* 2011) or due to even more recent erosive processes (Lo Cascio & Corti 2006; Lucchi *et al.* 2013). This is particularly evident for CFG, CRA and SLP, that were connected with the coast of Lipari by small stony bridges just emerging from the sea level until recent times.

The other islets are the remains of active volcanoes whose emersion occurred independently; data concerning their lava composition and age of formation are given according to Lucchi *et al.* (2013 and references therein). BAS and SPI (Fig. 4) are part of the same rhyolitic endogenous dome emerged about 54,000 yrs BP and subsequently fragmented by erosion. The islets off the E coast of Panarea Island (BOT, LBA, LNE) lie along a submerged crater rim, whose hydrothermal activity strongly altered local lava products. LBA (Fig. 5) is mainly dacitic, while BOT and LNE are respectively andesitic and andesitic-dacitic. The emersion of this group started about 130,000 yrs BP; this

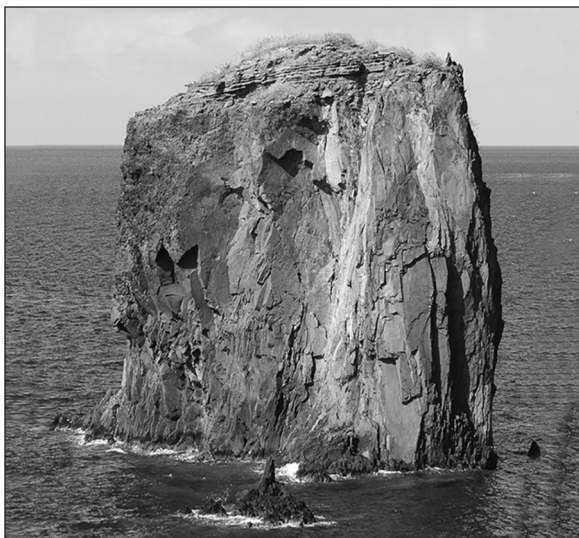


Figure 2. Parmara (PAR), off the western coast of Lipari (photo P. Lo Cascio).

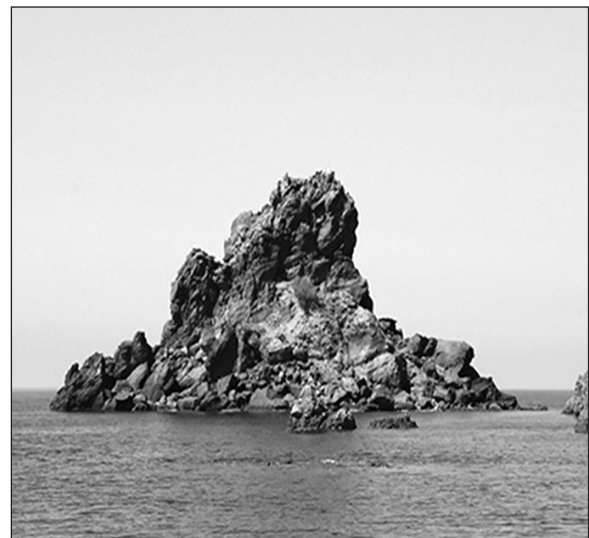


Figure 3. Crapazza (CRA), off the southern coast of Lipari (photo P. Lo Cascio).

islet	a	b	c	d	e	f	g	h	i
BAS	281,237	3,249	165.2	1.813	3,544	R	100	3.5	7
LBA	31,066	812	32.7	3.107	3,011	D	35	11.2	4
STR	7,623	443	49.0	1.005	1,505	A/B	2	2.6	3
BOT	7,490	410	23.1	2.088	2,791	A	12	16.0	3
SFA	5,765	337	33.5	1.238	287	B	14	24.3	3
SPI	5,239	304	78.1	0.523	3,500	R	15	28.6	2
PQU	5,204	272	34.0	1.197	33	R	8	15.3	2
NAV	3,858	270	39.4	0.898	126	A/B	6	15.5	2
CFG	3,659	243	32.3	1.066	11	A/D	13	35.6	2
CAN	3,481	224	70.0	0.475	1,620	B	3	8.6	n.e.
PBA	3,289	221	21.0	1.540	467	B	16	48.7	1
PAR	3,219	285	34.5	0.941	98	A/B	20	62.3	1
CRA	2,007	168	26.5	0.972	20	R	1	5	n.e.
PME	1,472	167	28.3	0.773	385	R	16	108.8	1
CFP	1,466	155	31.0	0.696	80	A/B	0	0	n.e.
FPP	1,463	167	21.0	1.027	55	R	0	0	n.e.
GIA	1,452	154	23.0	0.934	98	B	1	6.8	1
PLU	1,274	154	60.5	0.335	235	R	11	86.6	1
SLP	845	115	37.5	0.443	9	A/B	0	0	n.e.
FPE	749	110	42.0	0.367	14	R	1	13.5	1
BRI	188	51	7.0	1.105	13	R	0	0	n.e.
SGI	166	49	5.0	1.453	9	R	0	0	1

Table 1. Abiotic and biotic characteristics of the study islets (in order of decreasing surface): a) surface (in m²), b) coastal perimeter (in m), c) top elevation (in m a.s.l.), d) steepness index (SI), e) distance from the nearest main island (in m), f) geo-chemistry (abbreviations: A = andesites, B = basalts, D = dacites, R = rhyolites), g) number of gull nesting pairs, h) density gull nests (N nests/hectare), i) number of suitable habitats/vegetation units (abbreviation: n.e. = not evaluable).

eruptive centre was subject to repeated explosive phases and is still active, with magmatic fluids that interact with the shallow hydrothermal system and had a strong upsurge in 2002 (Capaccioni *et al.* 2007; Aliani *et al.* 2010). Furthermore, the whole area including the satellites of Panarea was also involved in local tectonic subsidence processes (Anzidei *et al.* 2014; Esposito *et al.* 2015).

STR (Fig. 6) is an andesitic-basaltic neck of a volcano emerged about 205,000 yrs BP (before the emersion of the nearby Stromboli Island) and dismantled by erosive processes when its

activity ended up. Finally, CAN (Fig. 7) is the basaltic neck of an eruptive centre that was active about 29,000 yrs BP and successively destroyed by sea erosion.

The morphology of the Aeolian islets is mainly characterized by the occurrence of steep cliffs, and some of these are typical examples of columnar basalts (e.g. BRI, CAN, FPE, PLU, SLP), while just on the top of the largest ones (e.g. BAS, BOT, LBA, SFA) flat or slightly sloping plateaus occur. LNE collapsed in 2002 due to sea and wind erosion, and this islet is currently fragmented in several small bare rocks.



Figure 4. In the foreground, Basiluzzo (BAS) and Spinazzola (SPI); in the background, from left to right, Lisca Bianca (LBA), Bottaro (BOT), the residual rocks of Lisca Nera (LNE) and Dattilo (photo P. Lo Cascio).



Figure 5. Lisca Bianca (LBA), off the eastern coast of Panarea (photo P. Lo Cascio).

As there are no meteorological stations on the islets, local climate is roughly inferred from the available data recorded on the nearby main islands (Blanco & Cicala 1984; Cicala & Blanco 1993, 1997). The archipelago is characterised by an average annual rainfall of 540-680 mm with a dry period lasting around 4.5 months, and by an average annual temperature of 18.3 °C with an annual range of monthly average temperatures

13.5-13.9 °C. More in detail, combining the available data on yearly temperature and rainfall, the coastal areas of the Aeolian Islands (including the islets) are subject to pluvisseasonal oceanic climate.

Local bioclimate belongs to the upper thermomediterranean thermotype and to dry-subhumid ombrottype (Cavallaro *et al.* 2009, Bazan *et al.* 2015).



Figure 6. Strombolicchio (STR), off the north-eastern coast of Stromboli (photo P. Lo Cascio).



Figure 7. La Canna (CAN), off the western coast of Filicudi (photo P. Lo Cascio).

Historical setting and human exploitation

The archaeological investigation carried out since 1920s showed that some satellite islets of Panarea (BAS, LBA, LNE) were visited by fishermen and/or hunters since the Upper Neolithic (3rd millennium BCE) (Libertini 1921; De Fiore 1921, 1925; Bernabò Brea 1949; Martinelli & Lo Cascio 2018). Human settlements probably occurred there during the Helladic and Roman ages (Bernabò Brea 1949; Cavalier 1985, 1991a, 1991b), and especially BAS was almost certainly seasonally inhabited, as suggested by the occurrence of a villa dating back to the 2nd century AD, several ruins (Libertini 1921; Medaglia 2008) and a coeval defensive building which is nowadays located in the SE shore at -2 m, due to a local subsidence (Bernabò Brea 1985; Anzidei *et al.* 2014). After a long period during which the supremacy of north-African pirates in southern Tyrrhenian Sea constituted a severe limit for the communities of peripheral and vulnerable islands, in the early 17th century BAS was colonized once again by local farmers (La Rosa 1784). Some travellers, who visited this islet between late 18th and middle 19th centuries, reported the presence of few inhabitants in a small rural settlement which probably was occupied only seasonally (Spallanzani 1793; Smyth 1824; Dumas 1842). This agricultural use lasted until late 19th century (Habsburg Lothringen 1895), while seasonal grazing has occurred on this islet until the second half of 20th century. Moreover, LBA and BOT were occasionally exploited during the 19th century for sulphur and alum extraction, and as seasonal grazing land for goats and sheep (Lojacono 1878; Habsburg Lothringen 1895). Out of curiosity, we mention that in late

1950s LBA was the set of the movie “L’Avventura” directed by Michelangelo Antonioni.

Concerning the other islets, human presence has never been documented and should be excluded without any doubt, due to their small size and their harsh morphology; the only exception concerns STR, whose top has been largely demolished at the end of the 19th century to build a lighthouse, and its elevation was reduced from about 70 to 49 m a.s.l.

At present day, all the study islets are uninhabited, uncultivated nor grazed by domestic animals, but anthropogenic disturbance affected BAS until 1990s with occasional fires and the occurrence of few feral goats. On STR, however, the stairs leading to the lighthouse offer uncontrolled and frequent access for hundreds of visitors in summer.

Faunal remarks

Due essentially to their small size, many islets harbour poor faunal assemblages where the only terrestrial vertebrates are lizards and geckoes. Mammals occur only on BAS, inhabited by large populations of *Oryctolagus cuniculus* (L.) and *Rattus rattus* L. (P. Lo Cascio, unpublished data). Among birds, the yellow-legged Mediterranean gull *Larus michahellis* Naumann is the most common species and represents, at least for most of the year, the main biotic constrain affecting the structure of these micro-insular ecosystems. Gulls’ colonies occur on eighteen islets with a size ranging from 1 to 100 nesting pairs; the largest population inhabits BAS, while the highest density values were recorded for PME, PLU, PAR and PBA

(Table 1). Some islets are also breeding sites for *Falco eleonora* Gén  (BAS, CAN, NAV and occasionally also STR), *Calonectris diomedea* (Scopoli) and *Hydrobates pelagicus melitensis* Schembri (SFA), but their seasonal occurrence has undoubtedly a less significant impact on local environment (Massa *et al.* 2015; Lo Cascio 2016).

Nature protection

All the study islets are included in the boundaries of the Nature 2000 network, namely within the Special Protection Area ITA030044, with the only exception of SFA (Fig. 8) that is not yet subject to any environmental regulation: this represents a striking anomaly considering its great biological importance, as this islet harbours some species listed in Annexes of 43/92 and 147/09 EU Directives and one of the last populations of the threatened endemic Aeolian wall lizard (Lo Cascio & Pasta 2004; Cavallaro *et al.* 2009; Lo Cascio 2010). STR also lies in the boundaries of the Special Protection Area ITA030026.

Nature reserves of some main islands (Stromboli, Filicudi and Panarea) stretch over all or most



Figure 8. Scoglio Faraglione (SFA), off the western coast of Salina (photo P. Lo Cascio).

of their satellite islets, with access restrictions for STR, CAN, BAS, LBA and BOT; however, the effectiveness of the management of these protected areas, entrusted to the regional Department of Rural and Territorial Development, is objectively inconspicuous due to the absence of dedicated staff and offices throughout the archipelago.

MATERIAL AND METHODS

Floristic data

Data reported in this study issue from field surveys and are documented by the plant material collected during fifteen years (1994–2009). Each islet was visited in all seasons, and the larger ones have been repeatedly surveyed in order to achieve floristic censuses resulting as comprehensive as possible; further observations on some islets have been performed during the last decade. Data con-

cerning LNE were collected in summer 1995, and after its collapse (2002) no steady plant populations were found on the residual fragments of this islet.

The exsiccata of all the collected specimens are temporarily kept in authors' herbaria, and part of them has been deposited in Herbarium Mediterraneum (PAL). The second edition of "Flora d'Italia" (Pignatti *et al.* 2017-2019) was used as reference for plant identification as well as for the nomenclatural treatment of all the infrageneric taxa and the family names cited in the text; both genera and families were listed in alphabetical order.

Floristic data, including those given in literature, have been summarized in a checklist (see Appendix 1). For each taxon basic information was given concerning: i) life form (sensu Raunki r 1934); ii) chorotype (sensu Arrigoni 1983, modified) or alien status (whose degree on naturalisation was classified according to Richardson *et al.* 2000); iii) life strategy (sensu Grime 2001); iv) dispersal strategy (from Pignatti *et al.* 2017-2019 and personal observations) adopting the following categories: A = anemochory; B = barochory; EN = endozoochory (including ornithochory); EP = epizoochory; H = hydrochory; M = myrmecochory, v) detailed distribution within the study area is given by using the above-mentioned three-letters codes referring to each islet. Some additional notes are provided, too. New records have no references (e.g.: BAS), the symbol ° refers to previously recorded plants that were not observed during our field investigations, while the symbol * indicates that its local occurrence has been confirmed.

Other data sources

In Table 1 the prevalent geo-chemical composition of the islets' substrates and the number of gulls' nesting pairs were given according to Lucchi *et al.* (2013) and Massa *et al.* (2015), respectively. Steepness index (SI) was assessed by simplifying the three-dimensional geometric shape of each islet into a cone, following the methodology proposed by Fois *et al.* (2016). Habitat diversity was assessed during the drawing of the Management Plan of Nature 2000 Sites of the Aeolian Islands (Cavallaro *et al.* 2009) and/or from personal observations carried out during the field work.

Data elaboration and analysis

Data elaboration was carried out in order to check whether and how the pattern of life forms, chorotypes, dispersal strategies, primary life strategies and species richness varied between islets.

The life strategy spectrum of each islet has been assessed by using the prevalence score (%)

of each strategy (percentage weight of each strategy out of the total of the strategies of islet's vascular flora), which in turn was computed as a weighted sum of the prevalence scores, where the "pure" strategy (e.g. C, S or R) was weighted by a factor 1, the "double" strategy (e.g. CS, CR or SR) by 0.5. For instance, prevalence of strategy C (%) is calculated as follows: $1 \times C + 0.5 \times CS + 0.5 \times CR$. The same procedure as above has been adopted to calculate the average dispersal strategy spectrum of the flora of each islet: a "pure" strategy (e.g. endozoochorous) was weighted by the factor 1, a "double" strategy (e.g. endozoochorous-barochorous) by 0.5.

Similarity between islets' floras was assessed by comparing couples of islets using Jaccard distance, that is defined as $1 - a/(a + b + c)$, where a is the number of taxa common to both floras of the confronted pair, b is the number of taxa only occurring in the first one and c are those exclusive of the second one; in this way, the comparison of floras showing similar composition but a very different species-richness leads to a value of Jaccard approaching 1 (Hausdorf & Hennig 2003). To obtain groups with a certain degree of internal homogeneity, an average linkage cluster analysis (UPGMA) was used (Sneath & Sokal 1973).

Relative species changes (expressed in % yr⁻¹) between two floristic data sets have been calculated according to Morrison (1998, 2002) with the following formula:

$$Sr = [(I + E)/t (S1 + S2)] \times 100,$$

where t is the time lapse between the two data collections, E and I are the number of species found only in the first and second set, respectively, and S1 and S2 are the whole number of species found in each set.

Simple and multiple regression analysis and Pearson's r correlations were used to identify the relationships between species richness and the main abiotic and biotic factors (area, elevation, distance from the closest island, number of gull nests and number of habitats) considered as suitable proxies; some variables (area, coastal perimeter) were log-transformed to normalize their distribution.

Statistical analyses were performed by using the open source software PAST 3.04, while cluster analysis was carried out using MVSP 3.1.

RESULTS

Species richness

Considering the data issuing from ancient and recent literature and those obtained from our field surveys, as much as 174 vascular plant taxa,

belonging to 135 genera and 51 families, have been reported for the satellite islets and stacks of the Aeolian Archipelago (see Appendix 1). Among them, only 146 taxa, belonging to 118 genera and 48 families, currently occur there (Table 2), whilst 28 taxa, 17 genera and 3 families have not been confirmed by recent field surveys and are probably extinct.

The species-richest families, including as much as 40.4% of the confirmed or newly recorded taxa, are Asteraceae, Poaceae and Fabaceae, with 26, 21 and 12 taxa, respectively.

Highly significant positive correlations were found between the logarithms of the number of species and islet surface ($\log N$ species – \log area: $r^2 = 0.584$, $P = 0.0001$), as well as with their coastal perimeter and their habitat diversity; also the correlation between \log number of species and \log distance from the nearest island resulted very significant (Fig. 9, Table 3). Contrariwise, a weaker, yet significant correlation was found between species richness and islet elevation; however, focusing on the islets with SI value >1.000 , this correlation becomes very significant and $r^2 = 0.810$, thus the regression line describes more accurately the relationship between species number and island elevation.

Life forms

Almost half of all recorded taxa are therophytes (47.9%), while hemicryptophytes represent 17.4%, chamaephytes 11.1%, geophytes 10.4%, phanerophytes 7.6% and nanophanerophytes 5.6% of the whole vascular flora (Fig. 10a).

Therophytes are also largely represented in the spectra of each single islet (Fig. 10b and Table 2), and generally are the main life form on the largest islets, with few exceptions (GIA, PBA, PME). Testing this relationship through a linear regression, no correlation was found between the logarithms of the number of therophytes and islet surface ($r^2 = 0.383$, $P = 0.07$), while excluding the islets with SI <1.000 this correlation became highly significant ($r^2 = 0.663$, $P = 0.0001$) (Fig. 9, Table 3).

Also woody species (P, NP, Ch) are well represented, in some cases with percentages higher than 80% (e.g. SPI). The relative weight of Raunkiaer's life forms varies remarkably among the floristic assemblages of the study islets.

Chorotypes and alien status

The most represented chorotypes resulted Tethysian-European *sensu lato* and Mediterranean s.l. (31.3% and 30.6%, respectively), followed by taxa with wide distribution range (11.9%), "Tethysian s.l." (9.7%), "endemic" (6.3%), "Holarctic" (5.6%) and aliens (4.2%). The

Islet	N	N/ha	Life form (%)						Chorotype (%)							
			T	H	G	Ch	NP	P	End	Med	Tet	Teu	Hol	WD	Al	n.a.
BAS	99	4	42.4	18.2	12.1	12.1	7.1	8.1	7.1	31.3	11.1	30.3	6.1	11.1	3.0	0.0
LBA	45	14	44.4	20.0	8.9	17.8	2.2	6.7	8.9	33.3	8.9	26.7	6.7	8.9	6.7	0.0
STR	20	26	30.0	25.0	5.0	20.0	5.0	15.0	10.0	45.0	5.0	25.0	5.0	0.0	10.0	0.0
BOT	23	31	52.2	17.4	4.3	17.4	8.7	0.0	4.3	34.8	8.7	26.1	8.7	13.0	4.3	0.0
SFA	39	68	59.0	10.3	7.7	17.9	2.6	2.6	10.3	35.9	10.3	28.2	5.1	7.7	2.6	0.0
SPI	14	27	0.0	7.1	7.1	42.9	28.6	14.3	21.4	35.7	7.1	21.4	7.1	0.0	7.1	0.0
PQU	11	21	9.1	45.5	0.0	18.2	18.2	9.1	18.2	36.4	0.0	18.2	9.1	18.2	0.0	0.0
NAV	16	41	31.3	12.5	6.3	37.5	6.3	6.3	18.8	43.8	0.0	31.3	0.0	0.0	6.3	0.0
CFG	12	33	8.3	25.0	0.0	33.3	33.3	0.0	16.7	50.0	0.0	16.7	8.3	8.3	0.0	0.0
CAN	5	14	20.0	60.0	20.0	0.0	0.0	0.0	0.0	40.0	0.0	20.0	20.0	20.0	0.0	0.0
PBA	4	12	50.0	25.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	50.0	0.0	0.0
PAR	7	22	14.3	28.6	0.0	28.6	14.3	14.3	14.3	28.6	0.0	28.6	0.0	14.3	14.3	0.0
CRA	3	15	33.3	0.0	0.0	33.3	0.0	33.3	33.3	33.3	0.0	0.0	0.0	33.3	0.0	0.0
PME	4	27	75.0	25.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0	0.0	0.0	50.0	0.0	25.0
CFP	8	55	25.0	37.5	0.0	37.5	0.0	0.0	12.5	12.5	0.0	50.0	12.5	12.5	0.0	0.0
FPP	1	7	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
GIA	1	7	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
PLU	5	39	20.0	20.0	20.0	40.0	0.0	0.0	20.0	40.0	0.0	20.0	0.0	20.0	0.0	0.0
SLP	4	47	0.0	25.0	0.0	75.0	0.0	0.0	50.0	25.0	0.0	25.0	0.0	0.0	0.0	0.0
FPE	5	67	0.0	40.0	0.0	40.0	20.0	0.0	60.0	0.0	0.0	20.0	20.0	0.0	0.0	0.0
BRI	1	53	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
SGI	8	482	25.0	25.0	0.0	37.5	12.5	0.0	25.0	37.5	12.5	25.0	0.0	0.0	0.0	0.0

Table 2. Number of taxa (N), number of taxa per hectare (N/ha), percentage of life forms and percentage of chorotypes on the study islets. Life forms: T) therophyte, H) hemicryptophyte, G) geophyte, Ch) chamaephyte, NP) nanophanerophyte, P) phanerophyte; chorotypes: End) endemic, Med) Mediterranean s.l., Tet) Tethysian s.l., Teu) Tethysian-European s.l., Hol) Holarctic s.l., WD) wide distribution range, Al) alien, n.a.) not assigned.

chorological spectra of the biggest islets, i.e. BAS, LBA, SFA and STR, are very similar (Table 2). Only five alien taxa occur in the study area. Among them, *Opuntia ficus-indica* is widespread and well-established on many islets; *Carpobrotus edulis*, a potentially invasive plant dispersed by seagulls (Médail & Vidal 1998a), occurs only at LBA; *Erigeron bonariense* shows low invasive potentialities due to its water requirements; finally, *Olea europaea* var. *europaea* and *Solanum lycopersicum* behave as casual aliens. Number of aliens and number of nesting gulls are significantly correlated, but a stronger correlation occurs between this latter and the number of widely distributed taxa (see Table 3).

Life strategies

Ruderals (R), stress-tolerants (S), mixed S-R and mixed competitive-ruderals (C-S) are the main groups in the life strategy spectrum (Fig. 11), with values, respectively, of 47.2, 22.9, 13.9 and 12.5%, while only a low number of C and C-R species (0.7 and 2.8%, respectively) has been recorded (Fig. 11). Figure 12 shows the numerical value of the Grime strategies scores for each islet. Considering the average score of each “pure” strategy, R, S and C resulted equal to 55.6%, 36.1% and 8.3%, respectively. More in detail, however, 16 out of 22 islets fit with an “ecological identikit” where actually C is the dominant type (from 30 to 70%), while R and S are represented,

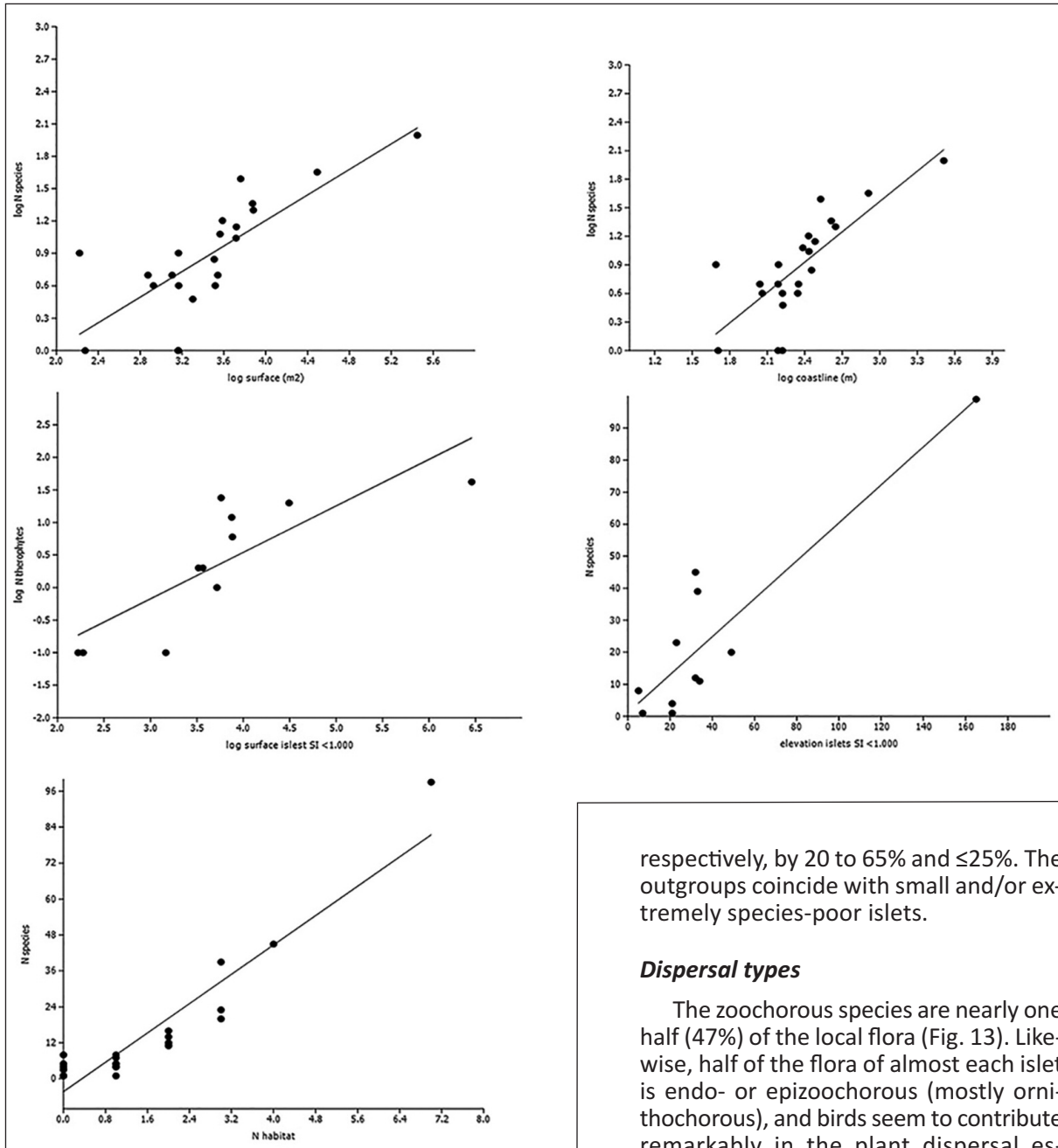


Fig. 9. Plots of relationships between species richness (or selected group richness) and some abiotic/biotic factors.

respectively, by 20 to 65% and $\leq 25\%$. The outgroups coincide with small and/or extremely species-poor islets.

Dispersal types

The zoochorous species are nearly one half (47%) of the local flora (Fig. 13). Likewise, half of the flora of almost each islet is endo- or epizoochorous (mostly ornithochorous), and birds seem to contribute remarkably in the plant dispersal especially on steeper islets (Table 4).

examined correlation	correlation coefficient r^2	significance P
log N species / log coastal perimeter	0.871	0.0001
N species / N habitat	0.870	0.0001
N species / elevation islets with SI <1.000	0.810	0.006
log N therophytes / log area islets with SI <1.000	0.663	0.0001
log N species / log area	0.584	0.0001
N species / distance nearest island	0.446	0.001
N species / elevation	0.557	0.01
N WD species / N gull nests	0.960	0.0001
N alien species / N gull nests	0.575	0.005

Table 3. Pearson's r correlations (coefficient >0.5) for abiotic/biotic factors and species richness.

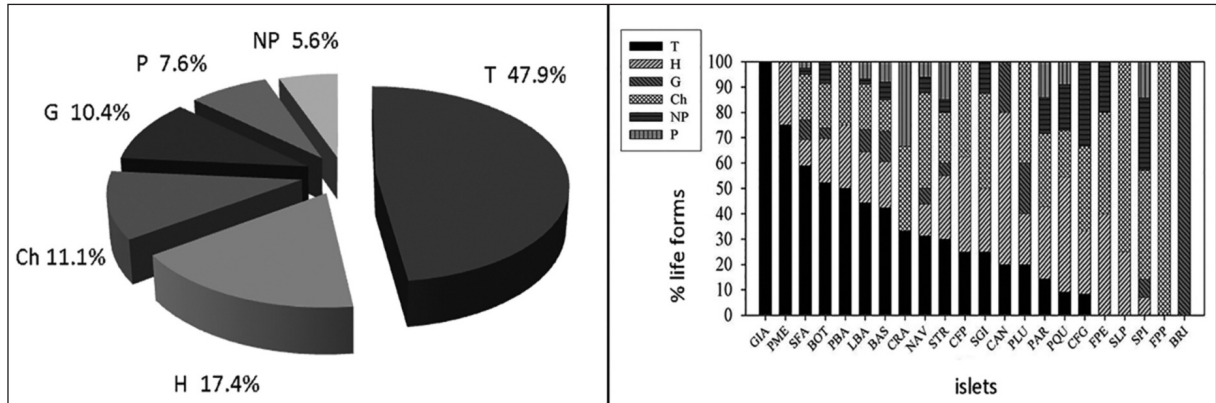


Fig. 10a (left). Life form spectrum of the whole islets' flora. Fig. 10b (right). Life form spectra of all the study islets.

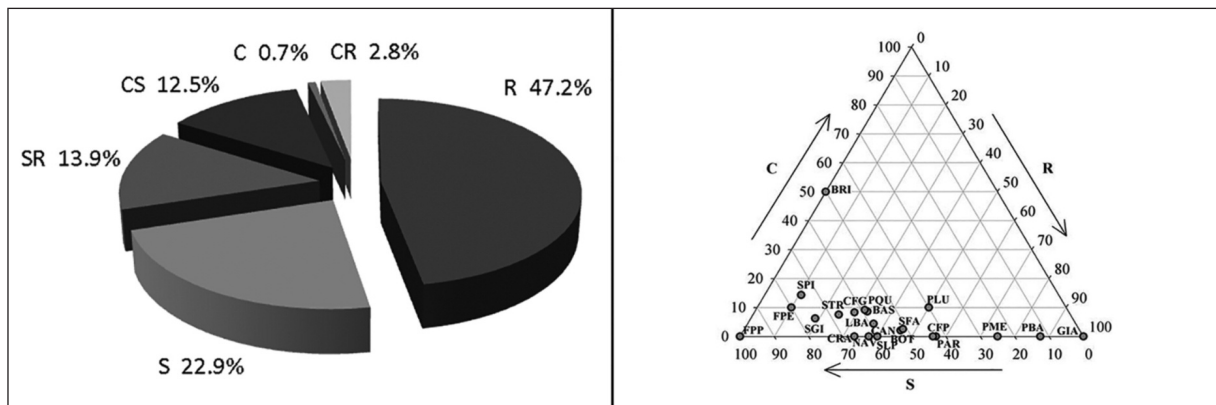


Fig. 11 (left). Life strategy spectrum of the whole islets' flora. Fig. 12 (right). Life form spectra of all the study islets.

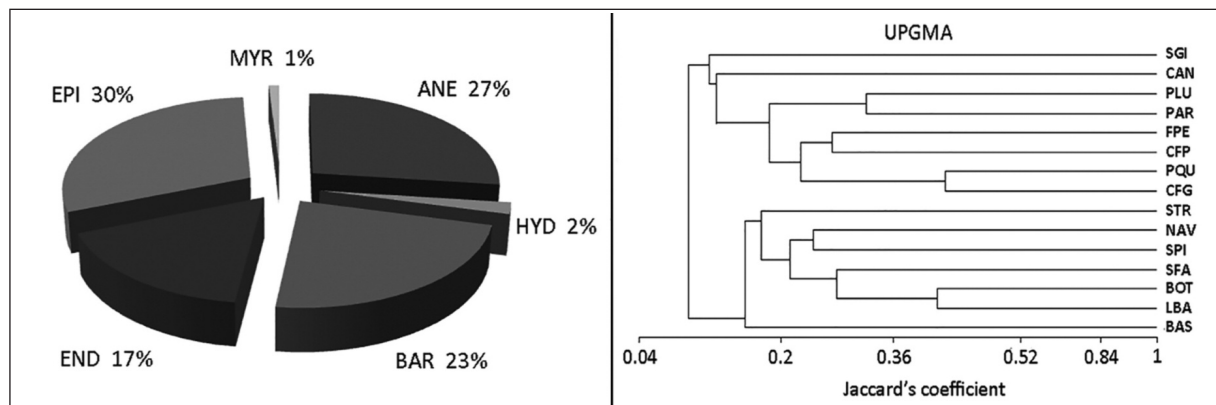


Figure 13 (left). Dispersal type spectrum. Figure 14 (right). Dendrogram obtained by UPGMA clustering for the islets currently hosting >5 taxa, according to Jaccard's index similarity matrix.

Dispersal type	BAS	LBA	BOT	SPI	SFA	NAV	CFG	PQU	STR	CRA	PBA	CAN	PAR	GIA	PLU	CFP	PME	FPE	FPP	SLP	SGI	BRI
A	32	26	33	14	24	44	17	18	30	17	13	30	7	0	10	19	13	10	100	13	25	0
H	1	3	4	4	1	3	4	0	3	17	13	0	7	0	0	6	0	0	0	13	6	0
B	22	27	17	21	22	19	38	27	10	50	38	20	36	50	30	25	38	50	0	38	50	0
En	14	17	20	46	12	13	21	32	18	0	25	10	29	0	30	13	25	0	0	13	0	100
Ep	30	28	26	14	41	22	21	23	35	17	13	40	21	50	30	38	25	40	0	25	31	0
M	1	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4. Proportions (%) of dispersal types in the single islets. A) anemochory, B) barochory, En) endozoochory (including ornithochory), Ep) epizoochory, H) hydrochory, M) myrmecochory.

Also the anemochorous species are well represented (27% of the whole flora), while hydrochorous and myrmechochorous species generally show negligible values. Barochorous plants represent 23% of the whole flora and account for one-fifth to one-third of the flora of each islet.

Plants' turnover and persistence

Floristic data collected by Gussone (1832-1834, 1842-1845) in May 1828 and by us in spring and summer 1995 were compared for two islets (BAS and LNE) in order to check the relative species changes occurred through a period of 167 years; these islets differ remarkably in both their geographical and environmental traits and especially the small ecosystem of LNE could be characterised by great instability before the definitive collapse (in 2002). On BAS and LNE Gussone recorded 70 (24 not confirmed in 1995) and 3 (2) taxa, respectively; by contrast, our 1995 inventory was 99 (47 not found in 1828) for BAS and 4 (3) taxa for LNE. The calculation of the turnover from the two data sets is $[(47 + 24) / 167 (70 + 99)] \times 100 = 0.248$ % yr⁻¹ for BAS and $[(3 + 2) / 167 (3 + 4)] \times 100 = 0.427$ yr⁻¹ for LNE.

Patterns of floristic similarity

The analysis of the average link cluster (UPGMA) was performed using Jaccard's coefficient in order to evaluate the floristic similarity only between the islets currently hosting more than 5 taxa. The dendrogram shown in figure 14 allows to identify two large groups: the first (SGI, CAN, PLU, PAR, FPE, CFP, PQU, CFG) includes essentially the satellites of Lipari Island (except CAN and PQU); the second group (STR, NAV, SPI, SFA, BOT, LBA, BAS) is mostly represented by larger islets, with the only exception of STR and SFA, and includes all the satellites of Panarea Island.

DISCUSSION

The vascular flora of the Aeolian satellites represents a small fraction of that occurring on the main islands: only 146 (16.2%) out of the 899 plant taxa growing in the Aeolian Archipelago (Pasta *et al.* 2019) are currently found in the study islets. Among them, 83 (56.8% of the whole islets' flora) occur on one single islet; in contrast, only 12 taxa (8.2%) grow on more than 5 islets, and the two most frequent ones (*Limbarda crithmoides* and *Mesembryanthemum nodiflorum*, occurring on more than half of the study islets) are ubiquitous halophytic species typical to coastal plant communities (Fig. 15).

Not only the islets appear to differ remarkably one from another from a floristic point of view,

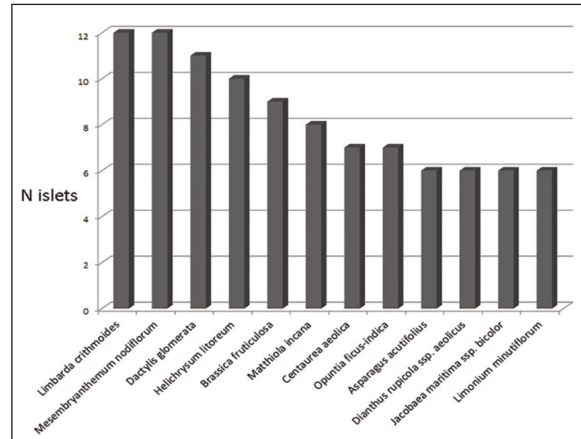


Figure 15. Frequency of the most common species on the study islets.

but they also harbour some plants whose occurrence has never been recorded in the main islands: *Hordeum marinum* subsp. *gussoneanum* and *Parapholis marginata* are two annual grasses not previously recorded for the archipelago, while *Ephedra distachya* and *Eochochia saxicola* (Fig. 16) are two woody plants that within the Aeolian context only occur on STR. Also *Hyoseris taurina* and *Dianthus rupicola* subsp. *aeolicus* (Fig. 17) seem to be more frequent on islets, where both often "dare" to colonize open and flat areas (for instance, on LBA): this fact suggests that cliffs and ledges of the major islands represent probably a secondary "refuge" habitat, where these species behave as obligatory chasmophytes avoiding grazing pressure and/or other disturbances.

The only plant that could be recognized as "islet specialist" (sensu Rechinger & Rechinger-Moser 1951; see also Höner & Greuter 1988; Snogerup & Snogerup 2004; Panitsa *et al.* 2018) is *Anthemis aeolica* (Fig. 18), a narrow endemic originally found on four islets off Panarea (BAS, LBA, BOT and Dattilo) and on the island of Stromboli (Lojacono-Pojero 1902b) but currently confined only to LBA. According to Georgiou *et al.* (2006), the "islet specialists" are in fact usually common and abundant in the islets where they grow but totally absent from neighbouring ones despite the occurrence of suitable habitats, supposedly due to a reduced possibility to establish steady populations or a great extinction risk (Runemark 1969). *A. aeolica* fits well with this picture: although the causes of its disappearance from four out of the five sites occupied at the end of the 19th century remain unclear, it should be noted that 4/5 of its originally known range were islets. The same genus includes other "islet specialists", namely *Anthemis glaberrima* (Rech.f.) Greuter and *A. scopulorum* Rech.f., growing in some micro-insular systems of the Aegean Sea (Greuter 1968; Georgiou *et al.* 2006; Pasta *et al.* 2017b). Anyhow the last 200-250 individuals of



Figure 16. Detail of fruits of *Eokochia saxicola* with winged perianth (photo P. Lo Cascio).



Figure 17. *Dianthus rupicola* subsp. *aeolicus* and *Hyoseris taurina* growing on the cliffs of Strombolicchio (STR) (photo P. Lo Cascio).

this species (Lo Cascio 2017), exclusively occur on an islet whose surface is just 3 ha, represent a conservation priority and should be classified in the Red List as “CR” (critically endangered) following the criteria B1ab (iv, v) + B2ab (iv, v) of risk assessment guidelines proposed by IUCN Standards & Petitions Committee (2019).

The life form spectrum of the Aeolian satellite islets is dominated by therophytes (47.9%: see

Fig. 10). This result is consistent with the bioclimatic features of the Mediterranean area, but the value appears lower than those reported for the main Aeolian and circum-Sicilian islands (ranging from 53 to 65%: see Pasta 1997; Mazzola *et al.* 2002). A general decrease in therophytes numbers along with the diminishing island surfaces has already been observed in the Mediterranean micro-insular environments (Bibiloni *et al.* 1993; Panitsa & Tzanoudakis 1996, 2001; Pasta 2002; Panitsa *et al.* 2004, 2006; Foggi *et al.* 2009; Rita & Bibiloni 2012). Within the study area, therophytes result to be more largely represented on the bigger islets and their occurrence appears to be strongly correlated with the surface of the smoothest islets (Fig. 9, Table 3). Similarly, a fairly high rate of woody species has been recorded like in the micro-insular environments of the Pelagic and Tuscan archipelagoes (Pasta 2002; Foggi *et al.* 2009).

Concerning the life strategies, plant assemblages are largely dominated by S and R strategists (Figs. 11-12), except in the smaller or very species-poor islets. Most of the S strategists are perennial herbs typical to open, dry and less disturbed grasslands or of very extreme habitats (e.g. cliffs), while R species are linked to intense and frequent disturbance, that in the study area is mostly induced by gulls. CS strategists occur with a moderate percentage (8.3%) and include primarily hemicryptophytes and subshrubs typical to xeric grasslands, garrigues and low maquis; especially the latter are able to colonize scattered soil pockets within the rocky outcrops and to withstand severe summer drought and other stress factors (high solar radiation, wind and salt-spray influence, etc.). In fact, with the only exception of BAS, soil coverage on the islets is absent or discontinuous



Figure 18. Flowers (above) and individuals (below) of *Anthemis aeolica* on Lisca Bianca (LBA); in the background, the islet of Bottaro (BOT) (photo P. Lo Cascio).

and characterized by poor development, eutrophication and lacking of exchangeable ions due to the high salinity, as consequence of the deposit of salt-spray and gull guano; this may explain the low number of “pure” C and CR strategists.

It is well known that seabird colonies generally represent a severe constrain for the structure and dynamism of micro-insular plant assemblages (Médail & Vidal 1998a; Vidal *et al.* 1998; García *et al.* 2002; Caldarella *et al.* 2010; Bouyahmed & Moulai 2018). Between 1995 and 2005 it was possible to document an increase in the gulls’ nesting pairs on one of our target islets (SFA), which coincided with some changes in the structure and composition of local vegetation, namely an increase of therophytes mainly belonging to the Poaceae family and a constant spread of *Mesembryanthemum nodiflorum* (Lo Cascio, 2006). In general, the presence of gulls on the study islets seems to be well correlated with that of nitrophilous-ruderal and trampling-tolerant species with a wide distribution range (usually belonging to plant communities framed into the phytosociological classes *Stellarietea mediae*, *Sarcocornietea fruticosae* and *Polygono-Poetea annuae*) and, to a lesser extent, with that of alien species (see Table 3). These data agree with the information provided by figure 13, where endo- and epizoochory represent nearly one half (47%) of the dispersal types of the local flora, and especially on steeper islets birds seem to play a remarkable role in plant dispersal (Table 4). In other islets, such as LBA and BOT, characterised by rather flat tops, a long-term history of massive presence of gulls, as well the ornithocrophilous behaviour of *Atriplex portulacoides* and *Suaeda vera*, may explain the over-abundance of these halo-nitrophilous species, which are instead extremely rare on the main Aeolian islands (Figs. 19a, 19d).

The impact of gulls in the Aeolian context does not seem to induce the levels of disturbance documented for other Mediterranean islets in terms of species impoverishment, while the role of these birds on local plant turnover remains unclear.

Turnover rate was assessed for the flora of BAS and LNE by comparing our data with those collected by Gussone during the first half of 19th century. We obtained a S_r of 0.248% yr⁻¹ and 0.427% yr⁻¹, respectively. As these islets show sharply different geographical and environmental features, it is no surprise that their turnover pattern differ accordingly.

The high value of turnover found for LNE likely depends on the strong instability of the poor flora growing on its very small suitable surface (see also Lo Cascio *et al.* 2014b); the turnover rate of LNE is even lower than those found in the Riou Islands (0.469-1.187% yr⁻¹), a southern-French archipelago where the structure and dynamics of

local plant communities were strongly affected by seagulls (Vidal *et al.* 2000).

Instead, the turnover rate of BAS is comparable with that found for the Habibas Islands in Algeria (0.264% yr⁻¹), where according to Véla *et al.* (2013) turnover was mostly driven by the abandonment of agricultural practices. Also BAS (Fig. 19b) underwent substantial land-use change during last two centuries. There, the cessation of agro-pastoral activities affected either the cultivated species (like *Hedera helix*, *Lathyrus cicera* and *Rosmarinus officinalis*) or those linked with extensive crop fields and fallows (such as *Anisantha* spp., *Cladanthus mixtus*, *Delphinium* spp., *Echium pustulatum*, *Euphorbia terracina*, *Galactites tomentosa*, *Glebionis coronaria*, *Hypochoeris glabra*, *Medicago murex*, *Orobancha caryophyllacea*, *Phalaris* spp., *Rumex pulcher*, *Vicia* spp.). Similar patterns of floristic turnover related to land-use change have been recognized for other circum-Sicilian islands (Gianguzzi *et al.* 2006; La Mantia *et al.* 2011; Pasta & La Mantia 2013).

Other extinctions may have been triggered by other factors: for instance, the psammophilous *Polygonum maritimum* has vanished from LBA likely as consequence of the contraction of its elective habitat (the small pocket-beach in the western side of the islet), while *Cistus monspeliensis* and *Seseli bocconeii* subsp. *bocconeii* disappeared from STR after the construction of the lighthouse, hence due to the direct human disturbance.

The current floristic richness of the study islets seems to be mainly influenced by coastal perimeter, habitat diversity and surface, while it appears less correlated with the distance from the largest island and elevation; when the islets with SI value <1.000 (mostly stacks with wide bare surfaces, where probably prevail other selective factors) are sorted out from data elaboration, elevation appears instead strongly correlated with species richness (Fig. 9, Table 3).

This result partially agrees with those found in the Aegean islets by Panitsa *et al.* (2006, 2008), where species richness is better explained by elevation which in turn is assumed as indirect indicator of the habitat heterogeneity. Among the Aeolian islets, however, elevation seems constrained by morphology, although the threshold of SI value adopted here (1.000) is arbitrary and not always fully representative of the ratio area/elevation: this is the case of STR, whose SI was equal to 1.005, thus this islet was included among the “smoother” group, but a large amount of its real surface is formed by cliffs (Fig. 19c).

Furthermore, it is hard to establish the real impact of surface on species richness, because in the study area this factor may suffer from an “idiosyncratic” behaviour due to the Small Island Effect



Figure 19. Different habitats on the study islets: a) halo-nitrophilous formations with *Atriplex portulacoides* and *Suaeda vera* on Bottaro (BOT); b) low maquis with *Pistacia lentiscus* and *Erica arborea* growing on the abandoned fields on Basiluzzo (BAS); c) sparse individuals of *Eokochia saxicola* on the northern cliff of Strombolicchio (STR); d) the flat plain of Lisca Bianca (LBA), covered by halo-nitrophilous shrubs (photo P. Lo Cascio).

(SIE) (see Sfenthourakis & Triantis 2009; Schrader et al. 2019 and references therein). In fact, we found a highly significant correlation between log area and log species, but the regression is lower ($r^2 = 0.584$) than those resulted for other abiotic factors (Table 3), and SIE could be better defined only taking into account the whole archipelago.

The floristic relationships between the Aeolian islets according to Jaccard similarity coefficient are shown in figure 14. Two main groups seem to be clustered mostly on the basis of islets' geographic closeness, as the first includes many satellites of Lipari while the second those of Panarea; at the same time, this latter includes the larger islets, suggesting therefore that also islets' size may play an important role in the floristic affinity among them; despite belonging to this group, BAS appears to be relatively isolated due to its noteworthy floristic richness. Although this latter is not outstanding, the study islets represent a unique context within the Aeolian scenario,

where a complex network of driving forces determines the composition and the similarity of plant assemblages. Their importance is primarily due to the presence of many species of biogeographic and conservation interest: *Anthemis aeolica*, a narrow endemic whose only known population occurs on LBA; *Eokochia saxicola*, listed in the Annex B of 43/92 EU Directive as priority species, that occurs on STR with about 15% of its global population (Strumia et al. 2015); and several taxa endemic to the archipelago and/or rare and localized at the regional level, such as *Centaurea aeolica*, *Dianthus rupicola* subsp. *aeolicus*, *Genista tyrrhena*, *Helichrysum litoreum* and *Hyoseris taurina*.

Furthermore, even if in some cases local plant communities resulted to be moderately influenced by the presence of seagulls (and by previous agricultural activities on BAS), these tiny environments on the whole seem to be relatively undisturbed and maintain most of their original

features, as suggested by the fairly low number of alien species found during our field surveys. Due to their intrinsic fragility, however, the overall positive situation is prone to rapid changes, as suggested by the rate of turnover assessed for some islets.

Island environments, especially the volcanic ones (Pretto *et al.* 2010; Pasta & La Mantia 2013; Pasta *et al.* 2017a), are in fact highly permeable and exposed both to alien invasion and to other disturbances (Heywood 2011). For this reason, their conservation would require careful protection measures which, in the case of the study area, seem not to be implemented enough by the institutions in charge of the management of these protected areas (Lo Cascio & Pasta 2004).

At STR, for instance, the uncontrolled and massive occurrence of tourists during summer can pose a threat to the survival of *Eokochia saxicola* and in general for the fragile biological heritage of this islet. Similar considerations may be extended to LBA, where also the potentially high invasive *Carpobrotus edulis* could represent a serious menace for the conservation of *Anthemis aeolica* and therefore should be eradicated from the islet. Apart from these local actions urgently needed actions, what still seems to be missing nowadays is a conservation perspective, based on a modern and homogeneous approach, that only the institution of a national park could offer, through constant monitoring and specific environmental improvement. A “National Park” extended to terrestrial and marine areas of the Aeolian Archipelago had been foreseen by a national law (Law 244/2007) already thirteen years ago, but unfortunately its effective implementation seems to require as long time as that spent to publish the results of the present research.

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LITERATURE CITED

- Aliani S., Bortoluzzi G., Caramanna G. & Raffa F. 2010. Seawater dynamics and environmental setting after November 2002 gas eruption of Bottaro (Panarea, Aeolian Islands, Mediterranean Sea). *Continental Shelf Research*, 30: 1338–1348.
- Anzidei M., Esposito A. & Benini A. 2014. Evidence of active subsidence at Basiluzzo island (Aeolian islands, southern Italy) inferred from a Roman age wharf. *Quaternary International*, 332: 143–150.
- Arrigoni P.V. 1983. Aspetti corologici della flora sarda. *Lavori della Società italiana di Biogeografia*, 8: 83–109.
- Baroni E. 1902. [A proposito della scoperta della *Kochia saxicola* a Strombolicchio]. *Bollettino della Società botanica italiana*, [1902] 9: 127.
- Bazan G., Marino P., Guarino R., Domina G. & Schicchi R. 2015. Bioclimatology and vegetation series in Sicily: A geostatistical approach. *Annales Botanici Fennici*, 52: 1–18.
- Bergmeier E. & Dimopoulos P. 2003. The vegetation of islets in the Aegean and the relation between the occurrence of islet specialists, island size, and grazing. *Phytocoenologia*, 33: 447–474.
- Bernabò Brea L. 1949. Basiluzzo e scogli vicini. *Notizie dagli scavi di antichità*, 1 [1947]: 238–239.
- Bernabò Brea L. 1985. Basiluzzo. Banchina di approdo sommersa in età romana. *Bollettino d'Arte, Ministero dei Beni culturali e ambientali*, 29/85(suppl.): 77–79.
- Bibiloni G., Alomar G. & Rita J. 1993. La flora vascular dels illots i addiccions a la flora de Cabrera Gran, pp. 179–206. In: Alcover J.A., Ballesteros E. & Fornós J.J. (Eds.), *Història Natural del Arxipèlag de Cabrera*. Monografia de la Societat d'Historia natural de les Balears 2.
- Blanco C. & Cicala A. 1984. Analisi statistica dei valori della temperatura e delle precipitazioni delle isole Eolie. *Bollettino dell'Accademia gioenia di Scienze naturali*, 17(323): 89–103.
- Bouyahmed H. & Moulai R. 2018. Influence of the yellow-legged gull on soil, composition and organisation of plant communities on some small islands of Algeria. *Zoology & Ecology*, 28: 300–312.
- Brullo S. & Minissale P. 2002. Il gruppo di *Dianthus rupicola* Biv. nel Mediterraneo centrale. *Informatore botanico italiano*, 33 [2001]: 537–542.
- Brullo S., Minissale P., Siracusa S. & Spampinato G. 1997. Taxonomic and phytogeographical considerations on *Hyoseris taurina* (Compositae), a S. Tyrrhenian element. *Boccone*, 5: 707–716
- Brullo S., Catara S., Cristaudo A., Lo Cascio P. & Salmeri C. 2016. Note tassonomiche e biosistematiche su

- Anthemis aeolica* (Asteraceae), pp. 11–12. In: Domina G. & Peruzzi L. (Eds.), Riunioni scientifiche dei gruppi di lavoro e delle sezioni regionali della Società botanica italiana onlus. Gruppo per la floristica, sistematica ed evoluzione (Roma, 21–22 ottobre 2016).
- Caldarella O., La Rosa A., Pasta S. & Di Dio V. 2010. La flora vascolare della Riserva Naturale Orientata Isola delle Femmine (Sicilia nord-occidentale): aggiornamento della check-list e commento del turnover. *Il Naturalista siciliano*, 34: 421–476.
- Capaccioni B., Tassi F., Vaselli O., Tedesco D. & Poreda R. 2007. Submarine gas burst at Panarea Island (southern Italy) on 3 November 2002: a magmatic versus hydrothermal episode. *Journal of Geophysical Research*, 112: B05201.
- Cavalier M. 1985. Basiluzzo, pp. 14–17. In: Nenci G. & Vallet G. (Eds.), *Bibliografia topografica della colonizzazione greca in Italia e nelle isole tirreniche*. 4. Scuola Normale di Pisa, Pisa.
- Cavalier M. 1991a. Lisca Bianca, p. 186. In: Nenci G. & Vallet G. (Eds.), *Bibliografia topografica della colonizzazione greca in Italia e nelle isole tirreniche*. 9. Scuola Normale di Pisa, Pisa.
- Cavalier M. 1991b. Lisca Nera, p. 187. In: Nenci G. & Vallet G. (Eds.), *Bibliografia topografica della colonizzazione greca in Italia e nelle isole tirreniche*. 9. Scuola Normale di Pisa, Pisa.
- Cavallaro F., Morabito M., Navarra E., Pasta S., Lo Cascio P., Campanella P., Cavallaro M., Cavallaro A., Merenda A., Di Procolo G., Rühl J. & Ioppolo G. 2009. Piano di Gestione dei Siti Natura 2000 delle Isole Eolie. Regione Siciliana, Assessorato Territorio e Ambiente.
- Cicala A. & Blanco C. 1993. Contributo alla conoscenza climatica delle isole Eolie. La stazione “Sturiale” di Lipari Castellaro. *Bollettino dell’Accademia gioenia di Scienze naturali*, 25(339) [1992]: 161–177.
- Cicala A. & Blanco C. 1997. Risultati delle osservazioni meteorologiche effettuate nel decennio 1986–1995 presso la stazione meteorologica “Sturiale” di Lipari Castellaro. *Bollettino dell’Accademia Gioenia di Scienze naturali*, 29(351) [1996]: 113–132.
- De Angelis D’Ossat G. 1900. Elenco delle Piante determinate nel R. Istituto Botanico dell’Università di Roma diretto dal ch. prof. R. Pirotta sopra esemplari raccolti specialmente dal socio Traverso. *Bollettino della Società geologica italiana*, 19: 72–74.
- De Fiore O. 1921. Le eruzioni sottomarine, i fenomeni vulcanici secondari delle Eolie e le eruzioni storiche di Lipari. *Zeitschrift für Vulkanologie*, 6: 114–154.
- De Fiore O. 1925. *Bibliografia delle isole Eolie*. *Bulletin Volcanologique*, 3–4: 113–161.
- Di Palma M.G., 1980. La lucertola del faraglione “La Cannà” nelle Isole Eolie: *Podarcis sicula cucchiarae* subsp. nova (Reptilia, Lacertidae). *Il Naturalista siciliano*, 4: 3–12.
- Domina G., Marino P. & Castellano G. 2011. The genus *Orobanche* (Orobanchaceae) in Sicily. *Flora mediterranea*, 21: 205–242.
- Dumas A. 1842. Excursions aux îles Eoliennes, pp. 43–78. In: Dumas A., *Impressions de voyage*. Le capitaine Aréna. Lévy, Paris.
- Esposito A., Pietrantonio G., Bruno V., Anzidei M., Bonforte A., Guglielmino F., Mattia M., Puglisi G., Sepe V. & Serpelloni E. 2015. Eighteen years of GPS surveys in the Aeolian Islands (southern Italy): open data archive and velocity field. *Annals of Geophysics*, 58: S0439.
- Fernandes R. 1976. *Anthemis* L., pp. 145–159. In: Tutin T.G., Heywood V.H., Burges N.A., Moore D.M., Valentine D.H., Walters S.M. & Webb D.A. (Eds.), *Flora Europaea*. 4. Plantaginaceae to Compositae (and Rubiaceae). Cambridge University Press, Cambridge.
- Ferrarini E. 1987. Note tassonomiche e corologiche su alcune Umbelliferae delle Alpi Apuane. *Webbia*, 41: 45–60.
- Ferro G. & Coniglione D. 2014. Osservazioni su *Anthemis aeolica* e *A. maritima* (Asteraceae), specie critiche della flora siciliana, pp. 21–22. In: Peruzzi S. & Domina G. (Eds.), *Società botanica italiana, Gruppo per la floristica, sistematica ed evoluzione*. Comunicazioni (Roma, 21–22 novembre 2014). Società botanica italiana, Firenze.
- Ferro G. & Furnari F. 1968. Flora e vegetazione di Stromboli (Isole Eolie). *Archivio botanico e biogeografico italiano*, 12: 21–45; (3): 59–85.
- Fiori A. 1927. *Nuova Flora analitica d’Italia*. 2. Ricci, Firenze, pp. 481–800.
- Foggi B., Guidi T., Capecchi M., Baldini R.M. & Grigioni A. 2009. Biological flora of the Tuscan Archipelago islets (Tyrrhenian Sea). *Webbia*, 64: 23–45.
- Fois M., Fenu G. & Bacchetta G. 2016. Global analyses underrated part of the story: finding applicable results for the conservation planning of small Sardinian islets’ flora. *Biodiversity & Conservation*, 25: 1091–1106.
- García L.V., Marañón T., Ojeda F., Clemente L. & Redondo R. 2002. Seagull influence on soil properties, chenopod shrub distribution, and leaf nutrient status in semi-arid Mediterranean islands. *Oikos*, 98: 75–86.
- Georgiou O., Panitsa M. & Tzanoudakis D. 2006. *Anthemis scopulorum* (Asteraceae), an “islet specialist” endemic to the Aegean islands (Greece). *Willdenowia*, 36: 339–349.
- Gianguzzi L., Scuderi L. & Pasta S. 2006. La flora vascolare dell’isola di Marettimo (Arcipelago delle Egadi, Sicilia occidentale): aggiornamento e analisi fitogeografica. *Webbia*, 61: 359–402.
- Greuter W. 1968. Contributio floristica austro-aegaea 13. *Candollea*, 23: 143–150.
- Greuter W. 2008. Med-Checklist. A critical inventory of vascular plants of the circum-Mediterranean countries. 2. Dicotyledones (Compositae). OPTIMA Secretariat, Palermo-Berlin-Genève, 798 pp.
- Grime J.P. 2001. *Plant Strategies, Vegetation processes and Ecosystem Properties*. 2nd ed., J. Wiley & Sons, West Sussex, 456 pp.
- Gussone G. 1832–1834. Supplementum ad Florae Siciliae Prodromum, quod et specimen florum insularum Siciliae ulteriori adjacentum. Ex Regia Typographia, Neapoli, fasc. I [1832], pp. i–ix+1–166; fasc. II [1834], pp. 171–242.
- Gussone G. 1843–1845. *Florae Siciliae Synopsis exhibens plantas vasculares in Sicilia insulisque adjacentibus hucusque detectas secundum systema Lin-*

- neanum dispositas. Typographia Tramatè, Neapoli, vol. 1 [1843], v+575 pp.; vol. 2 (I) [1844], pp. i–iii+1–526; (II) [1845], pp. 527–920.
- Habsburg Lothringen L.S. 1893a. Die Liparischen Inseln. Erstes Heft: Vulcano. H. Mercy, Praha, xii+95 pp.
- Habsburg Lothringen L.S. 1893b. Die Liparischen Inseln. Zweites Heft: Salina. H. Mercy, Praha, ix+72 pp.
- Habsburg Lothringen L.S. 1894. Die Liparischen Inseln. Drittes Heft: Lipari. H. Mercy, Praha, 158 pp.
- Habsburg Lothringen L.S. 1895. Die Liparischen Inseln. Viertes Heft: Panaria. H. Mercy, Praha, viii+30 pp.
- Habsburg Lothringen L.S. 1896. Die Liparischen Inseln. Siebentes Heft: Stromboli. H. Mercy, Praha, v+51 pp.
- Hausdorf B. & Hennig C. 2003. Biotic element analysis in biogeography. *Systematic Biology*, 52: 717–723.
- Herwitz S.R., Wunderlin R.P. & Hansen B.P. 1996. Species turnover on a protected subtropical barrier island: a longterm study. *Journal of Biogeography*, 23: 705–715.
- Heywood V.H. 1983. Relationships and evolution in the *Daucus carota* complex. *Israel Journal of Botany*, 32: 51–65.
- Heywood V.H. 2011. The hazardous future of island floras, pp. 488–510. In: Bramwell D. & Caujapé-Castells J. (Eds.), *The Biology of Island Floras*. Cambridge University Press, Cambridge.
- Höner D. & Greuter W. 1988. Plant population dynamics and species turnover on small islands near Karpathos (South Aegean, Greece). *Vegetatio*, 77: 129–137.
- IUCN Standards and Petitions Committee 2019. Guidelines for Using the IUCN Red List Categories and Criteria. Version 14. On-line at: www.iucnredlist.org/documents/RedListGuidelines.pdf.
- La Mantia T., Carimi F., Di Lorenzo R. & Pasta S. 2011. The agricultural heritage of Lampedusa (Pelagic Archipelago, South Italy) and its key role for cultivar and wildlife conservation. *Italian Journal of Agronomy*, 6: e17.
- Lambeck K., Antonioli F., Anzidei M., Ferranti L., Leoni G., Scicchitano G. & Silenzi S. 2011. Sea level change along the Italian coast during the Holocene and projections for the future. *Quaternary International*, 232: 250–257.
- La Rosa G. 1784. *Pyrologia Topostoriografica dell'isole di Lipari seu Lipari sacro*. Parte quarta. (unpublished manuscript kept at the Bishop's Archive of Lipari).
- Libertini G. 1921. Le isole Eolie nell'antichità greca e romana. *Ricerche storiche ed archeologiche*. R. Bemporad & F., Firenze, 236 pp.
- Lo Cascio P. 2004. Preliminary observations on the insect fauna associated with two threatened plant species, *Bassia saxicola* (Guss.) A.J. Scott and *Cytisus aeolicus* Guss., on the Aeolian Islands (Southern Tyrrhenian Sea). *Il Naturalista siciliano*, 28: 1155–1169.
- Lo Cascio P. 2006. Aspetti ecologici e problemi di conservazione di una popolazione di *Podarcis raffonei* (Mertens, 1952) (Reptilia: Lacertidae). *Il Naturalista siciliano*, 30: 495–521.
- Lo Cascio P. 2010. Attuali conoscenze e misure di conservazione per le popolazioni relitte dell'endemica lucertola delle Eolie, *Podarcis raffonei*. *Il Naturalista siciliano*, 34: 295–317.
- Lo Cascio P. 2016. Marine birds of the Aeolian Archipelago, South Tyrrhenian Sea: present status and conservation, pp. 96–99. In: Yésou P., Sultana J., Walmsley J. & Azafzaf H. (Eds.), *Conservation of marine and coastal birds in the Mediterranean*. Proceedings of the UNEP-MAP-RAC/SPA Symposium (Hammamet, 20–22 February 2015). RAC/SPA-AAO-BirdLife Tunisia-Medmaravis.
- Lo Cascio P. 2017. *Luoghi e natura di Sicilia 1. Le Isole Eolie*. Danaus, Palermo, 316 pp.
- Lo Cascio P. & Corti C. 2006. The micro-insular distribution of the genus *Podarcis* within the Aeolian Archipelago: historical vs. palaeogeographical interpretation, pp. 87–98. In: Corti C., Lo Cascio P. & Biaggini M. (Eds.), *Mainland and Insular Lizards: a Mediterranean Perspective*. Firenze University Press, Firenze.
- Lo Cascio P. & Pasta S. 2004. Il patrimonio biologico delle Isole Eolie: dalla conoscenza alla conservazione, 457–476. In: Casamento G., Lo Valvo M., Massa B. & Pasta S. (Eds.), *Il contributo dei Parchi alla conservazione della natura in Sicilia. Il Naturalista siciliano*, 28.
- Lo Cascio P. & Pasta S. 2011. Floristic and ecological remarks on the islet Formica di Burano (Tuscan Archipelago, Tyrrhenian Sea). *Atti della Società toscana di Scienze naturali, Memorie Serie B*, 116 [2009]: 45–48.
- Lo Cascio P. & Pasta S. 2012. Lampione, a paradigmatic case of Mediterranean island biodiversity. In: Proceedings 1st International Congress “Insularity and Biodiversity” (May 11–13, 2012, Palermo, Italy). *Biodiversity Journal*, 3: 311–330.
- Lo Cascio P., Grita F., Guarino L. & Speciale C. 2014a. A little is better than none: new insights into the natural history of the Aeolian wall lizard *Podarcis raffonei* from La Canna stack (Squamata Sauria). *Il Naturalista siciliano*, 38: 203–214.
- Lo Cascio P., Biaggini M. & Corti C. 2014b. Lisca Nera lizards: history of an extinction through zoology and literature, pp. 63–75. In: Capula M. & Corti C. (Eds.) *Scripta Herpetologica. Studies on Amphibians and Reptiles in honour of Benedetto Lanza*. Monografie della Società Herpetologica Italica 3, Belvedere, Latina.
- Lojacono[-Pojero] M. 1878. *Le Isole Eolie e la loro vegetazione con enumerazione delle piante spontanee vascolari*. Tipografia G. Lorisnaider, Palermo, 140 pp.
- Lojacono-Pojero M. 1888. *Flora Sicula, o descrizione delle piante vascolari spontanee o indigenate in Sicilia*. Vol. 1 (1). Stabilimento Tipografico Virzi, Palermo, 234+xiv pp.
- Lojacono-Pojero M. 1891. *Flora Sicula, o descrizione delle piante vascolari spontanee o indigenate in Sicilia*, vol. 1 (2) (Polypetalae Calyciflorae). Tipografia Statuto, Palermo, 312+xvi pp.
- Lojacono-Pojero M. 1902a. *Kochia saxicola* Guss. Bollettino della Società botanica italiana [1902] 9: 119–125.
- Lojacono-Pojero M. 1902b. *Flora Sicula, o descrizione delle piante vascolari spontanee o indigenate in Sicilia*, vol. 2 (1). Tipo-Litografia S. Bizzarrilli, Palermo, 240+xiv pp.

- Lojacono-Pojero M. 1904. Flora Sicula, o descrizione delle piante vascolari spontanee o indigenate in Sicilia, vol. 2 (2) (Corolliflorae, Monochlamydeae, Gymnospermae). Tipo-Litografia S. Bizzarrilli, Palermo, 428 pp.
- Lojacono-Pojero M. 1908. Flora Sicula, o descrizione delle piante vascolari spontanee o indigenate in Sicilia, vol. 3 (Monocotyledones, Cryptogamae vasculares). Scuola Tipografia "Boccone del Povero", Palermo, 448+xvi pp.
- Lo Presti R.M. & Oberprieler C. 2009. Evolutionary history, biogeography and eco-climatological differentiation of the genus *Anthemis* L. (Compositae, Anthemideae) in the circum-Mediterranean area. *Journal of Biogeography*, 36: 1313–1332.
- Lucchi F., Peccerillo A., Keller J., Tranne C.A. & Rossi P.L. (Eds.), 2013. The Aeolian Islands Volcanoes. Geological Society Memoir No. 37, The Geological Society, London, 520 pp.
- Martinelli M.C. & Lo Cascio P. 2018. Topografia della preistoria nelle Isole Eolie, pp. 65–78. In: Bernabò Brea M., Cultraro M., Gras M., Martinelli M.C., Pouzadoux C. & Spigo U. (Eds.) *A Madeleine Cavalier*. Collection du Centre Jean Bérard 49, Naples.
- Massa B., Lo Cascio P., Ientile R., Canale E. & La Mantia T. 2015. Gli uccelli delle isole circumsiciliane. *Il Naturalista siciliano*, 39(2): 105–373.
- Mazzola P., Geraci A. & Raimondo F.M. 2002. Endemismo e biodiversità floristica nelle isole circumsiciliane. *Biogeographia*, 22 [2001]: 45–63.
- Medaglia S. 2008. Carta archeologica dell'isola di Basiluzzo (Arcipelago delle Eolie). *Sicilia Antiqua*, 5: 167–196.
- Médail F. & Vidal É. 1998a. Rôle des Goélands leucophaées dans l'implantation et l'expansion d'espèces végétales allochtones sur l'archipel de Riou (Marseille, France). *Bioscosme Méditerranéen*, 15: 123–140.
- Médail F. & Vidal É. 1998b. Organisation de la richesse et de la composition floristiques d'îles de la Méditerranée occidentale (sud-est de la France). *Canadian Journal of Botany*, 76 : 321–331.
- Morrison L.W. 1998. The spatiotemporal dynamics of insular ant metapopulations. *Ecology*, 79: 1135–1146.
- Morrison L.W. 2002. Island biogeography and metapopulation dynamics of Bahamian ants. *Journal of Biogeography*, 29: 387–394.
- Onno M. 1936. Die Wildformen von *Daucus* sect. *Carota*. Beihefte zum Botanisches Centralblatt, 56: 83–136.
- Panitsa M. & Tzanoudakis D. 1996. Contribution to the knowledge and the management of the biodiversity in the East Aegean area: The small islands group Kalolimnos-Imia (Dodekanisos), pp. 105–111. In: Proceedings of the 6th Botanical Scientific Conference of the Hellenic Botanical Society (5–11 April 1996, Paralimni, Cyprus). University Studio Press, Thessaloniki. (in Greek).
- Panitsa M. & Tzanoudakis D. 2001. A floristic investigation of the islet groups Arki and Lipsi (East Aegean area, Greece). *Folia Geobotanica*, 36: 265–279.
- Panitsa M., Bazos I., Dimopoulos P., Zervou S., Yannitsaros A. & Tzanoudakis D. 2004. Contribution to the study of the flora and vegetation of the Kithira island group: Offshore islets of Kithira (S Aegean, Greece). *Willdenowia*, 34: 101–115.
- Panitsa M., Tzanoudakis D., Triantis K.A. & Sfenthourakis S. 2006. Patterns of species richness on very small islands: the plants of the Aegean archipelago. *Journal of Biogeography*, 33: 1223–1234.
- Panitsa M., Tzanoudakis D. & Sfenthourakis S. 2008. Turnover of plants on small islets of the eastern Aegean Sea within two decades. *Journal of Biogeography*, 35: 1049–1061.
- Panitsa M., Kagiampaki A. & Kougioumoutzis K. 2018. Plant diversity and biogeography of the Aegean archipelago: a new synthesis, pp. 223–244. In: Sfenthourakis S., Pafilis P., Parmakelis A., Poulakakis N. & Triantis K.A. (Eds.), *Biogeography and biodiversity of the Aegean*. In honour of Prof. Moysis Mylonas. Broken Hill, Nicosia.
- Pasta S. 1997. Analisi fitogeografica della flora delle isole minori circumsiciliane. PhD Thesis, "Biosistemica ed Ecologia Vegetale" (IX Ciclo), Università degli Studi di Firenze, 2 vols.
- Pasta S. 2002. La flora vascolare e le sue peculiarità, pp. 41–47. In: Corti C., Lo Cascio P., Masseti M. & Pasta S. (Eds.), *Storia naturale delle Isole Pelagie*. L'Epos, Palermo.
- Pasta S. & La Mantia T. 2013. Species richness, biogeographic and conservation interest of the vascular flora of the satellite islands of Sicily: patterns, driving forces and threats, pp. 201–240. In: Cardona Pons E., Estaún Clarisó I., Comas Casademont M. & Fraga i Arguimbau P. (Eds.), *Islands and plants: preservation and understanding of flora on Mediterranean Islands* (2nd Botanical Conference in Menorca). Institut Menorquí d'Estudis & Consell Insular de Menorca, Maó.
- Pasta S., Lo Cascio P. & Pancioli V. 1999. Sull'effettiva consistenza numerica e distribuzione delle Orchidaceae nell'Arcipelago Eoliano (Mar Tirreno sudorientale). *Il Naturalista siciliano*, 23: 467–484.
- Pasta S., Buscemi I., Crisafulli A., Giovino A., Lo Cascio P., Buord S., Guarino R. & La Mantia T. 2014a. Ecologia e distribuzione di *Chamaerops humilis* L. (Arecaceae) nella Sicilia nord-orientale. *Il Naturalista siciliano*, 38: 291–306.
- Pasta S., Sciberras A., Sciberras J. & Scuderi L. 2014b. Analysis of the vascular flora of four satellite islets of the Egadi Archipelago (W Sicily), with some notes on their vegetation and fauna. *Biodiversity Journal*, 5: 39–54.
- Pasta S., Ardenghi N.M.G., Badalamenti E., La Mantia T., Livreri Console S. & Parolo G. 2017a. The alien vascular flora of Linosa (Pelagic Islands, Strait of Sicily): update and management proposals. *Willdenowia*, 47: 135–144.
- Pasta S., Perez-Graber A., Fazan L. & Montmollin B. (de) (Eds.), 2017b. The Top 50 Mediterranean Island Plants UPDATE 2017. IUCN/SSC/Mediterranean Plant Specialist Group. Neuchâtel (Switzerland), 141 pp.
- Pasta S., La Rosa A., Pavon D., Lo Cascio P. & Médail F. 2019. Tentamen Florae Aeolicae: a critical checklist of the vascular plants of the Aeolian Islands (Sicily, Italy), p. 71. In: Bareka P., Domina G. & Kamari

- G. (Eds.), Book of Abstracts of the XVI OPTIMA Meeting (Athens, Agricultural University of Athens, 2–5 October 2019).
- Pignatti S. 1982. Flora d'Italia. Edagricole, Bologna, vol. 1, 790 pp.; vol. 2, 732 pp.; vol. 3, 780 pp.
- Pignatti S., Guarino R. & La Rosa M. 2017–2019. Flora d'Italia. Edagricole, Milano, vol. 1 [2017], xlvii+1064 pp.; vol. 2 [2017], xviii+1178 pp.; vol. 3 [2018], xix+1287 pp.; vol. 4 [2019], cxlv+1054 pp.
- Pretto F., Celesti-Grappo L., Carli E. & Blasi C. 2010. Influence of past land use and current human disturbance on non-native plant species on small Italian islands. *Plant Ecology*, 210: 225–239.
- Pujadas-Salvà A.J. 2003. *Daucus*, pp. 97–125. In: Nieto-Feliner G., Jury S.L., Herrero A. (Eds.), Flora Iberica: plantas vasculares de la Península Ibérica e islas Baleares, Vol. 10 (Apiaceae). Real Jardín Botánico & CSIC, Madrid.
- Raunkjær C. 1934. The life forms of plants and statistical plant geography. Oxford University Press, Oxford, 721 pp.
- Rechinger K.H. & Rechinger-Moser F. 1951. Phytogeographia Aegea. Akademie der Wissenschaften in Wien, Mathematisch-Naturwissenschaftliche Klasse, Denkschriften, 105: 1–208.
- Richardson D.M., Pyšek P., Rejmánek M., Barbour M.G., Panetta F.D. & West C.J. 2000. Naturalization and invasion of alien plants: concepts and definitions. *Diversity & Distributions*, 6: 93–107.
- Rita J. & Bibiloni G. 2013. The flora of the islets of the Balearic Islands, pp. 309–322. In: Cardona Pons E., Estaún Clarisó I., Comas Casademont M. & Fraga i Arguimbau P. (Eds.), Islands and plants: preservation and understanding of flora on Mediterranean Islands (2nd Botanical Conference in Menorca). Institut Menorquí d'Estudis & Consell Insular de Menorca, Maó.
- Runemark H. 1969. Reproductive drift, a neglected principle in reproductive biology. *Botaniska Notiser*, 122: 90–129.
- Sáenz Laínz C. 1981. Research on *Daucus* L. (Umbelliferae). *Anales del Jardín Botánico de Madrid*, 37: 481–533.
- Santangelo A., Croce A., Lo Cascio P., Pasta S., Strumia S. & Troia A. 2013. *Eokochia saxicola* (Guss.) Freitag & G. Kadereit. *Informatore botanico italiano*, 44: 428–431.
- Schrader J., König C., Triantis K.A., Trigas P., Kreft H. & Weigelt P. 2020. Species-area relationships differ among plant growth forms. *Global Ecology & Biogeography*, 29: 814–829.
- Sciberras A. & Sciberras J. 2012. Flora of “U Briantinu”, a satellite stack of Panarea Island, Aeolian Archipelago (Sicily, Italy). In: Proceedings 1st International Congress “Insularity and Biodiversity” (May 11–13, 2012, Palermo, Italy). *Biodiversity Journal*, 3: 397–399.
- Sfenthourakis S. & Triantis K.A. 2009. Habitat diversity, ecological requirements of species and the Small Island Effect. *Diversity & Distributions*, 15: 131–140.
- Smyth W.H. 1824. Memoir Descriptive of the Resources, Inhabitants and Hydrography of the Sicily and its Islands interspersed with Antiquarian and other Notices. J. Murray, London, 289 pp.
- Sneath P.H.A. & Sokal R.R. 1973. Numerical Taxonomy: The principles and practice of Numerical classification. Freeman, San Francisco, 573 pp.
- Snogerup S. & Snogerup B. 2004. Changes in the flora of some Aegean islets 1968–2000. *Plant Systematics & Evolution*, 245: 169–213.
- Spallanzani L. 1793. Viaggi alle Due Sicilie e in alcune parti dell'Appennino, Tomo IV. Stamperia B. Comini, Pavia, 256 pp.
- Strumia S., Croce A. & Santangelo A. 2015. New distributional data of the rare endemic species *Eokochia saxicola* (Guss.) Freitag and G. Kadereit (Chenopodiaceae): effects on biogeography and conservation. *Plant Biosystems*, 149: 559–564.
- Troia A. 2012. Insular endemism in the Mediterranean vascular flora: the case of the Aeolian Islands (Sicily, Italy). In: Proceedings of the 1st International Congress “Insularity and Biodiversity” (Palermo, 11–13 May 2012). *Biodiversity Journal*, 3: 369–374.
- Troia A., Cardinale M., La Manna M., Lo Cascio P., Pasta S., Puglia A.M., Quatrini P. & Voutsinas E. 2005. Preliminary results of EOLIFE99, a project concerning the conservation of four endangered plant species of Aeolian Archipelago (South Tyrrhenian Sea, Italy). *Quaderni di Botanica ambientale e applicata*, 16: 173–174.
- Véla E., Saatkamp A. & Pavon D. 2013. Flora of Habibas Islands (N-W Algeria): richness, persistence and taxonomy, pp. 271–287. In: Cardona Pons E., Estaún Clarisó I., Comas Casademont M. & Fraga i Arguimbau P. (Eds.), Islands and plants: preservation and understanding of flora on Mediterranean Islands (2nd Botanical Conference in Menorca). Institut Menorquí d'Estudis & Consell Insular de Menorca, Maó.
- Vidal E., Médail F., Taton T., Roche P. & Vidal P. 1998. Impact of gull colonies on the flora of the Riou Archipelago (Mediterranean islands of South-East France). *Biological Conservation*, 84: 235–243.
- Vidal E., Médail F., Taton T. & Bonnet V. 2000. Seabirds drive plant species turnover on small Mediterranean islands at the expense of native taxa. *Oecologia*, 122: 427–434.
- Whittaker R.J. & Fernández-Palacios J.M. 2006. Island Biogeography. Ecology, Evolution, and Conservation. 2nd edition. Oxford University Press, Oxford, 414 pp.

APPENDIX 1

List of the vascular plant taxa and their distribution in the study islets. New records have no references (e.g.: BAS), while previously recorded taxa are marked by the symbol ° if not observed during our field investigations and by the symbol * if its local occurrence is confirmed. For other abbreviations, see Floristic data in “Material and Methods”.

PTERIDOPHYTA
PTERIDACEAE

Anogramma leptophylla (L.) Link - G rhiz - Subcosmopolitan - S - A – BAS.

GYMNOSPERMAE
EPHEDRACEAE

Ephedra distachya L. - P caesp - CE Mediterranean - CS - EN – *STR (Ferro & Furnari 1968 sub *Ephedra fragilis* Desf.; Lo Cascio 2017).

ANGIOSPERMAE
AIZOACEAE

Carpobrotus edulis (L.) N.E.Br. - Ch succ - Transformer alien - SR - EN – LBA.

Mesembryanthemum nodiflorum L. - T scap - Tethysian-Capense - R - B/EP – BAS, *BOT (Lojacono 1878; Habsburg Lothringen 1895), CAN, CFG, CRA, GIA, *LBA (Lojacono 1878; Habsburg Lothringen 1895; Lo Cascio 2017), LNE, PAR, PBA, PLU, PME, *SFA (Habsburg Lothringen 1893b; Lo Cascio 2006, 2017).

AMARANTHACEAE

Atriplex halimus L. - NP - Mediterranean-Saharan - CS - A – *BAS (Gussone 1842-1845; Lojacono 1878; Habsburg Lothringen 1895; De Angelis D'Ossat 1900), *BOT (Gussone 1842-1845).

Atriplex portulacoides L. - NP - Tethysian-European - CS - A – *BOT (Lojacono 1878 and Habsburg Lothringen 1895 sub *Obione portulacoides* Moq. in DC.), *LBA (Lojacono 1878 and Habsburg Lothringen 1895 sub *O. portulacoides*; Lo Cascio 2017), NAV, SPI.

Chenopodium album L. - T scap - Holarctic-Palaeotropical - R - B/EN – BOT, CFP, PBA, PME.

Eokochia saxicola (Guss.) Freitag & G.Kadereit - Ch suffr - Apulian-Sicilian Endemic - S - EP – *STR [Habsburg Lothringen 1896, Baroni 1902, Lojacono-Pojero 1902a, 1904, Ferro & Furnari 1968 and Brullo et al. 1997 sub *Kochia saxicola* Guss.; Troia et al. 2005 and Lo Cascio 2004 sub *Bassia saxicola* (Guss.) A.J.Scott; Santangelo et al. 2013; Lo Cascio 2017; Pignatti et al. 2017-2019].

Suaeda vera J.F.Gmelin - Ch frut - Tethysian-Atlantic - CS - EN/H – *BAS (Gussone 1832-1834, 1842-1845 and Lojacono 1878 sub *Chenopodium fruticosum* L.), *BOT (Gussone 1832-1834, 1842-1845 and Lojacono 1878 sub *C. fruticosum*), *LBA (Gussone 1832-1834, 1842-1845 and Lojacono 1878 sub *C. fruticosum*; Lo Cascio 2017), *LNE (Gussone 1832-1834 and 1842-1845 sub *C. fruticosum*).

AMARYLLIDACEAE

Allium commutatum Guss. - G bulb - Mediterranean - SR - B – °LBA (Gussone 1832-1834 and 1842-1845 sub *Allium rotundum* L.), NAV.

Narcissus tazetta L. - G bulb - Mediterranean-Macaronesian - SR - B – BAS.

ANACARDIACEAE

Pistacia lentiscus L. - P caesp - Mediterranean-Macaronesian - CS - EN – *BAS (Gussone 1842-1845; Habsburg Lothringen 1895 as “Mastixgebüsche”; De Angelis D'Ossat 1900; Lo Cascio 2017), *LBA (Gussone 1842-1845; Lojacono-Pojero 1891, Habsburg Lothringen 1895 as “Mastixsträucher”), SPI.

APIACEAE

Crithmum maritimum L. - Ch suffr - Mediterranean-Atlantic - S - B/H – SGI.

Daucus carota L. s.l. - H bienn - Subcosmopolitan - R - EP – BAS.

Daucus gingidium L. subsp. *fontanesii* (Thell.) Onno (incl. *Daucus foliosus* Guss.) - H bienn - CW Mediterranean - S - EP – *BAS (Gussone 1832-1834 and 1842-1845 sub *Daucus foliosus*), CFG, PQU, STR (Gussone 1832-1834 and 1842-1845 sub *D. foliosus*; Ferro & Furnari 1968 sub *Daucus carota* var. *hispidus* Desf.; Brullo et al. 1997). Notes: all recent monographs on genus *Daucus* (Onno 1936; Sáenz Láinz 1981; Heywood 1983; Pujadas-Salvà, 2003) pointed out the intricate phylogenetic relationships among the infraspecific taxa referred to *Daucus gingidium* s.l., *D. foliosus* belongs with no doubt to this polymorphic group (J.-P. Reduron, pers. comm.) and may be considered as a synonym of *D. gingidium* subsp. *fontanesii*. A dry specimen collected on STR and identified as *Athamanta sicula* L. by Habsburg Lothringen (1896) and by Ferrarini (1987) is currently kept in Herbarium Centrale Italicum and belongs to *Daucus gingidium* s.l. as well.

Ferula communis L. subsp. *communis* - H scap - Mediterranean-Macaronesian - SR - A – *BAS (Gussone 1832-1834, 1842-1845; Lojacono 1878; Lojacono-Pojero 1891; De Angelis D'Ossat 1900).

Seseli bocconeii Guss. subsp. *bocconeii* - Ch frut - Sicilian Endemic - S - B – °STR (Gussone 1832-1834). Notes: the occurrence of this species on the islet has not been reported by the same author in his “Flora Siculae Synopsis” (Gussone 1842-1845).

Thapsia garganica L. subsp. *garganica* - H scap - CW Mediterranean - SR - A – *BAS (Lo Cascio 2017), LBA.

ARACEAE

Arisarum vulgare Targ.-Tozz. - G rhiz - Mediterranean - SR - EN – BAS.

ARALIACEAE

Hedera helix L. - P lian - Mediterranean-European - C - EN – °BAS (Gussone 1842-1845; Habsburg Lothringen 1895 as “Epheu”).

ARECACEAE

Chamaerops humilis L. - NP - CW Mediterranean - CS - EN – *BAS (Gussone 1842-1845; Habsburg Loth-

ringen 1895; Pasta et al. 2014a; Lo Cascio 2017), CFG, *SPI (Habsburg Lothringen 1895; Pasta et al. 2014a; Lo Cascio 2017).

ASPARAGACEAE

Asparagus acutifolius L. - G rhiz - Mediterranean - CS - EN - *BAS (Gussone 1832-1834, 1842-1845; Lojacono 1878), *BOT (Lojacono 1878), BRI, *LBA (Gussone 1832-1834, 1842-1845; Lojacono 1878; Lojacono-Pojero 1908), PLU, SPI.

Charybdis pancration (Steinh.) Speta - G bulb - C Mediterranean (Boscaiu et al. 2003) - S - B - *BAS (Habsburg Lothringen 1895 as "*Scylla*"; Lo Cascio 2017 sub *Drimia maritima*), LBA, *SFA [Habsburg Lothringen 1893b as "*Scylla*"; Lo Cascio 2006 sub *Charybdis maritima* (L.) Speta].

Muscari comosum (L.) Mill. - G bulb - Tethysian-European - CR - B - BAS.

ASPHODELACEAE

Asphodelus ramosus L. - G rhiz - CW Mediterranean-Macaronesian - S - B - *BAS (Gussone 1832-1834, 1842-1845, Lojacono 1878 and De Angelis D'Ossat 1900 sub *Asphodelus microcarpus* Viv.).

ASTERACEAE

Achillea ligustica All. - H scap - Mediterranean - CS - A - BAS.

Aetheorhiza bulbosa (L.) Cass. - G bulb - Mediterranean - S - A/EP - SFA.

Andryala integrifolia L. subsp. *undulata* (C.Presl) Zangh. - T scap - Apulian-Sicilian Endemic - R - EP - *BAS (Gussone 1842-1845), *SFA (Lo Cascio 2006).

Anthemis aeolica Lojac. - H scap - End Aeolian Islands - SR - B - °BAS (Gussone 1842-1845 sub *Anthemis maritima* L. "var. a"; Lojacono-Pojero 1902b), °BOT (Gussone 1842-1845 sub *A. maritima* "var. a"; Lojacono-Pojero 1902b), *LBA (Lojacono 1878 sub *A. maritima*; Ferro & Coniglione 2014 sub *A. maritima* subsp. *aeolica*; Brullo et al. 2016; Lo Cascio 2017; Pignatti et al. 2017-2019). Notes: this species has been considered as synonym of *A. maritima* (Fiori 1927; Pignatti 1982; Lo Presti & Oberprieler 2009), as subspecies of this latter (Ferro & Coniglione 2014), or as doubtful taxon that needs further investigations (Fernandes 1976; Greuter 2008; Troia 2012). According to Brullo et al. (2016), it should be however considered a valid species that differs from *A. maritima* in several morphological and ecological traits: this latter is typical of plant communities of coastal sand dunes referred to *Ammophilettea* Br.-Bl. & R. Tx. ex Westhoff, Dijk & Passchier, while *A. aeolica* grows either on tuffs or on rocky substrates within perennial chenopod-dominated shrubberies and together with several halo-nitrophilous chamaephytes and hemicryptophytes typical to *Sarcocornietea fruticosae* Br.-Bl. & R. Tx. ex A. & O. de Bolòs em. O. de Bolòs. The past range of the species included also Stromboli and Dattilo (Gussone 1842-1845; Lojacono-Pojero 1902-1903), as well as BAS and BOT, where its occurrence has

not been confirmed anymore; the only known population on LBA is estimated about 200-250 individuals distributed within a surface of less than 1 hectare (Lo Cascio 2017).

Artemisia arborescens L. - NP - SW Mediterranean - SR - B - *BAS (De Angelis D'Ossat 1900), CFG, PAR, °PBA (Habsburg Lothringen 1895), *SFA (Habsburg Lothringen 1893b; Lo Cascio 2006), SLP, SPI.

Calendula arvensis L. - T scap - Tethysian-European - R - EP - *SFA (Lo Cascio 2006).

Carlina corymbosa L. - H scap - Mediterranean - SR - A - BAS.

Carthamus lanatus L. subsp. *lanatus* - T scap - Tethysian-European - R - EP - *BAS (Gussone 1842-1845).

Centaurea aeolica DC. subsp. *aeolica* - Ch suffr - End Aeolian Islands - SR - EP - *BAS (Gussone 1842-1845), CFP, FPE, *LBA (Gussone 1842-1845), NAV, PAR, PLU, SLP.

Cladanthus mixtus (L.) Oberprieler & Vogt - T scap - Mediterranean - R - B - °BAS (Gussone 1842-1845 and Lojacono-Pojero 1902b sub *Anthemis mixta* L.). *Dittrichia graveolens* (L.) Greuter - T scap - Mediterranean-Irano-Turanian - R - A - BAS.

Dittrichia viscosa (L.) Greuter - H scap - Tethysian - SR - A - *BAS (Gussone 1842-1845 sub *Erigeron viscosum* L.), LBA, PQU, SGI.

Erigeron bonariense (L.) Cronq. - T scap - Naturalized - R - A - *BAS (Gussone 1842-1845 sub *Conyza ambigua* DC.).

Galactites tomentosa DC. - H bienn - Mediterranean - R - A - °BAS (Gussone 1842-1845; De Angelis D'Ossat 1900).

Glebionis coronaria (L.) Spach - T scap - Mediterranean - R - A - °BAS (Gussone 1842-1845 and De Angelis D'Ossat 1900 sub *Chrysanthemum coronarium* L.).

Hedypnois cretica (L.) Willd. - T ros - Tethysian - R - EP - *BAS (Gussone 1842-1845 also sub *Hedypnois tubaeformis* Ten.), LBA.

Hedypnois rhagadioloides (L.) F.W.Schmidt - T ros - Mediterranean-Irano-Turanian - R - EP - *SFA [Lo Cascio 2006 sub *Hedypnois cretica* (L.) Willd.].

Helichrysum litoreum Guss. - Ch suffr - Apulian-Sicilian-Tyrrhenian endemic - S - B - *BAS (Gussone 1842-1845), CFG, CRA, FPE, LBA, PQU, *SFA (Lo Cascio 2006), SGI, SPI.

Hyoseris radiata L. - H ros - Mediterranean - CS - A/EP - *BAS (Gussone 1842-1845), *CAN [Di Palma 1980; Lo Cascio et al. 2014a sub *H. taurina* (Pamp.) Martinoli], °LNE (Gussone 1842-1845), PME, SGI.

Hyoseris taurina (Pamp.) Martinoli - H caesp - SW Mediterranean - S - A/EP - BOT, LBA, NAV, *SFA (Lo Cascio 2006), *STR [Ferro & Furnari 1968 sub *Hyoseris radiata* L. var. *baetica* (Sch.-Bip. ex Nyman) Fiori; Brullo et al. 1997; Lo Cascio 2017 sub *H. lucida* subsp. *taurina*].

Hypochoeris achyrophorus L. - T ros - Mediterranean - R - A - *BAS (Gussone 1842-1845 sub *Seriola aethnensis* L.).

Hypochoeris glabra L. - T scap - Mediterranean-European - R - A - °BAS (Gussone 1842-1845).

Jacobaea maritima (L.) Pelsers & Meijden subsp. *bicolor* (Willd.) B.Nord. & Greuter - Ch frut - Apulian-Sicilian-Tyrrhenian endemic - S - A - *BAS (Gussone 1842-1845 sub *Cineraria bicolor* Willd.), CFG, FPP,

- PQU, *SFA [Lo Cascio 2006 sub *Senecio bicolor* (Willd.) Tod.; Lo Cascio 2017], *STR [Ferro & Furnari 1968 sub *Senecio cineraria* DC.; Brullo et al. 1997 sub *S. bicolor*].
- Limbarda crithmoides* (L.) Dumort. subsp. *longifolia* (Arcang.) Greuter - Ch suffr - Mediterranean-Atlantic - CS - A/H – *BAS (Gussone 1842-1845 and Habsburg Lothringen 1895 sub *Inula crithmoides* L.; Lojacono 1878 sub *Limbardia tricuspis* Cass.), *BOT (Lojacono 1878 sub *L. tricuspis*), CFG, CFP, *LBA (Gussone 1842-1845 and Habsburg Lothringen 1895 sub *I. crithmoides*; Lojacono 1878 sub *L. tricuspis*; Lo Cascio 2017), NAV, PAR, PBA, *SFA (Habsburg Lothringen 1893b and Lo Cascio 2006 sub *I. crithmoides*), SLP, SPI, °STR (Gussone 1842-1845 sub *I. crithmoides*).
- Logfia gallica* (L.) Coss. & Germ. - T scap - Mediterranean-European - R - A/B – *BAS (Gussone 1842-1845 sub *Filago gallica* L.).
- Phagnalon saxatile* (L.) Cass. subsp. *saxatile* - Ch suffr - CW Mediterranean - SR - A – *BAS (Gussone 1842-1845 sub *Conyza saxatilis* L.).
- Reichardia picroides* (L.) Roth - H scap - Mediterranean - SR - A/B – LBA.
- Senecio leucanthemifolius* Poir. s.l. - T scap - CW Mediterranean - R - A – *BAS (Gussone 1842-1845 sub *Senecio crassifolius* Willd., De Angelis D'Ossat 1900), BOT, *LBA (Gussone 1842-1845 sub *S. crassifolius*; Lo Cascio 2017), °LNE (Gussone 1842-1845 sub *S. crassifolius*), NAV, *SFA (Lo Cascio 2006).
- Sonchus asper* (L.) Hill subsp. *asper* - T scap - Boreal-Tethysian - R - A/EN – LBA.
- Sonchus oleraceus* L. - T scap - Boreal-Tethysian - R - A/EN – BOT, *SFA (Lo Cascio 2006).
- BORAGINACEAE**
- Echium pustulatum* Sm. - H bienn - Mediterranean - CR - B – *BAS (De Angelis D'Ossat 1900)
- Heliotropium dolosum* De Not. - T scap - Tethysian-Pontic - R - B/EN – BAS.
- Heliotropium* sp. - T scap - R - B/EN – PME.
- Myosotis ramosissima* Rochel - T scap - Tethysian-European - R - EP – BAS.
- BRASSICACEAE**
- Arabidopsis thaliana* (L.) Heyn - T scap - Tethysian-Eurosiberian - R - A – BAS.
- Brassica fruticulosa* Cirillo - H caesp - CW Mediterranean - CR - B/EN – BAS, CFG, CFP, NAV, *SFA (Lo Cascio 2006), PAR, PLU, PQU, SLP.
- Capsella rubella* Reut. - T scap - Cosmopolitan - R - A – BAS.
- Iberis semperflorens* L. - Ch frut - C Mediterranean - S - A/B – *BAS (Gussone 1832-1834, 1842-1845; Lojacono 1878; Lo Cascio 2017).
- Lobularia maritima* (L.) Desv. - H scap - Mediterranean-Pontic - SR - A/B – *BAS [Habsburg Lothringen 1895 sub "*Honiga*" (= *Koniga*) *maritima*; De Angelis D'Ossat 1900 sub *Alyssum maritimum* L.], CFP, FPE, PQU, *STR (Ferro & Furnari 1968).
- Matthiola incana* (L.) R.Br. s.l. - Ch suffr - Mediterranean-Atlantic - SR - A/B – *BAS (Gussone 1832-1834 and 1842-1845 sub *Matthiola incana* var. *sinuatifolia* Guss.; Lojacono-Pojero 1888), CFG, CFP, LBA, LNE, NAV, PLU, *SFA [Habsburg Lothringen 1893b sub *Matthiola sinuata* (L.) R.Br.; Lo Cascio 2006, 2017], SGI.
- CACTACEAE**
- Opuntia ficus-indica* (L.) Mill. s.l. - P succ - Naturalized - S - EN – *BAS (Gussone 1832-1834 sub *Cactus opuntia* L. and *Cactus maximus* Guss., Gussone 1842-1845 sub *Opuntia amyclaea* Ten.), LBA, NAV, PAR, *SFA (Habsburg Lothringen 1893b as "Opuntien"; Lo Cascio 2006), SPI, STR.
- CAPPARACEAE**
- Capparis spinosa* L. subsp. *rupestris* (Sibth. & Sm.) Nyman - NP - Mediterranean - S - EN – *BAS (Gussone 1832-1834, 1842-1845; Habsburg Lothringen 1895 as "Kapernsträuchern"), CFG, PQU, SPI.
- CARYOPHYLLACEAE**
- Dianthus rupicola* Biv. subsp. *aeolicus* (Lojac.) Brullo & Minissale - Ch suffr - Apulian-Sicilian Endemic - S - EP – *BAS (Gussone 1832-1834 and 1842-1845 sub *Dianthus bisignani* Ten. var. *virescens*; Habsburg Lothringen 1895 sub *Dianthus* sp.), °BOT (Gussone 1832-1834 and 1842-1845 sub *D. bisignani* var. *virescens*), *LBA (Gussone 1832-1834 and 1842-1845 sub *D. bisignani* var. *virescens*), NAV, *SFA (Habsburg Lothringen 1893b sub *D. bisignani* Ten.; Lo Cascio 2006, 2017), SPI, *STR (Gussone 1832-1834 and 1842-1845 sub *D. bisignani* var. *virescens*; Lojacono-Pojero 1902a and Brullo et al. 1997 sub *D. rupicola* Biv.; Brullo & Minissale 2002; Lo Cascio 2017).
- Polycarpon tetraphyllum* L. - T scap - Tethysian-European - R - EP – BAS.
- Sagina maritima* G.Don - T scap - Mediterranean-Atlantic - R - B – BAS, LBA.
- Silene neglecta* Ten. - T scap - CW Mediterranean - R - A – *BAS (De Angelis D'Ossat 1900), BOT, LBA, NAV, *SFA (Lo Cascio 2006).
- Spergularia maritima* (All.) Chiov. - H scap - Subcosmopolitan - S - A/EP – BAS, LBA, BOT.
- CISTACEAE**
- Cistus monspeliensis* L. - NP - Mediterranean-Macaronesian - S - EP – °STR (Gussone 1832-1834 and 1842-1845 sub *Cistus affinis* Bertol.).
- CLUSIACEAE**
- Hypericum perforatum* L. - H scap - Mediterranean - S - A – BAS.
- Hypericum perforatum* L. - H scap - Tethysian-European - S - A – BAS.

CRASSULACEAE

- Sedum caespitosum* (Cav.) DC. - T succ - Tethysian-European - R - A – NAV.
Sedum litoreum Guss. - T succ - Mediterranean - R - A – *SFA (Lo Cascio 2006, 2017).
Umbilicus horizontalis (Guss.) DC. - G bulb - CE Mediterranean - S - A – *BAS (Gussone 1832-1834 and 1842-1845 sub *Cotyledon horizontalis* Guss.), *CAN (Lo Cascio et al. 2014a), LBA, *SFA (Lo Cascio 2006), STR.

CYPERACEAE

- Cyperus rotundus* L. - G rhiz - Holarctic-Palaeotropical - CR - B/EN – BAS.

ERICACEAE

- Erica arborea* L. - P caesp - Tethysian-Palaeotropical - CS - B – *BAS (Lo Cascio 2017).

EUPHORBIACEAE

- Euphorbia dendroides* L. - NP - Mediterranean - CS - M – *BAS (Habsburg Lothringen 1895; De Angelis D'Ossat 1900), *STR (Ferro & Furnari 1968; Brullo et al. 1997; Lo Cascio 2017).
Euphorbia terracina L. - T scap - Mediterranean - R - M – °BAS (Gussone 1832-1834, 1842-1845).

FABACEAE

- Coronilla scorpioides* (L.) Koch - T scap - Mediterranean-European - R - EP – *BAS (Gussone 1832-1834 and 1842-1845 sub *Ornithopus scorpioides* L.).
Cytisus infestus C.Presl subsp. *infestus* - P caesp - C Mediterranean - SR - M – °BAS (Gussone 1832-1834, 1842-1845).
Genista tyrrhena Valsecchi - NP - Aeolian Endemic - CS - B – *BAS (Gussone 1832-1834 and 1842-1845 sub *Genista "ephedrioides"*), CFG, FPE, PQU, SGI.
Lathyrus cicera L. - T scap - Casual - R - A – °BAS (De Angelis D'Ossat 1900).
Lathyrus clymenum L. - T scap - Mediterranean - R - A/EN – *BAS (Gussone 1832-1834 and 1842-1845 sub *Lathyrus tenuifolius* Desf.).
Lotus cytisoides L. - Ch suffr - Mediterranean - S - B/EN – BAS, BOT, *LBA (Lo Cascio 2017), NAV, *SFA (Lo Cascio 2006, 2017), SPI.
Lotus edulis L. - T scap - Mediterranean - R - B/EN – BOT, LBA, SFA.
Lotus subbiflorus Lag. - T scap - Tethysian-Atlantic - R - B/EN – BAS.
Lupinus angustifolius L. s.l. - T scap - Mediterranean - R - EP – *BAS (Gussone 1832-1834, 1842-1845), STR.
Medicago littoralis Loisel. - T scap - Tethysian-European - R - EP – °BAS (De Angelis D'Ossat 1900).
Medicago murex Willd. - T scap - Mediterranean - R - EP – °BAS (Gussone 1832-1834, 1842-1845).
Ononis diffusa Ten. - T scap - Mediterranean - R - EP – *BAS (Gussone 1832-1834, 1842-1845; Lojacono 1878; Lojacono-Pojero 1891).

- Ononis reclinata* L. - T scap - Tethysian-Atlantic - R - EP – °BAS (Gussone 1832-1834, 1842-1845, Lojacono 1878 and Lojacono-Pojero 1891 sub *Ononis mollis* Savi).
Ornithopus compressus L. - T scap - Mediterranean-European - R - EP – °BAS (Gussone 1832-1834, 1842-1845).
Scorpiurus muricatus L. - T scap - Mediterranean - R - EP – °BAS (Gussone 1832-1834 and 1842-1845 sub *Scorpiurus "subvillosa"* L.)
Spartium junceum L. - P caesp - Tethysian-European - SR - B – *BAS (Gussone 1832-1834, 1842-1845).
Trifolium angustifolium L. - T scap - Tethysian-European - R - EP – *BAS (Gussone 1832-1834, 1842-1845), STR.
Trifolium arvense L. - T scap - Tethysian-Eurosiberian - R - EP – *BAS (Gussone 1832-1834, 1842-1845).
Trifolium scabrum L. - T scap - Tethysian-Atlantic - R - EP – LBA, NAV.
Vicia benghalensis L. - T scap - Mediterranean - R - B – °BAS (Gussone 1832-1834, 1842-1845, Lojacono 1878 and De Angelis D'Ossat 1900 sub *Vicia atropurpurea* Desf.)
Vicia sativa L. subsp. *macrocarpa* (Moris) Arcang. - T scap - Tethysian - R - B – °BAS (Gussone 1832-1834 and 1842-1845 sub *Vicia heterophylla* Presl).
Vicia villosa L. subsp. *ambigua* (Guss.) Kerguelen - T scap - CE Mediterranean - R - B – °BAS (Gussone 1832-1834 and 1842-1845 sub *Vicia pseudocracca* Bertol.).

FRANKENIACEAE

- Frankenia pulverulenta* L. - T scap - Tethysian-Pontic - R - B/EP – BOT, LBA.

GENTIANACEAE

- Centaurium erythraea* Rafn s.l. - T ros - Tethysian-European - R - A – BAS.
Centaurium maritimum (L.) Fritsch - T scap - Mediterranean - R - A – *BAS (Lojacono 1878 and Lojacono-Pojero 1904 sub *Erythraea maritima* Pers.), NAV.
Centaurium pulchellum (Swartz) Druce - T scap - Holarctic - R - A – BAS, LBA (Lo Cascio 2017).

GERANIACEAE

- Erodium chium* (L.) Willd. - T scap - Tethysian - R - AU – °BAS (Lojacono-Pojero 1888-1889).

JUNCACEAE

- Juncus acutus* L. - H caesp - Mediterranean-European - S - EP/H – *LBA (Gussone 1832-1834, 1842-1845; Lo Cascio 2017).
Juncus capitatus Weigel - T scap - Subcosmopolitan - C - EP – BAS.

LAMIACEAE

- Clinopodium nepeta* (L.) Kuntze - H scap - Mediterranean - S - EP – BAS.
Micromeria graeca (L.) Rchb. subsp. *consentina* (Ten.) Arcang. - Ch suffr - Apulian-Sicilian Endemic - S - EP – *BAS (Gussone 1832-1834 and 1842-1845 sub *Satureja consentina* Ten.).
Rosmarinus officinalis L. - NP - Casual - S - B – °BAS (Habsburg Lothringen 1895 as "Rosmarin").

LINACEAE

Linum trigynum L. - T scap - European-Tethysian - R - B – *BAS (Gussone 1832-1834 sub *Linum aureum* Waldst. & Kit; Gussone 1842-1845 sub *Linum gallicum* L.).

MALVACEAE

Malva arborea (L.) Webb & Berthel. - H bienn - Mediterranean-Atlantic - R - B/EN – *CAN [Di Palma 1980 sub *Lavatera arborea* L.; Lo Cascio et al. 2014a sub *Malva veneta* (Mill.) Soldano, Banfi & Galasso; Lo Cascio 2017], PAR, PBA (Lo Cascio 2017).

Malva multiflora (Cav.) Soldano, Banfi & Galasso - T scap - Mediterranean - R - A/EN – °BAS (Lojacono 1878 sub *Lavatera cretica* L.), SFA, *STR (Habsburg Lothringen 1896 sub *Malva* sp.; Lojacono-Pojero 1902a sub *Lavatera* sp.).

MORACEAE

Ficus carica L. - P scap - Naturalized - SR - EN – *BAS (Habsburg Lothringen 1895 as “Feigenbäumen”).

MYRTACEAE

Myrtus communis L. - NP - Mediterranean-European - CS - EN – BAS.

OLEACEAE

Olea europaea L. var. *europaea* - P scap - Naturalized - CS - EN – BAS, STR.

ORCHIDACEAE

Anacamptis longicornu (Poir.) R.M.Bateman, Pridgeon & M.W.Chase - G bulb - CW Mediterranean - S - A – *BAS (Pasta & al. 1999 sub *Orchis morio* L.).

Anacamptis papilionacea (L.) R.M.Bateman, Pridgeon & M.W.Chase s.l. - G bulb - Mediterranean-Pontic - S - A – *BAS (Pasta & al. 1999 sub *Orchis papilionacea* L. var. *grandiflora* Boiss.; Lo Cascio 2017).

Serapias parviflora Parl. - G bulb - Tethysian-Atlantic - S - A – *BAS (Pasta & al. 1999).

OROBANCHACEAE

Orobanche amethystea Thuill. - T par - Mediterranean-European - R - B – LBA, °SFA (Lo Cascio 2006 sub *Orobanche crinita* Viv.), *STR (Domina et al. 2011). Notes: the plant was not observed anymore after 1996 (Lo Cascio 2006).

Orobanche caryophyllacea Sm. - T par - Tethysian-European - R - B – °BAS (Gussone 1832-1834 and 1842-1845 sub *Orobanche galii* Duby).

Orobanche variegata Wallr. - T par - CW Mediterranean - R - B – *BAS (Gussone 1832-1834 and 1842-1845 sub *Orobanche spartii* Vaucher ex Guss.).

PAPAVERACEAE

Fumaria cfr. *capreolata* L. - T scap - Mediterranean-Atlantic - R - B/EN – °SFA (Lo Cascio 2006). Notes: the

plant was not observed anymore after 1996 (Lo Cascio 2006).

PLANTAGINACEAE

Linaria peltisseriana (L.) Mill. - T scap - Mediterranean-European - R - B – BAS.

Misopates orontium (L.) Raf. - T scap - Mediterranean-European - R - EP – *BAS (Gussone 1832-1834 and 1842-1845 sub *Antirrhinum orontium* L.), *SFA (Lo Cascio 2006).

Plantago coronopus L. subsp. *coronopus* - T ros - Mediterranean-Atlantic - R - B/EP – STR.

Plantago coronopus L. subsp. *commutata* Rchb. - H bienn - Mediterranean-Irano-Turanian - S - B/EP – BOT, LBA, *SFA (Lo Cascio 2006 sub *Plantago coronopus* L.).

PLUMBAGINACEAE

Limonium minutiflorum (Guss.) Kuntze - Ch suffr - NE Sicilian Endemic - S - A/B – *BAS (Gussone 1832-1834, 1842-1845, Lojacono 1878, Habsburg Lothringen 1895 sub *Statice minutiflora* Guss.; De Angelis D'Ossat 1900 sub *Statice dictyoclada* Boiss.; Lojacono-Pojero 1904 sub *Statice sicula* Tin. ex Lojac.), BOT, *LBA (Gussone 1832-1834 and 1842-1845 sub *S. minutiflora*; Lo Cascio 2017), NAV, *SFA (Habsburg Lothringen 1893b sub *S. minutiflora*; Lo Cascio 2006, 2017), SPI.

POACEAE

Aira caryophyllea L. - T scap - Subcosmopolitan - R - EP – *SFA (Lo Cascio 2006).

Anisantha diandra (Roth) Tzvelev - T scap - Mediterranean-Irano-Turanian - R - EP – *BAS (Gussone 1842-1845 sub *Bromus “gussonii”* Parl.; Lojacono 1878 sub *Bromus maximus* Desf.).

Anisantha madritensis (L.) Nevski - T scap - Tethysian-European - R - EP – °BAS (Gussone 1832-1834 and 1842-1845 sub *Bromus madritensis* L.).

Anisantha sterilis (L.) Nevski s.l. - T scap - Tethysian-Eurosiberian - R - EP – °BAS (Gussone 1832-1834 and 1842-1845 sub *Bromus sterilis* L.).

Avena barbata Link - T scap - Tethysian-Pontic - R - EP – *SFA (Lo Cascio 2006).

Brachypodium retusum (Pers.) P.Beauv. - H caesp - Mediterranean - S - B/EP – *BAS (Gussone 1842-1845 sub *Brachypodium “phoenicoides”* Link).

Briza maxima L. - T scap - Mediterranean - SR - B – BAS.

Catapodium hemipoa (Sprengel) Lainz subsp. *occidentale* (Paunero) H. & S.Scholz - T scap - CW Mediterranean-Atlantic - R - EP – *SFA [Lo Cascio 2006 sub *Catapodium rigidum* (L.) C.E.Hubbard].

Catapodium pauciflorum (Merino) Brullo, Giusso, Minissale & Spampinato - T scap - CW Mediterranean - R - EP – BAS, BOT, LBA, SGI.

Catapodium rigidum (L.) C.E. Hubbard subsp. *rigidum* - T scap - Tethysian-European - R - EP – BAS.

Cynodon dactylon (L.) Pers. - G rhiz - Subcosmopolitan - R - B/EP – LBA.

Dactylis glomerata L. s.l. - H caesp - Holarctic - S - EP – BAS, BOT, *CAN (Lo Cascio et al. 2014a), CFG, CFP,

FPE, *LBA (Lo Cascio 2017), LNE, PQU, *SFA (Lo Cascio 2006), SPI, *STR (Habsburg Lothringen 1896 and Brullo et al. 1997 sub *Dactylis hispanica* Roth).
Hordeum leporinum Link - T scap - Mediterranean-European - R - EP – BAS, BOT, CFP, LBA, *SFA (Lo Cascio 2006).

Hordeum marinum Huds. subsp. *gussoneanum* (Parl.) Thell. - T scap - Mediterranean - S - EP – LBA. Notes: first record of this taxon for the Aeolian Archipelago.

Hyparrhenia hirta (L.) Stapf. s.l. - H caesp - Tethysian-Palaeotropical - S - EP – BAS.

Lagurus ovatus L. subsp. *ovatus* - T scap - Mediterranean-Atlantic - R - A – BAS, BOT, LBA, SFA, *STR (Habsburg Lothringen 1896).

Lamarckia aurea (L.) Moench - T scap - Tethysian - R - EP – *SFA (Lo Cascio 2006).

Lolium temulentum L. s.l. - T scap - Holarctic - R - EP – *BAS (Gussone 1832-1834 sub *Lolium speciosum* M.Bieb., 1842-1845 sub *Lolium maximum* Willd.).

Oloptum miliaceum (L.) Röser & H.R.Hamasha s.l. - H caesp - Tethysian - SR - A/B – BAS.

Parapholis incurva (L.) C.E.Hubbard - T scap - Tethysian-European - S - B/EP – *LBA (Gussone 1832-1834 and 1842-1845 sub *Rotboella incurvata* L.).

Parapholis marginata Runemark - T scap - Mediterranean - S - B/EP – BOT, LBA, SGI. Notes: first record of this taxon for the Aeolian Archipelago.

Phalaris minor Retz. - T scap - Mediterranean-Iranian-Turanian - R - B – °BAS (Gussone 1832-1834, 1842-1845), *SFA (Lo Cascio 2006).

Phalaris paradoxa L. - T scap - Mediterranean-Macaronesian - R - B – °BAS (Gussone 1832-1834, 1842-1845).

Rostraria cristata (L.) Tzvelev - T caesp - Tethysian-European - R - EP – BAS, °BOT (Lojacono 1878 sub *Koeleria phleoides* Pers.), *LBA (Lojacono 1878 sub *K. phleoides*), SFA.

Stipellula capensis (Thunb.) Röser & H.R.Hamasha - T scap - Subcosmopolitan - R - A/EP – PQU.

Triticum vagans (Jord. & Fourr.) Greuter - T scap - Tethysian-Pontic - R - EP – *SFA (Lo Cascio 2006 sub *Aegilops geniculata* Roth; Lo Cascio 2017 sub *Triticum ovatum*).

Vulpia ciliata Dumort. - T scap - Tethysian-European - R - EP – BAS.

POLYGONACEAE

Polygonum maritimum L. - H rept - Tethysian-European - S - B – °BOT (Lojacono 1878), °LBA (Lojacono 1878).

Rumex bucephalophorus L. s.l. - T scap - Mediterranean-Macaronesian - R - EP – BAS, *SFA (Lo Cascio 2006).

Rumex pulcher L. - H bienn - Tethysian-European - CR - EP – °BAS (Gussone 1832-1834, 1842-1845).

PORTULACACEAE

Portulaca oleracea L. - T scap - Subcosmopolitan - R - B/EN – LBA, *SFA (Habsburg Lothringen 1893b; Lo Cascio 2006).

PRIMULACEAE

Anagallis arvensis L. subsp. *arvensis* - T scap - Tethysian-European - R - B – BAS.

RANUNCULACEAE

Clematis flammula L. - P lian - Tethysian-European - CS - A – BAS.

Delphinium halteratum Sm. - T scap - CW Mediterranean - R - EP – °BAS (Gussone 1832-1834 and 1842-1845 also sub *Delphinium longipes* Moris).

Delphinium peregrinum L. - T scap - CE Mediterranean - R - EP – °BAS (Gussone 1832-1834 and 1842-1845 sub *Delphinium junceum* DC.).

ROSACEAE

Rubus ulmifolius Schott - P lian - Tethysian-European - CR - EN – BAS, PQU.

SANTALACEAE

Osyris alba L. - Ch frut - Mediterranean-European - CS - EN – *BAS (Gussone 1842-1845), SPI.

SMILACACEAE

Smilax aspera L. - P lian - Mediterranean-Palaeotropical - CS - EN – *BAS (Gussone 1842-1845; Habsburg Lothringen 1895).

SOLANACEAE

Solanum lycopersicum L. - T scap - Casual - R - EN – °BOT. Notes: the small population detected for the first time in 1998 has not been observed recently.

Solanum nigrum L. - H scap - Cosmopolitan - R - EN – PQU.

TAMARICACEAE

Tamarix africana Poir. - P scap - CW Mediterranean - SR - A/H – CRA.

THYMELAEACEAE

Thymelaea hirsuta (L.) Endl. - NP - Mediterranean - S - EN – BAS.

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