Centro Conservazione Biodiversità (CCB)
Dipartimento di Scienze della Vita e dell'Ambiente
Università degli Studi di Cagliari

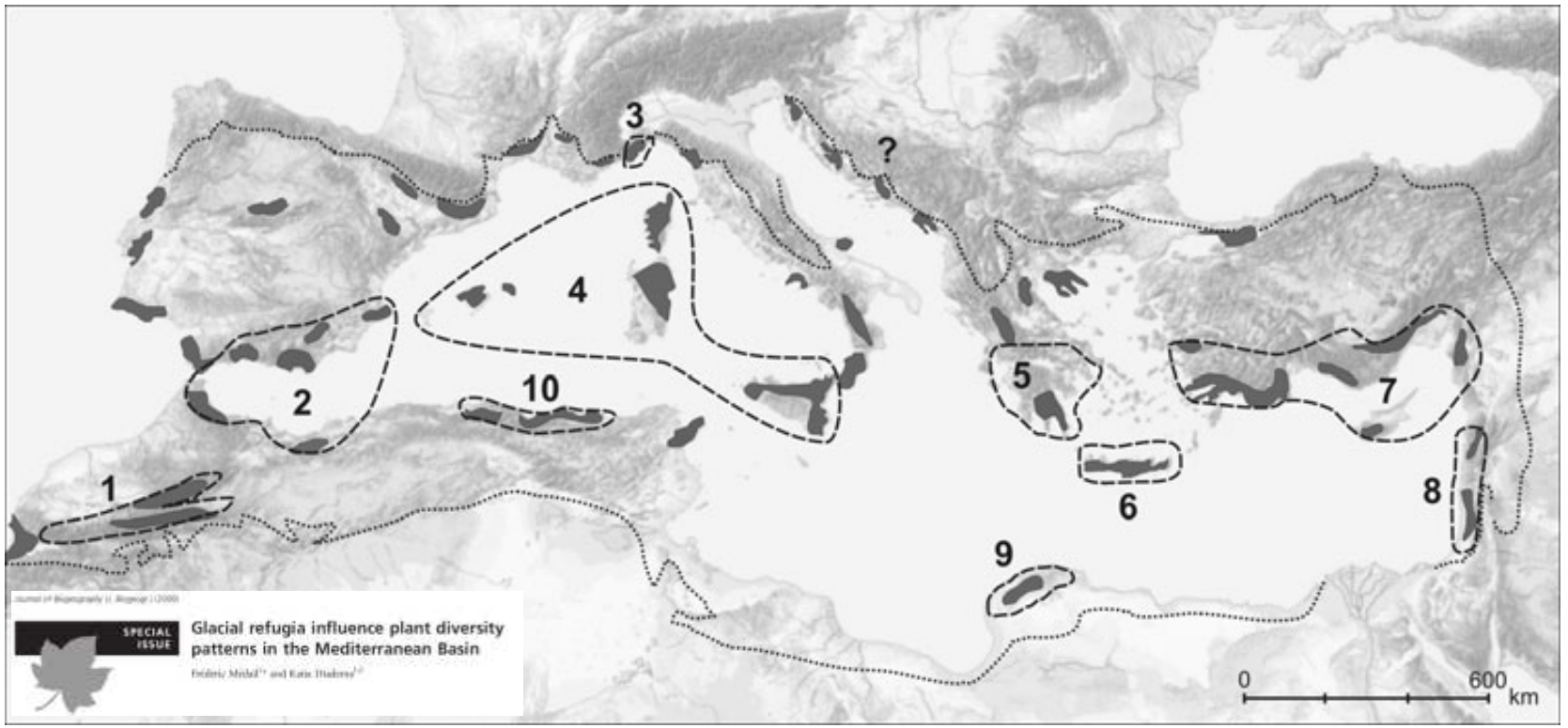
Une approche intégrée pour la conservation in-situ et ex-situ de la flore vasculaire

G. Bacchetta

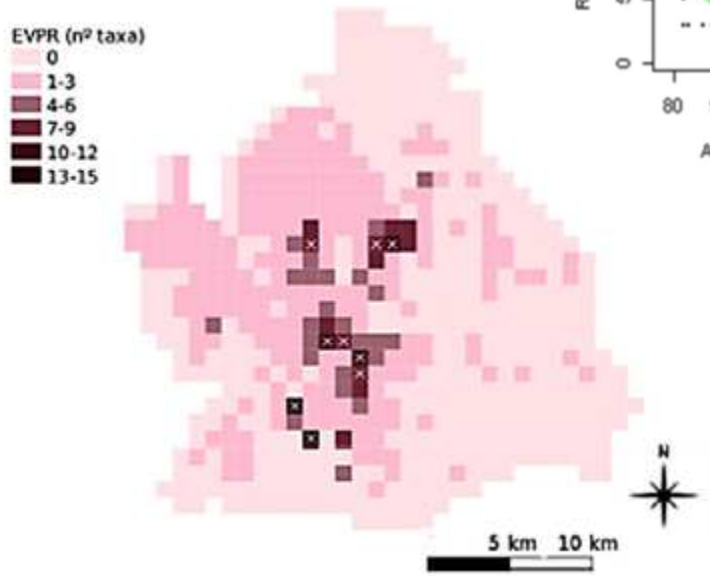
Tunis, 13.11.2015

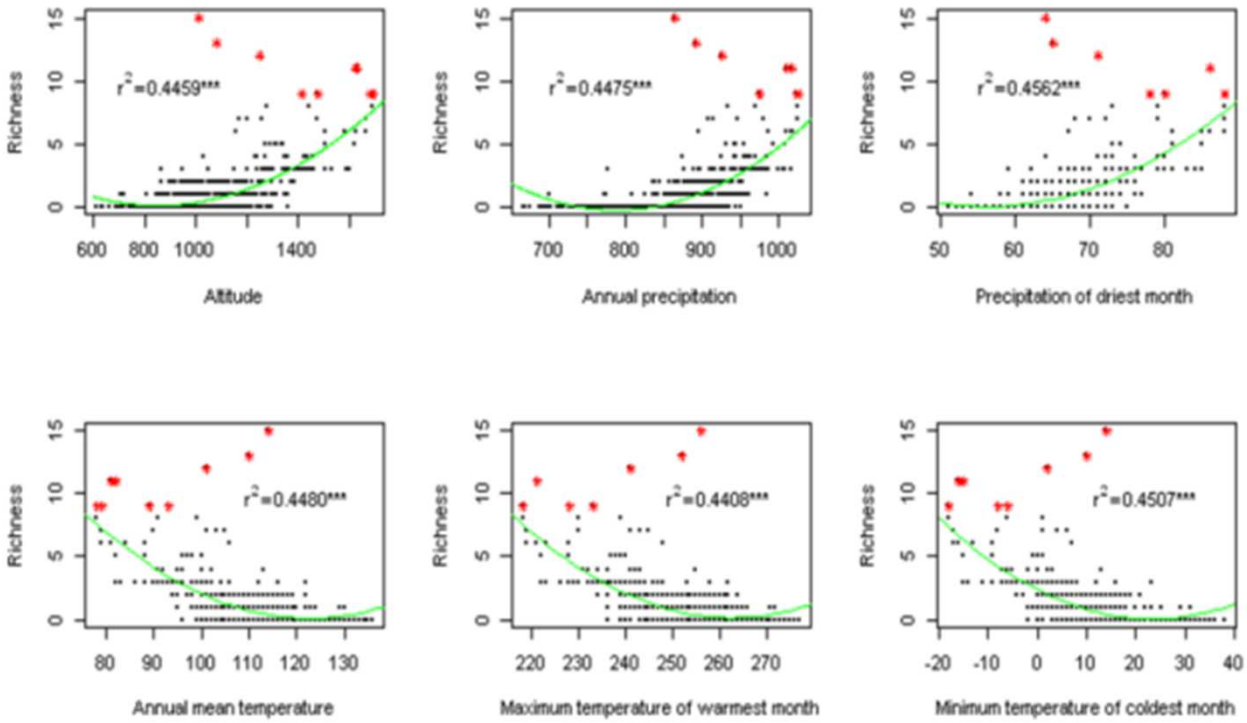
La biodiversità vegetale in Sardegna



Micro- nano-hotspots della Sardegna





Contents lists available at ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon

spots within hotspots: Endemic plant richness, environmental
ers, and implications for conservation

M. Cañadas [a,b,*], Giuseppe Fenu [a], Julio Peñas [b], Juan Lorite [b], Efisio Mattana [a,c], Gianluigi Bacchetta [a]

Flora vascolare esclusiva della Sardegna

La flora endemica della Sardegna consiste di 184 taxa, di cui 144 sono specie, 31 sottospecie, 4 varietà e 3 ibridi, appartenenti a 39 famiglie e 75 generi.

Tra le Angiosperme prevalgono le dicotiledoni (89,82% dell'intera flora endemica esclusiva), mentre le monocotiledoni rappresentano il 10,18%. Non sono presenti Pteridofite e Gimnosperme endemiche esclusive della Sardegna.

Le famiglie più rappresentate sono le Plumbaginaceae, seguite dalle Asteraceae e dalle Fabaceae; è significativo inoltre il numero di Caryophyllaceae, Boraginaceae e Orchidaceae.

I generi più ricchi sono *Limonium*, *Genista*, *Dianthus*, *Anchusa, Ophrys*, *Silene*, *Astragalus* e *Centaurea* .
L'analisi delle forme biologiche ha evidenziato una netta prevalenza delle camefite (45,51%) e delle emicriptofite (22,16%), seguite dalle (nano-)fanerofite (13,17%), dalle geofite (12,57%) e dalle terofite (6,59%).


Borago morisiana


Campanula forsythii

Bacchetta et al., 2012, Annales Jardin Botanico de Madrid, 69(1): 81-89 - updated

Flora vascolare esclusiva della Sardegna

Nove specie endemiche esclusive sono incluse nell'Allegato II della Direttiva Habitat (Commissione Europea, 1992) e 8 di queste sono considerate prioritarie:

- *Astragalus maritimus* e *A. verrucosus*
- *Centaurea horrida*
- *Lamyropsis microcephala*
- *Limonium pseudolaetum* e *L. insulare*
- *Linum muelleri*
- *Ribes sardoum*


Centaurea horrida


Astragalus maritimus


Astragalus verrucosus

Bacchetta et al., 2012, Annales Jardin Botanico de Madrid, 69(1): 81-89

Stato di conservazione della flora esclusiva della Sardegna

Per quanto riguarda lo status di conservazione degli endemismi esclusivi della Sardegna, 60 taxa sono inclusi nella Lista rossa regionale (Conti et al., 1997), 9 di questi sono considerati *critically endangered* (CR), 10 *endangered* (EN), 13 *vulnerable* (VU) e 28 *lower risk* (LR). Inoltre, 33 taxa sono inclusi nella Lista rossa nazionale (Conti et al., 1992).

Aquilegia barbaricina

Ribes sardoum

Centranthus amazonum

Odontarrhena tavolarae

Bacchetta et al., 2012, Annales Jardin Botanico de Madrid, 69(1): 81-89

Azioni di conservazione: criterio della Responsabilità Regionale

Conservazione delle piante endemiche esclusive della Sardegna a maggior rischio di estinzione

Conservazione delle specie forestali della Sardegna

Plant Biosystems, Vol. 146, No. 3, September 2012, pp. 649–653

Taylor & Francis
Taylor & Francis Group

Regional responsibility for plant conservation: The 2010 GSPC Target 8 in Sardinia

E. MATTANA, G. FENU, & G. BACCHETTA

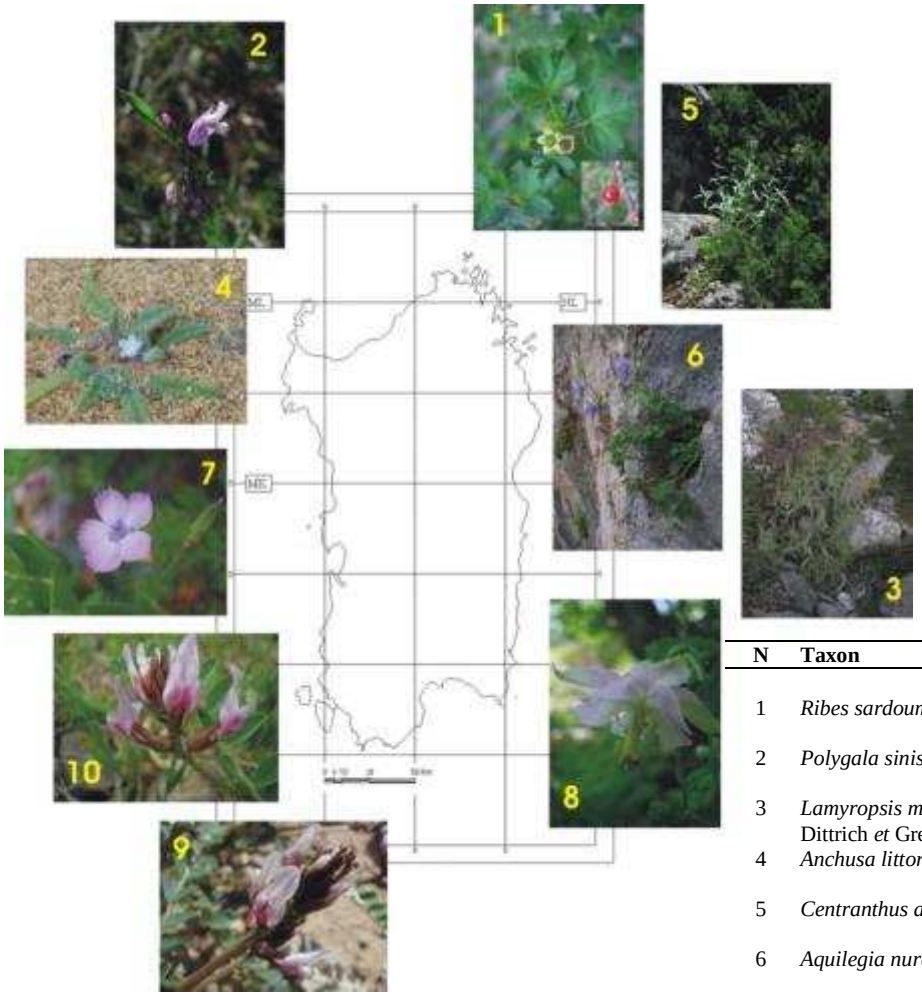
REGIONE AUTONOMA DELLA SARDEGNA

Criteri per identificare le priorità di conservazione

	Parameter	Description	Values
Rarity (*)	Endemicity	Based on biogeographic patterns (Rivas-Martinez, 2007).	1: endemic *taxa* spread in all the Island (Sardinian subprovince); 2: endemic *taxa* limited to a biogeographic sector or subsector; 3: narrow endemics.
	N° of populations	Number of known populations.	1: n > 20; 2: 11 < n < 20; 3: 6 < n < 10; 4: 2 < n < 5; 5: n = 1.
	Area of occupancy (AOO)	Area of occupancy *sensu* IUCN (2001). However the ranking was modified because following IUCN criteria (VU D2 = AOO < 20 km^2) also species widespread in the Island should be considered as VU.	1: AOO > 100 km^2; 2: 10 < AOO < 100 km^2; 3: 1 < AOO < 10 km^2; 0.1 < AOO < 1 km^2; 5: 0.0 < AOO < 0.1 km^2.
	Population dimensions	Number of total reproductive individuals	1: n > 50.000; 2: 5001 < n < 50.000; 3: 501 < n < 5000; 4: 51 < n < 500; 5: n < 51.
	Ecological range	Number of habitats where a *taxon* has been found (Block and Brennan, 1993; Andreas and Lichvar, 1995).	1: n > 4; 2: n = 4; 3: n = 3; 4: n = 2; 5: n = 1.
Threats level (*)	Natural threats	Level of direct and indirect natural threats that hang over the populations of a *taxon*.	1: very low (no quantifiable disturbances); 2: low (no habitat alterations, significant reproductive individuals number decrease and population area size reduction); 3: moderate (VU E); 4: high (EN E); 5: extreme (CR E).
	Anthropic threats	Level of direct and indirect anthropic threats that hang over the populations of a *taxon*.	1: very low (no quantifiable disturbances; 2: low (no habitat alterations, significative reproductive individuals number decrease and population area size reduction); 3: moderate (VU E); 4: high (EN E); 5: extreme (CR E).
	Decline	Following IUCN guidelines (IUCN, 2006) the population decline was measured as individuals reduction (measured, estimate or inferred) in the last 10 years or 3 generations.	1: x < 10%; 2: 10 < x < 30%; 3: 30 < x < 50% (VU A2); 4: 50 < x < 80% (EN A1+2); x ? 80% (CR A2).
Protection status	Dir. 92/43/CEE	*Taxa* inserted in the Annexe II of the European directive "Habitat"	1: NP (non priority); 2: P (priority)
	IUCN Red list	*Taxa* inserted in the Global, national and regional IUCN Red Lists.	0: NE; 1: DD; 2: LC; 2.5: LR (IUCN, 1994); 3: NT; 4: VU; 5: EN; 6: CR; 7: EW; 8: EX.
	Mediterranean Top50 IUCN	*Taxa* inserted in the IUCN Mediterranean islands Top50. (Montmollin de and Strahm, 2005)	0: *taxon* not inserted; 1: *taxon* inserted.

Bacchetta et al., 2012, Annales Jardin Botanico de Madrid, 69(1): 81-89

Conservazione delle piante endemiche a maggior rischio di estinzione della Sardegna

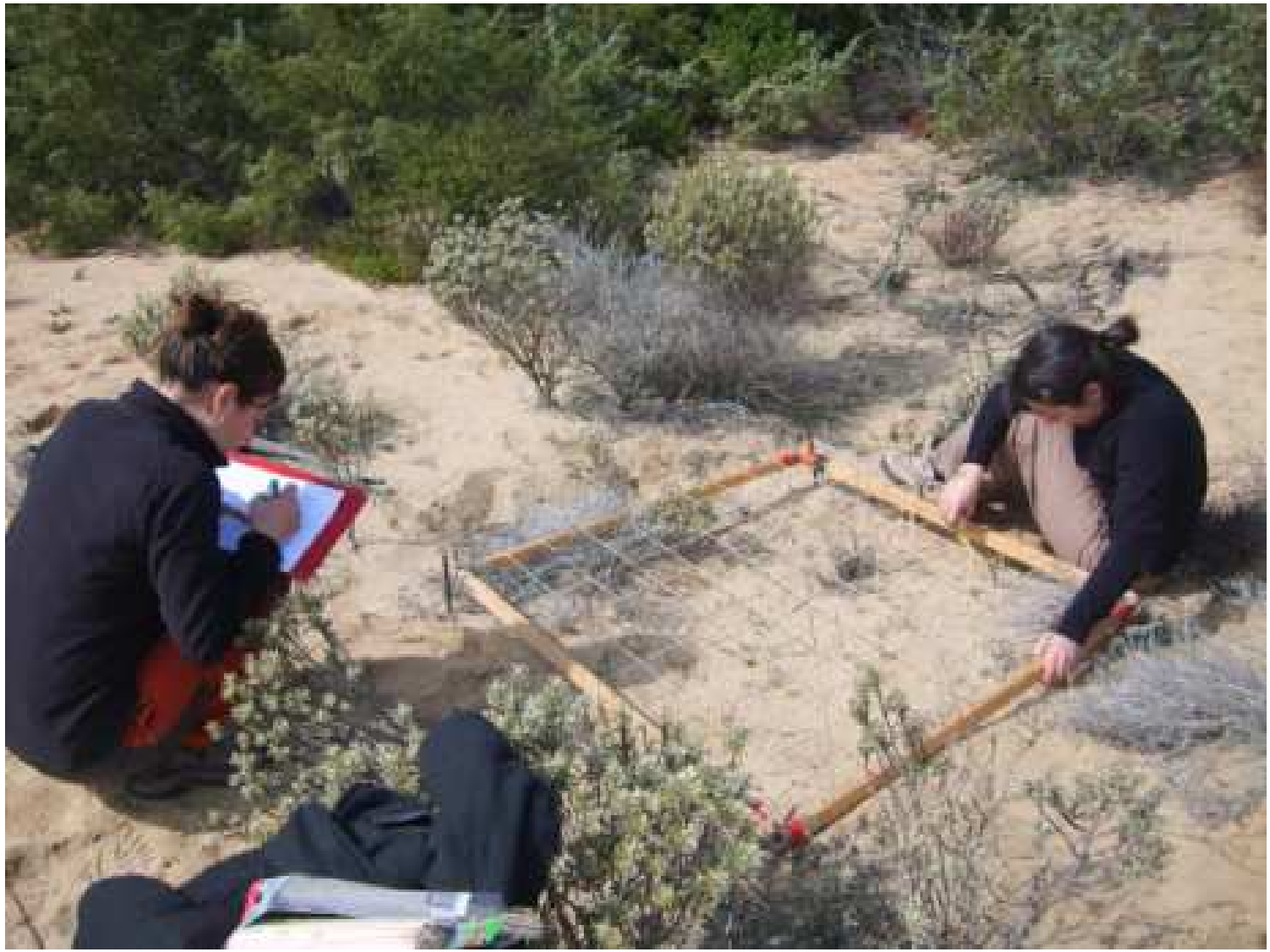


REGIONE AUTONOMA DELLA SARDEGNA

N	Taxon	Family	IUCN Category	Dir 92/43/CEE
1	*Ribes sardoum* Martelli	Grossulariaceae	CR B1ab(v)+2ab(v) (IUCN, 2008)	P
2	*Polygala sinisica* Arrigoni	Polygalaceae	CR B1ab(ii)+2ab(ii) (IUCN, 2008)	
3	*Lamyropsis microcephala* (Moris) Dittrich *et* Greuter	Asteraceae	CR B1ab(iii)+2ab(iii) (IUCN, 2008)	P
4	*Anchusa littorea* Moris	Boraginaceae	CR B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v) (Fenu and Bacchetta, 2008)	
5	*Centranthus amazonum* Fridl. *et* A. Raynal	Valerianaceae	CR B1ab(iii,iv)+2ab(iii,iv); D (IUCN, 2008)	NP
6	*Aquilegia nuragica* Arrigoni *et* Nardi	Ranunculaceae	CR B1ab(v)+2ab(v); D (IUCN, 2008)	
7	*Dianthus morisianus* Vals.	Caryophyllaceae	CR B1ab(i,ii,iii) + 2b(i,ii,iii) (Bacchetta and Pontecorvo, 2005)	
8	*Aquilegia barbaricina* Arrigoni *et* Nardi	Ranunculaceae	CR B1ab(ii,iv)+2ab(ii,iv); D (IUCN, 2008)	
9	*Astragalus maritimus* Moris	Fabaceae	CR (Scoppola and Spampinato, 2005)	P
10	*Astragalus verrucosus* Moris	Fabaceae	CR B1ab(i,ii,iii) (Bacchetta and Pontecorvo, 2005)	P

Bacchetta et al., 2012, Annales Jardin Botanico de Madrid, 69(1): 81-89

Monitoraggi in situ



Distribuzione e stato di conservazione del genere Anchusa

Taxa	n.s.	n. p.	n. ind.	Area	Trend	Main factors of disturb and threat
A. capellii	2	1	1.000	34.800	stable	grazing, natural events
A crispa ssp. crispa	9	3	2.100	60.000	declining	habitat loss by human activity, alien species
A. crispa ssp. maritima	5	5	6.000	90.000	declining	habitat loss by human activity, alien species
A. formosa	1	2	2.150	20.740	stable	natural events
A. littorea	6	1	350	2.800	declining	habitat loss by human activities, alien species
A. montelinasana	—	1	200	43.950	?	grazing, natural events
A. sardoa	1	1	1.500	30.000	declining	habitat loss by human activities, tourism

Table 2 Total number of sites recorded previously (n.s.), number of populations currently confirmed (n.p.), estimated number of fertile individuals (n.ind.), approximated area of occupancy of the populations (m^2), demographic trend, and main factors of threat of the Sardinian endemics.

Taxa	Habitat 92/43	National IUCN	Proposed IUCN category	ex situ
A. capellii	absent	CR	VU B2a; D1+2	CCB, FI, JBV
A crispa ssp. crispa	present	EN	CR B1ab(iv)c(iv)+2ab(iv)c(iv)	FI, CCB
A. crispa ssp. maritima	present	EN	VU B1ab(iii)+2ab(iii); D2	FI, CCB
A. formosa	absent	—	VU B2ac(iv); D2	CCB, FI, JBV
A. littorea	absent	CR	CR B1ab(i–v)+2ab(i–v)	CCB
A. montelinasana	absent	—	EN D	CCB, FI
A. sardoa	absent	—	CR B2ab(iii)	CCB, FI

Table 3 Presence/absence in the EU Directive Habitat 92/43, current IUCN category at the national level, category here proposed and location of *ex situ* collections of seeds or living plants of the Sardinian *Anchusa* endemics (CCB: Biodiversity Conservation Centre, Cagliari, Italy; FI: University Botanical Garden, Firenze, Italy; JBV: Jardí Botànic València, Spain).

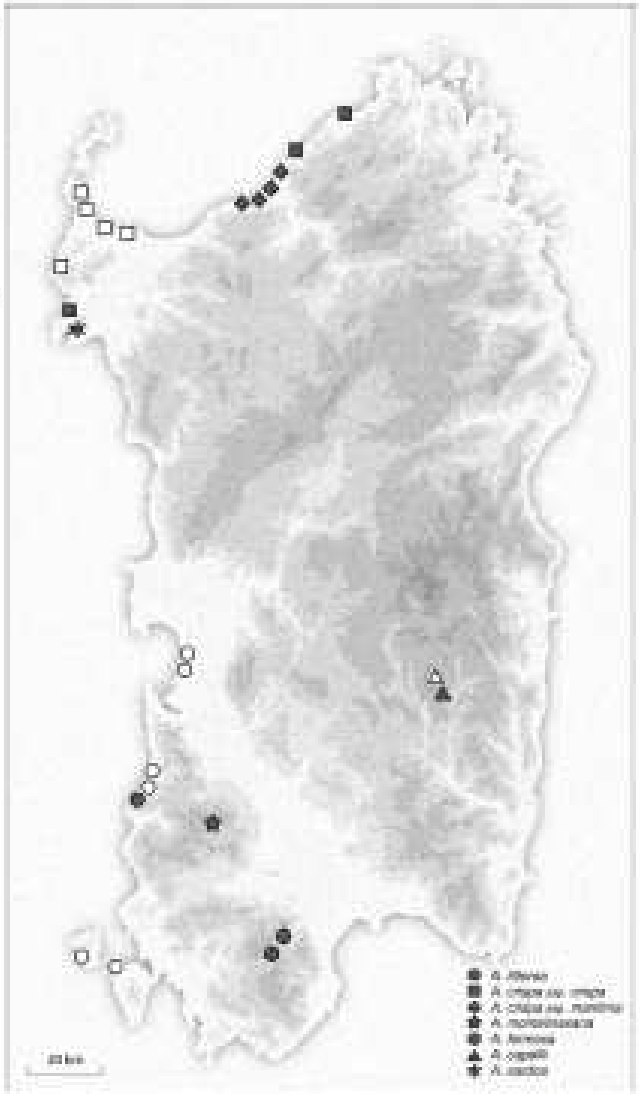


Figure 1 Distribution of the endemic *Anchusa* in Sardinia. Solid symbols refer to confirmed sites; empty symbols refer to historical (not confirmed) sites.

Bacchetta et al. (2008) Systematics and Biodiversity, 6(2): 161-174

Studi popolazionali: Anchusa littorea

ECOSCIENCE 20 (2): 131–136 (2013)

Effects of timing of emergence and microhabitat conditions on the seedling performance of a coastal Mediterranean plant[1]

Donatella COGONI, Giuseppe FENU[2] & Gianluigi BACCHETTA, Centro Conservazione Biodiversità (CCB), Dipartimento di Scienze della Vita e dell'Ambiente, Università degli Studi di Cagliari, Viale Sant'Ignazio da Laconi, 13, I-09123, Cagliari, Italia, e-mail: gfenu@unica.it

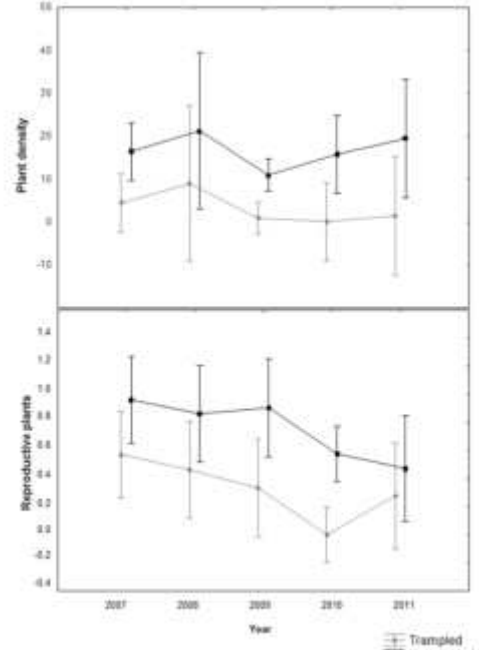
Contents lists available at SciVerse ScienceDirect

Flora

journal homepage: www.elsevier.com/locate/flora

The impact of human trampling on a threatened coastal Mediterranean plant: The case of *Anchusa littorea* Moris (Boraginaceae)

Giuseppe Fenu[a], Donatella Cogoni[a,*], Tiziana Ulian[b], Gianluigi Bacchetta[a]



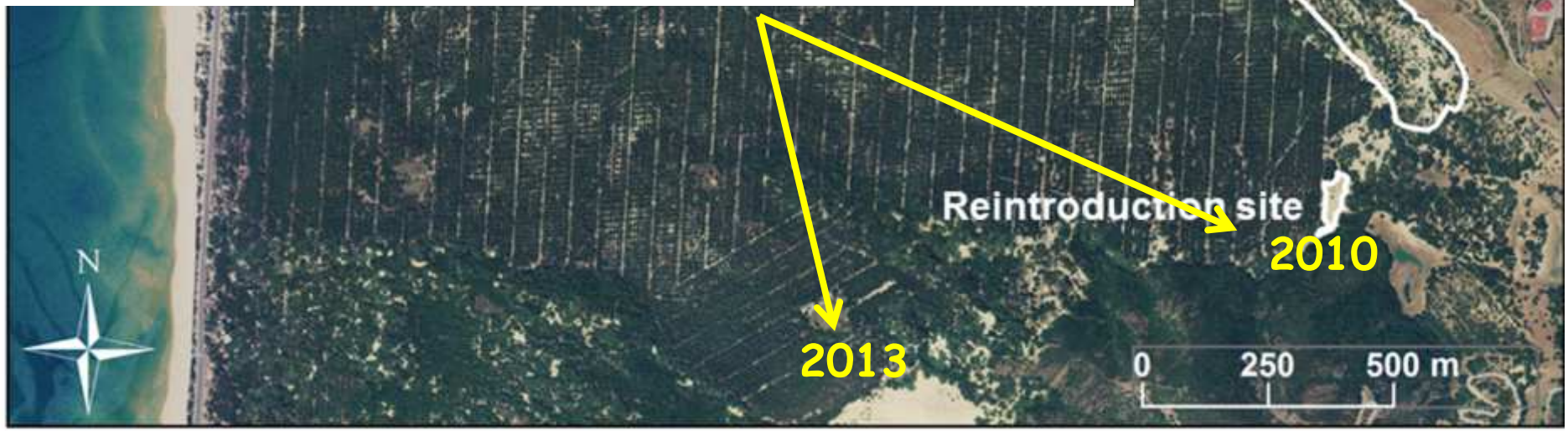
In collaborazione con

© 2013 Fauna & Flora International, *Oryx*, 47(2), 203–206 doi:10.1017/S003060531200169X

CAMBRIDGE JOURNALS

The effectiveness of plant conservation measures: the *Dianthus morisianus* reintroduction

DONATELLA COGONI, GIUSEPPE FENU, ERICA CONCAS and GIANLUIGI BACCHETTA






Group	No. plant reintroduced	First year						Second year					
		No. dead plant	Mortality rate	Flowered plant (%)	Fruited plant (%)	Mean fruits per plant	NS	No. dead plant	Mortality rate	Flowered plant (%)	Fruited plant (%)	Mean fruits per plant	ES
1	12	1	0.083	33.33	25.00	2.33±2.31	3	0	0	63.64	63.64	7.43±3.26	0
2	10	0	0	40.00	40.00	4.00±2.45	7	0	0	40.00	40.00	4.75±4.35	8
3	9	0	0	66.66	66.66	4.50±1.52	9	0	0	88.88	88.88	15.25±13.17	12
4	15	0	0	46.66	46.66	3.14±1.95	25	0	0	86.66	73.33	10.18±6.15	22
5	15	0	0	40.00	33.33	3.60±2.07	1	0	0	80.00	66.66	7.60±6.33	0
6	6	0	0	33.33	33.33	1.50±0.71	0	0	0	83.33	66.66	4.00±3.46	3
7	20	2	0.100	25.00	25.00	3.20±2.77	0	0	0	55.55	50.00	4.44±3.09	1
8	16	0	0	56.25	56.25	5.78±3.27	47	0	0	56.25	62.50	7.80±6.09	41
9	10	1	0.100	40.00	30.00	2.67±1.15	0	0	0	70.00	33.33	3.67±2.52	0
Total	113	4	0.035	41.59	38.94	3.84±2.48	92	0	0	68.80	60.55	7.97±7.11	87




CAMBRIDGE JOURNALS

© 2011 Fauna & Flora International, *Oryx*, 45(2), 180–186 doi:10.1017/S0030605310001122

Distribution, status and conservation of a Critically Endangered, extremely narrow endemic: *Lamyropsis microcephala* (Asteraceae) in Sardinia

GIUSEPPE FENU, EFISIO MATTANA and GIANLUIGI BACCHETTA

TABLE 1 The four sites where *Lamyropsis microcephala* has been located, with altitude range, mean slope (and range in parentheses), aspect and identified threats (IUCN, 2010b). Other threats (with * in the table) are coded in an earlier threats classification scheme (IUCN, 2007).

Locality	Altitude (m)	Slope (°)	Aspect (°)	Threats
Rio Aratu	1450–1820	20 (5–35)	West (280)	1.3 tourism & recreation areas; 2.3.1 nomadic grazing; 6.1 recreational activities; 2.4 pathogens/parasites*
Pisargiu	1580–1590	35	North (5)	1.3 tourism & recreation areas; 2.3.1 nomadic grazing; 2.4 pathogens/parasites*; 9.9 restricted range*; 9.4 inbreeding*
Bruncu Spina†	1625–1637	45	North (355)	1.3 tourism & recreation areas; 2.3.1 nomadic grazing; 2.4 pathogens/parasites*; 9.9 restricted range*; 9.4 inbreeding*
Bau 'e Laccos†	1450–1590	15 (10–30)	North (10)	1.3 tourism & recreation areas; 2.3.1 nomadic grazing; 2.4 pathogens/parasites*

†Localities newly discovered in this study

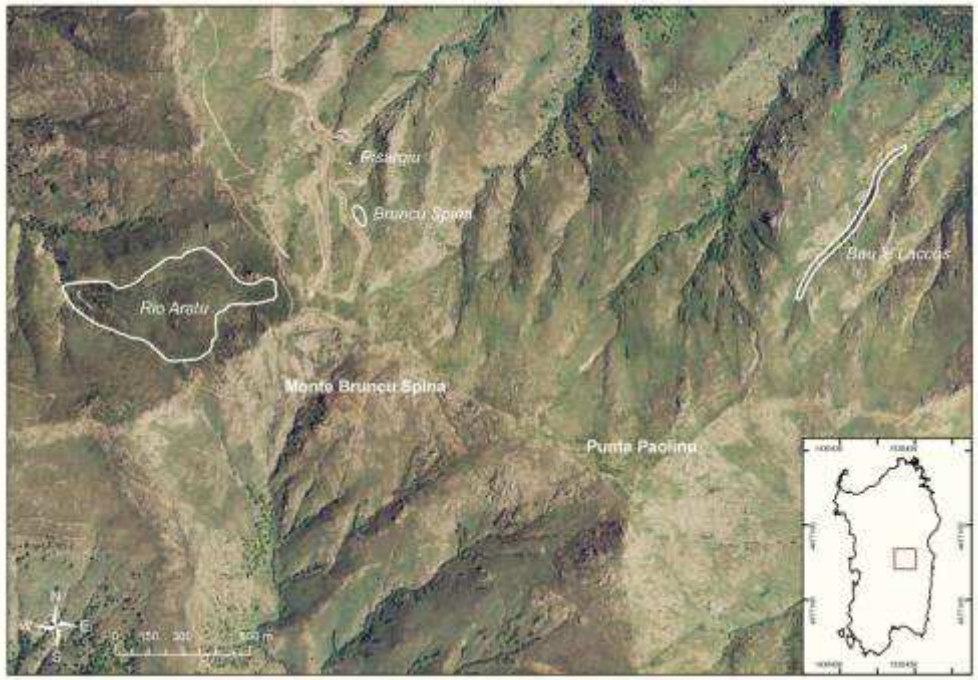
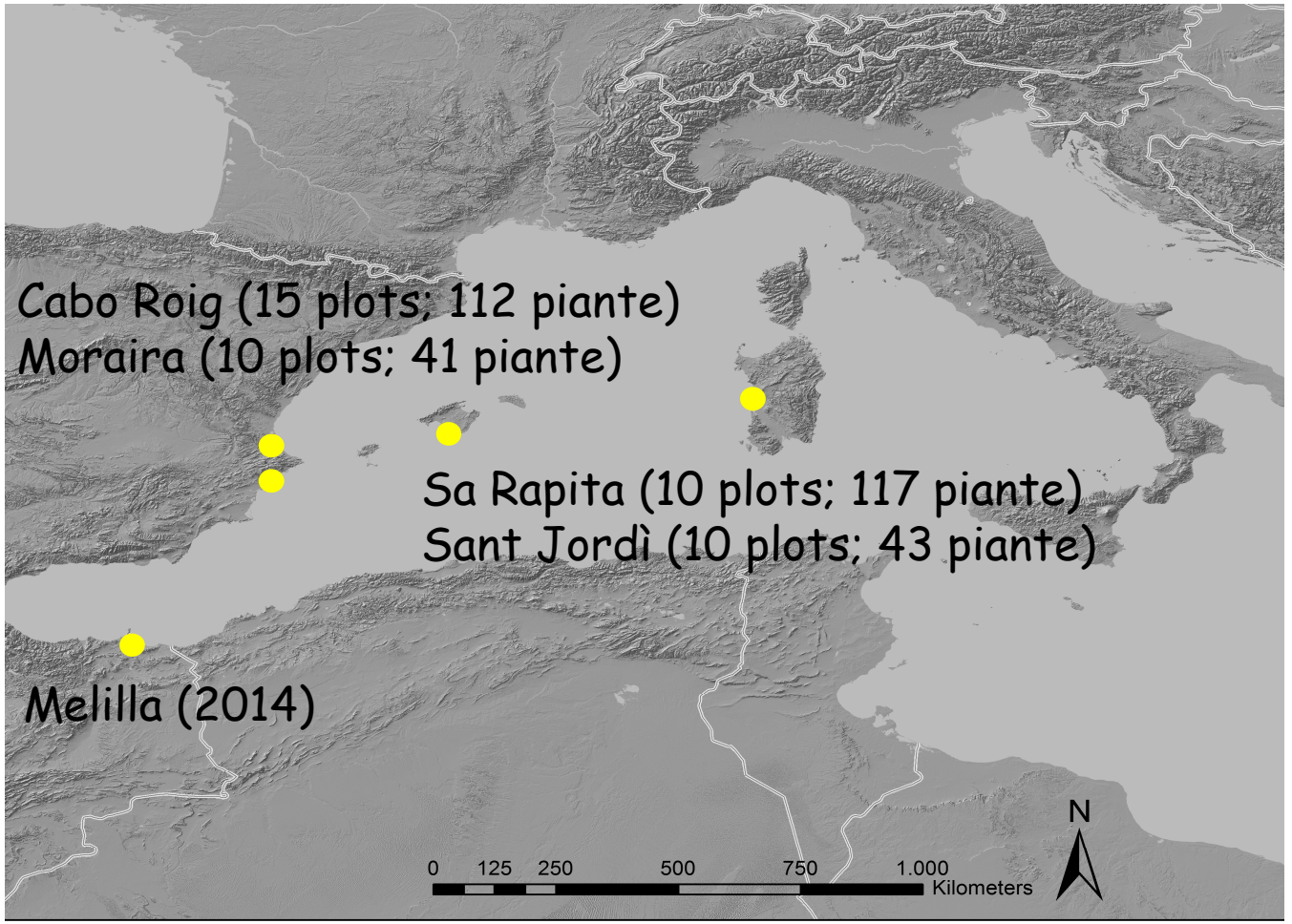


TABLE 2 For each of the four localities of *L. microcephala* in 2009 the area, number of 2 x 1 m monitoring plots, mean density of ramets, estimated population size, percentage of ramets reproductive, and mean number of capitula per reproductive ramet.

Locality	Area (m^2)	No. of plots	Mean density ± SD (ramets m^{-2})[1]	Estimated total no. of ramets	% of ramets reproductive	Mean no. of capitula per reproductive ramet ± SD[2](n)
Rio Aratu	240,000	55	8.29 ± 14.3	1,990,000	58.8	2.59 ± 1.7[a] (144)
Pisargiu	200	3	10.33 ± 10.5	2,066	52.3	1.98 ± 1.5[b] (100)
Bruncu Spina	600	3	8.66 ± 2.1	5,196	59.2	2.46 ± 1.8[a] (100)
Bau 'e Laccos	12,500	20	9.35 ± 18.5	116,875	56.7	2.69 ± 1.8[a] (188)

Helianthemum caput-felis Boiss.

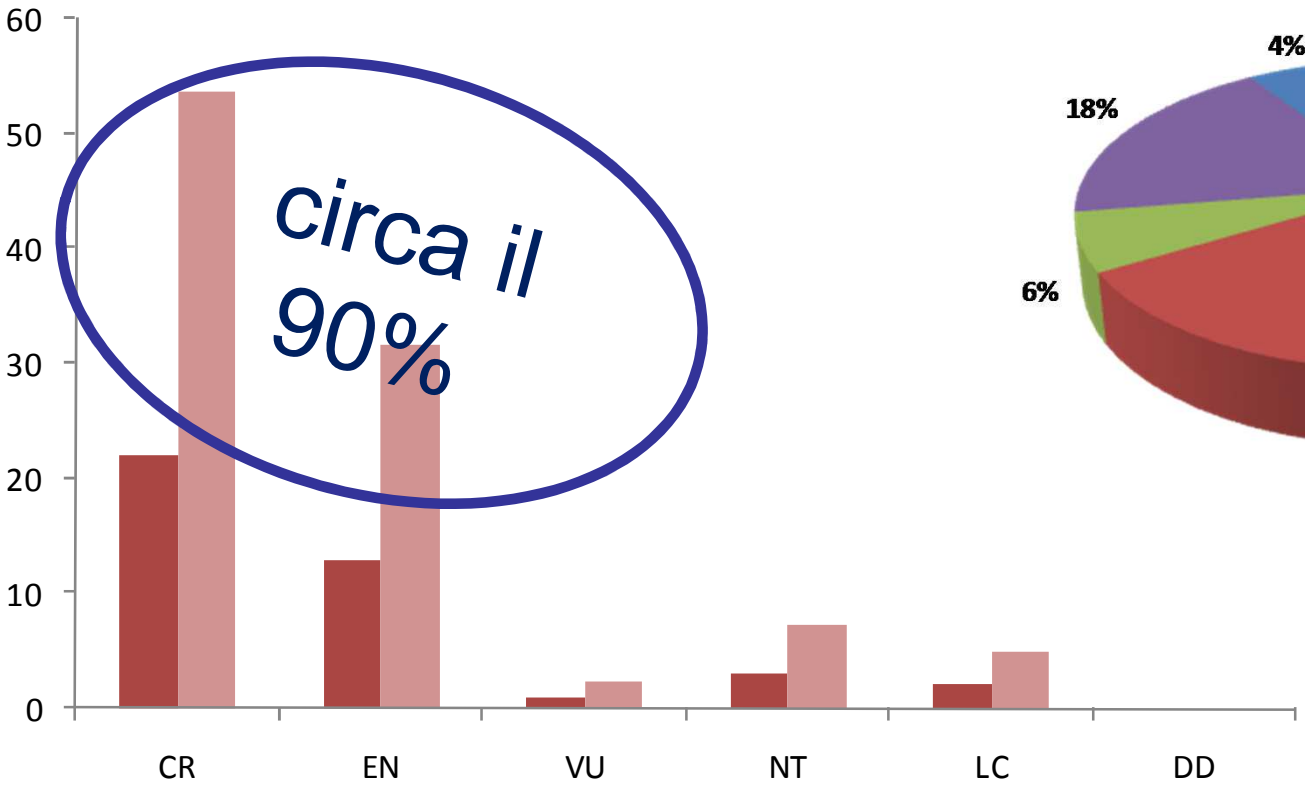
- ✓*40 plots random (20 a CM e 20 a ST).*
- ✓*Monitoraggio bisettimanale dei plots.*
- ✓*Monitoraggio bisettimanale delle piante marcate (378).*

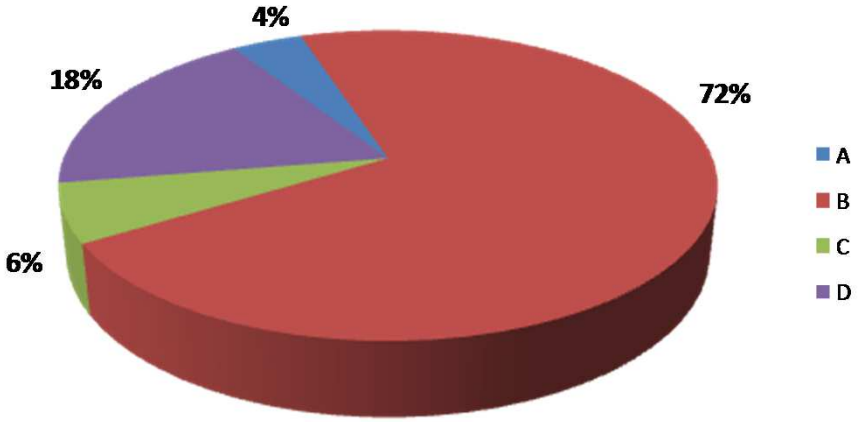

Cabo Roig (15 plots; 112 piante)
Moraira (10 plots; 41 piante)
Sa Rapita (10 plots; 117 piante)
Sant Jordì (10 plots; 43 piante)
Melilla (2014)
N
0 125 250 500 750 1.000
Kilometers

Attività pratiche di conservazione in situ

Attività pratiche di conservazione in situ

Assessment IUCN della flora sarda

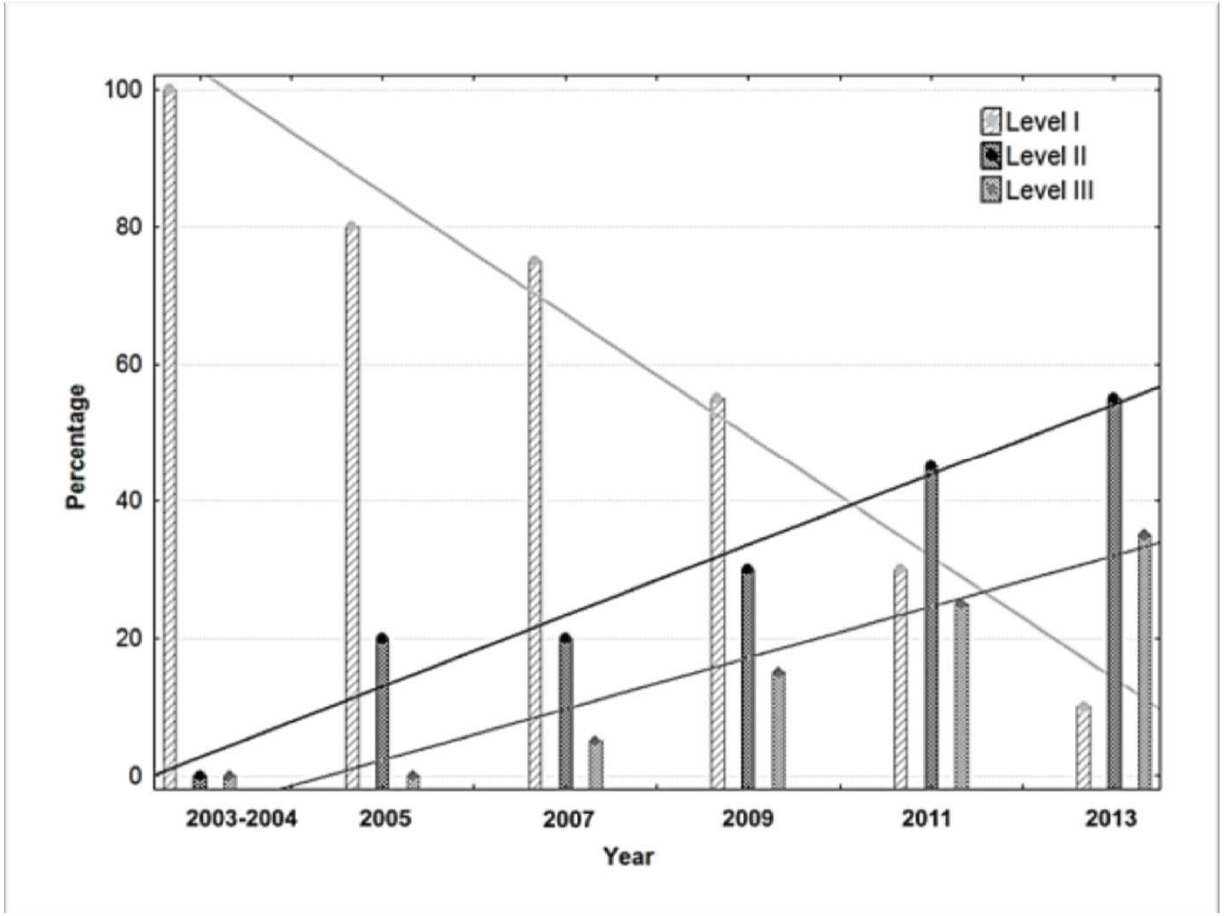




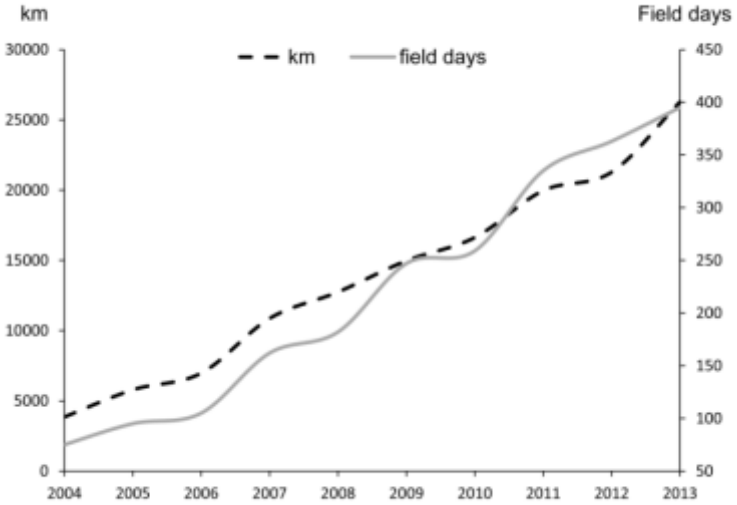
Finora è stato valutato:

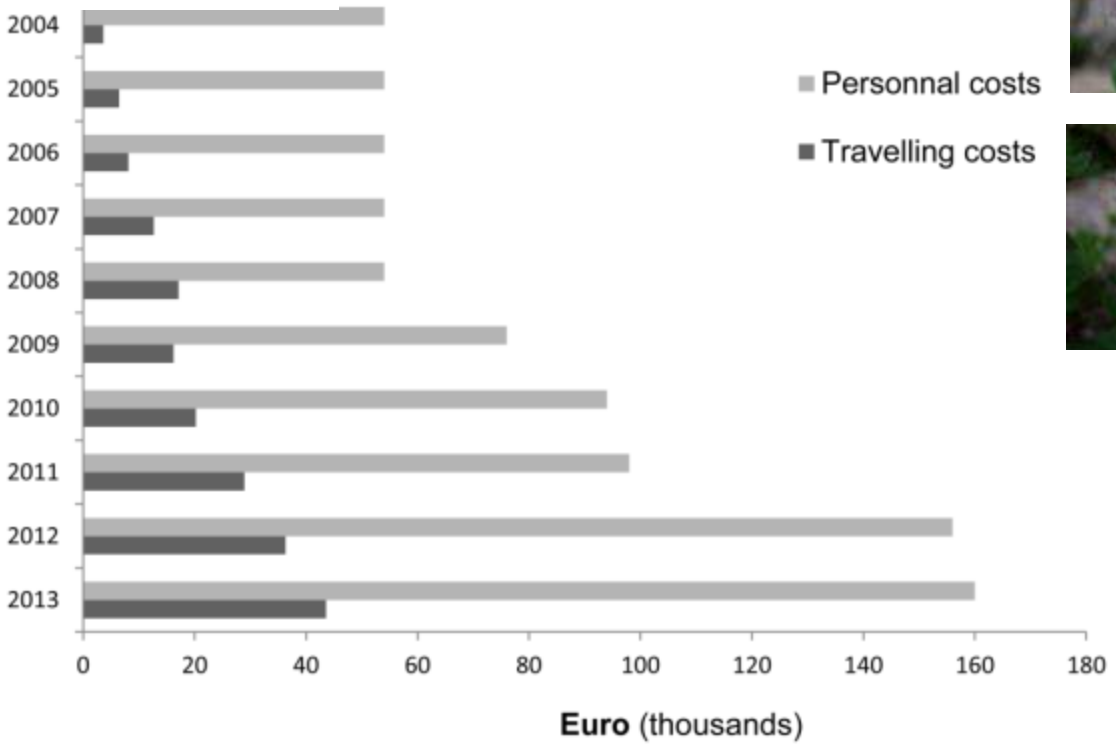
- **2,88%** delle flora sarda
- **21,6%** delle endemiche esclusive
- **100%** delle Policy Species

Complessità crescente dei monitoraggi

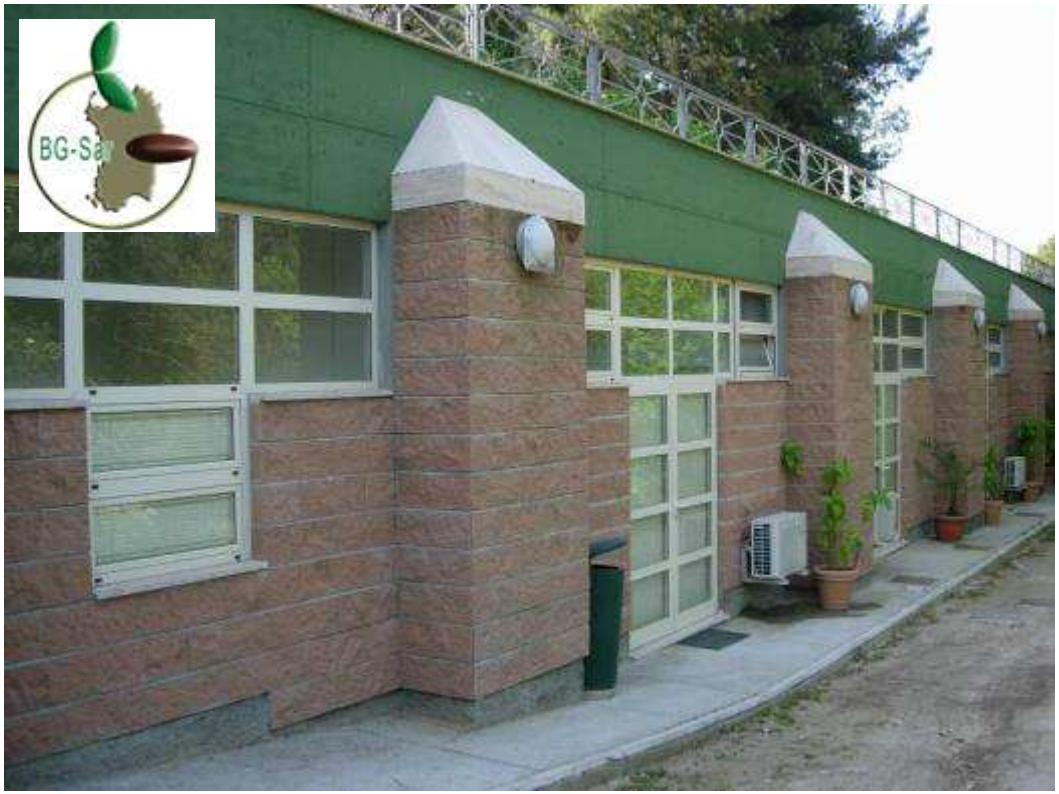


Analisi dei costi di monitoraggio





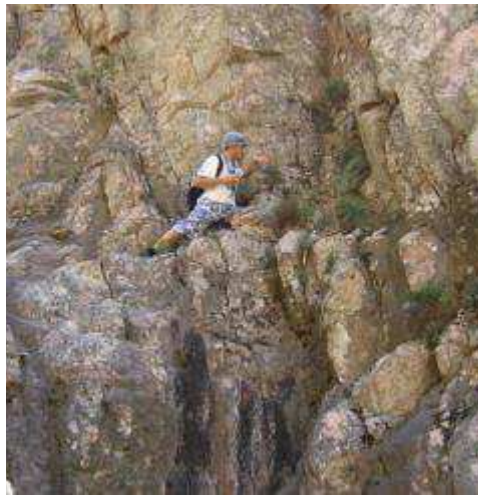
Studi *ex situ*



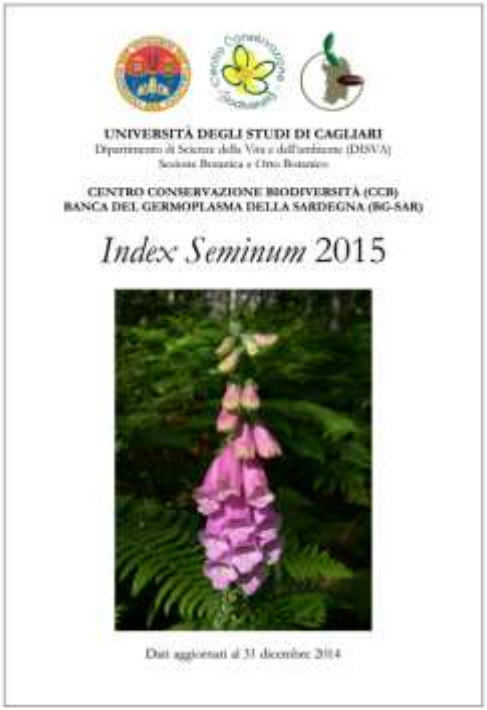
Centro Conservazione Biodiversitá (CCB)
Banca del Germoplasma della Sardegna (BG-SAR)

Raccolta germoplasma




Gestione germoplasma



Studi sull'ecofisiologia della germinazione

Plant Biosystems, Vol. 146, No. 2, June 2012, pp. 374–383

Taylor & Francis

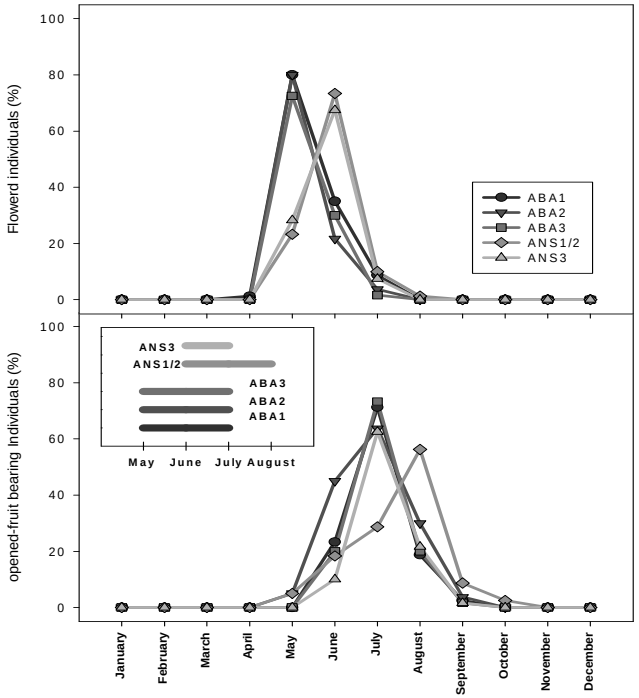
Adaptation to habitat in *Aquilegia* species endemic to Sardinia (Italy): Seed dispersal, germination and persistence in the soil

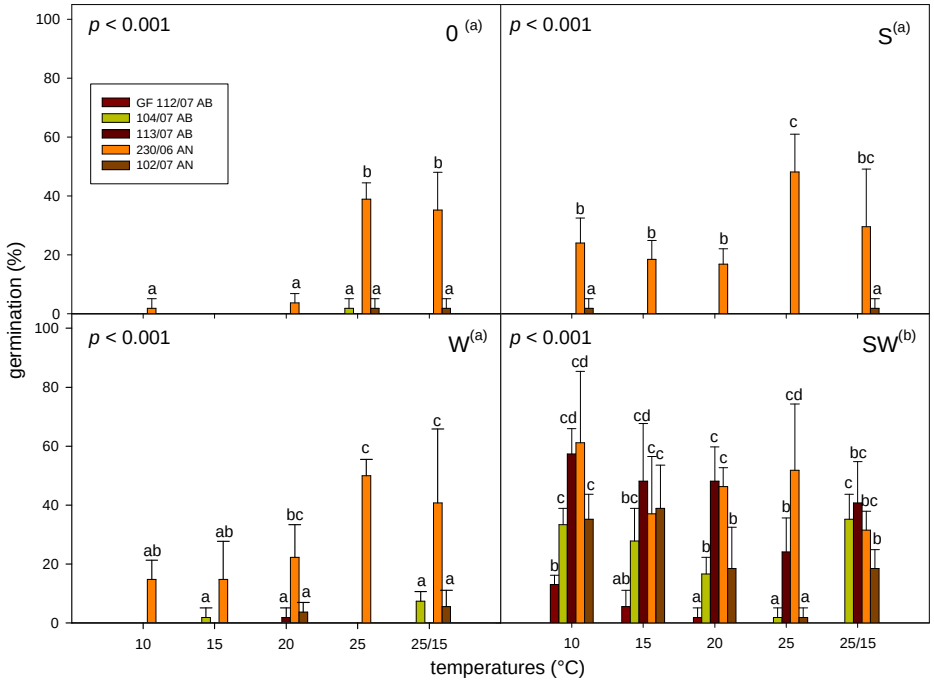
E. MATTANA[1], M. I. DAWS[2], G. FENU[1], & G. BACCHETTA[1]

[1]*Department of Botanic Sciences, Centre for the Conservation of Biodiversity (CCB), University of Cagliari, 09123, V.le S. Ignazio da Laconi 13, Cagliari, Italy and* [2]*Department of Seed Conservation, Royal Botanic Gardens, Kew, Wakehurst Place, Ardingly, West Sussex, UK*

Aquilegia nugorensis

Aquilegia barbaricina





Dormienze (epicotyl MPD) in semi di Ribes sandalioticum

plant biology

Plant Biology ISSN 1435-8603

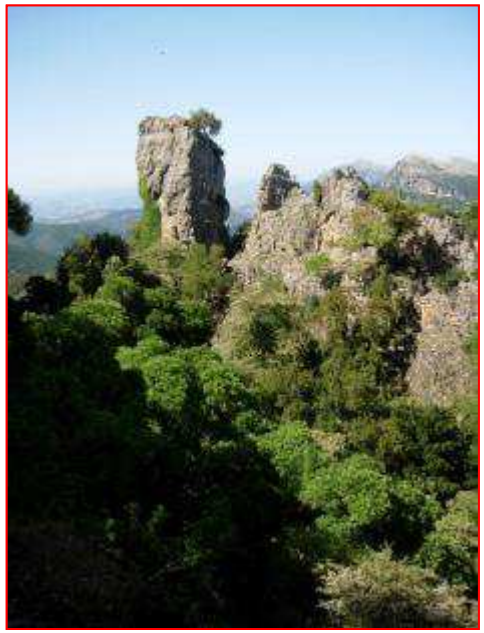
RESEARCH PAPER

Interchangeable effects of gibberellic acid and temperature on embryo growth, seed germination and epicotyl emergence in *Ribes multiflorum* ssp. *sandalioticum* (Grossulariaceae)

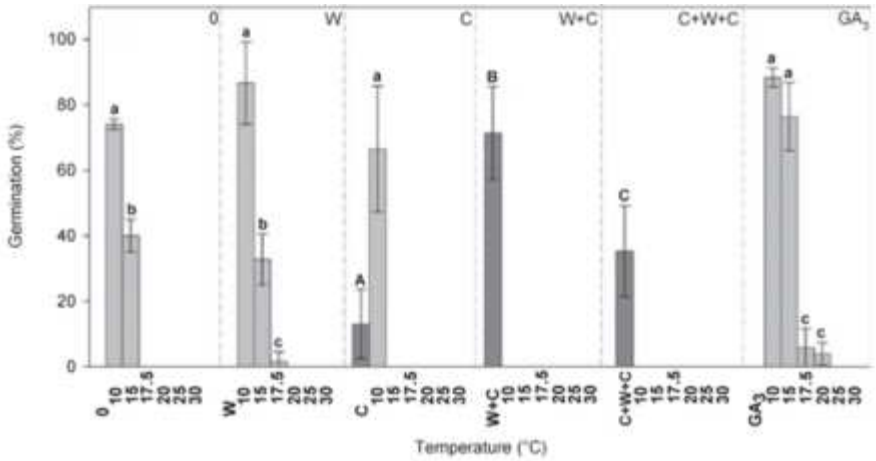
E. Mattana[1], H. W. Pritchard[2], M. Porceddu[1], W. H. Stuppy[2] & G. Bacchetta[1]

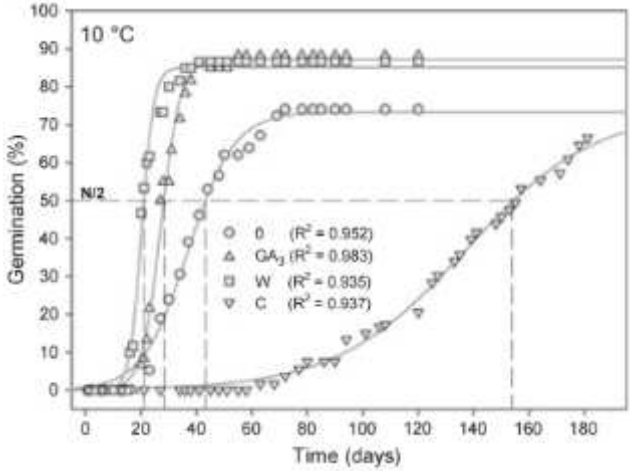
1 Centro Conservazione Biodiversità (CCB), Dipartimento di Scienze della Vita e dell'Ambiente, Università degli Studi di Cagliari, Italy

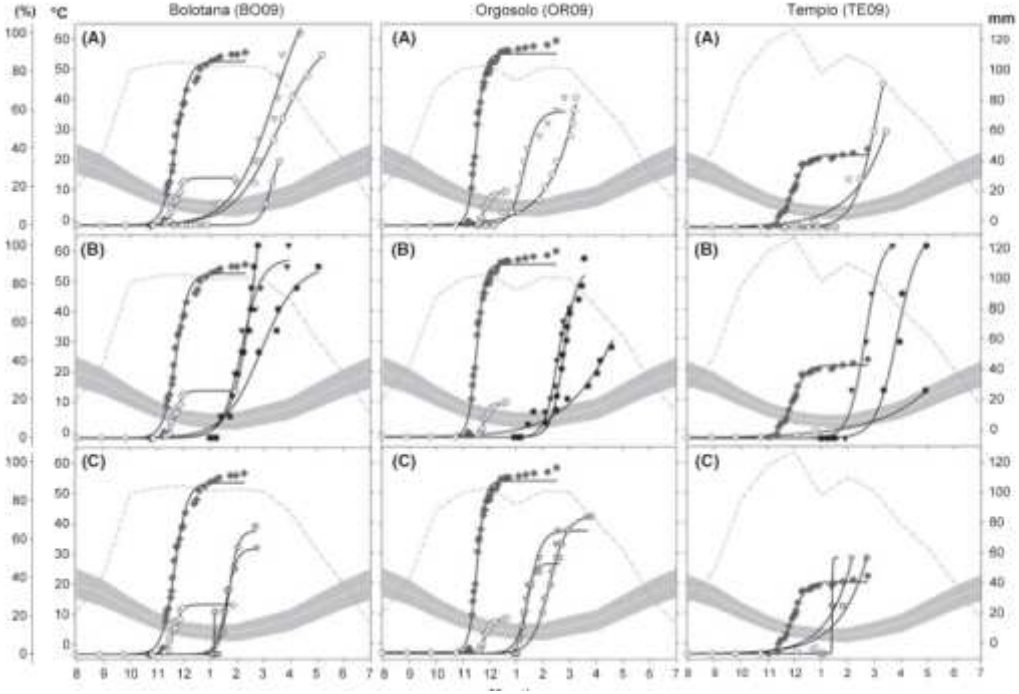
2 Seed Conservation, Royal Botanic Gardens, Kew, Wakehurst Place, Ardingly, West Sussex, UK



Dormienze (epicotyl MPD) in semi di Ribes sandalioticum







Requisiti termici per la germinazione dei semi di Vitis vinifera sylvestris

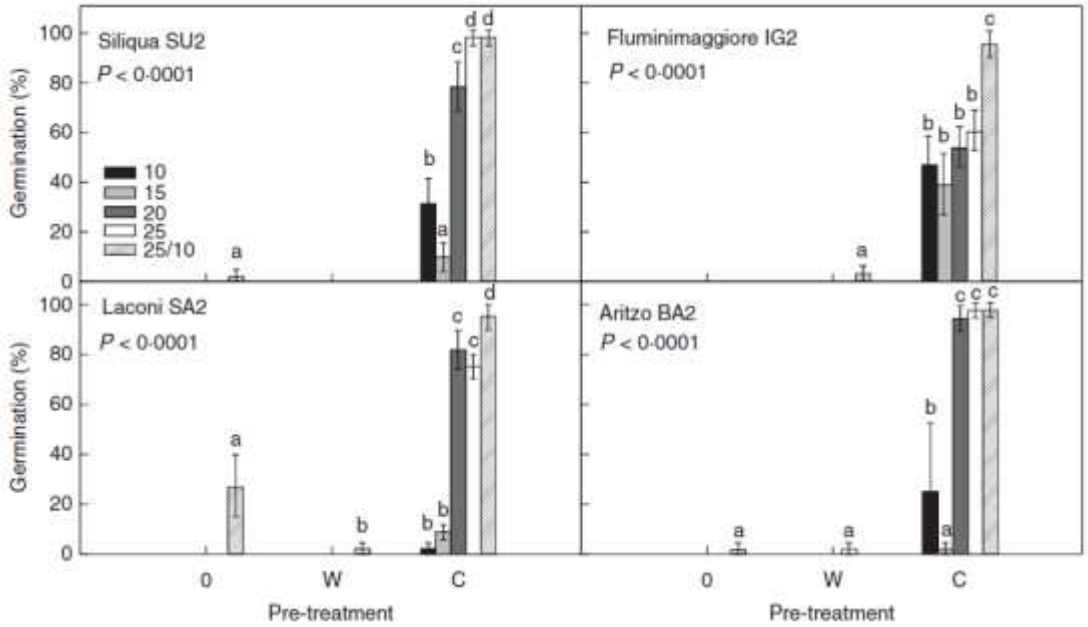
Annals of Botany **110**: 1651–1660, 2012
doi:10.1093/aob/mcs218, available online at www.aob.oxfordjournals.org

ANNALS OF BOTANY

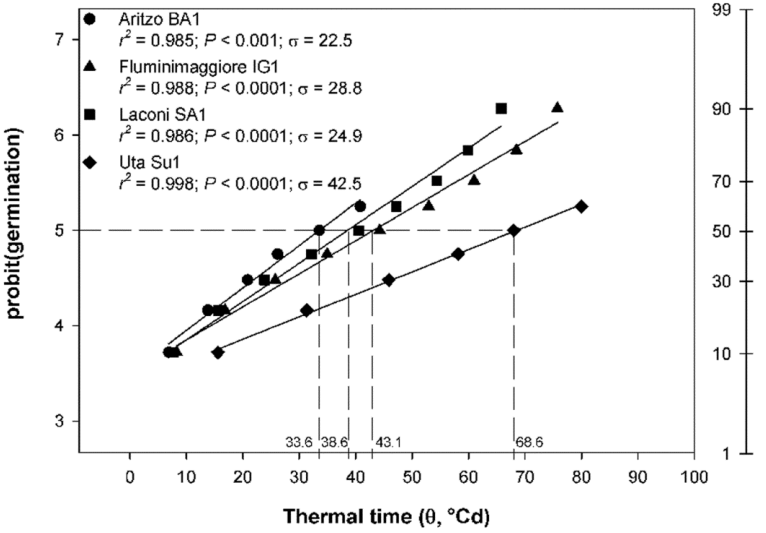
Thermal thresholds as predictors of seed dormancy release and germination timing: altitude-related risks from climate warming for the wild grapevine *Vitis vinifera* subsp. *sylvestris*

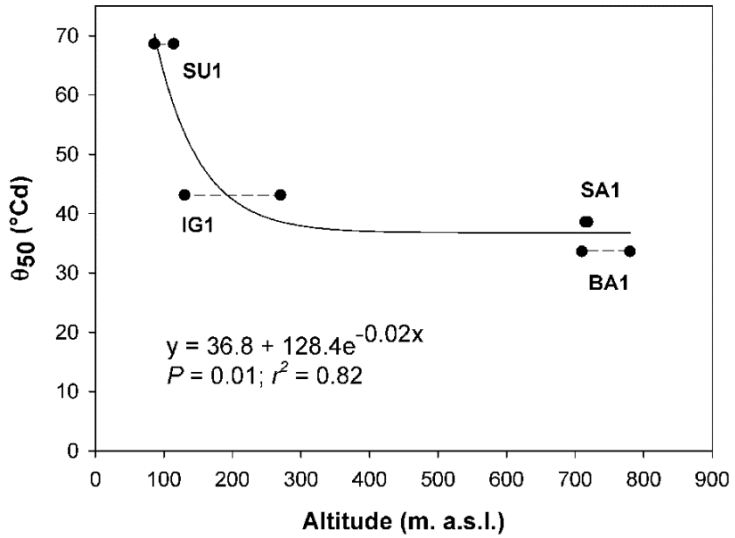
Martino Orrù[1], Efisio Mattana[1,*], Hugh W. Pritchard[2] and Gianluigi Bacchetta[1]

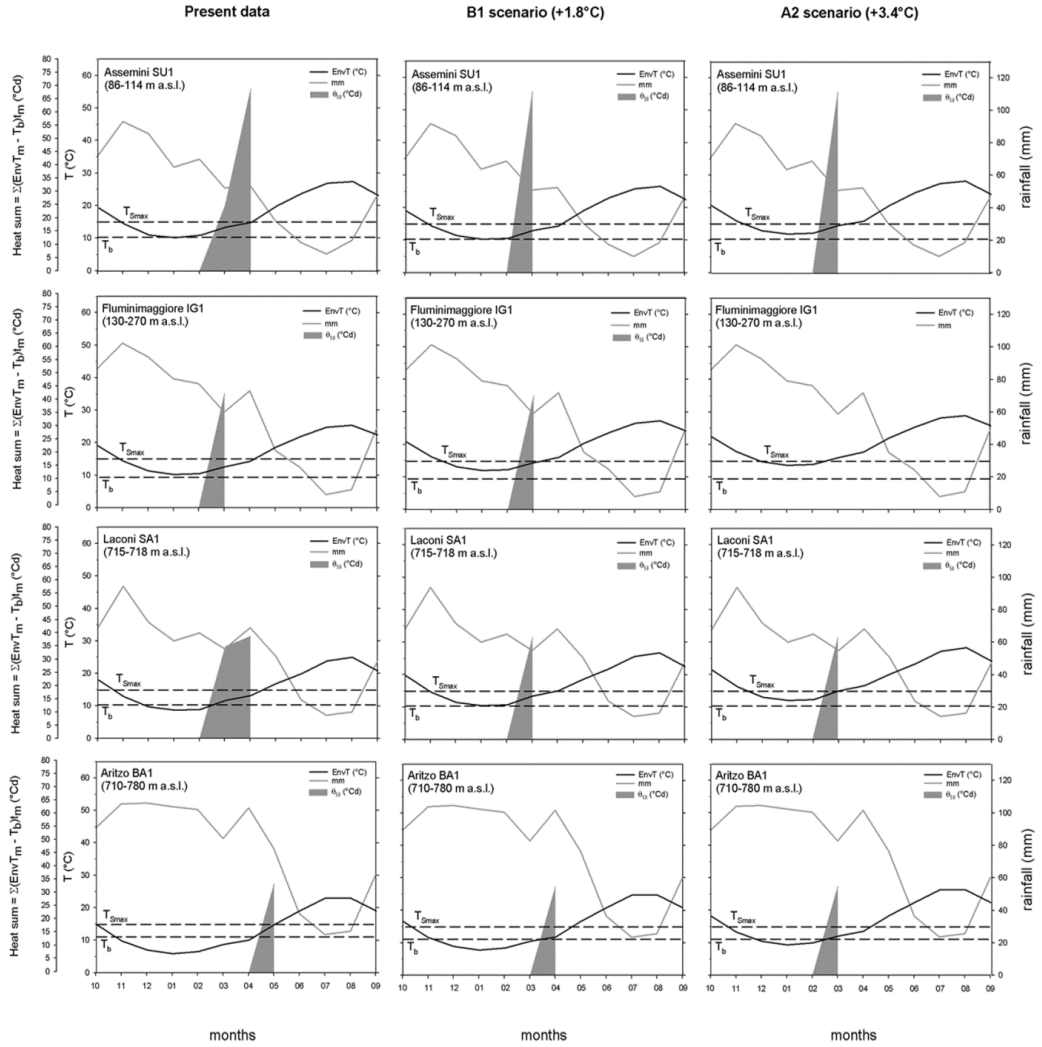
[1]*Centro Conservazione Biodiversità (CCB), Dipartimento di Scienze della Vita e dell'Ambiente, Università degli Studi di Cagliari, Viale Sant'Ignazio da Laconi, 13, Cagliari, 09123, Italy and* [2]*Seed Conservation Department, Royal Botanic Gardens, Kew, Wakehurst Place, Ardingly, West Sussex RH17 6TN, UK*



Requisiti termici per la germinazione dei semi di Vitis vinifera sylvestris







Modelli per la predizione della germinazione in situ

Annals of Botany **112**: 1887–1897, 2013
doi:10.1093/aob/mct238, available online at www.aob.oxfordjournals.org

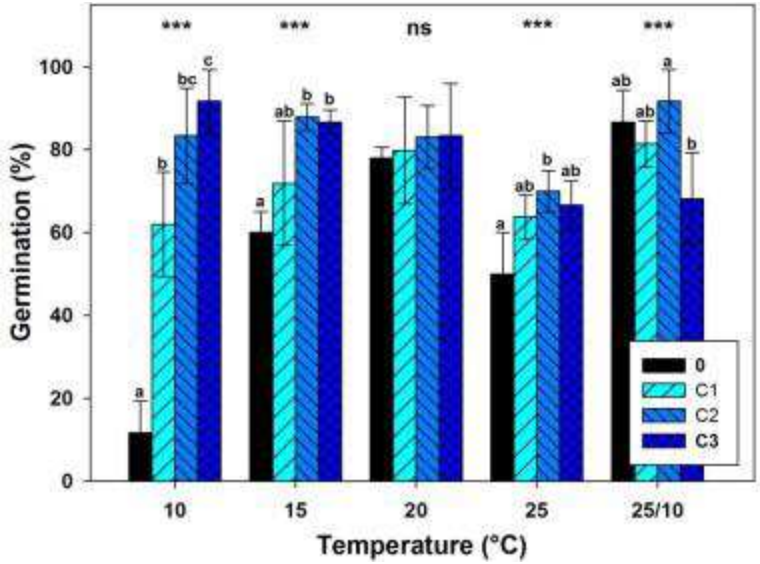
ANNALS OF BOTANY
Founded 1887

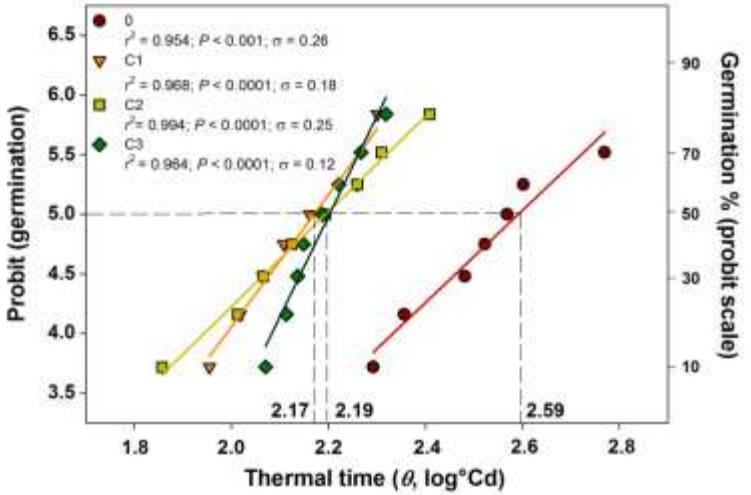
Thermal niche for *in situ* seed germination by Mediterranean mountain streams: model prediction and validation for *Rhamnus persicifolia* seeds

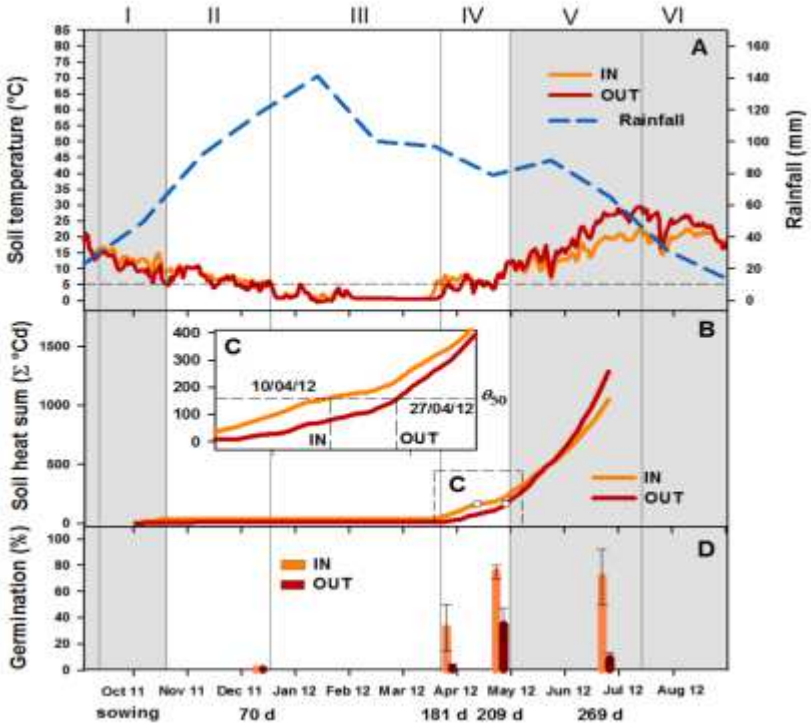
Marco Porceddu[1], Efisio Mattana[1,2,*], Hugh W. Pritchard[2] and Gianluigi Bacchetta[1]

[1]*Centro Conservazione Biodiversità (CCB), Dipartimento di Scienze della Vita e dell'Ambiente, Università degli Studi di Cagliari, Viale Sant'Ignazio da Laconi, 11–13, Cagliari, 09123, Italy and* [2]*Seed Conservation Department, Wellcome Trust Millennium Building, Royal Botanic Gardens, Kew, Wakehurst Place, Ardingly, West Sussex RH17 6TN, UK*

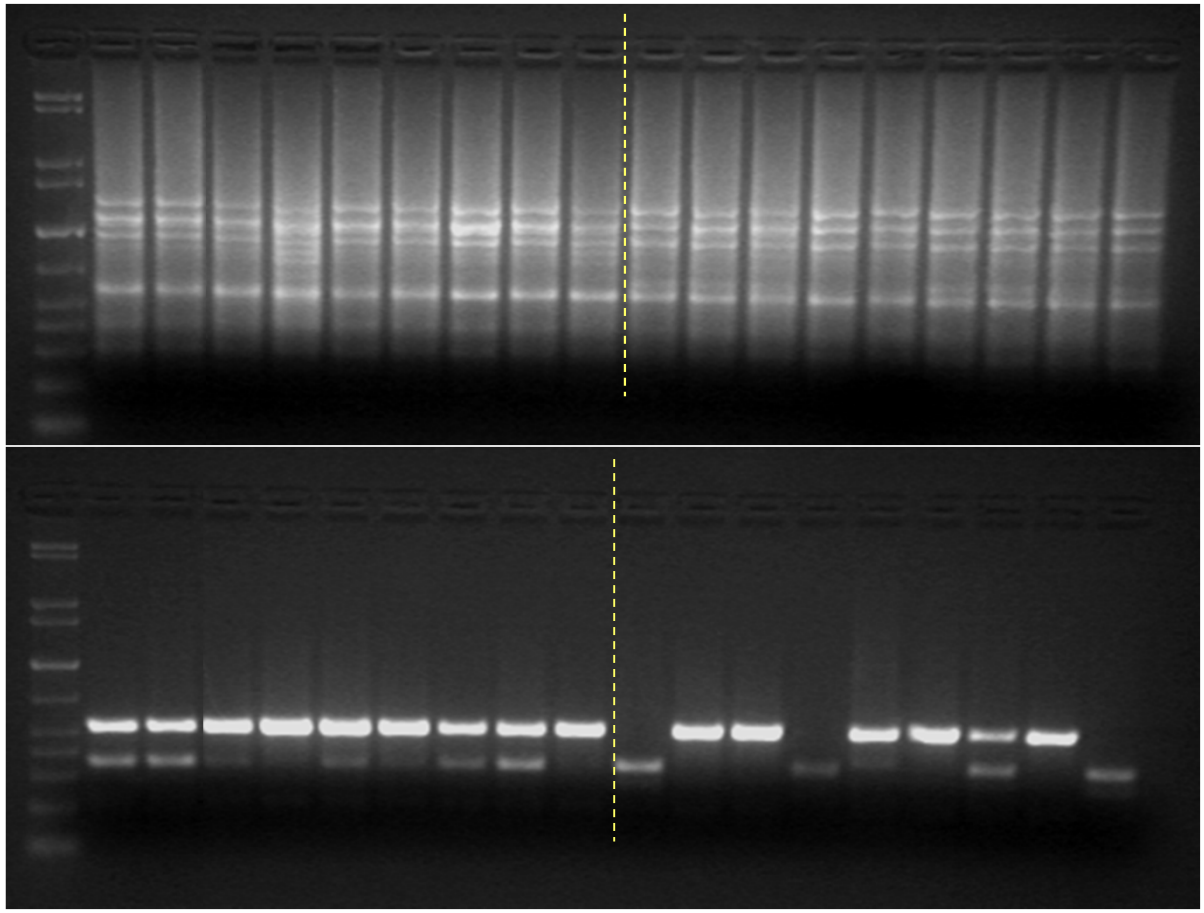
Modelli per la predizione della germinazione in situ



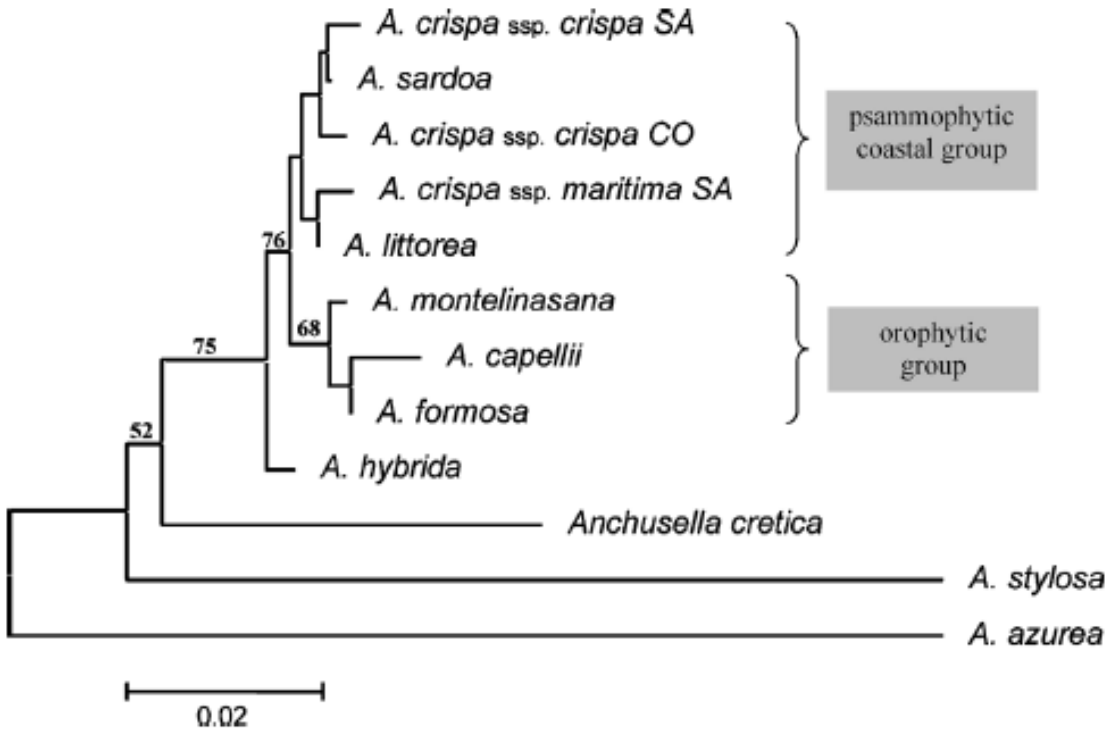




Studi genetici

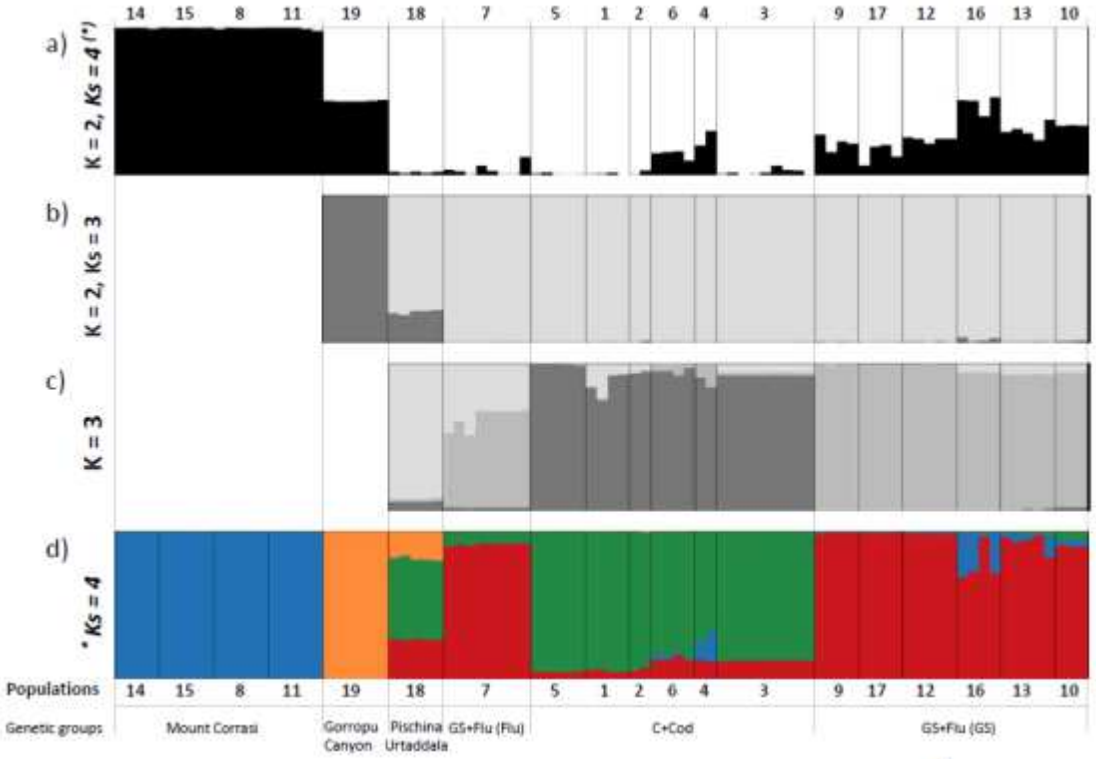


Sistematica e filogenesi del genere Anchusa



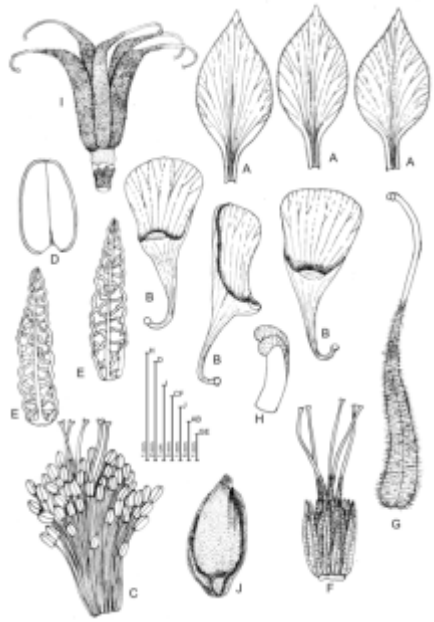
Bacchetta et al. (2008) Systematics & Biodiversity, 6(2): 161-174.

Struttura genetica spaziale del genere Aquilegia



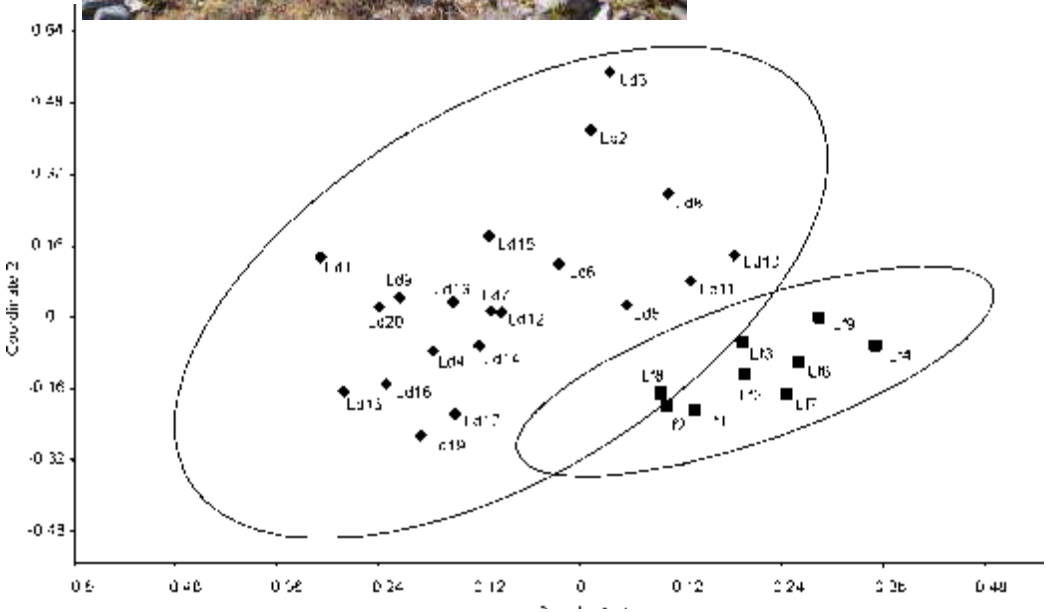
Garrido et al. (2012), Ann. Bot., 109(5): 953-64

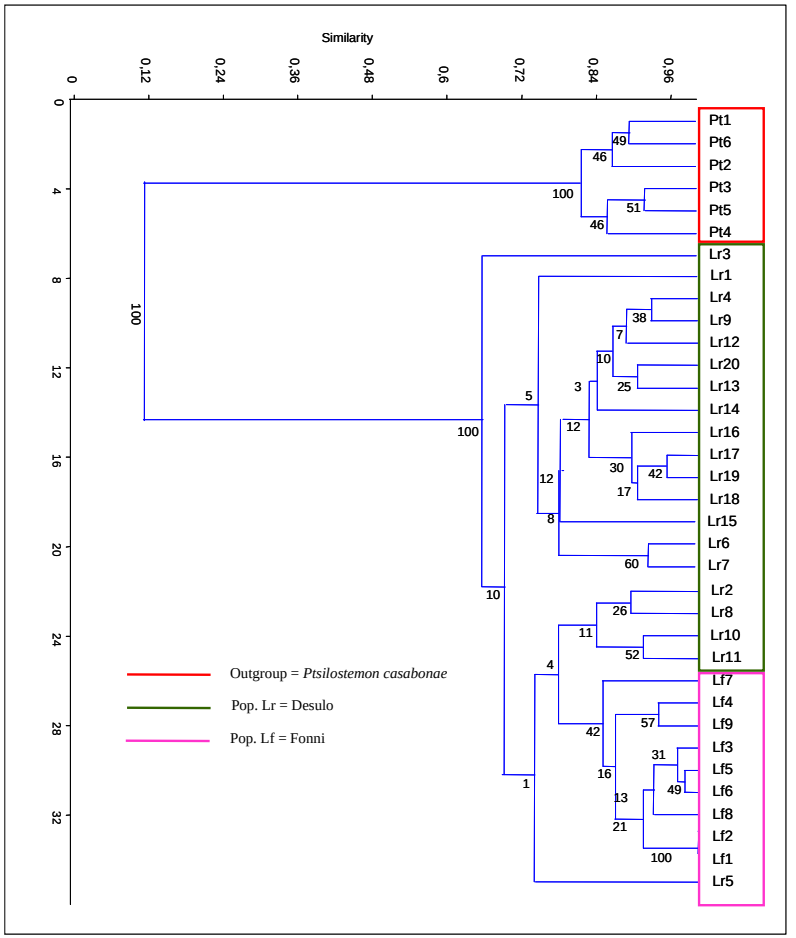
Una nuova specie di Aquilegia: A. cremnophila



Bacchetta et al. (2012), Phytotaxa 56: 59–64

Genetica di popolazione di Lamyropsis microcephala

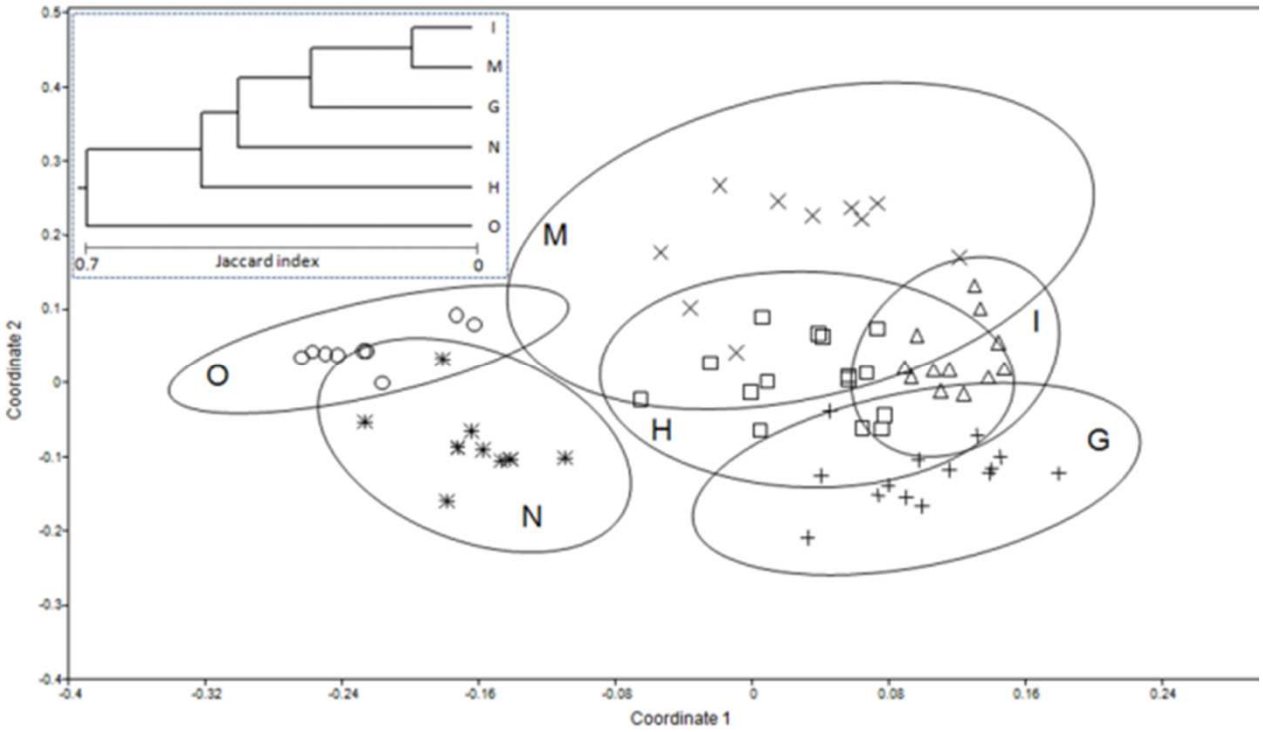


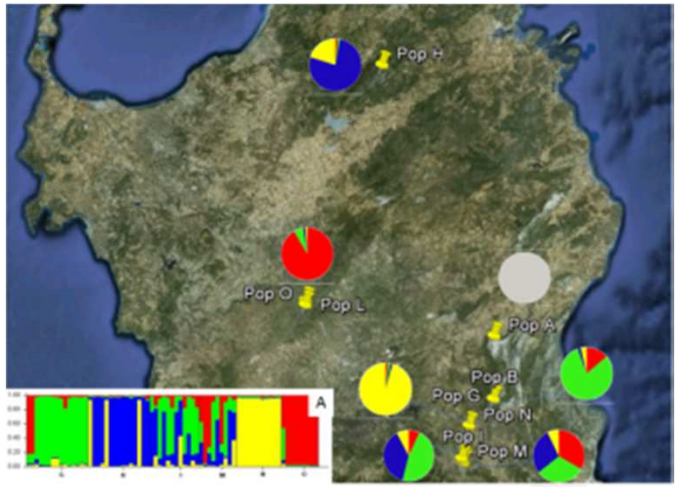


Preliminary assessment of the genetic diversity in *Lamyropsis microcephala* (Asteraceae)

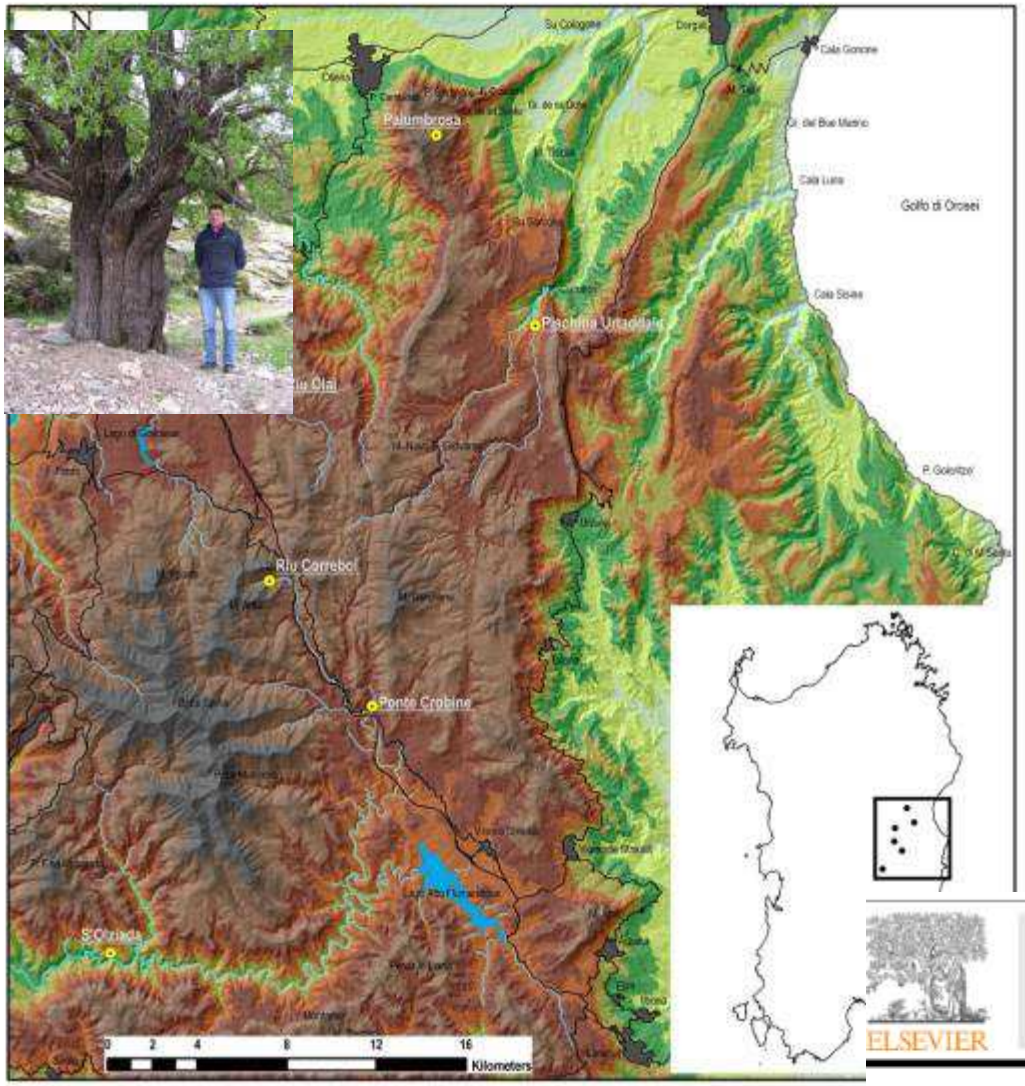
Bacchetta et al. (2013), Plant Biosystems, 147(2): 550-557

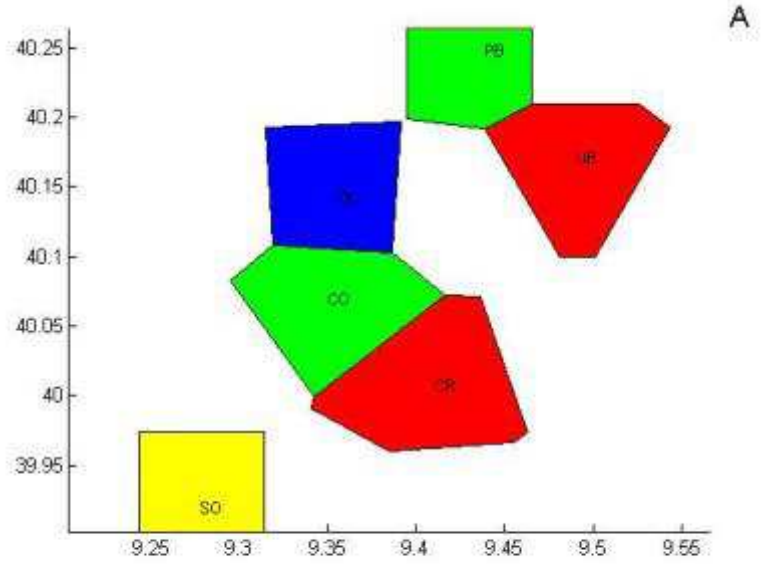
Genetica di popolazione del genere Ribes

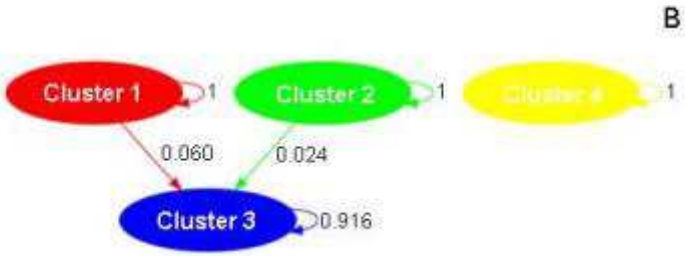




Genetica di popolazione e conservazione di Rhamnus persicifolia







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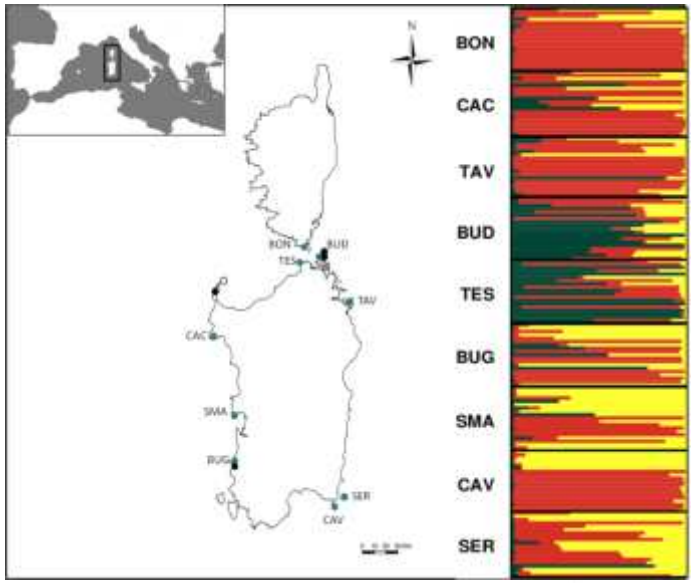
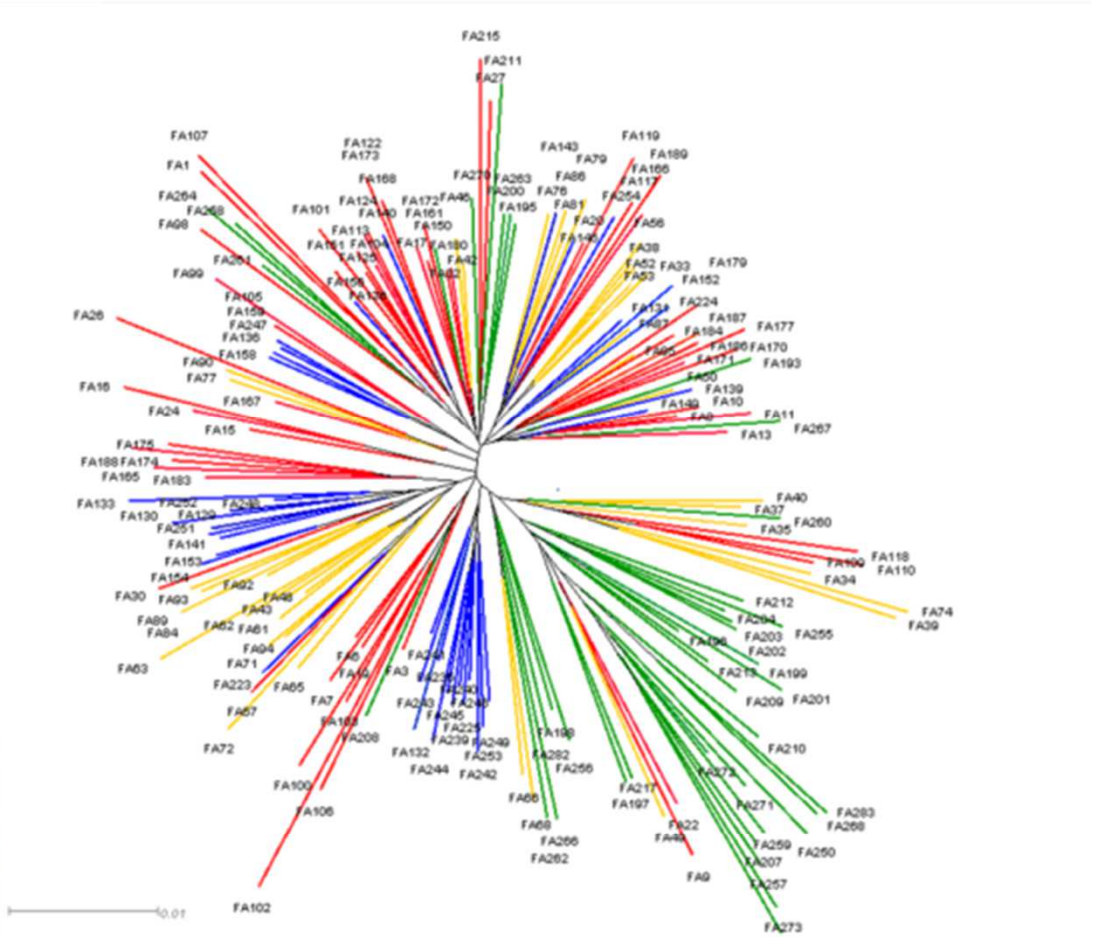
ELSEVIER

Genetic variability of the narrow endemic *Rhamnus persicifolia* Moris (Rhamnaceae) and its implications for conservation

Gianluigi Bacchetta [a], Giuseppe Fenu [a], Efisio Mattana [a], Giovanni Zecca [b], Fabrizio Grassi [b], Gabriele Casazza [c], Luigi Minuto [c,*]

Genetica di popolazione e conservazione di Ferula arrigonii





plant biology

Plant Biology ISSN 1435-8603

RESEARCH PAPER

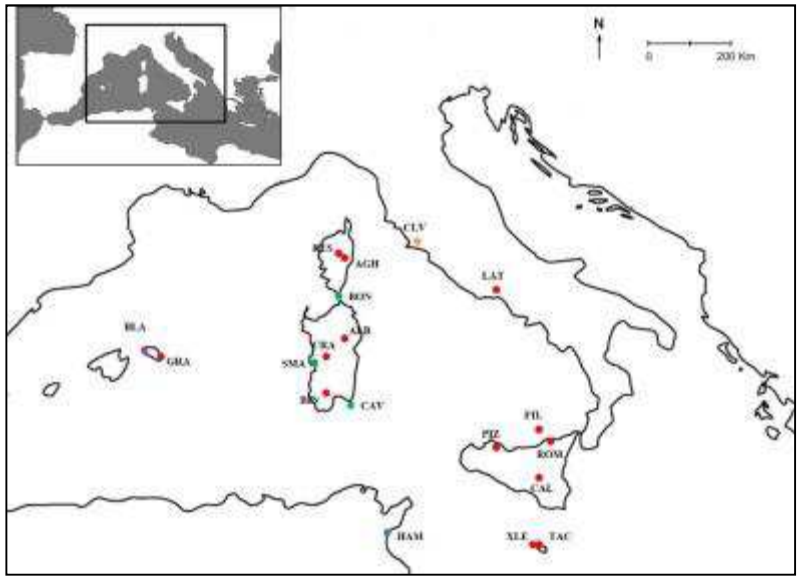
The genetic diversity and spatial genetic structure of the Corso-Sardinian endemic *Ferula arrigonii* Bocchieri (Apiaceae)

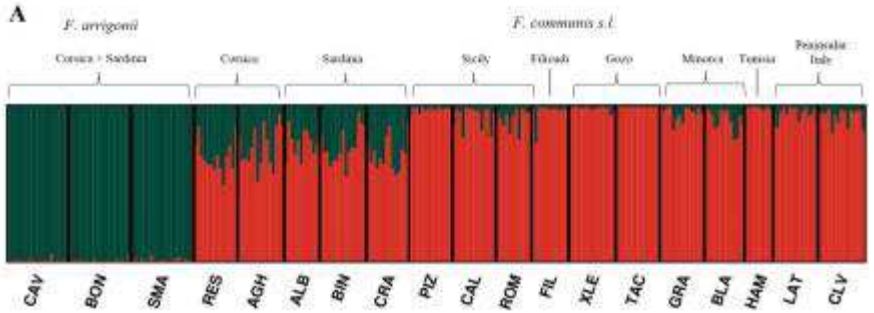
C. A. Dettori[1], S. Sergi[2], E. Tamburini[2] & G. Bacchetta[1]

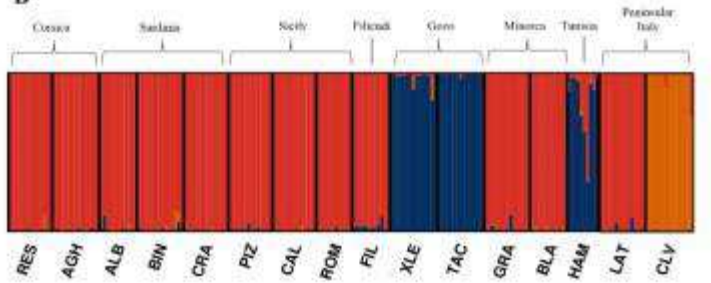
1 Dipartimento di Scienze della Vita e dell'Ambiente, Centro Conservazione Biodiversità (CCB), Università degli Studi di Cagliari, Cagliari, Italy

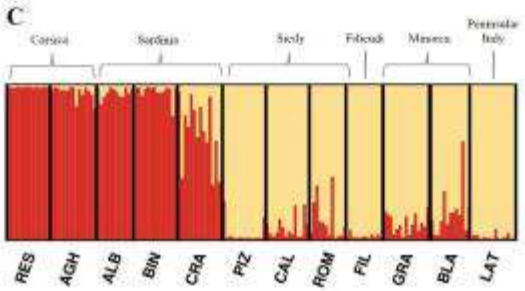
2 Dipartimento di Scienze Biomediche, Sezione di Microbiologia e Virologia, Università degli Studi di Cagliari, Monserrato (CA), Italy

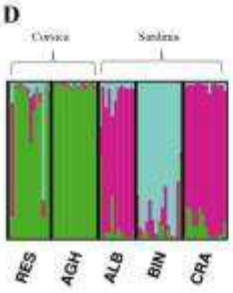
Struttura genetica di Ferula gr. communis nell'area tirrenica

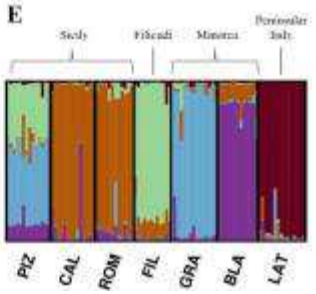


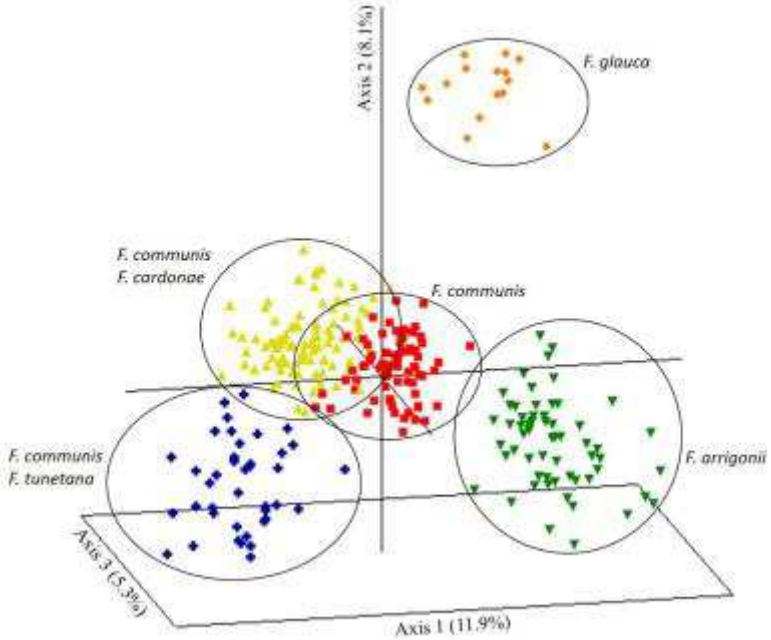












Grazie per l'attenzione