The RIBES strategy for *ex situ* conservation: *conventional and modern techniques to inform seed storage*

Sara Magrini*, Bacchetta G., Bedini G., Bonomi C., Borzatti A., Carasso V., Casavecchia S., Ceriani R., Cristaudo A., Di Cecco V., Di Martino L., Fabrini G., Guglielmo F., Mariotti M., Negri V., Porceddu M., Salmeri C., Villani M., Zappa E.

RIBES, Rete Italiana Banche del Germoplasma per la conservazione ex situ della flora spontanea

**Tuscia Germplasm Bank, Università della Tuscia, Viterbo*

3rd Mediterranean Plant Conservation Week

CHANIA, CRETE, GREECE | 27 SEPTEMBER - 1 OCTOBER 2021

Plant Conservation Strategies: from Science to Practice

29 September 2021 - SESSION 2 Conservation planning and *ex-situ / in situ* techniques

The RIBES members

RIBES is the Italian national seed-bank network for native species conservation.

It was established in December 2005 and today it includes 18 members representing 14 Italian regions.

18 seed-banks

14 Italian administrative regions

NODI RIBES

1. BG delle Alpi sud occidentali
2. Lombardy Seed Bank
3. Trentino Seed Bank
4. BG di Padova
5. BG dei Giardini Hanbury
6. BG di Pisa
7. BG di Livorno
8. BG delle Marche
9. BG di Perugia (dal 2012)
10. BG della Tuscia
11. BG di Roma
12. BG della Majella
13. BG della Sardegna
14. BG di Palermo
15. BG di Catania
16. BG di Udine (dal 2016)
17. BG della Valle d'Aosta (dal 2017)
18. BG dei Nebrodi (dal 2020)

International partnerships

RIBES is a member/partner of other wider networks so providing an active connection with the international context:

- ENSCONET (*European Native Seed Conservation Network*)
- Millennium Seed Bank Partnership
- INSR (*International Network for Seed-based Restoration*).

Genmeda
NETWORK OF MEDITERRANEAN PLANT CONSERVATION CENTRES

ENSCONET
European Native Seed Conservation Network

INSR
INTERNATIONAL NETWORK FOR SEED-BASED RESTORATION

SER
SOCIETY FOR ECOLOGICAL RESTORATION
AUSTRALASIA

MILLENNIUM SEED BANK PARTNERSHIP
Kew

RIBES mission

Mission: to improve the quality and safety of the germplasm reserves of Italian native plants to attain a long-term seed conservation

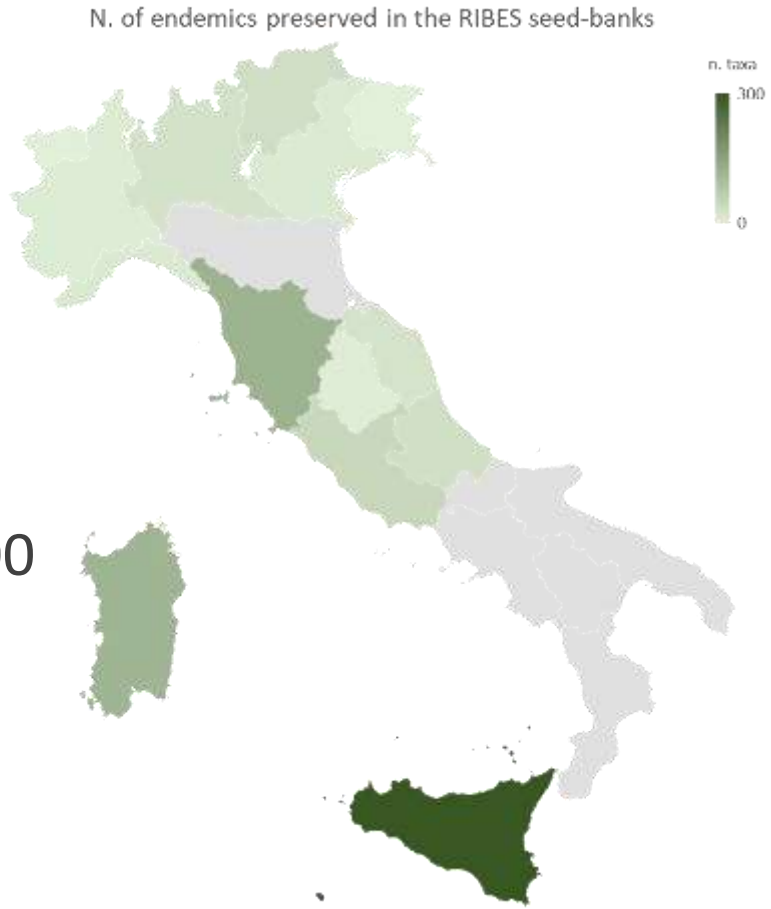
Vision: No plant goes extinct. Ribes holdings are used to reinforce diminishing populations and reverse extinction.

Ex situ conservation

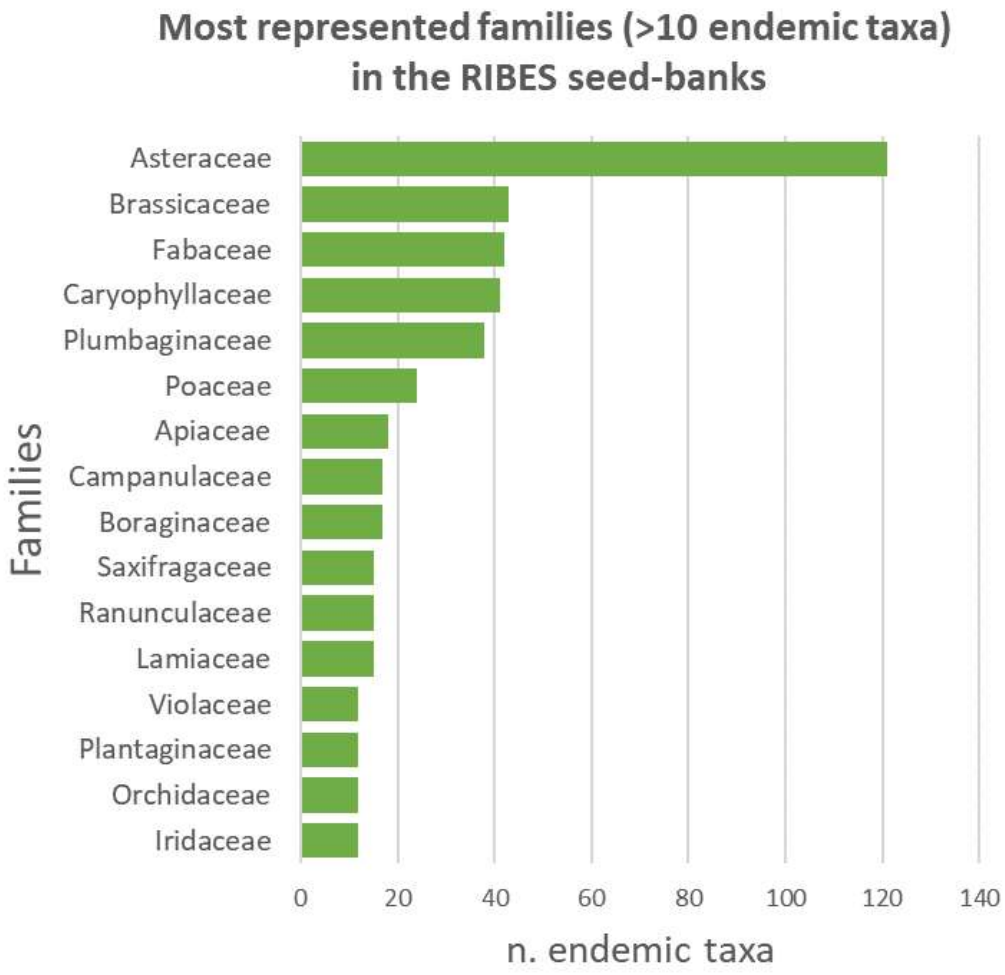
- About **3,200 taxa** representing approx. 40% of the Italian native vascular flora
- More than **25,000 accessions** of seeds and spores preserved *ex situ*
  - Endemic species
  - Threatened species
  - Crop Wild Relatives

Endemic taxa preserved in the RIBES seed-banks

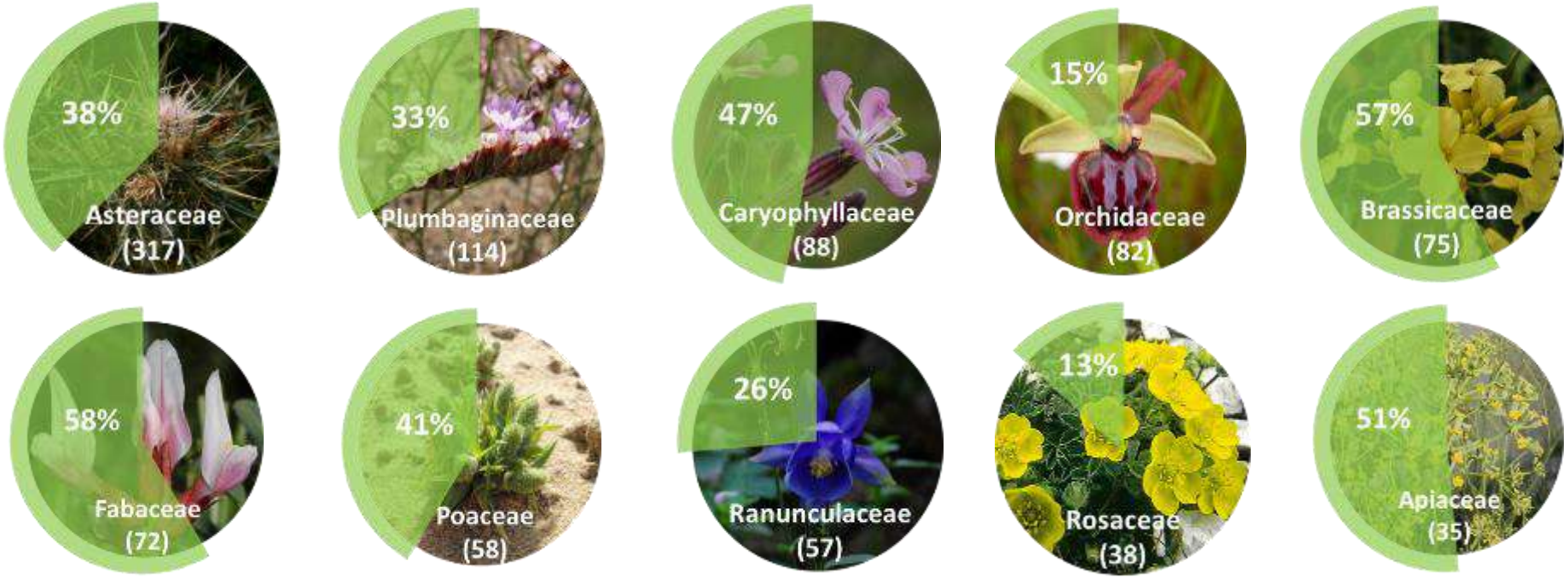
- ✓ **554** taxa, **41%** of the Italian endemics
- ✓ **48** families
- ✓ Stored in 16 seed-banks, maily in Sicily (300 taxa), Sardeinia and Tuscany (>110)



Endemic taxa preserved in the RIBES seed-banks

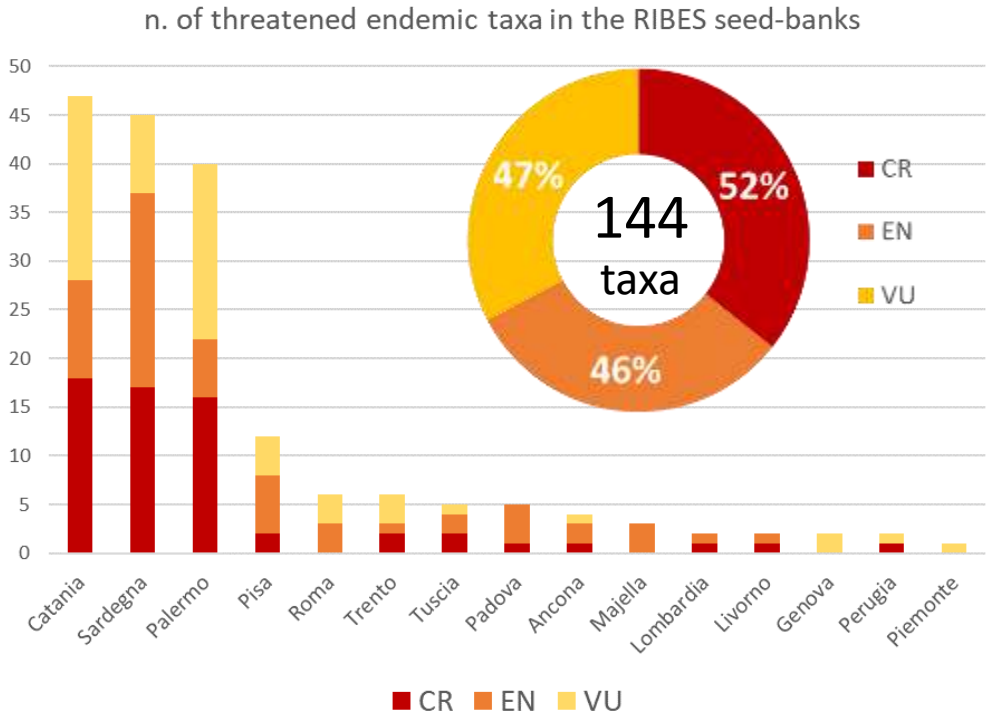


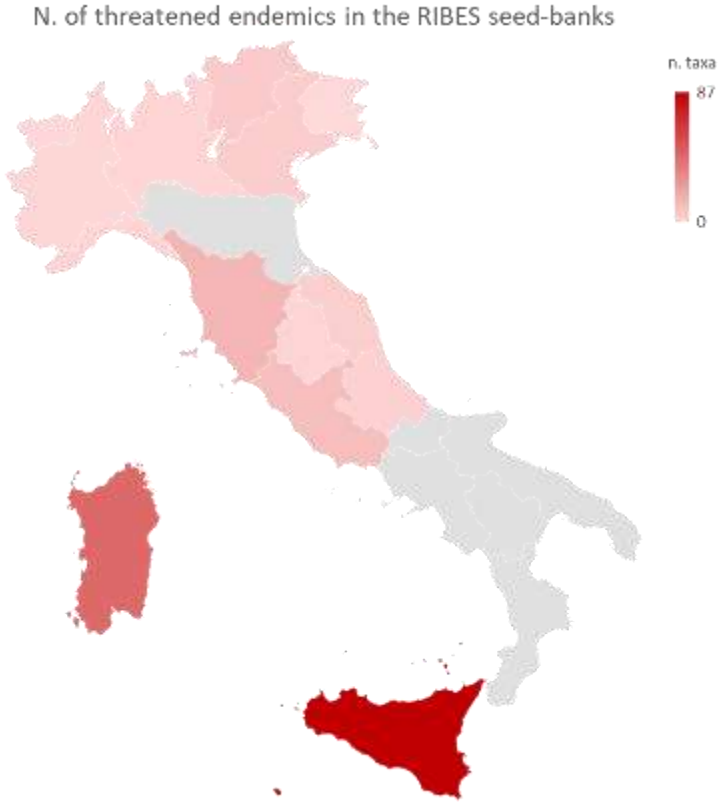
Ex situ conservation of the main families of the endemic Italian flora



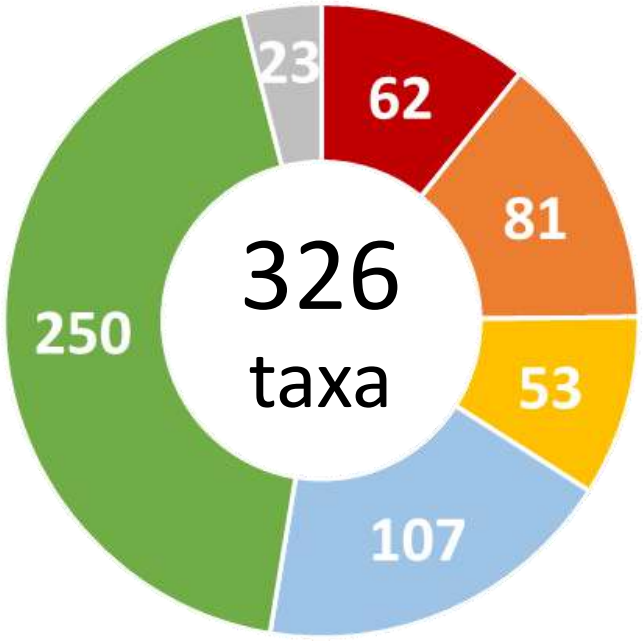
Threatened endemic taxa in the RIBES seed-banks

48% (144 out of 300 taxa) stored in 15 seed-banks, mainly in Sicily and Sardinia



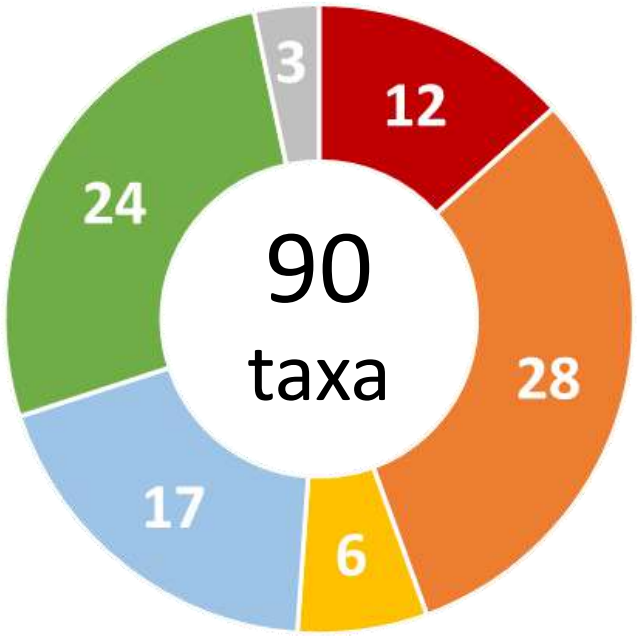


Threatened taxa



Policy Species

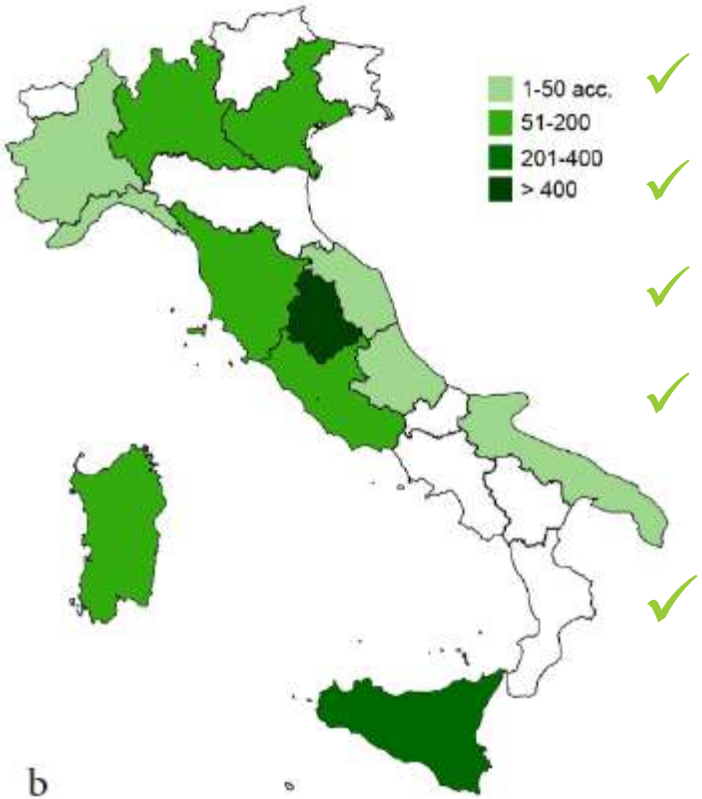
41% of the Italian Policy Species



Woodwardia radicans
BGT

The Crop Wild Relatives (CWR)

37% of the Italian CWRs in **14** seed banks



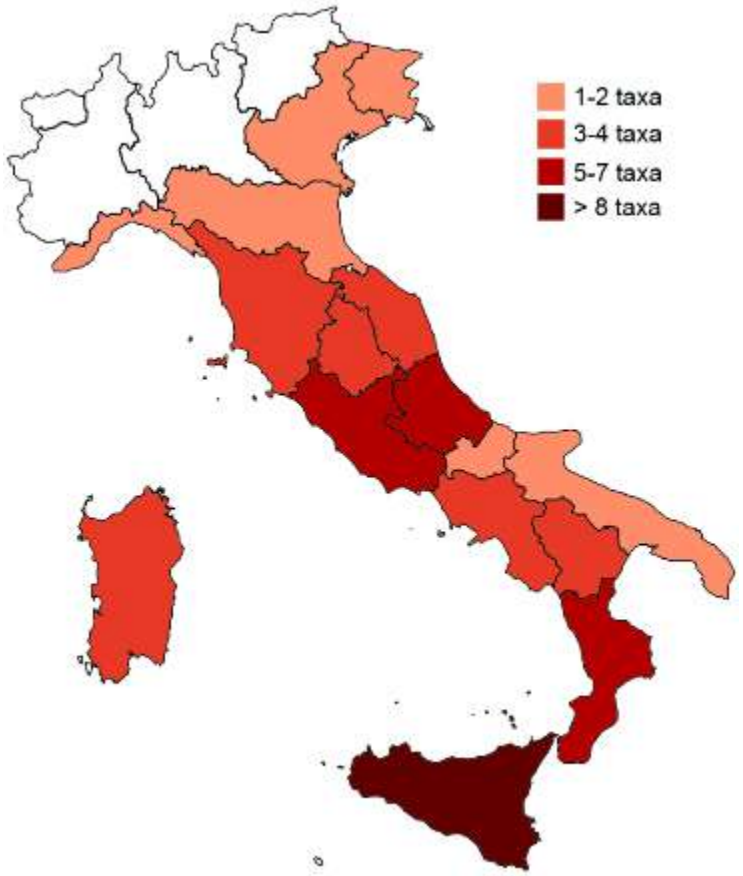
- ✓ **6029** seed-lots
- ✓ **229** taxa
- ✓ **11** families
- ✓ **57** genera
- ✓ **4** Policy Species

Brassica macrocarpa
Perugia, Lombardia, Palermo, Catania

Family	N. of taxa
Fabaceae	75
Poaceae	68
Brassicaceae	49

Genus	N. of taxa
Brassica	30
Trifolium	17
Vicia	16

The Crop Wild Relatives (CWR)



- **294 accessions of 14 endemic CWRs (50%), mainly** in 5 seed-banks: Catania, Sardegna, Perugia, Padova and Palermo

Brassica insularis – BG-SAR

LIFE SEEDFORCE project

«*Using SEEDbanks to restore and reinFORCE the endangered native plants of Italy*»

15 PARTNERS

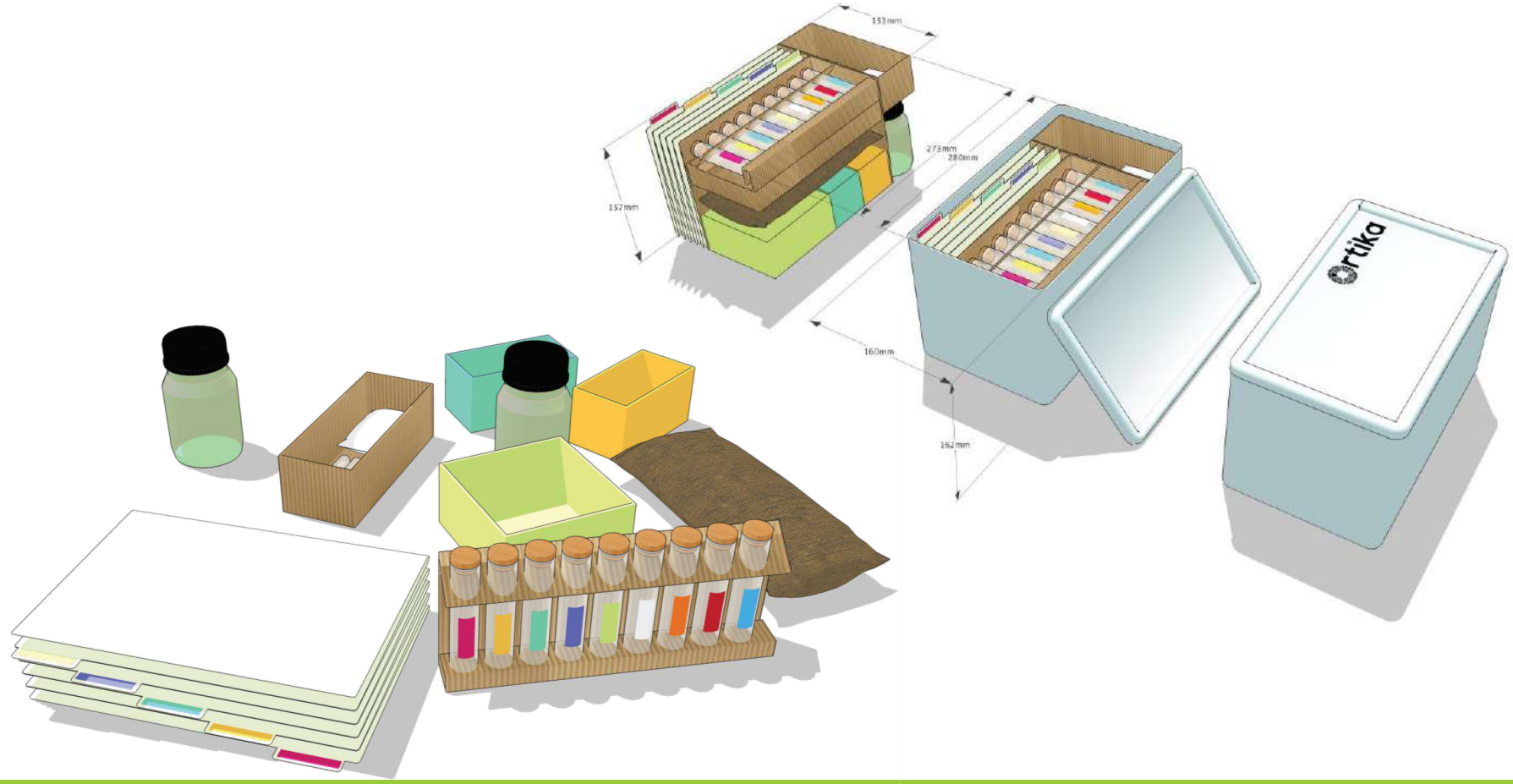
- 11 RIBES seed banks
- 3 cross-border partners from France, Slovenia, and Malta
- Legambiente Italia
- RIBES is a co-funder of the project
- RIBES will coordinate seed-banks activities and organise a back-up programme of duplicates to secure the collected accessions in the long-term

Education
Mini-seed bank

Seed collection

Dehydration

Conservation



Ortika
Design with and for Ibioldiversity

Priority lists

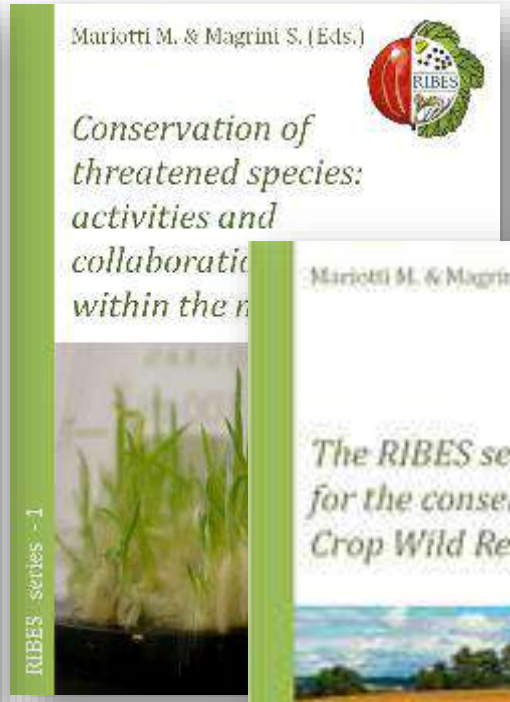
- Priority lists for seed collections
  - **156** threatened endemics (CR, EN e VU) not preserved ex situ
  - **135** occurring in 1 region only

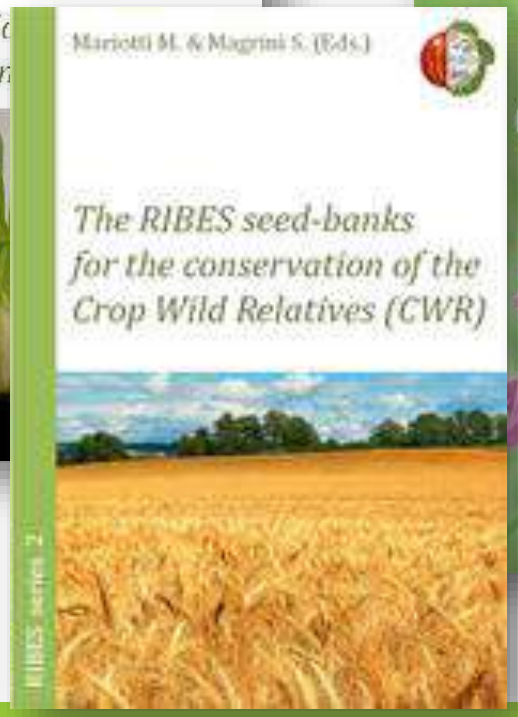
Family	Genus	Taxon	n° banche RIBES	Categor	Criteria	n° regioni (presenza
Asteraceae	Adenostyles	Adenostyles alpina (L.) Bluff & Fingerh. subsp. nebrodensis (Wagenitz & I.Müll.) Greuter	0	CR	B1ab(iii,iv,v)+2ab(iii,iv,v)	1
Asteraceae	Anthemis	Anthemis cretica L. subsp. messanensis (Brullo) Giardina & Raimondo	0	CR	D	1
Fabaceae	Anthyllis	Anthyllis hermanniae L. subsp. brutia Brullo & Giusso	0	CR	B1ab(ii,iii,iv,v)+2ab(ii,iii,iv,v)	1
Fabaceae	Anthyllis	Anthyllis hermanniae L. subsp. japygica Brullo & Giusso	0	CR	B1ab(iii,v)+2ab(iii,v)	1
Ranunculaceae	Aquilegia	Aquilegia nuragica Arrigoni & E.Nardi	0	CR	B1ab(ii,iii,v)+2ab(ii,iii,v)+D	1
Aspleniaceae	Asplenium	Asplenium adulterinum Milde subsp. presolanense Mokry, Rasbach & Reichst.	0	CR	B2ab(v)	1
Fabaceae	Astragalus	Astragalus tegulensis Bacch. & Brullo	0	CR	B1ab(ii,iii,v)+2ab(ii,iii,v)+C1	1
Apiaceae	Athamanta	Athamanta cortiana Ferrarini	0	CR	B1b(ii)c(iv)	1
Brassicaceae	Cardamine	Cardamine granulosa All.	0	CR	B1ab(v)+2ab(v)	1
Asteraceae	Centaurea	Centaurea aplolepa Moretti subsp. gallinariae (Briq. & Cavill.) Dostál	0	CR	B1ab(iii)+2ab(iii)+D	1
Caprifoliaceae	Cephalaria	Cephalaria squamiflora (Sieber) Greuter subsp. bigazzii (Bacch., Brullo & Giusso) Domina	0	CR	B1ab(ii,iii,v)+2ab(ii,iii,v)+C1	1
Orchidaceae	Epipactis	Epipactis maricae (Croce, Bongiorni, De Vivo & Fori) Presser & S.Hertel	0	CR	B1ab(v)+2ab(v)+D	1
Orchidaceae	Epipactis	Epipactis zaupolensis (Barbaro & Kreutz) Bongiorni, De Vivo & Fori	0	CR	B1ab(iii,v)+2ab(iii,v)	1
Brassicaceae	Erysimum	Erysimum montis-argentarii Peccenini & Polatschek	0	CR	D	1
Fabaceae	Genista	Genista pulchella Vis. subsp. aquilana F.Conti & Manzi	0	CR	B1ab(iii,v)+2ab(iii,v)	1
Fabaceae	Genista	Genista toluensis Vals.	0	CR	A2c	1
Cistaceae	Helianthemum	Helianthemum sicanorum Brullo, Giusso & Sciandr.	0	CR	B2ab(iii,v)	1
Indaceae	Iris	Iris revoluta Colas.	0	CR	B2ab(iii,v)	1
Plumbaginaceae	Limonium	Limonium albidum (Guss.) Pignatti	0	CR	B1ab(v)+2ab(v)	1
Plumbaginaceae	Limonium	Limonium algusae (Brullo) Greuter	0	CR	B1ab(v)+2ab(v)	1
Plumbaginaceae	Limonium	Limonium calabrum Brullo	0	CR	B1ab(iii)	1
Plumbaginaceae	Limonium	Limonium capitis-eliae Erben	0	CR	B1ab(iii,iv)+2ab(iii,iv)	1

Security back-up of the accessions

- Selection of the priority species to duplicate
- Specific collections
- Duplicates stored in 2 or more seed banks of RIBES
- Duplicates sent to the MSB

Common research & publications





Common research & publications

- De Vitis M., Magrini S., et al. 2021. **Seed banking assessment of coastal plants in the Mediterranean**. *Sustainability*, Special Issue "*Ecology and Conservation of Coastal Plant Communities*“

  A total of 47 co-authors (all from RIBES or GENMEDA network) provided data about ca. 6,000 seed accessions.

- Carta A., Cristaudo A., Magrini S., Salmeri C., et al. 2022. **Germination in the Asteraceae** (provisional title). *Plants*, Special Issue “*Seed dormancy and germination*”

  A total of 24 co-authors (all from RIBES network) provided data about ca. 70 taxa.

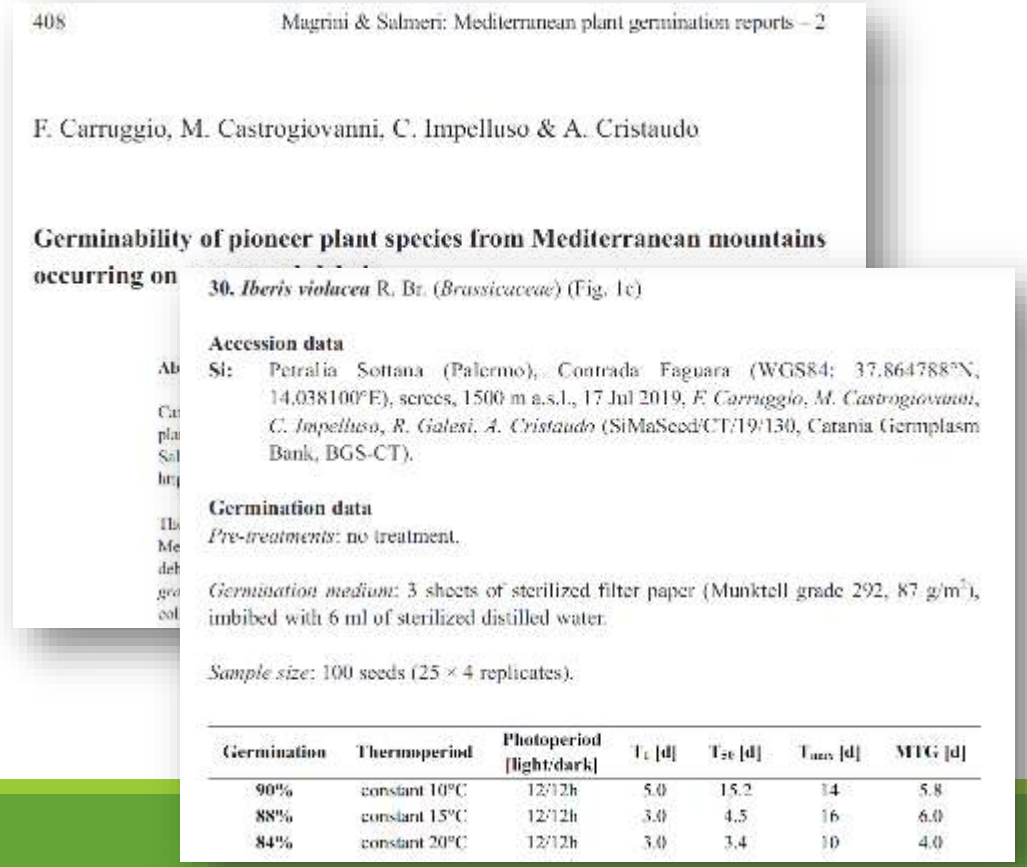
«Mediterranean plant germination reports»

- Sara Magrini & Cristina Salmeri (Eds.)**«*Mediterranean plant germination reports*»** a column proposed by RIBES and published annually on Flora Mediterranea

In the first two issues (2019-2020):

- 12 contributions
- 45 reports
- 32 authors
- 41 taxa

Deadline for contributions: 8th November, 2021



408 Magrini & Salmeri: Mediterranean plant germination reports – 2

F. Carruggio, M. Castrogiovanni, C. Impelluso & A. Cristaudo

Germinability of pioneer plant species from Mediterranean mountains occurring on

30. *Iberis violacea* R. Br. (*Brassicaceae*) (Fig. 1c)

Accession data

Si: Petralia Sottana (Palermo), Contrada Faguara (WGS84: 37.864788°N, 14.038100°E), screes, 1500 m a.s.l., 17 Jul 2019, *F. Carruggio, M. Castrogiovanni, C. Impelluso, R. Galesi, A. Cristaudo* (SiMaSeed/CT/19/130, Catania Germplasm Bank, BGS-CT).

Germination data

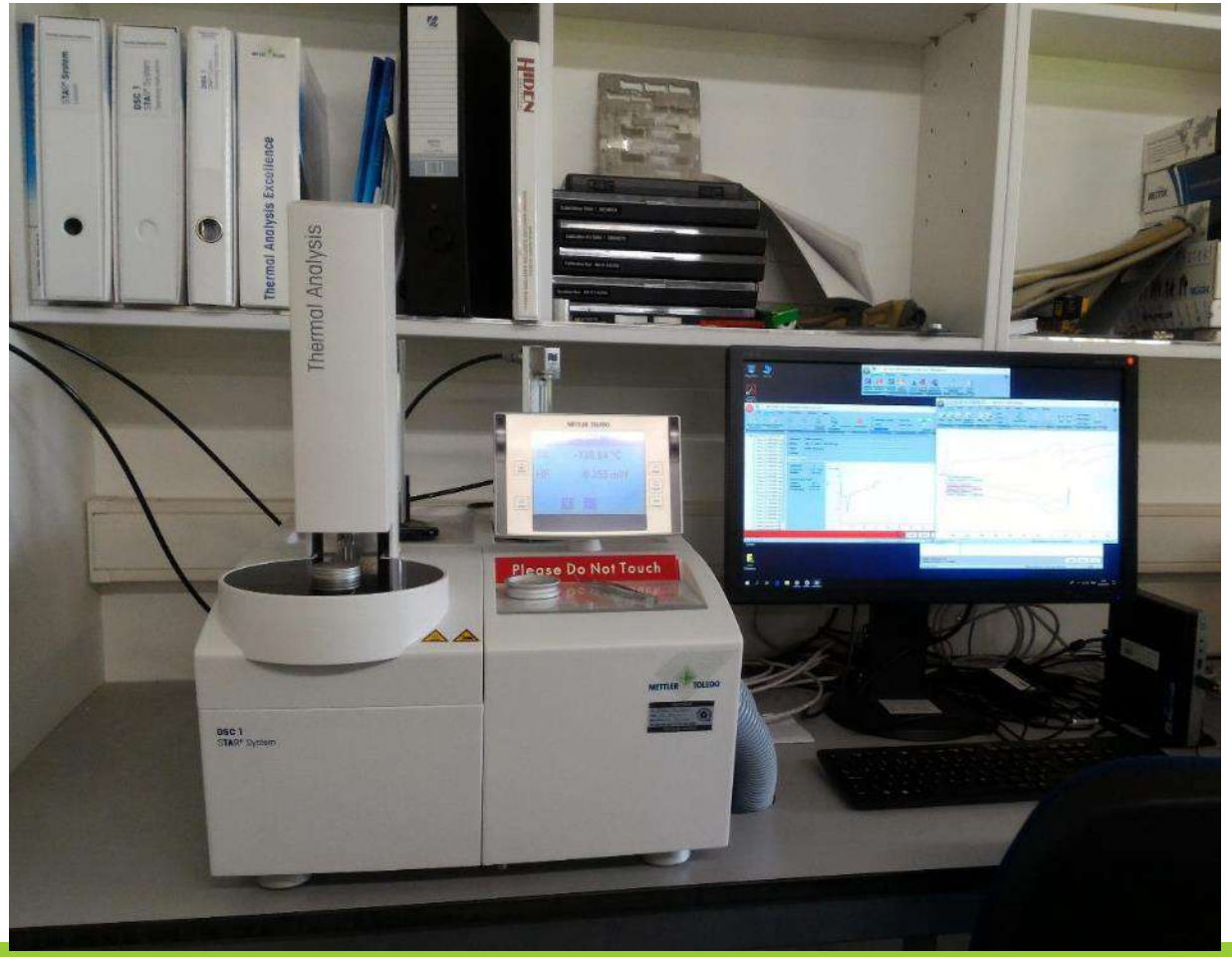
Pre-treatments: no treatment.

Germination medium: 3 sheets of sterilized filter paper (Munktell grade 292, 87 g/m^2), imbibed with 6 ml of sterilized distilled water.

Sample size: 100 seeds (25 × 4 replicates).

Germination	Thermoperiod	Photoperiod [light/dark]	T_c [d]	T_{50} [d]	T_{max} [d]	MTG [d]
90%	constant 10°C	12/12h	5.0	15.2	14	5.8
88%	constant 15°C	12/12h	3.0	4.5	16	6.0
84%	constant 20°C	12/12h	3.0	3.4	10	4.0

Seed longevity and ecophysiology studies to inform *ex situ* conservation



Research in collaboration with the Millennium Seed Bank

Objectives

1. to define the storage performance of seeds
2. to characterize biophysically the crystallization/melting patterns of seeds by thermal profiling in Differential Scanning Calorimetry (DSC) results (at MSB)
3. to predict the optimal storage temperatures for long term conservation of seeds, likely by avoiding freezing damage promoted by lipid crystallization and melting (detection by DSC) (at MSB).

Seeds for Future

A proposal for a global wild plant seed vault in Antarctica

- ✓ 43.7% of the world's plant species are threatened with extinction (State of the World's Plants and Fungi 2020).
- ✓ The global wild plant seed vault in Antarctica will provide a long-term security backup (extinction-proofing) for the most threatened plant species in the world to be used as the last option for saving species, just in case of necessity such as catastrophic events.
- ✓ Storage within ice caves (5 x 15 m, 5 m high) with a constant temperature of –56°C.
- ✓ The ice caves will host intermodal containers equipped with shelves for long-term storage.
- ✓ Safe storage of up to 40,000 seed-lots will be guaranteed using cryogenic containers, preserved in sealed steel boxes.
- ✓ Storing seeds in Antarctica offers guaranteed long-term seed preservation using 100% 'natural' storage, requiring no energy consumption for refrigeration and protecting the precious samples from any risk of disruption to refrigeration (technical problems, economic crisis, conflicts, acts of terrorism, etc.).

Among the letters of support: IUCN/SSC

IUCN SSC Species Survival Commission

IUCN Species Survival Commission
Calle La Joya con Avenida Libertador,
Unidad Técnica del Este, piso 10, oficina 29-30
Chacao ZP 1060, Caracas
Venezuela

Tel. +58 212 2637240

jonpaul.rodriguez@iucn.org
www.iucn.org/species

Prof. Silvano Onofri
President of the Italian Scientific Commission for Antarctica

Dr. Sara Magrini
President of RIBES, the Italian Network of Seed-Banks

8th April, 2021

Dear Professor Silvano Onofri and Dr. Sara Magrini,

The Species Survival Commission (SSC) of the International Union for Conservation of Nature (IUCN) is a science-based network of more than 10,000 volunteer experts from almost every country of the world, all working together towards achieving the vision of, "A just world that values and conserves nature through positive action to reduce the loss of diversity of life on earth". The IUCN SSC Seed Conservation Specialist Group, proposed at the World Conservation Congress in 2016 and inaugurated in 2017 under the IUCN SSC, is a global community of seed conservation specialists with over 100 members. Our mission is to promote seed conservation by providing a network for knowledge-sharing in different ecosystems around the world, and aiding in prioritization, capacity building, and development of best practices. As such, seed conservation through long-term seed banking to combat ongoing loss of plant diversity at both genetic and species levels is at the heart of our interests.

We are writing this letter in support of the proposal to establish a global wild plant seed vault in Antarctica which aims to provide a long-term security backup for endangered species and their genetic diversity. Antarctica can be the most reliable, natural freezer in the world and a seed vault placed there can function as an important repository, which can significantly contribute to reducing risks and improving the status of biodiversity by safeguarding genetic diversity.

This proposal has arisen within the Italian Scientific Commission for Antarctica and the Italian National Program for the Antarctic Research and is ratified by the Italian Network of Seed Banks and the Network of Mediterranean Plant Conservation Centres. Both the Seed Conservation Specialist Group and the broader IUCN SSC also consider the proposal to be of utmost importance for the conservation of plant diversity and the future of our planet. Thus, we are pleased to add our collective voice and fully endorse the "Seeds for Future" global wild plant seed vault in Antarctica initiative.

Sincerely,

Jon Paul Rodríguez, Ph.D.
Chair, IUCN Species Survival Commission

Marian Chau, Ph.D. and Uromi Goodale, Ph.D.
Co-Chairs, IUCN SSC Seed Conservation Specialist Group, iucn-scsg@outlook.com

@IUCNssc @IUCNssc @IUCNssc

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@IUCNssc @IUCNssc @IUCNssc

In Detail
Diplomatic network
Events
Press Releases
Dalla Farnesina

Della Vedova meets the National Scientific Committee for Antarctica

Date: 06/10/2021

The Deputy Minister responsible for matters regarding Antarctica, Benedetto Della Vedova, met today, by videoconference, the members of the National Scientific Committee for Antarctica (CSNA), a body which, under the control of the Ministry of Universities and Research, supervises the implementation of the National Programme for Antarctic Research (PRNA).

Della Vedova stressed that "Italy boasts an extraordinarily significant scientific presence in Antarctica, which the government has the duty to adequately enhance and support in the future". As the Deputy Minister pointed out, the two initiatives that will be presented at the forthcoming Antarctic Assembly (14-24 June 2021), chaired by France, bear witness to Italy's scientific commitment in the continent and its particularly qualified contribution to research there: the results of the surveys conducted on the biodiversity of the Ross Sea Marine Protected Area, and the innovative project for the conservation of endangered plant seeds. The Deputy Minister also referred to the expansion of international tourism in Antarctica before the outbreak of the pandemic, which has reached almost 60,000 visitors in 2019. A phenomenon that will have to be carefully monitored and regulated, he added, because of its potential repercussions on the continent's environment.

cement of scientific research and the protection of the environment and biodiversity in the stem of the Antarctic Treaty, will benefit from the renewed commitment of the United greater attention paid to environmental issues. In this regard, he emphasised the important Conference convened within the framework of the Commission for the Conservation of LR), in which he participated along with, among others, the US Special Presidential Envoy the US, along with New Zealand, announced its co-sponsorship of proposals to establish two new Marine Protected Areas by the EU Commission and Member States (and already co-sponsored by the UK, Australia, Norway and Uruguay), a clear demonstration of commitment to Antarctica's marine biodiversity.

Seeds for Future is strongly supported by the Italian Foreign Office

XLIIIE RÉUNION CONSULTATIVE DU TRAITÉ SUR L'ANTARCTIQUE

PARIS JUIN 2021

ENG

Agenda Item: ATCM 15a, CEP 10a
Presented by: Italy
Original: English
Submitted: 6/5/2021

Seeds for Future
Global Wild Plant Seed Vault

Opinion paper presented by the Italian Ministry of Foreign Affairs to the Antarctic Treaty Consultative Meeting in Paris, June 2021

IP 37

Seeds for Future

Global Wild Plant Seed Vault

Information Paper submitted by Italy

1. Summary

The purpose of this paper is to present the Seeds for Future (SFF) project within the framework of the Antarctic Treaty Consultative Meeting (ATCM) for establishing a Global Wild Plant Seed Vault in the Antarctic Plateau ice depth.

According to the *State of the World's Plants 2020*, the total number of known wild vascular plant species is about 350,000 but scientists say that 43.7% of all plant species (more than 150,000) are likely threatened with extinction. Several seed banks have been established in the World, preserving the germplasm of hundreds of thousand species. The rationale of preserving seeds of endangered plants in Antarctica lies in the possibility to recover extinct species in the event of the loss of germplasm stored elsewhere.

2. Background

Banking the world's seeds will give an insurance policy against the extinction of plants in the wild and protects our botanical heritage for future generations.

Establishing a *Global Wild Plant Seed Vault* in Antarctica, the most reliable natural freezer, is an effort to secure the safe storage of seeds of the most threatened plant species in the world, contributing to the Global Strategy for Plant Conservation and tackling the challenges of food security, sustainable energy, loss of biodiversity and climate change.

The SFF project idea was launched in Italy and France in 2019. Its international dimension has grown with the declaration of support of the IUCN Species Survival Commission which "*…consider the proposal to be of utmost importance for the conservation of plant diversity and the future of our planet*", and of national and international seed bank networks.

nity is now working to make it a global initiative in the coming years.

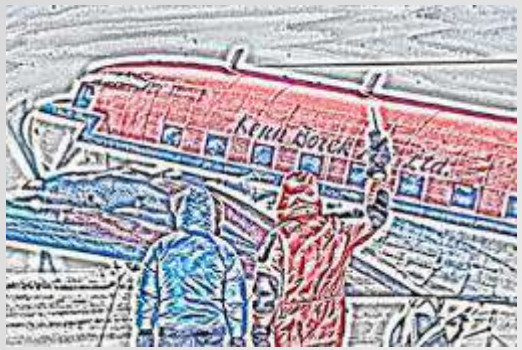
ect, a governance plan, agreed by the ATCM parties, is needed to contribute f threatened wild plants in Antarctica, particularly to ensure this complies Madrid Protocol.

reatened plants from all over the world before their extinction.

- Store these seed lots on a long-term basis (possibly hundreds of years) for future generations of scientists and humanity in general.

Programma Nazionale
di Ricerche in Antartide

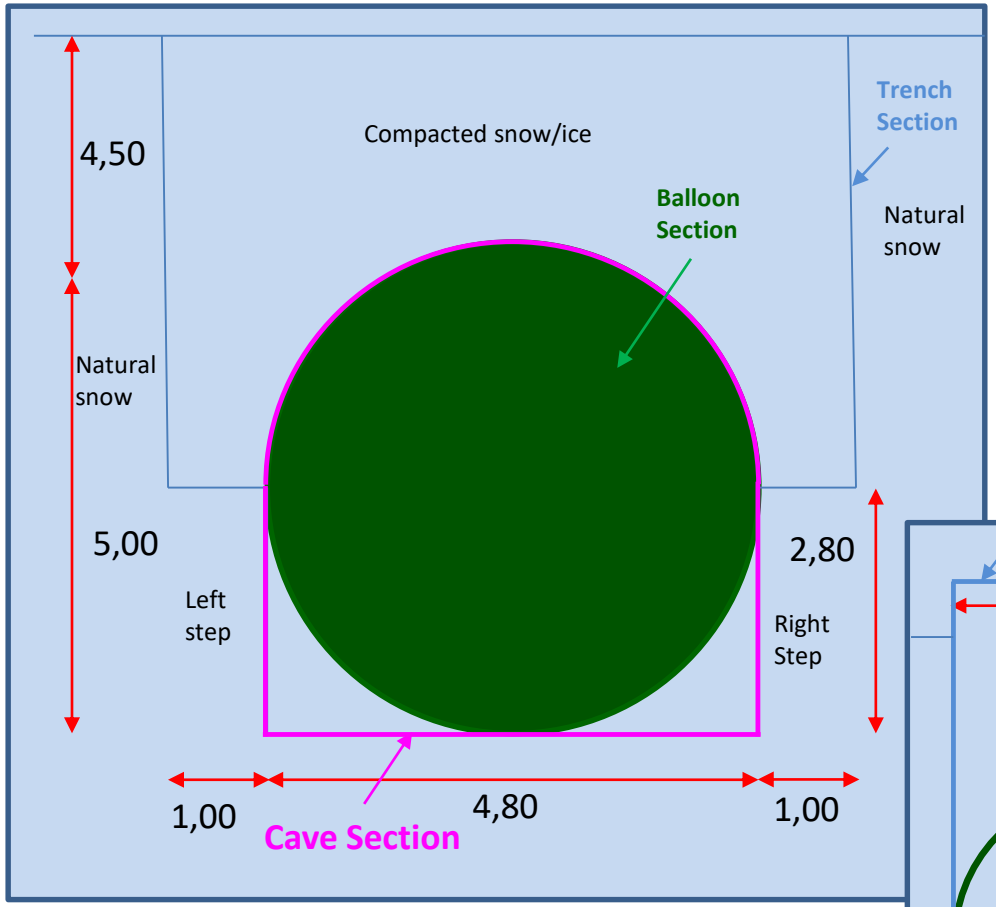
BALLOON CAVE PROJECT AT CONCORDIA

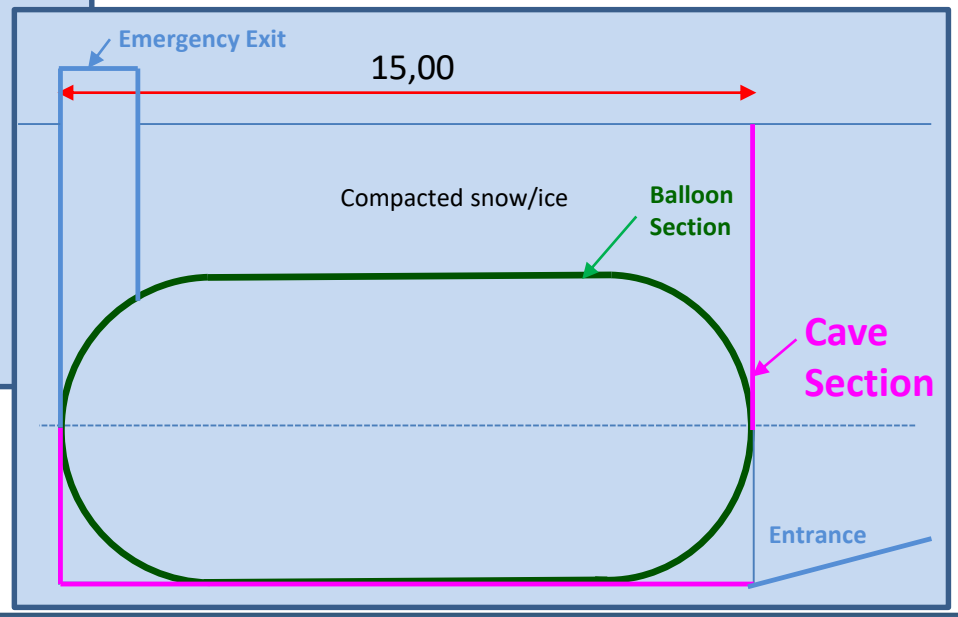


Rocco Ascione
ROCCO.ASCIONE@enea.it

balloon cave project

Layout





balloon cave

Equipment and Set-up….


LYSKI


POLAIRE


PROGRAMMA NAZIONALE DI RICERCHE IN ANTARTIDE
ITALIANTARTIDE


PROGRAMMA NAZIONALE DI RICERCHE IN ANTARTIDE
ITALIANTARTIDE

Foto di Warren Cairns (CNR-ISP)

Thank you for your attention!