



ProPartS - Developing strategies for the protection of taxa consisting of interconnected sexual and parthenogenetic reproducing strains



**biodiversa+**  
European Biodiversity Partnership



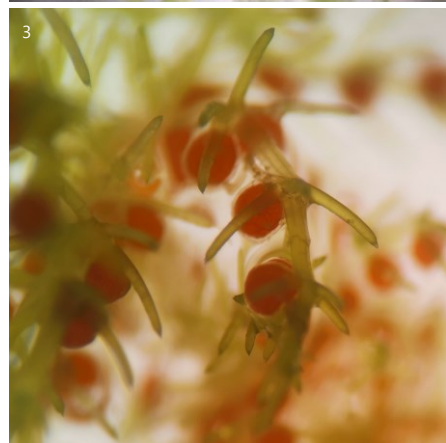
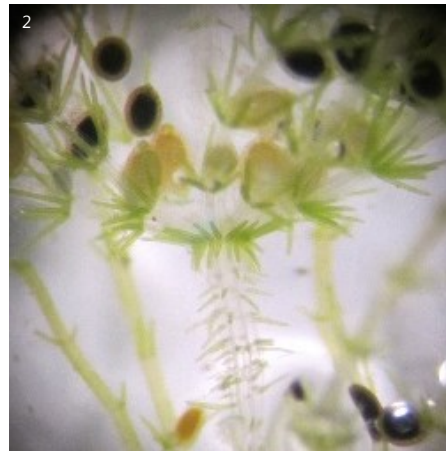
## THE GENERAL TOPIC

The loss of genetic diversity is considered a key element in entering the extinction vortex. Shrinking population size reduces the number of genetic variants available to cope with changes in habitat conditions. Together with other factors such as genetic drift, this loss progressively decreases the fitness of any given species.

This is especially true for asexually reproducing species, where recombination of traits is limited to the genetic variability of a single parent. The conservation of genetic diversity is thus a central element of conservation concepts.

In species where asexual and sexual populations occur, it is important to assess genetic diversity and genetic structure to identify priority conservation areas.

1. *Chara canescens*: a female plant (sc)
2. Detail of a female (parthenogenetic) individual, with oogonia and oospores (at)
3. Detail of a male individual, with antheridia (jb)
4. European distribution of *Chara canescens* (hk)
5. Detail of a oogonium (at)
6. One of the typical habitats of *C. canescens*: coastal brackish ponds and lagoons (at)



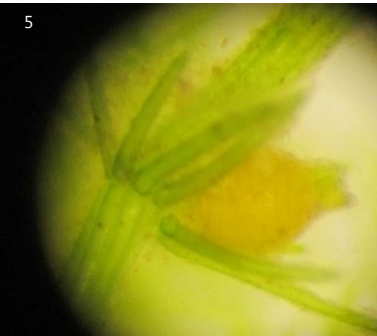




## THE TARGET SPECIES

In this project, *Chara canescens*, a stonewort alga, is studied. This species has mostly asexually reproducing populations, but also a few sexually reproducing populations. The asexual populations are widespread and found throughout Europe, with populations also known from North America, Australia and Central Asia.

The sexual populations are very rare and scattered, with only 5 sites currently known, all of them in Europe.



## THE HABITAT

*Chara canescens* is the only true brackish water species (i.e. unable to grow under freshwater as well as marine conditions) in its genus.

Parthenogenetic populations occur in brackish habitats in coastal lagoons and ponds, both permanent and temporary; sexual reproducing populations are restricted to European inland brackish water sites.



## PROJECT RATIONALE

Previous projects have shown that the asexual populations of *Chara canescens* have a higher genetic diversity than assumed. These results have led to the establishment of the following hypothesis: "Species consisting of linked sexual and asexual populations can overcome the risk of loss of genetic diversity as long as efficient transfer of genotypes between populations is ensured". So far, little is known about the connections between sexual and asexual lineages of a species.

All this together is the basis for the present project, which aims to clarify the extent to which populations from different regions and with different reproductive strategies are connected or whether genetic exchange takes place.

In order for an exchange and thus a coherent network of populations to be possible, stepping stone biotopes between the populations are necessary.

In these biotopes, the charophyte populations must be kept fit and lost stepping stone biotopes as well as former sites of sexually reproducing populations might still contain diaspores banks that can be revitalised to increase stability under climate change conditions.

**1.** The Pergusa Lake in Sicily, a shallow lake with brackish waters where one of the few sexual populations of *Chara canescens* has been reported (tp)

**2.** Preparation of a herbarium specimen from freshly collected charophytes (jb)

**3.** Detail of a *C. canescens* oogonium from a herbarium specimen (at)







In the framework of this project, we will gather the knowledge necessary for the development of transnational conservation strategies. Based on this, we will establish a network for the sustainable conservation of a species composed of extremely rare bisexual and common parthenogenetic populations. For this, field work at recent sites as well as analysis of herbarium material will be carried out to unravel recent and past gene flow within and between populations.



## THE KEY ACTIONS OF THE PROJECT

The key activities will be:

- (1) to identify former and recent inland brackish water sites suitable for sexually and parthenogenetically reproducing populations;
- (2) to gain knowledge on recent and past genetic diversity of the target species;
- (3) to evaluate the potential of a few sexual populations in sustaining the genetic diversity of the widespread parthenogenetic populations.

These data will provide a sound scientific basis for the ultimate goal, which is to develop management plans for inland brackish water sites that meet the requirements of *Chara canescens* embedded in a transnational network of sites with sexually mature populations, and focus on maintaining effective gene flow.

**1.** Sampling *Chara canescens* in the Austrian sexual population (jb)

**2.** Looking for *C. canescens* in Sicilian temporary ponds (at)

**3.** Sampling *C. canescens* in the Austrian site (aa)

**4.** Male plants of *C. canescens* in the Austrian site (jb)

1





2



## FURTHER DEVELOPMENTS

To our knowledge, no investigations about the role of maintained bisexual ancestor populations for long-term success of parthenogenetic reproducing pioneer populations have been performed so far, targeting on the development of a transnational protection scheme. Once developed, such scheme will serve as a model for other parthenogenetic taxa as well as species with very fragmented ranges of occurrence.

3



4



This research was funded by Biodiversa+, the European Biodiversity Partnership under the 2021-2022 BiodivProtect joint call for research proposals, co-funded by the European Commission (GA N°101052342) and with the funding organisations Deutsche Forschungsgemeinschaft e.V. (Germany), Agencia Estatal de Investigación, Fundación Biodiversidad (Spain), Ministry of Universities and Research (Italy), Österreichischer Wissenschaftsfonds FWF (Austria).

Project partners:

**Prof. Hendrik Schubert, Dr. Arne Schoor, Claudia Lott, Birgit Munzert and Johanna Weitzel**, University of Rostock (Germany), Institute for Biosciences, Chair of Aquatic Ecology.

**Prof. Maria A. Rodrigo and Adriana Arnal**, University of Valencia (Spain), Cavanilles Institute for Biodiversity and Evolutionary Biology.

**Prof. Pablo Garcia Murillo**, University of Sevilla (Spain), Department of Plant Biology and Ecology.

**Prof. Riccardo Guarino, Dr. Angelo Troia, Prof. Vincenzo Ilardi**, University of Palermo (Italy), Department of Biological, Chemical and Pharmaceutical Sciences and Technologies (STEBICEF).

**Prof. Karl-Georg Bernhardt, Dr. Karin Tremetsberger and Dr. Barbara Turner**, University of Natural Resources and Life Sciences, Vienna (Austria), Department of Integrative Biology and Biodiversity Research.

#### REFERENCES

- Calero S. & Rodrigo M.A.** 2017. The life cycle of a parthenogenetic population of *Chara canescens* from an interdunal Mediterranean pond. *Botany Letters* 165(1): 55-65.
- Guarino R., Marcenò C., Ilardi V., Mannino A.M. & Troia A.** 2019. One *Chara* does not make *Charatea* in the Mediterranean aquatic vegetation. *Webbia* 74: 139-147.
- Holzhausen A., Porsche C. & Schubert H.** 2017. Viability assessment and estimation of the germination potential of charophyte oospores: testing for site and species specificity, *Botany Letters* 165(1): 147-158.
- Kúr P., Pišová S., Tremetsberger K., Dřevojan P., Kački Z., Böckelmann J., Bernhardt K.G., Hroudová Z., Mesterházy A. & Sumberová K.** 2021. Ecology and genetics of *Cyperus fuscus* in Central Europe—A model for ephemeral wetland plant research and conservation. *Water* 13: 1277.
- Rodríguez-Merino A., Fernández-Zamudio R. & García-Murillo P.** 2019. Identifying areas of aquatic plant richness in a Mediterranean hotspot to improve the conservation of freshwater ecosystems. *Aquatic Conservation: Marine and Freshwater Ecosystems* 29(4): 589-602.

IMAGE CREDITS: Adriana Arnal (aa); Julian Bohme (jb); Sara Calero (sc); Heiko Korsch (hk); Toni Puma (tp); Angelo Troia (at); Klaus van de Weyer (kw).

FOR FURTHER INFORMATION, PLEASE CONTACT:

**Chair of Aquatic Ecology of the University of Rostock**, Albert-Einstein-Straße 3, 18059 Rostock, Germany. <https://www.oekologie.uni-rostock.de/en/> (hendrik.schubert@uni-rostock.de)

**Department STEBICEF of the University of Palermo**, Unit of Field Botany and Ecophysiology, via Archirafi 38, 90123 Palermo, Italy. <https://www.unipa.it/dipartimenti/stebicef/index.html> (angelo.troia@unipa.it)