

FLORA AND HABITATS OF VENDICARI ISLET (ISOLA DI VENDICARI) IN SOUTH EAST SICILY

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The vascular flora of 'Isola di Vendicari', a small islet (surface 4.45 hectares) located along the Ionian coast of south east Sicily, has been investigated. The surveyed taxa at specific and infraspecific level amount to 80, of which 21 are new records from this islet. The life form spectrum of the current flora brings out the dominance of therophytes as well as a significant occurrence of hemicyptophytes. The plant communities colonizing the surface of the islet have been investigated from floristic, phytosociological and ecological points of view. The vegetation is represented mainly by psammophilous and halophilous aspects. As regards the conservation area policy, the islet falls within the Nature Reserve of Vendicari, which is also a SCI of the Natura 2000 network, showing its remarkable importance for the biodiversity conservation.

Key words: Sicily, Islet, vascular plants, phytosociology, biodiversity, conservation

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Istraživana je vaskularna flora malog otočića 'Isola di Vendicari' (površina 4,45 ha) koji se nalazi uz jugske obale jugoistočne Sicilije. Utvrđeno je 80 vrsta i nižih svojiti, od toga je 21 nova za otočić. U spektru životnih oblika prevladavaju terofiti, uz značajan udio hemikriptofita. Biljne zajednice na otočiću analizirane su s florističkog, fitocenološkog i ekološkog gledišta. Vegetacija je uglavnom psamofitska halofitska. S aspekta zaštite, otočić je dio Rezervata prirode Vendicari, nalazi se unutar područja Natura 2000 ekološke mreže, što ukazuje na važnost potrebe očuvanja bioraznolikosti.

Ključne riječi: Sicilija, otočić, vaskularna flora, fitocenologija, biološka raznolikost, očuvanje

INTRODUCTION

All over the Mediterranean Basin the flora of small and very small islands has long been a subject of interest not only for the sake of pure floristic knowledge but also for the understanding of the mechanisms of the colonization of these isolated micro-territories in relation to the flora of the mainland (see e. g. ARRIGONI & BOCCHIERI, 1996; PANDŽA, 2002; BOGDANOVIĆ & MITIĆ, 2003; PANITSA *et al.*, 2006; LO CASCIO & PASTA, 2012; ILIADOU *et al.*, 2014; PASTA *et al.* 2014; PANDŽA & MILOVIĆ, 2015; JASPRICA *et al.*, 2015; FOIS *et al.*, 2016; SCIANDRELLO *et al.*, 2017).

The islet of Vendicari is located in the Ionian Sea near the south eastern coast of Sicily (36°47'29"N; 15° 6'18"E); in Italian maps it is called »Isola di Vendicari«, but it is a very little island of 4.45 ha. This islet is uninhabited and landing is forbidden except for research purposes. In the last century from 1917 to 1943 it was seasonally inhabited for tuna fishing in support of the nearby tuna fishery (MALANDRINO, 2010), which was su-

ccessively destroyed. Previously HOUEL (1785) wrote about this islet, on which he landed and made a drawing of the ancient ruins existing at that time.

On the islet, since 2010 the Audouin's Gull [*Larus audouinii* (Payraudeau, 1826)] has nested and this is the only known site in Sicily (IENTILE *et al.*, 2016). This species is included in the Annex I of »Bird Directive« 2009/147/CE. It states that special conservation measures must be provided with regard to the habitat, to ensure survival and reproduction of the listed species.

The vascular flora was investigated for the first time by ALBO (1959), who visited this islet in 1909 and 1917, publishing his research many years later. The flora of the coast facing the islet, corresponding to Vendicari Reserve was recently studied by MINISSALE & SCIANDRELLO (2010) without taking the islet into account. Therefore, the aim of this paper is to fill this gap and update the floristic after the passage of a century, with some information on the plant communities that occur and the main drivers of the establishment of plants.

STUDY AREA

Vendicari Islet falls within the Vendicari protected area, one of the most interesting parts of Sicily, since it is representative of a remarkable variety of environments that have

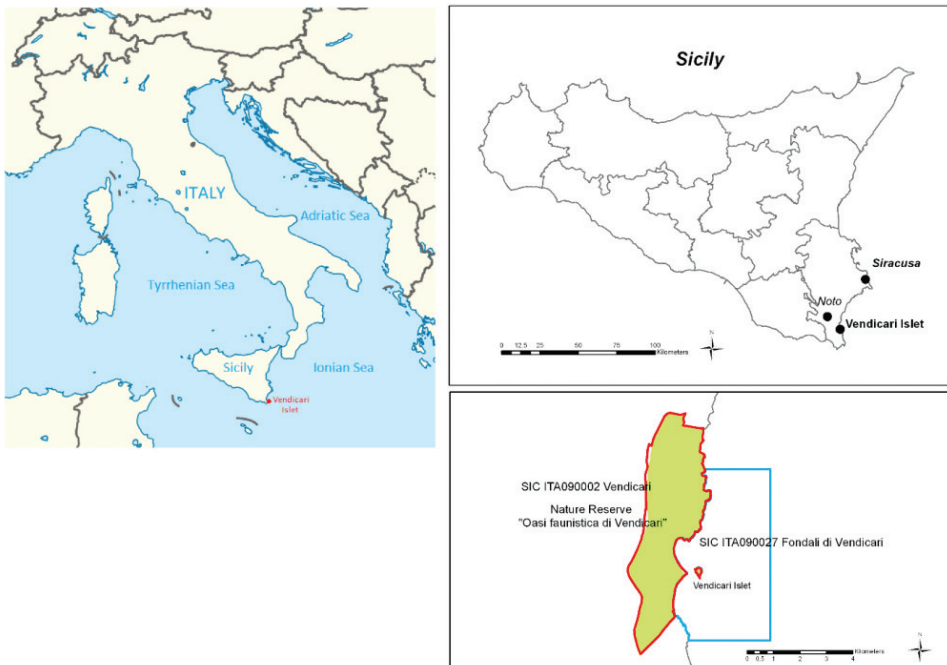


Fig. 1. Geographic location of Vendicari Islet (Isola di Vendicari). A. Location of the islet in Mediterranean Sea. Image from https://commons.wikimedia.org/wiki/File:Mediterranean_Sea_location_map.svg, modified. B. Location of the islet in Sicily. C. The island and the mainland are a Nature Reserve named »Oasi Faunistica di Vendicari« [Faunal Oasis of Vendicari]. They are also included within the Site of Community Importance ITA090002 »Vendicari«, while the seabed belong to the SCI ITA090027 »Fondali di Vendicari«.

largely disappeared or are now very degraded in the rest of the Sicilian territory. The reserve was established by the Regional Decree 03/14/1984 and lies entirely in the municipality of Noto, a town near Syracuse, in South-East Sicily (Fig. 1). The protected area extends over 1,512 ha: 575 ha in the A zone, having maximum protection, and 937 ha in the B zone or pre-reserve for agriculture and tourist activities-accommodation. The reserve is also a Site of Community Importance (SCI) of the Natura 2000 network under the name »ITA090002 Vendicari« as is the seabed, called »ITA090027 Fondali di Vendicari«. It is also part of the Special Protection Area (SPA) »ITA090029 Pantani della Sicilia sud-orientale, Morghella, Marzamemi, Punta Pilieri e Vendicari«.

The islet falls within the A zone and has a length of 320 m and a width of 255 m with an altitude of 2.5 m. It is 445 m distant from the coast (data taken from Google Earth satellite photos 2016) with a seabed from 0 to 5 m deep.

Vendicari Islet is located in the eastern coastal sector of the Hyblaean Plateau, which is the emerged part of a gently deformed segment of the African continental margin (DEWEY *et al.*, 1989). In particular, the Vendicari coastal belt is characterized by sloping rocks mixed with sandy dunes, which are inwards often replaced by large brackish lagoons (Pantano Sichilli, Pantano Roveto, Pantano Piccolo and Pantano Grande). The sedimentary sequence is composed of terrains from Pliocene to Quaternary age. The lower level consists of the Trubi Formation, made of white marls of Pliocene age (LENTINI *et al.*, 1996). Usually, there are deposits of massive yellow sandstones of Pliocene age above the white marls. Sometimes, at the top of this sequence there are white to yellowish organic calcarenitic and calciruditic deposits. In the islet these last two levels outcrop, partially covered by recent sands. All the area is affected by intense karstification, which accelerates the erosion of the whole rocky coast (PIRROTTA & BARBANO, 2011; GRACIA *et al.*, 2014).

The Vendicari area is affected by a Mediterranean bioclimate, with mild winters and hot and dry summers. For these analyses we refer to the weather station of Cozzo Spadaro near Portopalo (ZAMPINO *et al.*, 1997). In this locality the average annual rainfall does not reach 400 mm per year, with highs of over 60 mm in October, December and January, and values close to zero in the summer months (June to August). The average annual temperature is 18.2 °C. Overall the bio-climate of the area can be defined lower thermo-Mediterranean, lower dry, according to BAZAN *et al.* (2015).

MATERIALS AND METHODS

Field trips in the Vendicari Islet were carried out in May 2012. Floristic sample covered the whole surface of the islet and the exsiccata (preserved in the Herbarium of University of Catania – CAT) were studied using the Italian floras (FIORI, 1923–29; PIGNATTI, 1982) and some taxonomic revisions or monographs, while the nomenclature follows GIARDINA *et al.* (2007). The surveyed taxa are listed (Tab. 1), in alphabetical order. For each taxon, collectors, notes, life form and chorological element are reported. The life form classification follows the Raunkiaer system as proposed by PIGNATTI (1982).

Vegetation was studied according to the Braun-Blanquet approach (BRAUN-BLANQUET, 1964). The phytosociological analysis of the vegetation allowed the detection of some plant communities and the understanding of their ecological characteristics with considerations of their syntaxonomical position according to BRULLO *et al.* (2002) and BIONDI *et al.* (2014). In order to draw a habitat and vegetation map, aerial photos, dated 2007, were used and elaborated with ArcGis 10.3. Besides, in Tab. 2 the Corine Biotopes codes

Tab. 1. Floristic list of Vendicari Islet

Legend: Coll. Ac = collected by ALBO (1959), confirmed; n = new record for the islet.

Notes: nr = not recorded now; NV= new to the Vendicari Nature Reserve flora; pm = probably misidentified.

Life Forms: T = therophyte; H = hemiptophyte, G = Geophyte, Ch = Chamaephyte, NP = nano-phanerophyte, P = phanerophyte; scap = scapose; caesp = caespitose (tufted); bulb = bulbous; rhiz = rhizomatous; succ = succulent; suffr = suffruticose; frut = fruticose; bien = biennial; ros = rosulate.

Chorotypes: End. = Endemic; Med. = Circum-Mediterranean; C Med. = Centre Mediterranean; W Med.= West Mediterranean; E Med. = East Mediterranean; S Med. = South Mediterranean; Med. Trop. = Mediterranean Tropical; Med. Atl. = Mediterranean Atlantic; Euro-Med. = Euro-Mediterranean; Euro-Med.-Iran.-Tur = Euro-Mediterranean-Irano-Turanian; Med.-Iran.-Tur. = Mediterranean-Irano-Turanian; Paleotemp. = Paleotemperate; Circumbor. = Circumboreal; Cosmop. = Cosmopolitan (chorological types adapted from BRULLO *et al.*, 1998).

Family	Species	Life Form	Chorological type	Coll.	Notes
Poaceae	<i>Aeluropus lagopoides</i> (L.) Trin.	G rhiz	Med.-Trop.	Ac	
Alliaceae	<i>Allium commutatum</i> Guss.	G bulb	Med.	Ac	NV
Apiaceae	<i>Ammi majus</i> L.	T scap	Med.	Ac	nr, NV
Poaceae	<i>Ammophila australis</i> (Mabille) Porta & Rigo	H caesp	Med.	Ac	
Poaceae	<i>Anisantha rigida</i> (Roth) Hyl.	T scap	Med.	Ac	
Asteraceae	<i>Anthemis secundiramea</i> Biv.	T scap	C Med.	Ac	
Chenopodiaceae	<i>Arthrocnemum macrostachyum</i> (Moric.) Moris	Ch succ	Med.-Iran.-Tur.	Ac	
Asparagaceae	<i>Asparagus acutifolius</i> L.	NP	Med.	Ac	
Asphodelaceae	<i>Asphodelus ramosus</i> L. subsp. <i>ramosus</i>	G rhiz	Med.	Ac	
Asteraceae	<i>Asteriscus aquaticus</i> (L.) Less.	G bulb	Med.	Ac	
Fabaceae	<i>Astragalus boeticus</i> L.	T scap	Med.-Iran.-Tur.	n	
Poaceae	<i>Avena fatua</i> L.	T scap	Cosmop.	Ac	nr, NV
Chenopodiaceae	<i>Beta maritima</i> L.	H scap	Paleotemp.	Ac	
Brassicaceae	<i>Cakile maritima</i> Scop.	T scap	Med.	Ac	
Poaceae	<i>Catapodium balearicum</i> (Willk.) H. Scholz	T scap	Med.	Ac	
Poaceae	<i>Catapodium rigidum</i> (L.) Hubbard subsp. <i>rigidum</i>	T scap	Euro-Med.-Iran.-Tur	Ac	
Asteraceae	<i>Centaurea sicula</i> L.	H bien	O Med.	Ac	
Asteraceae	<i>Centaurea sphaerocephala</i> L.	H scap	Med.	Ac	
Hyacinthaceae	<i>Charybdis pancration</i> (Steinh.) Speta	G bulb	Med.	Ac	
Convolvulaceae	<i>Convolvulus elegantissimus</i> Miller	H scand	O Med.	Ac	
Apiaceae	<i>Crithmum maritimum</i> L.	Ch suffr	Med.-Atl.	Ac	
Poaceae	<i>Cutandia divaricata</i> (Desf.) Bentham	T scap	O-Med.	n	
Apiaceae	<i>Daucus carota</i> L. subsp. <i>carota</i>	H bien	Euro-Med.	Ac	
Asteraceae	<i>Dittrichia viscosa</i> (L.) Greuter	H scap	O Med.	Ac	
Apiaceae	<i>Echinophora spinosa</i> L.	H scap	Med.	n	
Boraginaceae	<i>Echium sabulicola</i> Pomel	H scap	O Med.	n	
Poaceae	<i>Elytrigia juncea</i> (L.) Nevski	G Rhiz	Med.	n	

Poaceae	<i>Elytrigia repens</i> (L.) Desv.	G rhiz	Paleotemp.	Ac	nr, pm
Ephedraceae	<i>Ephedra fragilis</i> Desf.	NP caesp	Med.	Ac	
Geraniaceae	<i>Erodium chium</i> (L.) Willd.	T scap	Med.	Ac	nr NV
Geraniaceae	<i>Erodium laciniatum</i> (Cav.) Willd.	T scap	Med.	n	
Geraniaceae	<i>Erodium malacoides</i> (L.) L'Her.	T scap	Med.	Ac	
Apiaceae	<i>Eryngium maritimum</i> L.	G rhiz	Med.-Atl.	Ac	
Euphorbiaceae	<i>Euphorbia paralias</i> L.	Ch frut	Med.-Atl.	Ac	
Euphorbiaceae	<i>Euphorbia pinea</i> L.	Ch suffr	Med.	Ac	
Euphorbiaceae	<i>Euphorbia terracina</i> L.	T scap	Med.	Ac	
Apiaceae	<i>Foeniculum vulgare</i> L. subsp. <i>vulgare</i>	H scap	S Med.	Ac	
Frankeniaceae	<i>Frankenia hirsuta</i> L.	Ch suffr	Med.-Iran.-Tur.	Ac	
Asteraceae	<i>Galactites elegans</i> (All.) Soldano	H bien	Med.	n	
Papaveraceae	<i>Glaucium flavum</i> Crantz	H scap	Circumbor.	n	
Asteraceae	<i>Glebionis coronaria</i> (L.) Spach	T scap	Med.	Ac	
Chenopodiaceae	<i>Halimione portulacoides</i> (L.) Aellen	Ch frut	Circumbor.	n	
Poaceae	<i>Hordeum murinum</i> L.	T scap	Circumbor.	Ac	nr, pm
Poaceae	<i>Hordeum leporinum</i> Link	T scap	Euro-Med.	n	
Juncaceae	<i>Juncus capitatus</i> Weigel	T scap	Med.-Atl.	Ac	
Poaceae	<i>Lagurus ovatus</i> L. subsp. <i>ovatus</i>	T scap	Med.	Ac	
Asteraceae	<i>Launaea fragilis</i> (Asso) Pau	Ch frut	S Med.	n	
Malvaceae	<i>Lavatera arborea</i> L.	H bien	Med.	n	
Malvaceae	<i>Lavatera cretica</i> L.	T scap	Med.	Ac	nr, pm
Asteraceae	<i>Limbarda crithmoides</i> (L.) Dumort. subsp. <i>longifolia</i> (Arcang.) Greuter	Ch suffr	Med.	Ac	
Plumbaginaceae	<i>Limonium narbonense</i> Miller	H ros	Med.	Ac	
Plumbaginaceae	<i>Limonium syracusanum</i> Brullo	Ch suffr	Hyblean End.	n	
Fabaceae	<i>Lotus creticus</i> L.	Ch suffr	Med.	Ac	
Solanaceae	<i>Mandragora autumnalis</i> Bertol.	H ros	Med.	Ac	
Brassicaceae	<i>Matthiola tricuspidata</i> (L.) R. Br.	T scap	Med.	Ac	
Fabaceae	<i>Medicago ciliaris</i> (L.) All.	T scap	Med.	Ac	
Euphorbiaceae	<i>Mercurialis annua</i> L.	T scap	Paleotemp.	Ac	
Aizoaceae	<i>Mesembryanthemum nodiflorum</i> L.	T scap	Med.-Trop.	Ac	
Cactaceae	<i>Opuntia ficus-indica</i> (L.) Miller	P succ	Nat. (Neotrop.)	n	
Amaryllidaceae	<i>Pancratium maritimum</i> L.	G bulb	Med.	Ac	
Poaceae	<i>Parapholis filiformis</i> (Roth) C. E. Hubbard	T scap	O Med.	Ac	
Poaceae	<i>Parapholis incurva</i> (L.) Hubbard	T scap	Med.-Atl.	Ac	
Poaceae	<i>Phalaris canariensis</i> L.	T scap	Euro-Med.	Ac	
Poaceae	<i>Piptatherum miliaceum</i> (L.) Coss. subsp. <i>miliaceum</i>	H caesp	Med.-Atl.	Ac	
Apiaceae	<i>Pseudorhiza pumila</i> (L.) Grande	T scap	Med.	Ac	

Iridaceae	<i>Romulea columnae</i> Seb. & Mauri	G bulb	Med.	Ac	
Polygonaceae	<i>Rumex bucephalophorus</i> L. subsp. <i>bucephalophorus</i>	T scap	Med.	Ac	
Chenopodiaceae	<i>Kali turgidum</i> (Dumort.) Gutermann.	T scap	Euro-Atl.	Ac	nr, pm
Chenopodiaceae	<i>Kali tragus</i> (L.) Scop.	T scap	Paleotemp.	Ac	
Chenopodiaceae	<i>Sarcocornia fruticosa</i> (L.) A.J. Scott	Ch succ	Boreo-Trop.	Ac	
Rosaceae	<i>Sarcopoterium spinosum</i> (L.) Spach	NP	E Med.	Ac	
Asteraceae	<i>Scolymus hispanicus</i> L.	H bien	Med.	n	
Crassulaceae	<i>Sedum rubens</i> L.	T scap	Med.-Atl.	Ac	
Asteraceae	<i>Senecio glaucus</i> L. subsp. <i>coronopifolius</i> (Maire) Alex.	T scap	Med.-Iran.-Tur.	Ac	NV
Asteraceae	<i>Senecio leucanthemifolius</i> Poiret	T scap	O Med.	n	NV
Apiaceae	<i>Seseli tortuosum</i> L. subsp. <i>maritimum</i> Brullo et al.	H bien	Sicily, Sardinia, Calabria End.	n	
Lamiaceae	<i>Sideritis romana</i> L.	T scap	O Med.	Ac	
Caryophyllaceae	<i>Silene colorata</i> Poiret	T scap	Med.	n	
Caryophyllaceae	<i>Silene nicaeensis</i> All.	T scap	Med.	Ac	
Caryophyllaceae	<i>Silene sedoides</i> Poiret	T scap	Med.	Ac	
Caryophyllaceae	<i>Silene vulgaris</i> (Moench) Garcke subsp. <i>tenoreana</i> (Colla) Soldano & F. Conti	H scap	Med.	Ac	
Asteraceae	<i>Sonchus oleraceus</i> L.	T scap	Cosmop.	n	
Asteraceae	<i>Sonchus tenerrimus</i> L.	H scap	Med.	Ac	nr
Caryophyllaceae	<i>Spergularia salina</i> J. & C. Presl	T scap	Paleotemp.	n	
Poaceae	<i>Stipa capensis</i> Thumb.	T scap	Med.	Ac	
Chenopodiaceae	<i>Suaeda vera</i> J. F. Gmelin	NP caesp	Med.-Atl.	Ac	
Fabaceae	<i>Vicia villosa</i> Roth subsp. <i>villosa</i>	T scap	Euro-Med.	n	
Poaceae	<i>Vulpia fasciculata</i> (Forssk) Fritsch	Tscap	Med.	n	

are listed according to DEVILLERS (1991), EUNIS habitat codes follow DAVIES *et al.* (2004) and the habitats of European Directive 92/43 CE are listed according to EUROPEAN COMMISSION, (2013) and BIONDI & BLASI (2010).

RESULTS

Flora

According to the list published by ALBO (1959), who recorded 67 taxa, and our collections and observation, the vascular flora of Vendicari islet consists of 88 specific and infraspecific taxa (Tab. 1). Excluding the 8 species we did not find (nr in the list), some of which were probably misidentified by ALBO (1959), the actual flora now consists of 80 taxa.

The life form spectrum of actual flora indicates the predominance of therophytes (40 species, 48%), with a relevant presence hemicryptophytes (20, 24%), and geophytes (8,

Tab. 2. Vencicari Islet plant communities.

Releve Nr.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Area (m2)	5	10	10	50	50	40	50	50	40	40	50	5	5	2	50	90	100	40	1
Cover (%)	60	90	70	90	90	90	85	85	85	90	85	70	90	90	100	90	50	80	80
Substrate	s	s	s	s	s	c	s	s	s	s	s	S	S	s	c	c	c	c	s
Corine Biotopes codes	17.2	15.72	15.72	15.72	15.72	15.61	16.211	16.223	16.223	16.223	16.223	16.223	16.223	16.223	34.81	34.81	15.61	15.61	15.12
Habitat 92/43 EEC codes	1210	1420	1420	1420	1420	1420	2110	2210	2210	2210	2210	2230	2230	2230	-	-	1420	1420	1310
CAKILION MARITIMAE & CAKILETEA MARITIMAE																			
<i>Matthiola tricuspidata</i>	3	+	.	+	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.
<i>Glaucium flavum</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Cakile maritima</i>	+	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.
CRUCIANELLETTALIA MARITIMAE & EUPHORBIO-AMMOPHILETEA AUSTRALIS																			
<i>Elytrigia juncea</i>	.	1	+	+	+	.	4	1	+	1	+	.	.	.	.	.	.	.	.
<i>Centaurea sphaerocephala</i>	.	.	.	.	.	.	1	4	+	+	5	.	.	.	.	.	.	.	.
<i>Seseli tortuosum</i> subsp. <i>maritimum</i>	.	.	.	.	.	.	2	1	3	4	2	+	+	+	.	.	.	.	.
<i>Euphorbia terracina</i>	.	.	.	+	+	.	+	+	1	+	+	.	.	.	.	.	.	.	.
<i>Lotus creticus</i>	+	.	.	+	.	.	1	2	2	3	1	+	+	+	+	.	.	.	.
<i>Pancratium maritimum</i>	.	.	.	.	.	.	+	+	1	+	1	.	.	.	.	.	.	.	.
<i>Launaea fragilis</i>	.	.	.	.	.	.	+	+	2	1	+	.	.	.	.	.	.	.	.
<i>Echinophora spinosa</i>	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.
<i>Scolymus hispanicus</i>	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
SARCOCORNIETEA FRUTICOSAE																			
<i>Suaeda vera</i>	.	4	2	4	5	5	.	.	.	.	.	.	.	.	1	2	2	.	.
<i>Arthrocnemum macrostachyum</i>	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	3	4	.
<i>Halimione portulacoides</i>	.	.	3	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Sarcocornia fruticosa</i>	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Limonium narbonense</i>	.	.	.	+	1	1	.	.	.	.	+	.	.	.	.	.	+	+	.
CRITHMO MARITIMI-LIMONIETEA																			
<i>Crithmum maritimum</i>	.	2	+	1	1	.	.	+	+	.	.	.	.	.	.	.	+	.	.
<i>Frankenia hirsuta</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1
<i>Limonium syracusanum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
CUTANDIETALIA MARITIMAE & HELIANTHEMETEA GUTTATI																			
<i>Cutandia divaricata</i>	.	.	.	.	.	.	+	+	.	.	.	4	3	3	.	.	.	.	.
<i>Lagurus ovatus</i> subsp. <i>ovatus</i>	.	.	.	.	.	.	+	+	.	.	.	+	+	1	.	.	.	.	.

<i>Silene colorata</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	1	.	.	.	.	.
<i>Vulpia fasciculata</i>	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	2	3	2	.	.	.	.	.
<i>Senecio leucanthemifolius</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.
<i>Erodium laciniatum</i>	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.
<i>Echium sabulicolum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.
<i>Senecio coronopifolius</i>	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
FRANKENION PULVERULENTAE & SAGINETEA MARITIMAE																								
<i>Spergularia salina</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
<i>Parapholis filiformis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
<i>Parapholis incurva</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
THERO-BROMETALIA & STELLARIETEA MEDIAE																								
<i>Mercurialis annua</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	.	.
<i>Sonchus oleraceus</i>	1	+	+	+	+	.	+	+	.	.	.	.	+	.	+	2	1	.	.	.	.	.	.
<i>Anisantha rigida</i>	.	.	.	.	.	.	.	+	.	.	.	+	+	+	1	2	+	.	.	.	.	.	.
<i>Astragalus boeticus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
<i>Vicia villosa subsp. villosa</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
<i>Erodium malacoides</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
<i>Dittrichia viscosa</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.
<i>Glebionis coronaria</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	1	+	.	.	.	.	.
<i>Galactites elegans</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
<i>Lavatera arborea</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.
<i>Other species</i>																								
<i>Asparagus acutifolius</i>	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.
<i>Ephedra fragilis</i>	.	.	.	.	.	.	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Convolvulus elegantissimus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	.	.	.	.	.
<i>Opuntia ficus-indica</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.
<i>Oryzopsis miliacea</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.
<i>Asphodelus ramosus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
<i>Charybdis pancration</i>	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
<i>Beta maritima</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Euphorbia pinea</i>	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Rel. 1-19: Isola di Vedicari, 10th May 2012. Substrate: s = sandy, c = calcarenitic. Rel. 1: *Glaucio flavi-Matthioletum tricuspidatae*; Rel. 2-6: *Halimiono portulacoidis-Suaedetum verae*; Rel. 7: *Cypero mucronati-Elytrigietum juncea*; Rel. 8-11: *Centaureo-Ononidetum ramosissimae*; Rel. 12-14: *Vulpio-Cutandietum divaricatae*; Rel. 15-16: *Thero-Brometalia*; Rel. 17-18: *Limonio virgati-Arthrocnemetum macrostachyi*; Rel. 19: *Parapholidetum filiformis*.

9%) (Fig. 2). The unique phanerophytes are *Ephedra fragilis*, a maquis species, and a few specimens of *Opuntia ficus indica* introduced by man during last century.

From the chorological viewpoint (Fig. 3) the greatest number of plants belong to the Mediterranean chorological element (54 species, 66%), including the Hyblaeen endemic

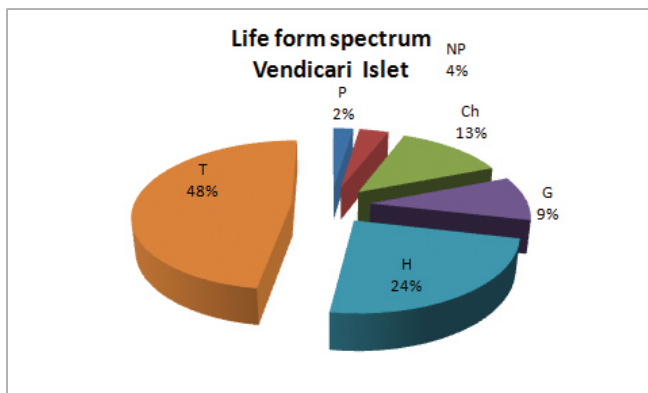


Fig. 2. Life-form spectrum of Venticari Islet.

Limonium syracusanum, (BRULLO *et al.*, 2011a), *Seseli tortuosum* subsp. *maritimum* endemic of Sicily, Sardinia and west Calabria (BRULLO *et al.*, 2011b); dominant inside the group is the Circum-Mediterranean element (40 species, 48%) and there is a relevant presence of W Mediterranean species (8, 10%), (Fig. 3). Among species with distribution areas extending outside of the Mediterranean area the most significant are the Atlantic-Mediterranean ones (8, 10%).

Plant communities and habitats

The islet is very low (no more than 2.5 m a.s.l.), so it is completely exposed to salt and sea aerosol influences, but the edaphic conditions show different features. Therefore, the vegetation is strictly correlated to the ecological factors, which have a decisive effect on the distribution of the plant communities on the islet. The recognized vegetation types are shown in the Tab. 2 according to the phytosociological method, mainly based on the

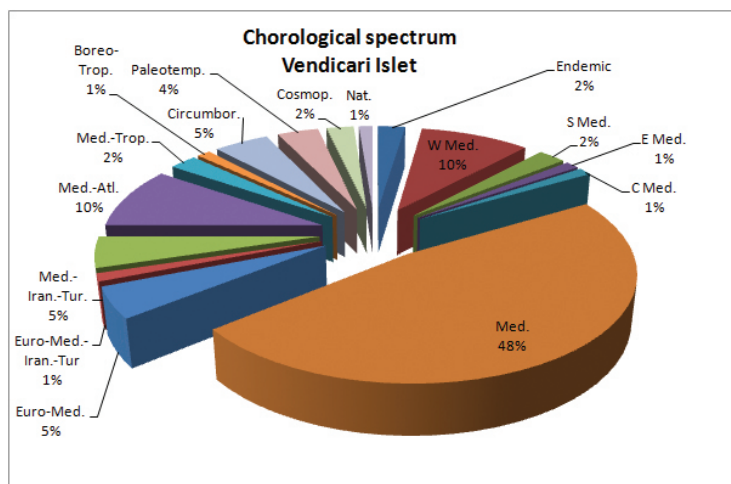


Fig. 3. Chorological spectrum of Venticari Islet.



Fig. 4. The east side of the islet with *Elytrigia juncea* community and some *Suaeda vera* shrub (photo by: P. Minissale)



Fig. 5. Plant community with *Seseli tortuosum* subsp. *maritimum* and *Centaurea sphaerocephala* (photo by: P. Minissale)

previous investigations carried out in Vendicari area and more generally of the south eastern coastal Sicily by BRULLO *et al.* (1980), BARTOLO *et al.* (1982) and MINISSALE & SCIANDRELLO (2010). In particular, the low sandy belt near the sea is colonized by annual halo-nitrophilous vegetation belonging to *Cakiletea maritimae* R.Tx. & Preising in Br.-Bl. & R.Tx.1952, where *Cakile maritima*, *Matthiola tricuspidata*, *Glaucium flavum* have their optimum growth. This community can be attributed to *Glaucio flavi-Matthioletum tricuspidatae* Blasi, Fascetti, Veri & Bruno 1983 (Rel. 1), previously quoted from Sicily by MARCENÒ & ROMANO (2010). Some embryonic dunes are colonized by an impoverished vegetation characterized by *Elytrigia juncea* referable to *Cypero mucronati-Elytrigietum juncea* Kühnholtz-Lordat ex Br.-Bl. 1933 (Rel. 7), association of the class *Ammophiletea* Br.-Bl. & Tüxen ex Westhoff, Dijk & Passchier 1946 (Fig. 4). On organic accumulations near the sea, consisting mainly of beached fragments of *Posidonia oceanica*, there is a



Fig. 6. Nitrophilous vegetation with *Glebionis coronaria*; *Ephedra fragilis* and the dunes of Vencicari coast in the background (photo by: P. Minissale)



Fig. 7. The south side of the islet with the *Arthrocnemum macrostachyum* community where Audouin's Gull nests (photo by: P. Minissale)

perennial plant community dominated by *Suaeda vera* associated with other halophilous species, such as *Halimione portulacoides* and *Crithmum maritimum*. This halo-subnitrophilous vegetation is referable to *Halimione portulacoidis*-*Suaedetum verae* Molinier & Tallon 1970 (Rels. 2-6), an association belonging to *Suaedion verae* Brullo & Furnari 1988, alliance of *Sarcocornietea fruticosae* Br.-Bl. & R.Tx. ex A. & O.Bolòs 1950. The central part of islet, with stabilized sandy soil, is colonized by psammophilous vegetation with species of *Crucianelletalia maritima* Sissing 1974, such as *Seseli tortuosum* subsp. *maritimum*, *Centaurea sphaerocephala*, *Lotus creticus*, *Euphorbia terracina*, *Launaea fragilis*, etc. (Fig. 5). On the islet *Ononis hispanica* subsp. *ramosissima* (Desf.) Förther & Podlech is lacking, although it is very common in the coast in front of the islet, so this community represents a simplified aspect of *Centaureo-Ononidetum ramosissimae* Br.-Bl. & Frei in Frei 1937 (Rels. 8-11). Within this vegetation, in the small clearings, there are frequent ephemeral dry

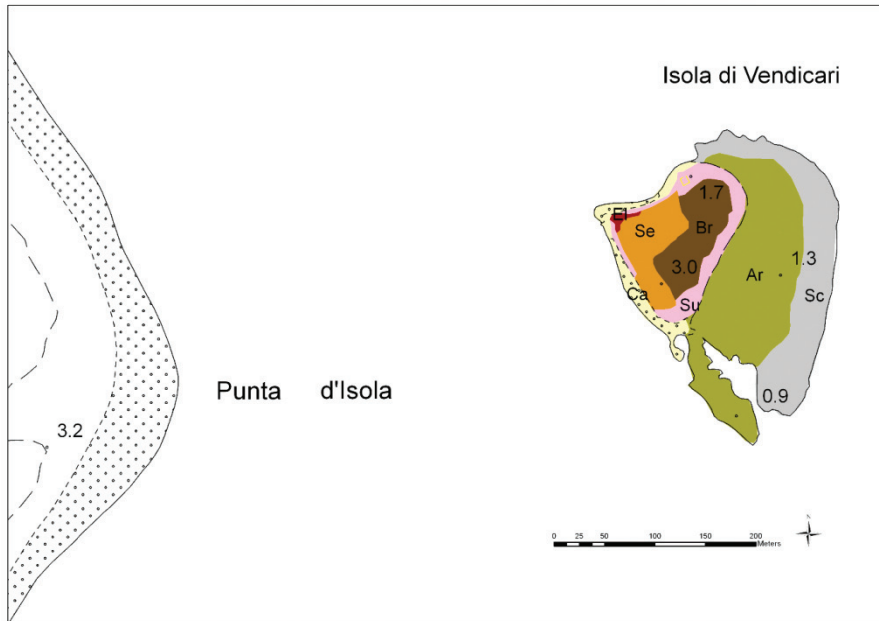


Fig. 8. Vegetation map: Ca – *Glaucio flavi-Matthioletum tricuspidatae*; Su – *Halimiono portulacoidis-Suaedetum verae*; E1 – *Cypero mucronati-Elytrigietum junceae*; Se – *Centaureo-Ononidetum ramosissimae*; Br – *Thero-Brometalia*; Ar – *Limonio virgati-Arthrocnemetum glauci*; Sc – Reef

grasslands of *Cutandietalia divaricatae* Rivas-Martínez, Díez-Garretas & Asensi 2002, characterized by psammophilous therophytes represented mainly by *Cutandia divaricata* and *Vulpia fasciculata*, which can be attributed to *Vulpio-Cutandietum divaricatae* Brullo & Scelsi 1998 (Rels. 12-14), an association distributed in southern Sicily. The calcarenitic rocks occurring along the eastern side of the islet are more exposed to the sea storms and aerosol, but are covered in the inner part by a community dominated by *Arthrocn-*

Tab. 3. Surfaces and European codes (Corine Biotopes, EUNIS and Habitat of Annex I Dir. 92/43) of the habitats occurring in the islet.

CORINE Biotopes	EUNIS	Habitat 92/43 CE	Acronym used in Fig. 8 (Vegetation map)	Surface (hectares)
15.61	A2.5	1420	Ac	1.780
15.61	A2.5	1420	Su	0.373
16.211	B1.3	2110	E1	0.022
16.223	B1.4	2210	Se	0.408
17.2	B1.12	1210	Ca	0.265
18.16	B3.1	0	Sc	1.140
34.81	E1.6	0	Br	0.462
		Total		4.450

mum macrostachyum, which is linked to salt soils (Fig. 7). This vegetation in terms of its ecology and physiognomic aspect is very similar to *Limonio virgati-Arthrocnemetum macrostachyi* Biondi, Casavecchia & Guerra 2006 (Rels. 17-18), an association of *Sarcocornietea fruticosae*, described by BIONDI *et al.* (2006), for Apulia on low calcarenitic cliffs. Frequently mixed with this vegetation is an ephemeral community dominated by halonitrophylous microphytes of *Saginetea maritimae* Westhoff, Van Leeuwen & Adriani 1962, such as *Parapholis filiformis*, *P. incurva* and *Spergularia salina*. This vegetation is referable to *Parapholidetum filiformis* Brullo, Scelsi & Siracusa 1994 (Rel. 19), an association widespread along the Sicilian coasts.

In the central part of the islet on soils enriched with nitrates, a legacy of human activities, now very distant in time, there is nitrophilous vegetation. It is a very heterogeneous community rich in annual therophytes mixed to some perennial species which can be attributed to *Thero-Brometalia* (Rivas Goday & Rivas-Martínez ex Esteve 1973) O.Bolòs 1975 order of *Stellarietea mediae* R.Tx., Lohmeyer & Preising ex von Rochow 1951 (Fig. 6).

The surfaces of these different habitats with their European codes (Corine Biotopes, EUNIS and Habitat of Annex I Dir. 92/43), are reported in Tab. 3. They are also mapped, as vegetation types, in Fig. 8.

DISCUSSION

The floristic settlement of the islet shows close relations with the flora of the not very distant Sicilian coast, so it could be interesting to compare the Vendicari Islet floristic list to the flora of Vendicari Nature Reserve. In particular according to MINISSALE & SCIANDRELLO (2010), the flora of this reserve (the islet excluded) consists of 486 taxa and almost all the species occurring on the islet are shared with this flora. The islet species not recorded for the Vendicari reserve are trivial and probably previously escaped observation or were misidentified.

As regard the colonization processes, it can be clearly hypothesized that the species with good dispersion ability reached the islet by the wind, sea currents or zoochoria. Moreover it has to be taken into account the proximity to the Sicilian coast and in any case during the Last Glacial Maximum the islet was certainly connected to the mainland (MICALLEFF *et al.*, 2013), followed in the Holocene by a rapid sea-level rise (SPAMPINATO *et al.*, 2011), but also in classical times (the Greek period) the sea level was at least 1 meter lower than at present (SCICCHITANO *et al.*, 2008). Therefore, it can be assumed that the islet had in the past a larger surface area and was less distant from the Sicilian coast. This probably allowed a human presence even if discontinuous, that ceased almost completely in the second half of the twentieth century. Due to its geomorphological shape, the environmental factors permitted colonisation by halophytes and psammophytes almost exclusively. The establishment of the nitrophilous component of the flora is due to the past human impact; this component currently is still well represented also in relation to the large population of gulls. The only alien species is *Opuntia ficus-indica*, which shows a limited ability to spread and thus its eradication should be pretty simple.

The results of this work will support the managing body of Vendicari Nature Reserve for conservation activities of the flora and fauna. Worth mentioning is the long lasting prohibition of landing on this islet, which has allowed the maintenance of an interesting flora and fauna, above all the seasonal establishment of Audouin's Gull, which finds here the special conditions of habitat and isolation that allow it to nest, making this unique site in Sicily.

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