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Riccardo Guarino, Pietro Lo Cascio,
Carmelo Mustica & Salvatore Pasta

A NEW NATURALIZED ALIEN PLANT IN SICILY: *COTULA AUSTRALIS* (SIEBER EX SPRENG.) HOOK. F. (*Asteraceae*) ON THE ACROPOLIS OF LIPARI ISLAND (AEOLIAN ARCHIPELAGO)

SUMMARY

In February 2018 a copious population of *Cotula australis* Hook f. (Asteraceae, Anthemideae) was found on the cobblestones of the Acropolis of Lipari Island (Aeolian Archipelago, NE Sicily). This population represents the first record in southern Italy and is located at a distance of about 470 km as the crow flies from the nearest neighbour. From the phytosociological point of view, *C. australis* dominates a therophytic subnitrophilous dwarf vegetation of trampled sites which can be ascribed to the cosmopolitan class *Polygono-Poetea annuae* Rivas-Mart. 1975. This plant community is proposed as a new association, *Galio muralis-Cotuletum australis*, which can be considered a Mediterranean vicariant of the *Polycarpo tetraphylli-Cotuletum australis* Wildpret, Perez de Paz, Del Arco & Garcia Gallo 1988, recorded from the Canary Islands and Portugal. Some hypotheses on the origin of the Aeolian population in the frame of a documented very fast recent propagation worldwide are discussed.

Key words: alien flora, Asteraceae, phytosociology.

RIASSUNTO

Una nuova specie aliena naturalizzata in Sicilia: Cotula australis *(Sieber ex Spreng.) Hook. F. (Asteraceae).* Nel febbraio 2018 una cospicua popolazione di *Cotula australis* Hook. F. (Asteraceae-Anthemideae) è stata rinvenuta sul selciato dell'Acropoli di Lipari (Isole Eolie, Sicilia nord-orientale). Questa popolazione rappresenta il primo rinvenimento della specie nell'Italia meridionale e si trova a una distanza di circa 470 km in linea d'aria dal popolamento più vicino. Dal punto di vista fitosociologico, *C. australis* domina una vegetazione terofitica subnitrofila nana di siti calpestati, riferibile alla classe cosmopolita *Polygono-Poetea annuae* Rivas-Mart. 1975. Questa comunità vegetale è proposta come associazione nuova, *Galio muralis-Cotuletum australis*, che può essere considerata

una vicariante mediterranea del *Polycarpo tetraphylli-Cotuletum australis* Wildpret, Pérez de Paz, Del Arco & García Gallo 1988, presente nelle isole Canarie e Portogallo. Vengono formulate alcune ipotesi sull'origine della popolazione eoliana della specie nell'ambito della sua documentata diffusione avvenuta in tempi brevi a livello globale.

Parole chiave: flora aliena, Asteraceae, fitosociologia.

INTRODUCTION

The genus *Cotula* belongs to the family Asteraceae and counts about 80 species. Most of them are endemic to New Zealand and South Africa, while some of them only occur in Australia, Asia, South America, North Africa and New Guinea (VAN ROYEN & LLOYD, 1975).

Cotula australis (Sieber ex Spreng.) Hook.f. is a prostrate annual creeping herb of the tribe Anthemideae Cass., with terete, thinly pubescent, 3-25 cm long stems. Its most distinctive traits are the 3 to 6 cm-long filiform stalks bearing small (diam. 3-6 mm) solitary capitula and the dimorphic pedicillate achenes: those of outer florets elliptic, narrowly winged; those of inner florets obovoid, not winged. *C. australis* is native to Australia (GRIERSON, 1980) but nowadays it can be considered subcosmopolitan, as it is naturalized in many temperate, tropical and Mediterranean regions worldwide, where in most of the cases was observed during last three decades, behaving as a fast-spreading weed linked to (sub)urban disturbed sites: in California (USA) it is naturalized since 1865 (BREWER *et al.*, 1876; WATSON, 2006; DROST & JUNAK, 2009), in India and Sri Lanka since 1968 (DAKSHINI & VIJAYARAGHAVAN 1970; VAID & NAITHANI, 1970; GRIERSON, 1980; ANSARI, 1984; SRIVASTAVA & KUMAR, 1996), in New Zealand since 1972 (HORNE *et al.*, 2005). More recently, it has been listed among the alien plants of Argentina (SÖYRINKI, 1991; POGGIO *et al.*, 2004), Hawai'i (WESTER, 1992), Mexico (VILLASEÑOR & ESPINOSA-GARCÍA, 2004), Japan (MITO & UESUGI, 2004), East Africa (BEENTJE, 2002), South Africa, (https://www.ispotnature.org/communities/southern-africa/species-dictionary/32604/cotula-australis), Taiwan (JUNG *et al.*, 2009) and Pakistan (SHABBIR & MUJAHID, 2017).

As for Europe, it occurs in Belgium since 1893 (LAMBINON *et al.*, 2004; VERLOOVE, 2006) and it escaped very early also in Switzerland (SCHINZ & KELLER, 1914). It also occurs in Portugal (PINTO DA SILVA, 1952; ALMEIDA & FREITAS, 2001, 2006), Spain (BARRAU I ANDREU, 1976; VALDÉS BERMEJO, 1981; SMITHIES, 1984; BOLÒS *et al.*, 1990; DEL MONTE & AGUADO, 2003; ESCOBAR GARCÍA *et al.*, 2003; VERLOOVE 2005; GUILLOT ORTIZ, 2010; SERRANO & MELERO, 2015), Balearic Islands (Majorca: BOLÒS *et al.*, 1990), in the archipelagos of Azores, Madeira and Canary islands (HANSEN & SUNDING, 1993), England (SMITH &

SMITH, 1997; SELL & MURRELL, 2006; HOUNSOME, 2014), Corsica (since 2001: JEANMONOD & GAMISANS, 2013), Czech Republic (PYŠEK *et al.*, 2002), southern France (VERLOOVE & VANDENBERGHE, 2002; TISON *et al.*, 2014), Norway-http://portal.cybertaxonomy.org/euromed/cdm_dataportal/taxon/0c2793ea-d70d-4c75-8dba-d508f4b5f45f - footnote-W (LID & LID, 2005) and Netherlands (since 2008: http://waarneming.nl/soort/view/82180).

C. australis was recorded for the first time in NW Italy by COSTALONGA (1992), who noticed it growing at Cape Noli, in Liguria. Later on it has been recorded in many other coastal places of Liguria and in one single street of Cremona city, in Lombardy (GALASSO & BONALI, 2008), where it seems to be disappeared in consequence of the remaking of local road paving (BANFI & GALASSO, 2010). Since 2008 it has also been observed in an increasing number of camping sites around Garda lake both in Trentino-Alto Adige and Veneto regions (BERTOLLI & PROSSER, 2011). The only record for central Italy concerns Latium, where it has been recently observed along the lakeshore of Trevignano Romano (LUCCHESE, 2017).

In February 2018, a copious population of *C. australis* was found by us in full bloom on the cobblestones of the Acropolis of Lipari Island (Aeolian Archipelago, NE Sicily), This population represents the first record in southern Italy and is located at a distance of about 470 km as the crow flies from that of Trevignano Romano.

MATERIAL AND METHODS

Lipari, the largest of the Aeolian Islands, represents the above-sea-level culmination of a broad, largely submerged volcanic complex. The island was formed since 270,000 years B.P. during nine eruptive cycles and the Acropolis, where *C. australis* has been found, is a rhyolitic endogenous lava dome emerged during the late 8th epoch (<20,000 years B.P.) (GIONCADA *et al.*, 2003; FORNI *et al.*, 2013). The population of *C. australis* was in full bloom on February 11st 2018, colonizing the cobblestones of the Acropolis both near the archaeological museum and on the stairway to the cathedral of San Bartolomeo, ranging between 40 and 90 m a.s.l., under a Thermomediterranean dry bioclimate (BAZAN *et al.*, 2015).

Specimens were collected and identified with the keys, images and descriptions published in PIGNATTI *et al.* (2017-2018). The collected specimens were also compared with several images available on the web and with high resolution digital images of exsiccata stored in H (type: Sieber, Franz W., #331, Australia, 1823) K & BM (isotypes from F.W. Sieber and J.D. Hooker),

LD, MO, MA, PI, SI, W, GH, E, UBT, all available on JSTOR - Global Plants (acronyms of Herbaria according to Thiers 2016 onwards).

In order to describe the species assemblage characterized by the occurrence of *C. australis*, vegetation plots have been sampled according to the Braun Blanquet's approach (BRAUN-BLANQUET, 1964; GUARINO *et al.*, 2018). The classification of the relevés followed the rules of the 'International Code of Phytosociological Nomenclature. 3rd edition' (WEBER *et al.*, 2000) and the most recent syntaxonomical framework of Sicily (GUARINO *et al.*, 2017). Nomenclature of vascular plants follows PIGNATTI *et al.* (2017-2018).

RESULTS AND DISCUSSION

The collected specimens have been pressed, dried and stored in PAL, with the following label: "*Cotula australis* (Sieber ex Spreng.) Hook.f., LIPARI (Isole Eolie), selciato dell'Acropoli, su sabbie interstiziali a matrice silicea, 11 Febbraio 2018. *Legit*: R. Guarino & S. Pasta. *Determinavit*: R. Guarino".

We could not find any accurate description of the vegetation where *C. australis* is native, but in the Flora of Western Australia it is reported to grow on sandy and peaty soils, usually near water, on granite rocks (https://florabase.dpaw.wa.gov.au, accessed in February 2018). The species requires relatively shady and moist sites. Due to its short life cycle, it can adapt to very different climatic conditions, ranging from the temperate ecosystems of central Europe, where it grows in summer, to the Mediterranean ecosystems, where it grows in winter and early spring. In temperate and Mediterranean ecosystems it has its optimum from the sea level up to 400 m a.s.l., but in the Canary Islands it was recorded between 400 and 800 m a.s.l. (WILDPRET DE LA TORRE *et al.*, 1988) and in Zimbabwe between 800 and 2270 m a.s.l. (www.zimbabweflora.co.zw; accessed in February 2018).

As for the European stands, our observations fully agree with TISON *et al.* (2014), who points out the ecological preference of *C. australis* for base-poor siliceous substrates. Indeed, our finding thrives on the volcanic siliceous sands accumulated in the interstices of the cobblestones of Lipari acropolis, where it dominates a vegetation which can be framed into the cosmopolitan class *Polygono-Poetea annuae* Rivas-Mart. 1975, grouping the therophytic subnitrophilous dwarf vegetation of trampled sites.

This vegetation is floristically characterized by therophytes and small perennial herbs of wide geographical distribution. Most of them are creeping or cespitose plants, in which holarctic and cosmopolitan (often of trop-

ical origin) floristic elements co-occur. In the Mediterranean region, the vegetation at issue is ascribed to the alliance *Polycarpion tetraphylli* Rivas-Mart. 1975. *C. australis* tends to be quite abundant and dominates the vegetation layer in the stands where it grows. A *Polycarpo tetraphylli-Cotuletum australis* Wildpret, Perez de Paz, Del Arco & Garcia Gallo 1988 was

Fig. 1 — Cotula australis, from the Acropolis of Lipari. In spite of the early season, the achenes of one of the portrayed capitula were already dispersed (credits: C. Mustica, February 12, 2018).

described in the Canary Islands (notably Tenerife and La Palma) and subsequently recorded also in Portugal (Espírito-Santo *et al.*, 2011). This association is structurally and physiognomically very similar to the vegetation sampled by us in Lipari, even if some floristic differences, most notably the abundance of *Galium murale*, which was only sporadic in the relevés from the Canary Islands, let to describe a new association, *Galio muralis-Cotuletum australis* Guarino *ass. nova* (holosyntypus relévé nr. 1, Table 1),

which can be considered a Mediterranean vicariant of the previously mentioned association. Even if we did not investigate thoroughly the moss layer, *Tortula muralis* Hedw. and *Funaria hygrometrica* Hedw. were quite common in the sampled plots from Lipari.

Table 1

Phytosociological relevés of Galio muralis-Cotuletum australis *from the Acropolis of Lipari, sampled on cobblestone with interstitial siliceous sands on February 12, 2018. Rel. 1-3: Staircase in front of the Church of San Bartolomeo. Rel. 4-5: Walkway behind the archaeological museum.*

Frequency	**Relevé nr.**	1	2	3	4	5
	Altitude (m a.s.l.)	40	40	60	75	75
	Surface (m²)	6	6	6	4	4
	Coverage (%)	40	40	30	303	0
	Slope (°)	0	0	0	0	0
	Character species					
5	*Cotula australis* (Sieber ex Spreng.) Hook.f.	3	2	2	1	1
5	*Galium murale* (L.) All.	1	2	+	2	+
	Char. of *Polycarpion tetraphylli* Rivas-Mart. 1975					
3	*Spergularia rubra* (L.) J. & C.Presl	+	.	1	.	+
3	*Plantago coronopus* L. subsp. *commutata* (Guss.) Pilger	.	+	.	+	1
3	*Trifolium suffocatum* L.	.	.	+	1	+
2	*Polycarpon tetraphyllum* (L.) L. subsp. *tetraphyllum*	.	+	+	.	.
	Char. of *Polygono-Poetalia annuae* R. Tx. in Géhu, Richard et R. Tx. 1972 and *Polygono-Poetea annuae* Rivas-Mart. 1975					
5	*Sagina apetala* Ardoino	1	+	1	1	+
4	*Ochlopoa annua* (L.) H.Scholz	+	1	.	+	+
1	*Oxalis corniculata* L.	.	.	+	.	.
	Co-occurring taxa					
4	*Catapodium rigidum* (L.) C.E.Hubb. subsp. *rigidum*	+	+	.	1	+
3	*Stellaria media* (L.) Vill.	+	+	.	+	.
3	*Mercurialis annua* L..+.++					
3	*Hypochoeris achyrophorus* L.	.	.	+	+	+
3	*Sonchus oleraceus* L.	.	.	+	+	+
2	*Silene gallica* L.	.	.	.	+	+
2	*Erigeron bonariensis* L.	+	.	+	.	.
2	*Hyoscyamus albus* L.	.	.	+	.	+
1	*Anisantha madritensis* (L.) Nevski	.	.	.	+	.
1	*Urtica membranacea* Poir. in Lam.	+	.	.	.	.
1	*Misopates orontium* (L.) Raf.	.	.	.	+	.
1	*Veronica* cf. *agrestis* L.	.	.	.	.	+
1	*Medicago polymorpha* L.	.	.	.	.	+
1	*Anagallis arvensis* L.	.	.	.	.	+
	Total species nr.	9	9	11	14	16

Conclusions

Due to its small size and short life-cycle, this precocious annual plant may easily pass unrecorded in the Mediterranean Region. Although it was not mentioned among the allochthonous species of Aeolian Islands in the overview on the alien flora of circum-Sicilian islands published by Domina & Mazzola (2008), *C. australis* probably occurred in the acropolis of Lipari already 20 years ago, when it might have been erroneously classified as *Anthemis cotula* L. (a species which prefers base-rich soils) by Di Martino (2000). Unfortunately, this hypothesis cannot be verified because, contrary to what Di Martino (2000) reported in her work, no specimens of *Anthemis cotula* collected in Lipari are currently registered and stored in PAL.

As already pointed out by Shabbir & Mujahid (2017), the vectors of *C. australis* in urban habitats worldwide remains obscure, although its achenes are known to be dispersed through raw wool or car mats. In our case, it may have been introduced inadvertently by local people who spent their holidays on Canary islands or in Iberian countries, or by central European tourists visiting the Aeolian islands. It is interesting to note, however, that there is an intense tourist flux also between Lipari and Australia, where a large number of islander immigrants occur since the early 20th century and many of them still keep close family relationships with their local relatives. Even if the long-distance disperser remains obscure, the local success of the species is probably due to the abundant production of vital seeds, which through the early dispersal might escape predation by ants, unlike the species it lives with. In all kinds of Mediterranean annual vegetation, ants strongly influence plant species density and diversity by collecting selectively their favoured seeds (Guarino *et al.*, 2005). Therefore, the lack of predation by ants, combined with the prolific seed set could be the reason why *C. australis* is able to form dense populations in a relatively short time. Both the international tourist fluxes and the increasing use of exotic ornamental plants are the main factors that facilitate the arrival and the spread of allochthonous plant species throughout the Mediterranean Basin. As already highlighted by several recent studies (e.g. Lazzaro *et al.*, 2014; Celesti-Grapow *et al.*, 2016; Pasta *et al.*, 2017) Italian small islands are particularly prone to plant invasions. This is true also for the Aeolian islands, which have experienced the first and/or the only Italian cases of naturalization of several non-native plants such as *Senecio talinoides* (DC.) Sch.-Bip. subsp. *mandraliscae* (Tineo) Rowl., a south-African plant which was first described during the XIX century from Vulcano island (Pasta, 2003), the south-African *Arctotheca calendula* (L.) Levyns (Madon, 1994),

the south-western-Australian *Paraseriathes lophanta* (Willd.) I.C. Nielsen (VILLARI & ZACCONE, 1999), and the central American *Salvia leucantha* Cav. (PASTA *et al*., 2008).

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Address of authors — R. GUARINO, Dipartimento STeBiCeF - Sezione Botanica, Università di Palermo, via Archirafi, 38 - 90123 Palermo, Italy; e-mail: riccardo.guarino@unipa.it; P. LO CASCIO, C. MUSTICA, Associazione Nesos, via Vittorio Emanuele, 24 - 98055 Lipari (ME), Italy; e-mail: associazionenesos@gmail.com; S. PASTA, Hernerstrasse, 78 - 45659 Recklinghausen, Germany; e-mail: salvatore.pasta@gmail.com