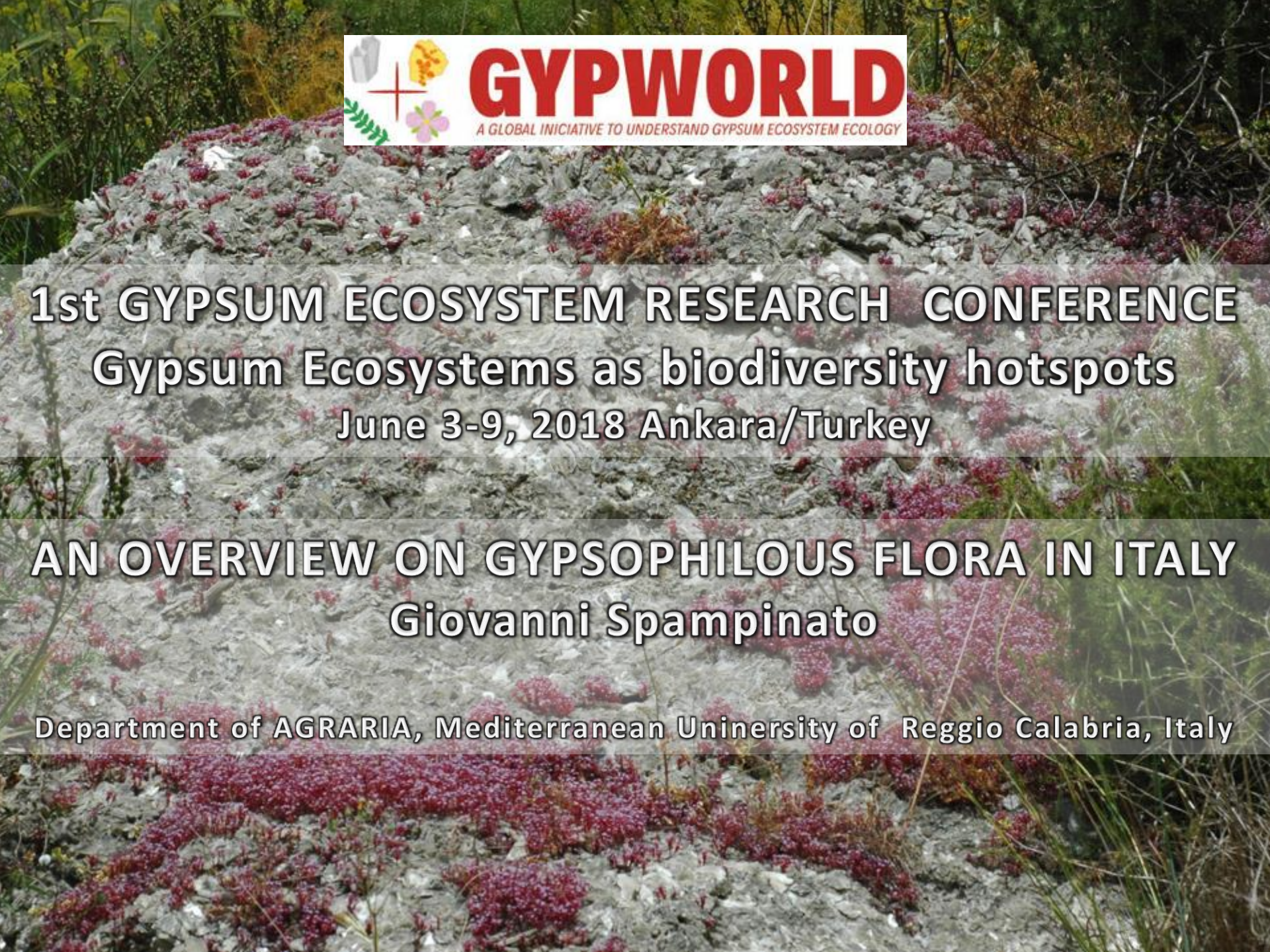


1st GYPSUM ECOSYSTEM RESEARCH CONFERENCE

Gypsum Ecosystems as biodiversity hotspots

June 3-9, 2018 Ankara/Turkey

AN OVERVIEW ON GYPSOPHILOUS FLORA IN ITALY

Giovanni Spampinato

Department of AGRARIA, Mediterranean Uninersity of Reggio Calabria, Italy

Introduction

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.

***Sedum ochroleucum* subsp. *mediterraneum*. Serre Cannarella (Sicily) ph Falci**

Introduction

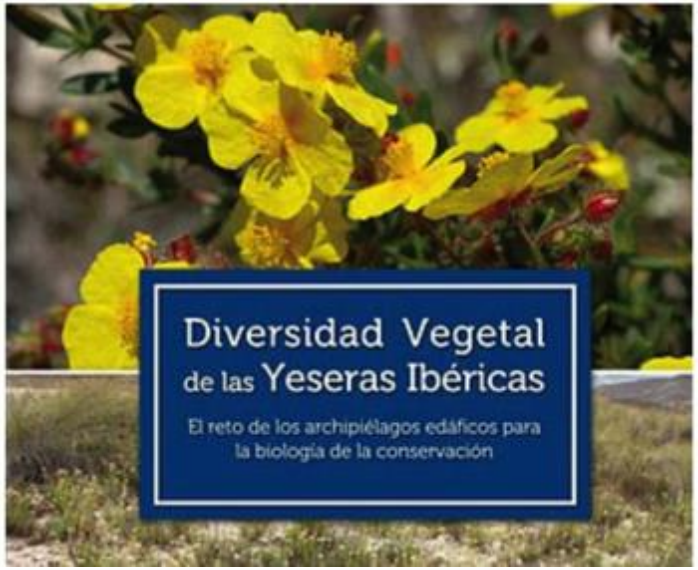
The gypsicolous substrates represent a largely underrated or ignored habitat, with serious consequences for both flora and fauna conservation.

Rocca Entella (Sicily) – ph. Spampinato

Introduction

Plenty of accurate information about gypsophilous species and plant communities is available for Spain (Mota et al. 2011), 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)



ARTICLES

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EDICIONES COMPLUTENSE

A first inventory of gypsum flora in the Palearctic and Australia

Francisco J. Pérez-García[1], Hossein Akhani[2], Robert F. Parsons[3], Jennifer L. Silcock[4], Latif Kurt[5], Ebru Özdeniz[5], Giovanni Spampinato[6], Carmelo M. Musarella[6], Esteban Salmerón-Sánchez[1], Fernando Sola[1], María E. Merlo[1], Fabián Martínez-Hernández[1], Antonio J. Mendoza-Fernández[1], Juan A. Garrido-Becerra[1] & Juan F. Mota[1]

Received: 30 November 2017 / Accepted: 5 March 2018

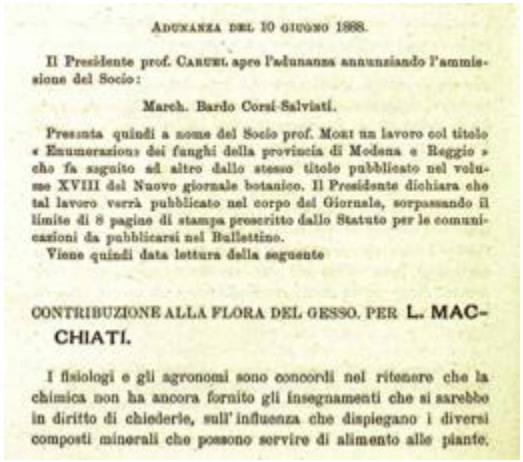
Abstract. Gypseous substrates are well-recognised as supporting distinctive and unique flora assemblages, including numerous gypsum endemic (gypsophile) species. Along with these, others are also frequent although their presence is not restricted to gypsum; they show a clear preference for them (gypsocline). While this phenomenon (gypsophily) has been studied regionally, and various hypotheses put forward to explain it, there has been little global synthesis. We present a preliminary check-list on the gypsophile and gypsocline flora of the Palaearctic and Australian areas as a part of a project to develop a global checklist of the World's gypsophytes, which can broaden our ecological and biogeographical understanding of these unique environments.
The database contains 935 taxa spanning 54 countries. The Irano-Turanian region –and to a lesser extent the Mediterranean region– emerged as the richest territories in terms of gypsophile species; this richness was much reduced in the Saharo-Arabian and, especially in the Eurosiberian regions.

Introduction

The peculiar flora growing on Italian gypsum substrates has been underlined since the 19th century.

The first scholar who studied the gypsophilous flora of Italy was Macchiati (1888).

Later other studies are increasing the knowledge about this flora in mainland Italy and Sicily (Cobau, 1932; Pasquini, 1944; Brullo et al., 1988; Gallo, 2014, ecc.).



ADUNANZA DEL 10 GIUGNO 1888.

Il Presidente prof. CARUEL apre l'adunanza annunziando l'ammissione del Socio:

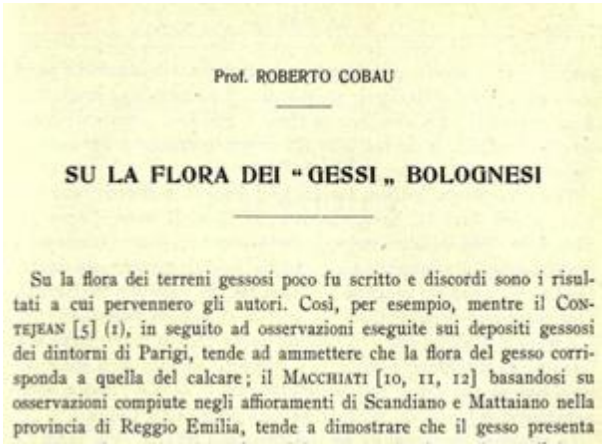
March. Bardo Corsi-Salviati.

Presenta quindi a nome del Socio prof. MORI un lavoro col titolo « Enumerazione dei funghi della provincia di Modena e Reggio » che fa seguito ad altro dallo stesso titolo pubblicato nel volume XVIII del Nuovo giornale botanico. Il Presidente dichiara che tal lavoro verrà pubblicato nel corpo del Giornale, sorpassando il limite di 8 pagine di stampa prescritto dallo Statuto per le comunicazioni da pubblicarsi nel Bullettino.

Viene quindi data lettura della seguente

CONTRIBUZIONE ALLA FLORA DEL GESSO. PER L. MACCHIATI.

I fisiologi e gli agronomi sono concordi nel ritenere che la chimica non ha ancora fornito gli insegnamenti che si sarebbe in diritto di chiederle, sull'influenza che dispiegano i diversi composti minerali che possono servire di alimento alle piante.



Prof. ROBERTO COBAU

SU LA FLORA DEI "GESSI„ BOLOGNESI

Su la flora dei terreni gessosi poco fu scritto e discordi sono i risultati a cui pervennero gli autori. Così, per esempio, mentre il CONTEJEAN [5] (1), in seguito ad osservazioni eseguite sui depositi gessosi dei dintorni di Parigi, tende ad ammettere che la flora del gesso corrisponda a quella del calcare; il MACCHIATI [10, 11, 12] basandosi su osservazioni compiute negli affioramenti di Scandiano e Mattaiano nella provincia di Reggio Emilia, tende a dimostrare che il gesso presenta

DOTT. DIEGO PASQUINI

La vegetazione dei gessi reggiani (*)

Sembra già appurato per le ricerche di L. MACCHIATI su i gessi reggiani e di R. COBAU su quelli bolognesi che i gessi hanno una vegetazione che assomiglia, pure non corrispondendo del tutto, a quella del calcare.

Tuttavia le osservazioni del MACCHIATI, che si riducono alla raccolta di 70 specie in tre escursioni eseguite sui gessi di Scandiano e di Mattaiano in provincia di Reggio Emilia, se pure hanno permesso di fornire un orientamento in questo senso, non ci danno l'idea completa della vegetazione dei gessi reggiani per cui, su consiglio del prof. GIORGIO NEGODI, ho ripreso lo studio dello

Introduction

The aims of this research were

- (i) to elaborate a checklist of the Italian gypsophilous vascular flora through a structured group communication process of experts;
- (ii) to expand the knowledge about this type flora on which conservation efforts need to be addressed;
- (iii) to examine the spectrum of taxonomical groups, life forms and chorotypes of this flora.

Sedum gypsycola* subsp. *trinacriae
Rocca di Entella (Sicily) – ph. Musarella

Materials and methods

Several approaches have been proposed to elucidate which plant species can be considered really linked to gypsum substrates (Mota et al. 2016).

Criteria which have been or can been used to determine whether or not a plant is a gypsophile species.

Criterion	Justification
Inductive criterion	Species always or almost always recorded as growing on gypsum outcrops. With accurate measurements, this criterion can also become a statistical criterion.
Expert criterion	Species which experts well acquainted with the gypsophilous flora deem as associated to gypsum outcrops.
Bibliographical criterion	Species mentioned in technical literature as being peculiar to gypsum outcrops.
Syntaxonomical criterion	Diagnostic or characteristic species of syntaxa peculiar to gypsum outcrops (*Gypsophiletalia*, *Sedo-Ctenopsion*).
Bioindicator criterion	Plant which occur or tend naturally to occur with undoubtedly gypsophilous species ("ultragypsophytes") .
Edaphic criterion	*Taxa* which grow on soils with a high gypsum content.
Ecophysiological criterion	Presence of morphoanatomical or physiological adaptations as a result of growing on gypsum outcrops.
Evolutive criterion	Molecular markers indicating gypsophily.

Materials and methods

Coping with an extremely species-rich flora of a wide territory like Italy, using the Delphi technique resulted to be the most effective way to build a checklist of the gypsophilous flora by using the so-called ‘expert criterion’ (Mota et al. 2008, 2009).

Available online at www.sciencedirect.com
ScienceDirect
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Flora 203 (2008) 359–375
FLORA
www.elsevier.de/flora

FLORA REVIEW

Dolomite flora of the Baetic Ranges glades (South Spain)

Juan Francisco Mota[a,*], José Miguel Medina-Cazorla[a], Francisco Bruno Navarro[b], Francisco Javier Pérez-García[a], Andrés Pérez-Latorre[c], Pedro Sánchez-Gómez[d], Juan Antonio Torres[e], Alfredo Benavente[f], Gabriel Blanca[g], Carlos Gil[h], Juan Lorite[g], María Encarnación Merlo[a]

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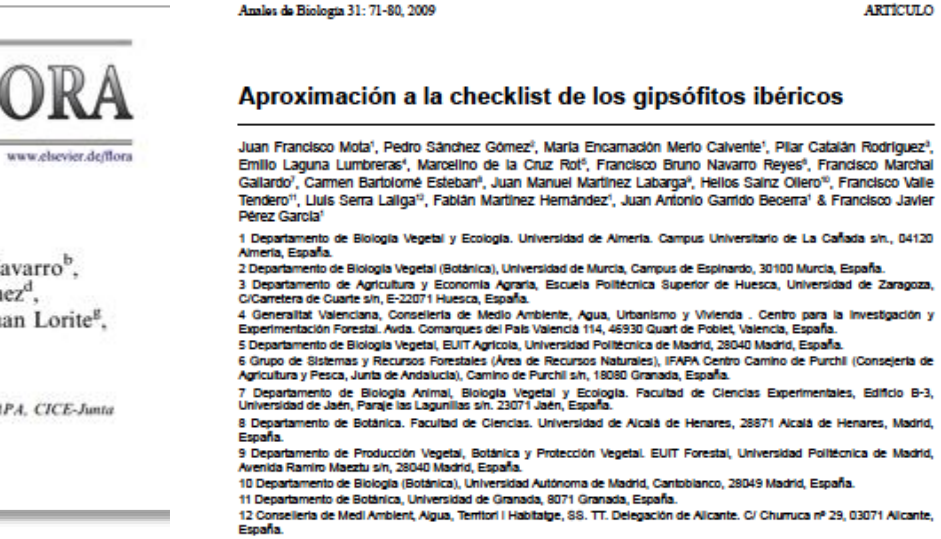
[f]*Consejería de Medio Ambiente, Junta de Andalucía, Cazorla, E-23470 Jaén, Spain*



Anales de Biología 31: 71-80, 2009 ARTÍCULO

Aproximación a la checklist de los gipsófitos ibéricos

Juan Francisco Mota[1], Pedro Sánchez Gómez[2], María Encarnación Merlo Calvente[1], Pilar Catalán Rodríguez[3], Emilio Laguna Lumbreras[4], Marcelino de la Cruz Rot[5], Francisco Bruno Navarro Reyes[6], Francisco Marchal Gallardo[7], Carmen Bartolomé Esteban[8], Juan Manuel Martínez Labarga[9], Helios Sainz Ollero[10], Francisco Valle Tendero[11], Lluís Serra Laliga[12], Fabián Martínez Hernández[1], Juan Antonio Garrido Becerra[1] & Francisco Javier Pérez García[1]

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12 Conselleria de Medi Ambient, Aigua, Territori i Habitatge, SS. TT. Delegación de Alicante. C/ Churruca nº 29, 03071 Alicante, España.

Materials and methods

Delphi technique

- The Delphi technique is a structured, anonymous and iterative survey of a panel of ‘experts’, which enables a group of individuals to collectively address a complex problem through a structured group communication process.
- This method has been applied in ecology to fill in data gaps through experience of the participants (Eycott et al., 2011; Ochoa-Gaona et al., 2010, Hasson and Keeney, 2011))
- Our scheme comprised two rounds of semi-structured questionnaires, each followed by aggregation of responses and anonymous feedback from the experts.

Materials and methods

Preparation of first round of the questionnaire

- A semi-structured survey drawing from evidences based on published literature was designed.
- The initial listing of taxa included species coming from bibliographical references

References on gypsophylous italian flora

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Troìa, A. (2002).

Materials and methods

Selection and invitation of a panel of experts

- Participants from a great diversity of backgrounds were included in order to obtain a wide range of perspectives and minimize bias arising due to self-interest or information preferences.
- The experts come from the Italian peninsula and Sardinia (9) and Sicily (11)

Panel of experts

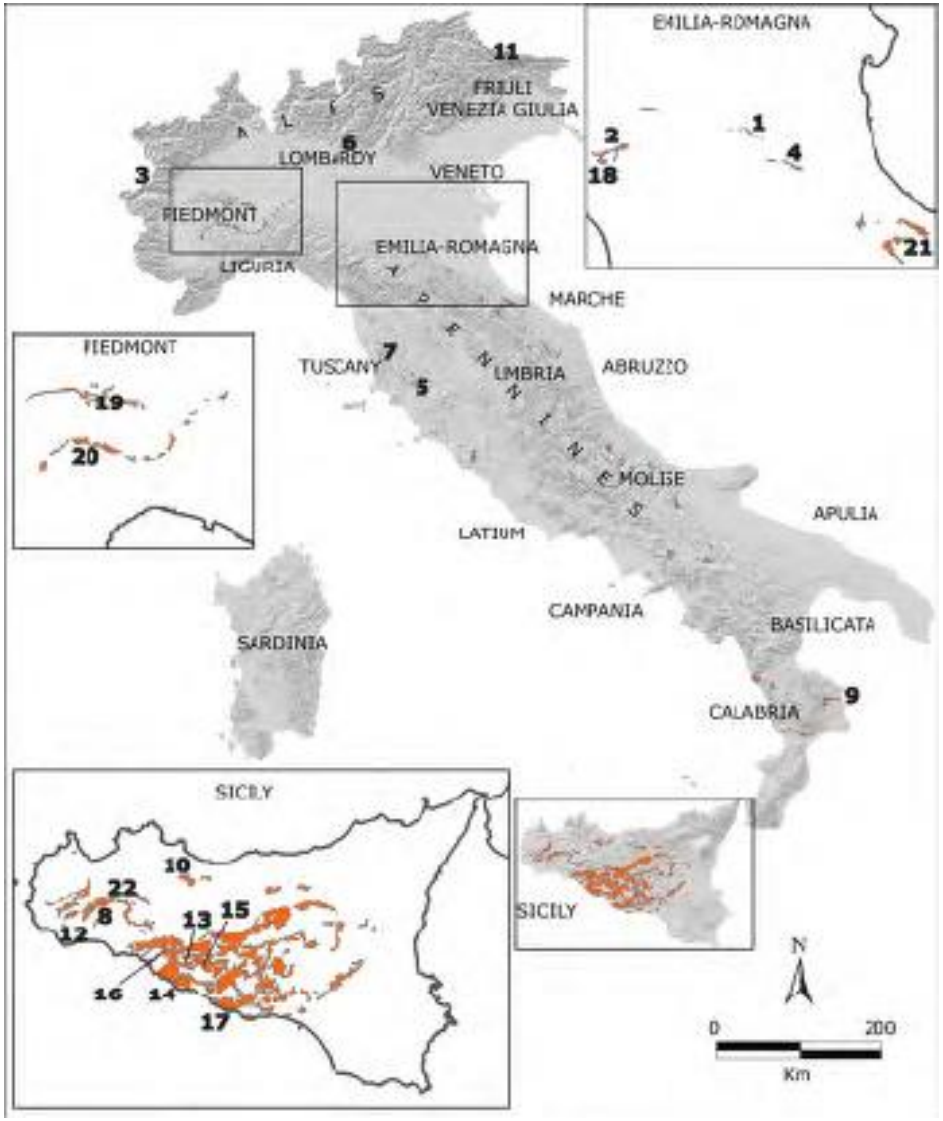
1. Alessandro Alessandrini – Bologna, Italy
2. Gianluigi Bacchetta – Cagliari, Sardinia
3. Salvatore Brullo, Catania, Sicily
4. Orazio Caldarella - Palermo, Sicily
5. Giampiero Ciaschetti – Sulmona, Italy
6. Fabio Conti - Camerino, Italy
7. Luciano Di Martino - Sulmona (AQ), Italy
8. Amedeo Falci – Calatanissetta, Sicily
9. Lorenzo Gianguzzi - Palermo, Sicily
10. Riccardo Guarino - Palermo, Sicily
11. Aurelio Manzi – Chieti, Italy
12. Pietro Minissale - Catania, Sicily
13. Sergio Montanari - Bagnacavallo (RA), Italy
14. Salvatore Pasta- Palermo, Sicily
15. Lorenzo Peruzzi - Pisa Italy
16. Lina Podda - Cagliari, Sardinia
17. Saverio Sciandrello - Catania, Sicily
18. Leonardo Scuderi - Trapani, Sicily
19. Angelo Troìa - Palermo, Sicily
20. Giovanni Spampinato – Reggio Calabria, Italy

Materials and methods

Study area

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).



Materials and methods

Collection and analysis of the completed questionnaire for the first round

- The preliminary plant catalogue was submitted to the group of experts.
- The experts were clearly asked to base their gypsophily assessment for each plant species only on their personal field experience in order to avoid any judgment based on bibliographical references, or other sources of information.
- The peers were provided with a series of criteria hierarchized according to Likert (1932) scale, a method where participants were asked to rank their responses on a scale of 'one to five'

Likert scale ranking for the gypsophilous character of the taxa		
5	Strictly gypsophile species, that is, species that do not live outside gypsum substrates . ALWAYS GROW ON GYPSUM	**Strict gypsophyte**
4	Species with great preference for gypsum and which are found very rarely outside this substrate. ALMOST ALWAYS GROW ON GYPSUM	**Preferential gypsophyte**
3	Species that live on gypsum, but which can also live on other substrates. If they live on many other different types of soil they will not fit into this category. GYPSUM AND OTHER VERY RELATED SUBSTRATES ARE THEIR PREFERENT HABITATS	**Subgypsophyte**
2	Species that may be abundant on gypsum, although they could be even more frequent on other types of substrates. CLEARLY MORE COMMON OUTSIDE OF GYPSUM	**Gypsovag**
1	Very rare species on gypsum or absent on this type of soil. NEVER (OR ONLY ACCIDENTALLY) ON GYPSUM	**Accidental**

Materials and methods

Preparation and analysis of second round questionnaire

- The collated responses of the first round were used to prepare a second questionnaire. The experts were requested to add new taxa candidates to be subsequently evaluated by the panel.
- The second round questionnaire was administered only to respondents who participated to the first round.
- The responses were collated and analysed using quantitative measures.
- The results were compiled into a report, which was used in the next step.

Materials and methods

Plant species data

Information about plant species included in the checklist was collected:

- taxonomic rank (Bartolucci et al. 2018);
- family (Peruzzi 2010);
- chorology (Pignatti 1982);
- life form (Pignatti 1982);
- conservation status (Rossi et al. 2014)
- functional groups (narrow gypsophiles, wide gypsophiles or gypsovags) according to Bolukbasi et al. (2016) and Palacio et al. (2007).


Annals of Botany 99: 333–343, 2007
doi:10.1093/aob/mcl263, available online at www.aob.oxfordjournals.org

OXFORD JOURNALS

Plants Living on Gypsum: Beyond the Specialist Model

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• *Background and Aims* Plants from gypsum habitats are classified as gypsophiles and gypsovags. The former include both narrow endemics limited to small gypsum areas and regionally dominant gypsophiles growing in gypsum areas of large regions, whereas gypsovags are plants that can grow both in gypsum and non-gypsum soils. Factors controlling the distribution of gypsum plants are still not fully understood.
• *Methods* To assess how the different types of gypsum plants deal with the stressful conditions of gypsum substrates, comparisons were made of the leaf chemical composition of four gypsovags, five regionally dominant gypsophiles and four narrow gypsum endemics growing in two massive gypsum areas of the Iberian Peninsula.


plant biology

Plant Biology ISSN 1435-8603

RESEARCH PAPER

Unravelling the mechanisms for plant survival on gypsum soils: an analysis of the chemical composition of gypsum plants from Turkey

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Keywords
Calcium sulphate; gypsophile endemism; gypsophily; gypsophytes; gypsum flora; leaf chemical composition; nutrients; Turkey.

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ABSTRACT

Depending on their specificity to gypsum, plants can be classified as gypsophiles (gypsum exclusive) and gypsovags (non-exclusive). The former may further be segregated into wide and narrow gypsophiles, depending on the breadth of their distribution area. Narrow gypsum endemics have a putative similar chemical composition to plants non-exclusive to gypsum (i.e. gypsovags), which may indicate their similar ecological strategy as stress-tolerant plant refugees on gypsum. However, this hypothesis awaits testing in different regions of the world. We compared the chemical composition of four narrow gypsum endemics, one widely distributed gypsophile and six gypsovags

Materials and methods

Data analysis

- According to the proposed Likert scale:
  - species with median values 3 and 4 could be considered like **gypsoclines** (subgypsophytes or preferential gypsophytes);
  - those with median values >4 as **gypsophytes**.
- Several statistical t-student and ANOVA tests were performed (SPSS ver. 22.0.0.0. IBM SPSS Statistics).
- Only taxa with gypsophily median values ≥2 were assessed in order to exclude casual occurring taxa.

Results

Decision Delphi technique

- The first round of the questionnaire comprised 115 plant taxa from bibliographic references
- Experts included more than 69% of other taxa growing on Italian gypsum substrates.
- Final number of species proposed for the second evaluation after revision goes down to 380.
- All these taxa were assessed by at least one of the experts.
- The set of 380 taxa received on average 9 valuations out of 20.

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

Results

Checklist of the Italian gypsophilous flora

Species are listed in decreasing order of Median ("Med"). Life-form: Therophyte (T), Chamaephyte (Ch), Hemicryptophyte (H), Nanophanerophyte (NP), Geophyte (G). Distribution: Endemic (Endem.), Mediterranean (Medit.), Sub-Mediterranean (S-Medit.), European (Europ.), Widespread (Wide.). IUCN category: Endangered (EN), Least Concern (LC) species. Number of assessment (NA). Median (Median) and average (Mean) values of experts' assessments. Standard deviation (SD). Median values from mainland Italy and Sicilian experts separately (Mainland Med/Sicily Med).

Species	Family	Life-form	Chorology	IUCN	NA	Score	Median	Mean	SD	Mainland Median	Sicily Median
Chaenorhinum rupestre (Guss.) Speta	Plantaginaceae	T	S-Medit.	-	11	55	5.00	5.00	0.00	-	5.00
Festuca gypsophila Hack.	Poaceae	T	Medit.	-	1	5	5.00	5.00	-	-	5.00
Sedum gypsicola Boiss. & Reuter subsp. *trinacriae* Afferni	Crassulaceae	Ch	Endem.	-	11	51	5.00	4.64	0.67	-	5.00
Petrosedum ochroleucum (Chaix)Niederle subsp. *mediterraneum* (Gallo)N	Crassulaceae	Ch	Endem.	-	9	38	5.00	4.22	1.30	-	5.00
Allosorus persicus (Bory) Christenh.	Pteridaceae	H	Medit.	EN	5	21	5.00	4.20	1.10	5.00	3.00
Artemisia pedemontana Balb.	Asteraceae	Ch	Europ.	-	2	9	4.50	4.50	0.71	5.00	4.00
Stipa austroitalica Martinovský subsp. *frentana* Moraldo & Ric.	Poaceae	H	Endem.	LC	5	21	4.00	4.20	0.84	4.50	4.00
Diplotaxis harra (Forssk.)Boiss. subsp. *crassifolia* (Raf.)Maire	Brassicaceae	Ch	S-Medit.	-	11	45	4.00	4.09	0.94	-	4.00
Brassica villosa Biv. subsp. *tineoi* (Lojac.) Raimondo & Mazz.	Brassicaceae	Ch	Endem.	-	11	43	4.00	3.91	1.30	-	4.00
Erysimum metlesicsii Polatschek	Brassicaceae	H	Endem.	-	11	40	4.00	3.64	0.92	-	4.00
Limonium catanzaroi Brullo	Plumbaginaceae	H	Endem.	-	5	18	4.00	3.60	1.67	-	4.00
Limonium optimae Raimondo	Plumbaginaceae	H	Endem.	-	5	18	4.00	3.60	1.67	-	4.00
Reaumuria vermiculata L.	Tamaricaceae	NP	S-Medit.	-	4	13	4.00	3.25	1.50	-	4.00
Gypsophila arrostii Guss. subsp. *arrostii*	Caryophyllaceae	Ch	Endem.	-	11	36	3.00	3.27	0.90	-	3.00
Matthiola fruticulosa (L.)Maire subsp. *coronopifolia* (Sm.)Giard. & Raimon	Brassicaceae	Ch	Endem.	-	1	3	3.00	3.00	-	-	3.00
Allium moschatum L.	Amaryllidaceae	G	Europ.	-	1	3	3.00	3.00	-	3.00	-
Elymus elongatus (Host) Runemark subsp. *elongatus*	Poaceae	G	Europ.	-	1	3	3.00	3.00	-	-	3.00
Thapsia meoides (Desf.) Guss.	Apiaceae	H	Medit.	-	4	11	3.00	2.75	0.50	-	3.00
Matthiola fruticulosa (L.) Maire subsp. *fruticulosa*	Brassicaceae	Ch	Europ.	-	11	30	3.00	2.73	0.90	2.00	3.00
Visnaga crinita (Guss.) Giardina & Raimondo	Apiaceae	T	Endem.	-	5	13	3.00	2.60	0.89	-	3.00
Stipa barbata Desf. subsp. *barbata*	Poaceae	H	Medit.	-	7	18	3.00	2.57	0.79	-	3.00
Linum decumbens Desf.	Linaceae	T	Medit.	-	9	23	3.00	2.56	0.53	-	3.00
Phagnalon rupestre (L.) DC. subsp. *illyricum* (H.Lindb.) Ginzb.	Asteraceae	Ch	Medit.	-	9	23	3.00	2.56	0.88	3.00	2.50
Astragalus caprinus L. subsp. *huetii* (Bunge) Podlech	Fabaceae	H	Endem.	-	11	28	3.00	2.55	1.13	-	3.00
Capparis sicula Veill.	Capparaceae	NP	Medit.	-	11	28	3.00	2.55	0.82	1.00	3.00
Teucrium luteum (Mill.) Degen	Lamiaceae	Ch	Medit.	-	7	16	3.00	2.29	0.95	-	3.00
Lygeum spartum L.	Poaceae	H	S-Medit.	-	9	20	3.00	2.22	0.97	3.00	2.50
Cachrys sicula L.	Apiaceae	H	Medit.	-	5	11	3.00	2.20	1.10	-	3.00
Parapholis strigosa (Dumort.) C.E.Hubb.	Poaceae	T	Medit.	-	5	11	3.00	2.20	1.10	1.00	3.00
Suaeda vera J.F.Gmel.	Amaranthaceae	NP	Wide.	-	5	11	3.00	2.20	1.10	1.00	3.00
Parapholis incurva (L.) C.E.Hubb.	Poaceae	T	Medit.	-	7	15	3.00	2.14	1.07	1.00	3.00

Results

Checklist of the Italian gypsophilous flora

Valuations of the Italian Checklist of gypsophilous flora:

5 taxa with median values equal to 5

8 taxa with median values equal to 4

18 taxa with median values of 3.

Gypsophila arrostii (Sicily) – ph. Gianguzzi

Median values equal to 5

Chaenorhinum rupestre (Guss.) Speta
Festuca gypsophila Hack.
Sedum gypsicola Boiss. & Reuter subsp. *trinacriae* Afferni
Petrosedum ochroleucum (Chaix)Niederle subsp. *mediterraneum* (Gallo)Niederle
Allosorus persicus (Bory) Christenh.

Median values equal to 4

Artemisia pedemontana Balb.
Stipa austroitalica Martinovský subsp. *frentana* Moraldo & Ric.
Diplotaxis harra (Forssk.)Boiss. subsp. *crassifolia* (Raf.)Maire
Brassica villosa Biv. subsp. *tineoi* (Lojac.) Raimondo & Mazz.
Erysimum metlesicsii Polatschek
Limonium catanzaroi Brullo
Limonium optimae Raimondo
Reaumuria vermiculata L.

Median values equal to 3

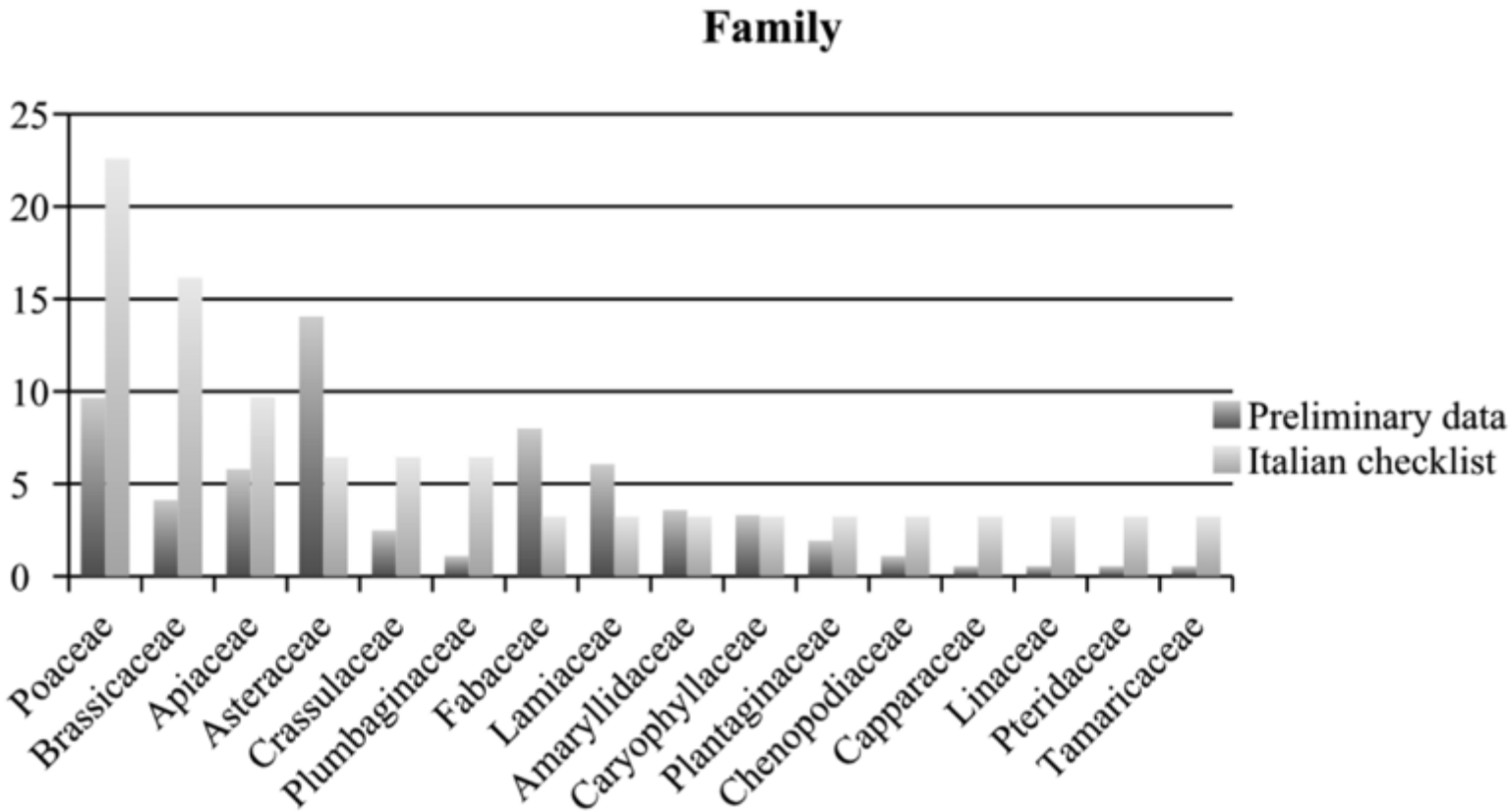
Gypsophila arrostii Guss. subsp. *arrostii*
Matthiola fruticulosa (L.)Maire subsp. *coronopifolia* (Sm.)Giard. & Raimondo
Allium moschatum L.
Elymus elongatus (Host) Runemark subsp. *elongatus*
Thapsia meoides (Desf.) Guss.
Matthiola fruticulosa (L.) Maire subsp. *fruticulosa*
Visnaga crinita (Guss.) Giardina & Raimondo
Stipa barbata Desf. subsp. *barbata*
Linum decumbens Desf.
Phagnalon rupestre (L.) DC. subsp. *illyricum* (H.Lindb.) Ginzb.
Astragalus caprinus L. subsp. *huetii* (Bunge) Podlech
Capparis sicula Veill.
Teucrium luteum (Mill.) Degen
Lygeum spartum L.
Cachrys sicula L.
Parapholis strigosa (Dumort.) C.E.Hubb.
Suaeda vera J.F.Gmel.
Parapholis incurva (L.) C.E.Hubb.

Results

Checklist of the Italian gypsophilous flora

Taxonomic spectrum

Percentage of taxa grouping by taxonomic families

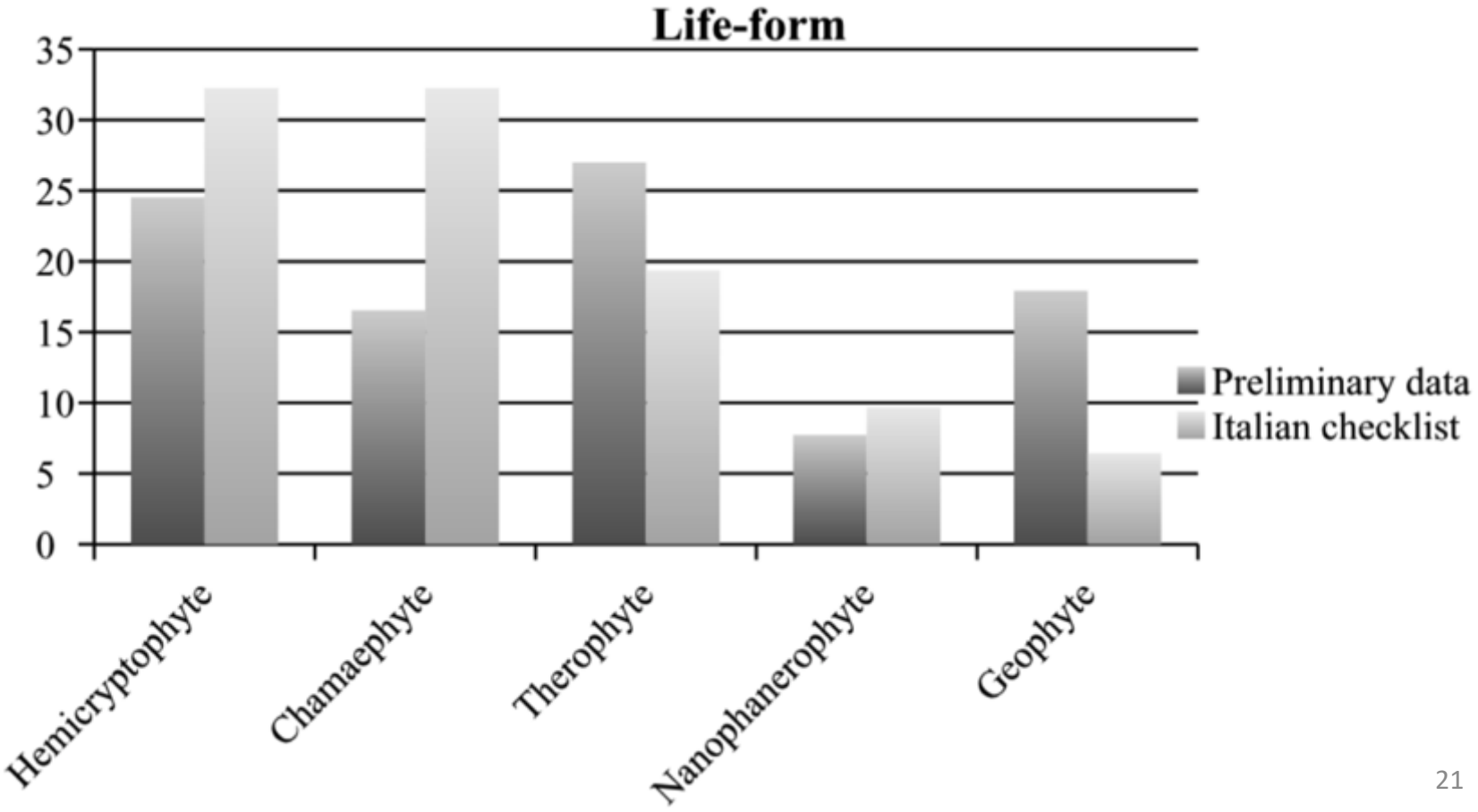


Results

Checklist of the Italian gypsophilous flora

Life-form spectrum

Percentage of taxa grouping by life-form

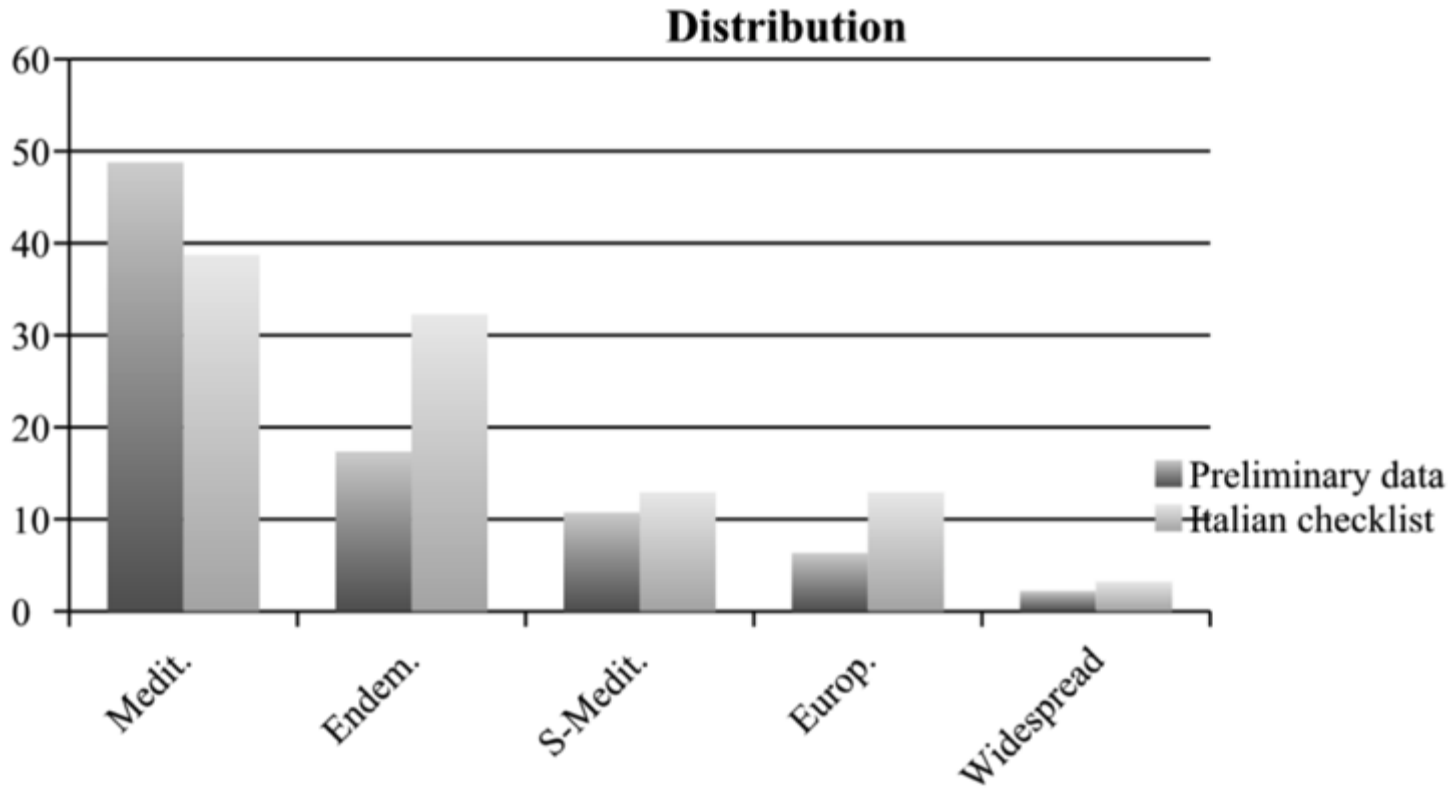


Results

Checklist of the Italian gypsophilous flora

Distribution

Percentage of taxa grouping by distribution



Results

Checklist of the Italian gypsophilous flora

Comparison between the evaluations of Sicilian and the Italian peninsula experts

Chaenorhinum rupestre
Rocca di Entella (Sicily)
ph. Musarella

Species	Family	Median	Mainland Median	Sicily Median
Chaenorhinum rupestre (Guss.) Speta	Plantaginaceae	5.00	-	5.00
Festuca gypsophila Hack.	Poaceae	5.00	-	5.00
Sedum gypsicola Boiss. & Reuter subsp. *trinacriae* Afferni	Crassulaceae	5.00	-	5.00
Petrosedum ochroleucum (Chaix)Niederle subsp. *mediterraneum* (Gallo)N	Crassulaceae	5.00	-	5.00
Allosorus persicus (Bory) Christenh.	Pteridaceae	5.00	5.00	3.00
Artemisia pedemontana Balb.	Asteraceae	4.50	5.00	4.00
Stipa austroitalica Martinovsky subsp. *frentana* Moraldo & Ric.	Poaceae	4.00	4.50	4.00
Diplotaxis harra (Forssk.)Boiss. subsp. *crassifolia* (Raf.)Maire	Brassicaceae	4.00	-	4.00
Brassica villosa Biv. subsp. *tineoi* (Lojac.) Raimondo & Mazz.	Brassicaceae	4.00	-	4.00
Erysimum metlesicsii Polatschek	Brassicaceae	4.00	-	4.00
Limonium catanzaroi Brullo	Plumbaginaceae	4.00	-	4.00
Limonium optimae Raimondo	Plumbaginaceae	4.00	-	4.00
Reaumuria vermiculata L.	Tamaricaceae	4.00	-	4.00
Gypsophila arrostii Guss. subsp. *arrostii*	Caryophyllaceae	3.00	-	3.00
Matthiola fruticulosa (L.)Maire subsp. *coronopifolia* (Sm.)Giard. & Raimon	Brassicaceae	3.00	-	3.00
Allium moschatum L.	Amaryllidaceae	3.00	3.00	-
Elymus elongatus (Host) Runemark subsp. *elongatus*	Poaceae	3.00	-	3.00
Thapsia meoides (Desf.) Guss.	Apiaceae	3.00	-	3.00
Matthiola fruticulosa (L.) Maire subsp. *fruticulosa*	Brassicaceae	3.00	2.00	3.00
Visnaga crinita (Guss.) Giardina & Raimondo	Apiaceae	3.00	-	3.00
Stipa barbata Desf. subsp. *barbata*	Poaceae	3.00	-	3.00
Linum decumbens Desf.	Linaceae	3.00	-	3.00
Phagnalon rupestre (L.) DC. subsp. *illyricum* (H.Lindb.) Ginzb.	Asteraceae	3.00	3.00	2.50
Astragalus caprinus L. subsp. *huetii* (Bunge) Podlech	Fabaceae	3.00	-	3.00
Capparis sicula Veill.	Capparaceae	3.00	1.00	3.00
Teucrium luteum (Mill.) Degen	Lamiaceae	3.00	-	3.00
Lygeum spartum L.	Poaceae	3.00	3.00	2.50
Cachrys sicula L.	Apiaceae	3.00	-	3.00
Parapholis strigosa (Dumort.) C.E.Hubb.	Poaceae	3.00	1.00	3.00
Suaeda vera J.F.Gmel.	Amaranthaceae	3.00	1.00	3.00
Parapholis incurva (L.) C.E.Hubb.	Poaceae	3.00	1.00	3.00

Results

Statistical analysis

t-student analyses by gypsophily level

taxa grouping by endemic and non-endemic species.

Number of species (N). Average (AV). Standard deviation (SD). Standard error (SE)

* p-value < 0.05

	N	AV	SD	SE	*p*-value	95% confidence interval	
						Min	Max
Endemism	46	2.4000	0.7731	0.1153	0.0030	2.1680	2.6320
Rest	293	2.1460	0.4744	0.0285		2.0900	2.2020
Total	339	2.1810	0.5321	0.0296		2.1230	2.2390

Results
Statistical analysis

ANOVA analysis by gypsophily level. (Average – AV; Standard deviation – SD)

Grouping by distribution: Endemic, Mediterranean, European and Wide distribution.

* p-value < 0.05

a) Chorotype		AV	SD	*p*-value	95% confidence interval	
					Min	Max
Endemic	Mediterranean	0.2358	0.0868	0.0350	0.0120	0.4600
	European	0.2917	0.1038	0.0270	0.0240	0.5600
	Eurasiat/Widespread	0.3412	0.1498	0.1060	-0.0460	0.7280
Mediterranean	Endemic	-0.2358	0.0868	0.0350	-0.4600	-0.0120
	European	0.0558	0.0774	0.8890	-0.1440	0.2560
	Eurasiat/Widespread	0.1054	0.1329	0.8580	-0.2380	0.4490
European	Endemic	-0.2917	0.1038	0.0270	-0.5600	-0.0240
	Mediterranean	-0.0558	0.0774	0.8890	-0.2560	0.1440
	Eurasiat/Widespread	0.0495	0.1446	0.9860	-0.3240	0.4230
Eurasiat/Widespread	Endemic	-0.3412	0.1498	0.1060	-0.7280	0.0460
	Mediterranean	-0.1054	0.1329	0.8580	-0.4490	0.2380
	European	-0.0495	0.1446	0.9860	-0.4230	0.3240

Results
Statistical analysis

ANOVA analysis by gypsophily level. (Average – AV; Standard deviation – SD)

Grouping by functional group: narrow gypsophile, wide gypsophile and gypsovag.

* p-value < 0.05

b) Functional group		AV	SD	*p*-value	95% confidence interval	
					Min	Max
Narrow gypsophile	Wide gypsophile	0.1524	0.1014	0.2910	-0.0860	0.3910
	Gypsovag	1.6692	0.0848	0.0000	1.4690	1.8690
Wide gypsophile	Narrow gypsophile	-0.1524	0.1014	0.2910	-0.3910	0.0860
	Gypsovag	1.5168	0.0596	0.0000	1.3760	1.6570
Gypsovag	Narrow gypsophile	-1.6692	0.0848	0.0000	-1.8690	-1.4690
	Wide gypsophile	-1.5168	0.0596	0.0000	-1.6570	-1.3760

Discussion

This work provides the first Checklist of Italian gypsophytes, including 31 taxa showing a great affinity for this substrate, 12 of which can be unequivocally considered as strictly gypsophytes.

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

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

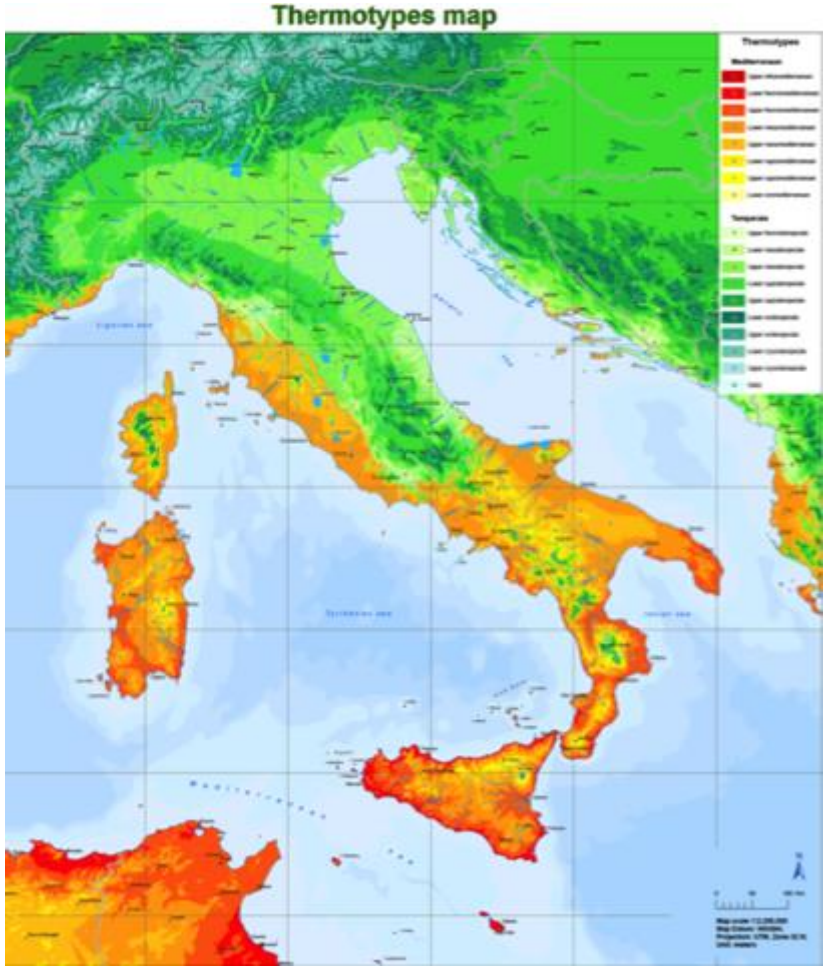
Discussion

Percentage of gypsophilous taxa grouping by taxonomic families and comparison between Italian and Spanish Checklists (Mota et al. 2011).

Family	Italian Checklist	Spanish Checklist
Amaryllidaceae	3.23	1.41
Apiaceae	9.68	1.41
Asteraceae	6.45	14.08
Brassicaceae	16.13	12.68
Campanulaceae	-	1.41
Capparaceae	3.23	-
Caryophyllaceae	3.23	8.45
Amaranthaceae	3.23	-
Cistaceae	-	4.23
Crassulaceae	6.45	1.41
Euphorbiaceae	-	1.41
Fabaceae	3.23	9.86
Frankeniaceae	-	1.41
Gentianaceae	-	1.41
Lamiaceae	3.23	11.27
Linaceae	3.23	-
Orobanchaceae	-	1.41
Plantaginaceae	3.23	5.63
Plumbaginaceae	6.45	12.68
Poaceae	22.58	4.23
Primulaceae	-	1.41
Pteridaceae	3.23	-
Resedaceae	-	4.23
Tamaricaceae	3.23	-

Discussion

Italy presents a complex scenario, with a strong North-South environmental gradient conditioning the composition and dynamics of plant communities.

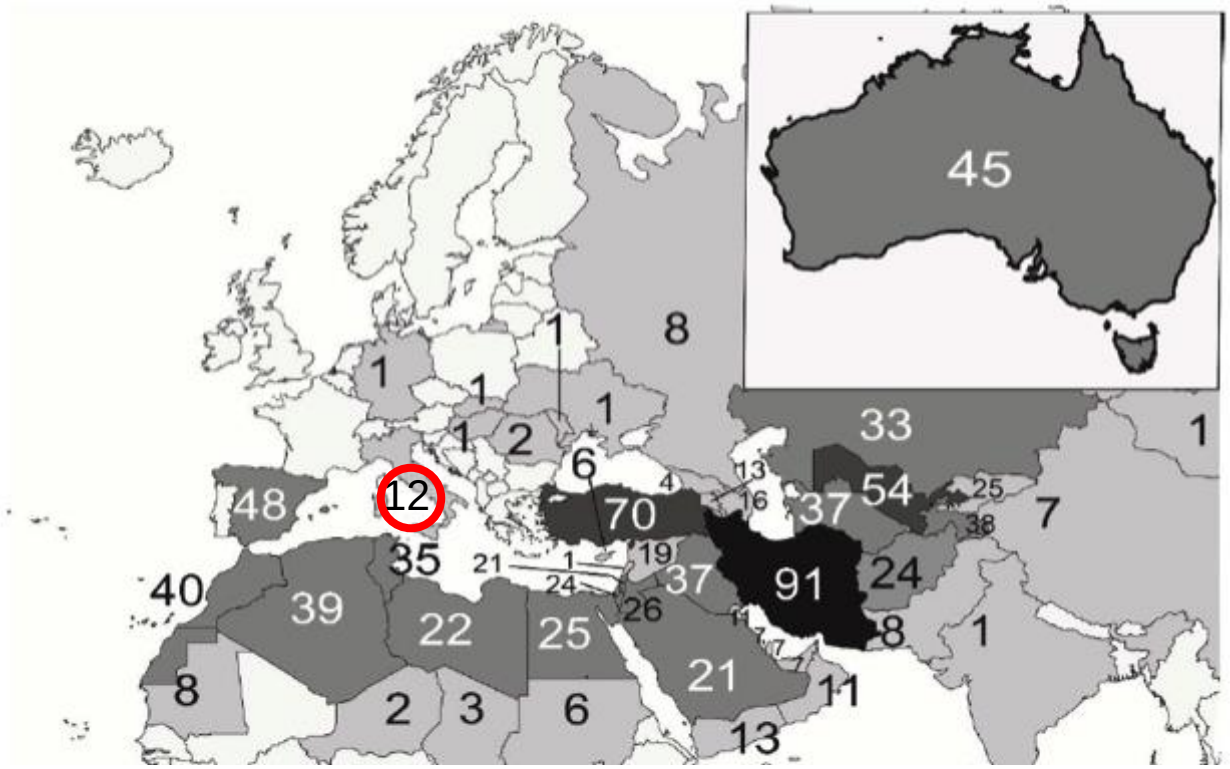


Bioclimatic maps of italy (from Pesari et al. 2014)

In the red the Mediterranean bioclimate, in green the temperate bioclimate.

Discussion

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)

Discussion

This study reinforces the idea that as long as there is no definitive criterion for establishing whether a species is a gypsophyte or not, the inductive approach based on the 'expert criterion' is plausible.

Sedum gypsicola subsp. *gypsicola*
Almeria (Spain) ph. Spampinato

Sedum gypsicola subsp. *trinacriae*
Rocca Entella (Sicily) ph. Musarella

Conclusion

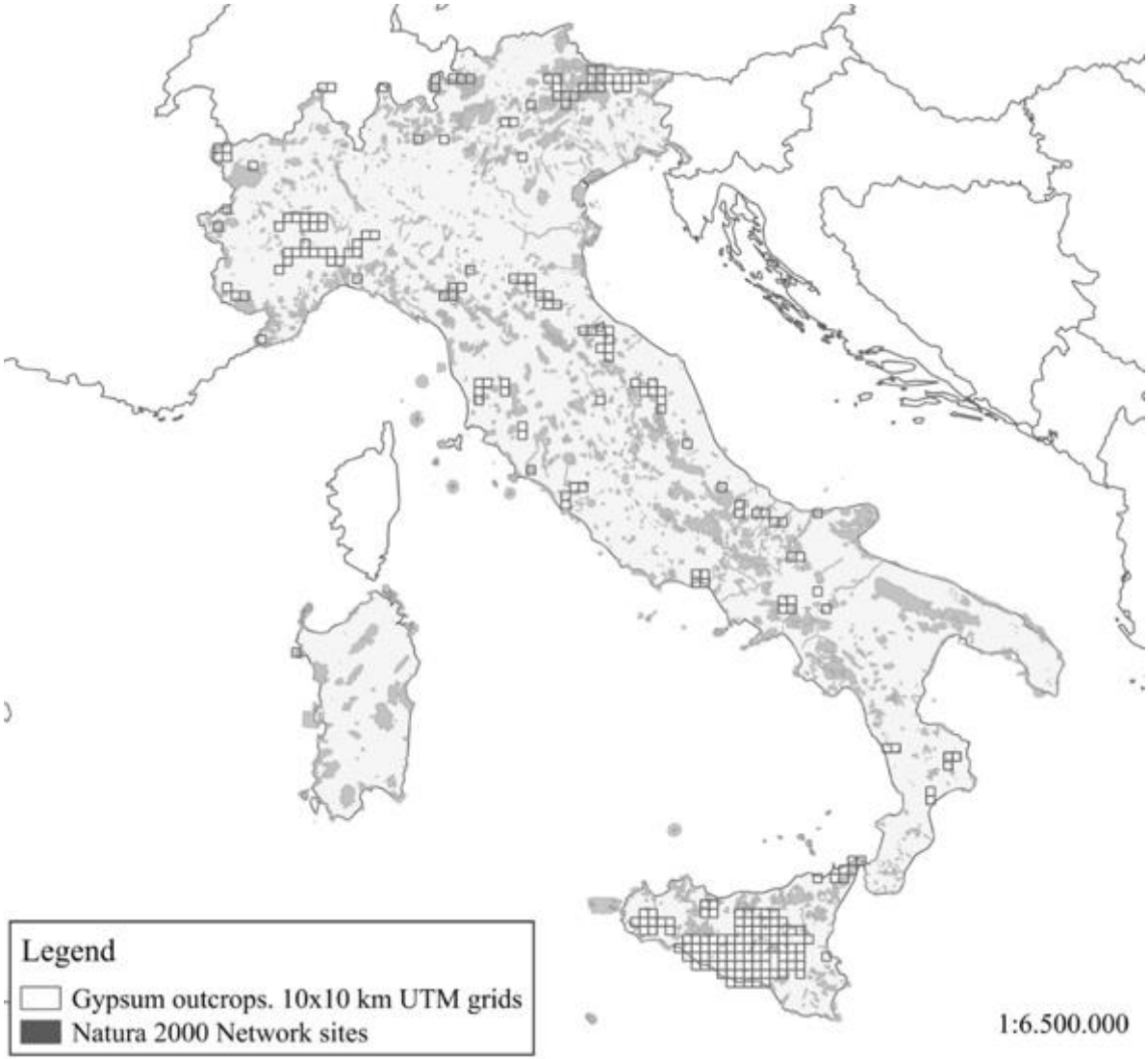
The endemic and rare flora with remarkable eco-morphological adaptations and the description of new taxa growing on gypsum outcrops fully justifies the conservation of these outcrops .

***Limonium catanzaroi* - Endemic**
Ribera (Sicily) – ph. Spampinato

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

Conclusion

Gypsum outcrops and nature 2000 Network Sites

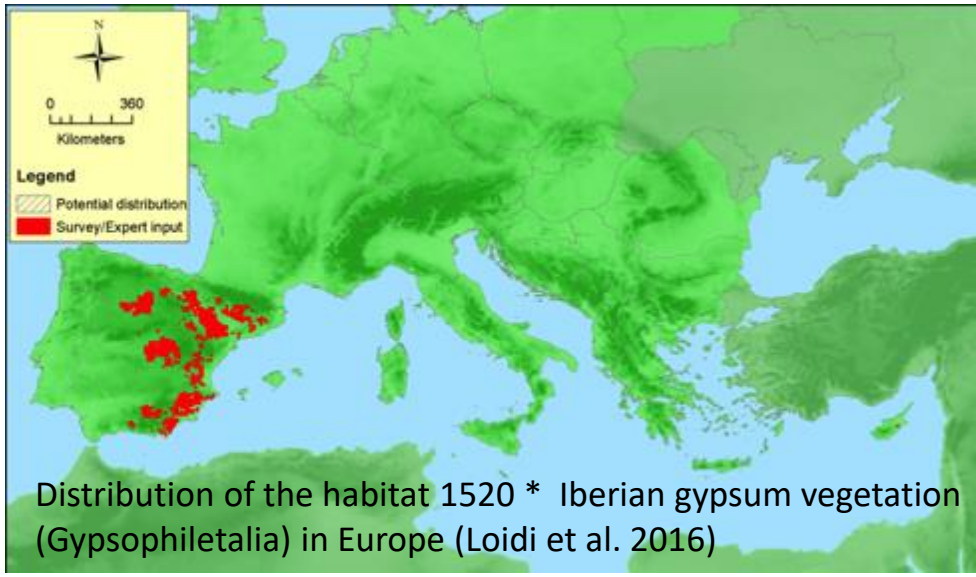


Conclusion

The scrub communities typical to Italian gypsum substrates represent one of the major gaps in conservation habitats in the European Union

Five plant Italian gypsophytes (Brassica villosa subsp. tineoi, Chaenorhinum rupestre, Festuca gypsophila, Erysimum metlesicsii and Sedum gypsicola) have been recognized as characteristic taxa of this habitat on the European Red List of Habitats by Loidi et al. (2016).

Gypsum vegetazion near Torre Manfria (Gela – CL) ph. Sciandrello



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

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