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Which habitat for Sicilian gypsophytes?

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The species and the plant assemblages growing on gypsum provide a clear example of strict relationship between soil and vegetation, as many plant species grow exclusively or preferentially on such peculiar substrates.



The gypsicolous substrates represent a largely underrated or ignored habitat, with serious consequences for both flora and fauna conservation.



Plenty of accurate information about gypsophilous species and plant communities is available for Spain (Mota et al. 2011; Escudero et al. 2015), but not for the other European countries where such substrata do also occur.

A preliminary database for exploring ecological and biogeographic issues relating to gypsophily was recently elaborate by Pérez-García et al. (2017)



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Plant life on gypsum: a review of its multiple facets

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AISTRACT

The adoptation of plasm is particular out types has long intrigoed biologies. Gypons with occupy large areas in many regions of the world and host a withing histogical diversity, but here iverptation has been much low misded that that developing over sequentiae or saline with. Herein, we review all aspects of plant life on gyponn ecceptores, diverses the main processes divide give in extreme and flanceiring, and highligh the main concervation thereins that they fourdetermined by they appear has a structure of the same size of the same processes that they fourdetermined by topography. Branc Briego on gypones solics carb echardle in single ecceptories (i) which are mainly determined by topography. Branc Briego on gypones solics carb echardler into three comparise (i) which more adults with the chemical finitations imposed by gypones solics (ii) neuronal hardness holds in socied with the chemical finitations inposed by gyponess solics (iii) carries gyponphilas are relinge plants which more observed on the physical relinger on gypone plants which can only their in gyponess more mean specialized they of solic, and (ii) gyponess are mean specialized gyponess plants are in gyponess flants.



A first inventory of gypsum flora in the Palearctic and Australia

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Abstract, Oypseous substrates are well-recognised as supporting distinctive and unique flows assemblagars, including muserous gyprum endomic (gypsophild) species. Along with these, others are also frequent albough their presence in and retricted to gyprum. they done a clear performance for them (gypsocfiles). While this phenomenon (gypsophily) has been studied regionally, and various hypotheres put forward to explana it, there has been liftle global synthesis. We present a performance beck-bit on the gypsochiar flows of the Palaearctic and Australian access as a part of a project to develop a global checkhist of the World's gypsochiar flows of the Palaearctic and Australian access as a part of a project to develop a global checkhist of the World's gypsophytes, which can broaden our ecological and biogeographical understanding of these tangen environments.

The database contains 915 taxa spanning 54 countries. The lance-Turnnian region - and to a lesser extent the Mediterraneau region -- amerged as the richest territories in terms of gypsophile species; this richness was much reduced in the Saharo-Arabana nat, expecially in the Eurosherian regions.

and, especially in the Eurosiberian regions.

Checklist of gypsophilous vascular flora in Italy

Through a structured group communication process of experts (application of the Delphi technique), a remarkable number of experienced Italian botanists have joined together to select focal plant species linked to gypsum substrates.



In our previous study, we have developed a list a Checklist of Italian gypsophytes, including 31 taxa showing a great affinity for this substrate, 12 of which can be unequivocally considered as strictly gypsophytes.

Species	Family	Life-form	Chorology	IUCN	Median	Mainland	Sicily
						Median	Median
Chaenorhinum rupestre (Guss.) Speta	Plantaginaceae	Т	S-Medit.	-	5.00	-	5.00
Festuca gypsophila Hack.	Poaceae	Т	Medit.	-	5.00	-	5.00
Sedum gypsicola Boiss. & Reuter subsp. trinacriae Afferni	Crassulaceae	Ch	Endem.	-	5.00	-	5.00
Petrosedum ochroleucum (Chaix)Niederle subsp. mediterraneum (Gallo)Niederle	Crassulaceae	Ch	Endem.	-	5.00	-	5.00
Allosorus persicus (Bory) Christenh.	Pteridaceae	Н	Medit.	EN	5.00	5.00	3.00
Artemisia pedemontana Balb.	Asteraceae	Ch	Europ.	-	4.50	5.00	4.00
Stipa austroitalica Martinovský subsp. frentana Moraldo & Ric.	Poaceae	Н	Endem.	LC	4.00	4.50	4.00
Diplotaxis harra (Forssk.)Boiss. subsp. crassifolia (Raf.)Maire	Brassicaceae	Ch	S-Medit.	-	4.00	-	4.00
Brassica villosa Biv. subsp. tineoi (Lojac.) Raimondo & Mazz.	Brassicaceae	Ch	Endem.	-	4.00	-	4.00
Erysimum metlesicsii Polatschek	Brassicaceae	Н	Endem.	-	4.00	-	4.00
Limonium catanzaroi Brullo	Plumbaginaceae	Н	Endem.	-	4.00	-	4.00
Limonium optimae Raimondo	Plumbaginaceae	Н	Endem.	-	4.00	-	4.00
Reaumuria vermiculata L.	Tamaricaceae	NP	S-Medit.	-	4.00	-	4.00



Diplotaxis harra subsp. crassifolia Torre Manfria (Sicily) ph. Sciandrello



Italy is one of the territories with fewer gypsophyte in the Palearctic and Australia region.



Number of gypsophytes in the countries of Palearctic and Australia regions

Color scale: black (> 74), dark grey (74-50), medium grey (49-20) and light grey (19-1).

(Modified from Pérez-García et al. 2018)

The vegetation and habitats of Italian gypsum are little known



The aims of this research were

- to evaluate the role of gypsophytes in the gypsum vegetation and habitat;
- to expand the knowledge about this type of habitat on which conservation efforts need to be addressed;
- to examine the spectrum of taxonomical groups, life forms and chorotypes of this habitat.



Materials and methods

The vegetation surveys were carried out with the phytosociological approach.

Data were collected from pure gypsiferous outcrops A stratified random sampling project was used to select the gypsum outcrops to be sampled.

The vegetation was sampled by stratifying each site by the three types of vegetation communities: annuals, perennial and bryophyte.

According to these three main types of vegetation communities, the phytosociological relevés have been arranged in three different matrices.

Multivariate analyses were used to classify the plant community assemblages using PC-ORD 4.34 software

Materials and methods

To evaluate the role of gypsophytes in the community structure, we calculate the biodiversity of plant community with the Shannon-Wiener H 'index (Shannon and Wiener, 1949)

$$H' = -\sum_{i=1}^{S} p_i \cdot \ln(p_i)$$

Where, **pi** is the proportion of individuals found in the ith species and 'In' denotes the natural logarithm.

We estimated the percentage contribution of gypsophytes to community biodiversity.

The study concerns Sicily where most of the gypsum outcrops of Italy are present.

Distribution of the main gypsum outcrops in Italy (from De Waele et al., 2017)

1) Acquafredda-Spipola Cave (Bologna); 2) Poiano (Upper Secchia Valley); 3) Moncenisio area; 4) Re Tiberio-Rio Basino (Vena del Gesso); 5) Grotta delle Vene (Grosseto); 6) Esino (Brescia); 7) Montecatini (Pisa); 8) Santa Ninfa (Trapani); 9) Grave Grubbo, Verzino (Crotone); 10) Ciminna (Palermo); 11) Quinis (Udine); 12) Preola Lake-Gorghi tondi (Trapani); 13) Sant'Angelo Muxaro (Agrigento); 14) Siculiana (Agrigento); 15) Monte Conca (Caltanissetta); 16) Montallegro (Agrigento); 17) Palma di Montechiaro (Agrigento); 18) Sassalbo (Massa-Carrara); 19) Moncalvo-Calliano (Asti); 20) Monticello d'Alba (Cuneo); 21) Onferno (Rimini); 22) Rocca di Entella (Palermo).



The Sicilian gypsum form constitute ecological "islands", characterized by peculiar edaphic and microclimatic conditions, immersed in an environmental matrix of Messinian evaporitic outcrops.



Distribution of evaporitic outcrops of the Messinian in Sicily. (from Madonia et al. 2013)

Sicily has a Mediterranean bioclimate with a prevalence of thermo- and mesomediterranean thermotypes and dry or sub umid ombrotype.





Bioclimatic maps of italy (from Pesari et al. 2014)

Climate diagrams of representative climate stations (based on Walter and Lieth 1960-1967)



The phytosociological relevés have been arranged in three different matrix:

- perennal vegetation (64 plots × 77 species)
- annual and stonecrop vegetation (75 plots × 68 species)
- bryophyte vegetation (24 plots x 40 species)



Plant community	H'	Gypsophyte (%)
Perennial		
Brassica tinei community	2,47	35
Euphorbia dendroidis community	2,59	10
Diplotaxis crassifolia communities	2,27	9
Thymus capitatus community	2,65	3
Pistacia lentiscus community	2,44	2

Brassica villosa subsp. tineoi community

Cliffs on gypsum rocks





Claster analisis of annualand stonecrops plant community



Plant community	н	Gypsophyte (%)	
Annuals and stonecrops			
Petrosedum ochroleucum community	1,81	31	
Chenorrhinum rubrifolium community	2,75	17	
Sedun gypsycola community	2,37	12	
Sedum caeruleum community	2,91	6	
Poa bulbosa community	2,8	3	
Stipa capensis community	2,01	1	

Petrosedum ochroleucum subsp. *mediterraneum* Community

Rock stonecrop plant community





Chaenorhinum rubrifolium community

Ephemeral therophytic vegetation





Plant community	H'	Gypsophyte (%)		
Bryophytae				
Tortula revolvens community	1,51	32		
Trichostomum crispulum community	1,62	2		

Tortula revolvens community

Tortula revolvens is the only bryophyte exclusive to the Italian gypsum outcrops





There is relationship between Gypsophyte (%) and biodiversity



rs = -0,0074; p-level < 0,05

Gypsophytes play an important role in structuring communities grows directly on gypsum or on thin layers of lithosol, poor-nutrient in low productive environments.





The plant communities growing on sicilian gypsum ouctrop are one of the major gaps in conservation habitats in the European Union

Five plant communities have been recognized as chacacteristi of gypsum outcrops

- Brassica tinei community
- Petrosedum ochroleucum community
- Chenorrhinum rubrifolium community
- Sedun gypsycola community
- Tortula revolvens community

They allow us to recognize the habitat 1520* also in Sicily as suggested in the European Red List of Habitats by Loidi et al. (2016).



Distribution of the habitat 1520 * Iberian gypsum vegetation (Gypsophiletalia) in Europe (Loidi et al. 2016)

Gypsum outcrops and nature 2000 Network Sites



Gypsum habitats host various endemic and rare flora with remarkable ecomorphological adaptations.



Diplotaxis harra subsp. *crassifolia* Torre Manfria (Sicily) ph. Sciandrello

Brassica villosa subsp. *tinei* Rocca Entella (Sicily) – ph. Musarella

Petrosedum ochroleucum subsp. mediterraneum Serre Cannarella (Sicily) - ph Falci

Thank you for your attention

Chaenorhinum rupestre - Rocca Entella (PA - Sicily) – ph. Spampinato