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Translocation of *Dianthus rupicola* Biv. subsp. *rupicola* in the Nature Reserve “Isola Lachea e Faraglioni dei Ciclopi”, Sicily, Italy

Gian Pietro Giusso del Galdo*, Cristina Blandino, Veronica Ranno & Saverio Sciandrello
Department of Biological, Geological and Environmental Sciences, University of Catania,
via A. Longo 19, Catania, Sicily, Italy * - g.giusso@unict.it

Introduction

Dianthus rupicola Biv. subsp. *rupicola* (fam. *Caryophyllaceae*) is an endemic species of southern Italy (Campania, Basilicata and Calabria) and Sicily. It is a chasmophyte that grows on steep rocky outcrops and coastal cliffs within the thermo- and meso-Mediterranean bioclimatic belts, from sea level up to about 800 m a.s.l. It forms small shrubs with erect stems and pink flowers that appear from late spring to autumn (Pignatti, 1982). Flowers are insect pollinated and seeds are dispersed by gravity, lacking clear long distance dispersal mechanisms. In Sicily, *D. rupicola* subsp. *rupicola* is found mostly on carbonatic substrates, except for a couple of very few-numbered populations growing on volcanic rocks located in the north-eastern sector of the island. This taxon is included in the Annex II and IV of the Habitat Directive (92/43/EEC) and is listed in the category “Least Concern” in the Red List of the Italian Flora (Rossi *et al.*, 2013) while the species is evaluated as “Near Threatened” at European level (Bilz *et al.*, 2011). The main threat to *Dianthus rupicola* subsp. *rupicola* is represented by habitat modification, both in terms of rock quarries or urban sprawl (e.g. touristic infrastructures, etc.) and, likely most severe, by invasive alien species (IAS) as, for example, *Opuntia* sp. pl.

Goals

- Seed collection, development of germination protocols and plant production (nursery).
- Establishment of a new population within the Nature Reserve “Isola Lachea e Faraglioni dei Ciclopi” (eastern Sicily).
- Eradication of invasive alien species (mostly *Opuntia ficus*



Close-up of *Dianthus rupicola* flower



-*indica* L.) in an area of ~10,000 m².

- Restoration of the natural vegetation within the reserve using native species (e.g. *Euphorbia dendroides* L., *Matthiola incana* L., *Olea europaea* L. var. *sylvestris*, *Pistacia lentiscus* L. and *Rhamnus alaternus* L.).
- Implementation of a long-term monitoring plan.

Success Indicators

- Achievement of a germination percentage >85% for the seeds collected and used in the project.
- Production of 300 plants from seeds (sampled on volcanic population) to be used for the introduction.
- Establishment of viable population of *Dianthus rupicola* subsp. *rupicola* in the Nature Reserve “Isola Lachea e Faraglioni dei Ciclopi”.
- Establishment of viable populations of *Euphorbia dendroides*, *Matthiola incana*, *Olea europaea* var. *sylvestris*, *Pistacia lentiscus* and *Rhamnus alaternus*.
- Reduction (75%) of the area invaded by IAS.

Project Summary

Feasibility: In Sicily, there are just two populations of *Dianthus rupicola* subsp. *rupicola* growing on volcanic substrates. One is located within the SCI ITA 070004 “*Timpa di Acireale*” and another one is found close to the Vallone Calcarone (Militello Val di Catania). Both are threatened by soil erosion and by invasive alien species, particularly by *Opuntia ficus-indica*. The loss of habitat and the competition with invasive alien species are, globally, recognized among the major drivers of biodiversity loss. To address these points within the CARE-MEDIFLORA project and to preserve the unique adaptation of the “*Timpa di Acireale*” population, we decided to introduce this genotype to a nearby volcanic islet, namely Isola Lachea, falling within the Nature Reserve “Isola Lachea and

Faraglioni dei Ciclopi”.

The Lachea islet has been managed as a private property for part of its history and there is still plenty of exotic vegetation on it.

Therefore, the introduction of *Dianthus rupicola* subsp. *rupicola* has to be coupled with the restoration of the native vegetation and the eradication of invasive alien species.



Transplanted *Dianthus rupicola* plant



Our target species was absent from the islet, but the environmental conditions are suitable for it, and may have occurred here in the past. Currently, the introduction area is managed by CUTGANA, an institution devoted to the management and conservation of natural ecosystems. All the actions (eradication of IAS, plants introduction, natural vegetation restoration, and long term management plan) have been agreed and realized by us, in collaboration with CUTGANA.

In order to maximize the survival rate of the introduced specimens, we planted both juvenile plants and seeds. The plants were produced from seeds collected from the population of “Timpa di Acireale”, previously tested at the Seed Bank of the University of Catania to assess their viability and germination requirements.

Finally, the location of the introduction site within a protected area and the involvement of the CUTGANA staff will ensure the protection of the new population and the monitoring of invasive species.

Implementation: The Botanic Garden of the University of Catania, in collaboration with a private company, provided the facilities and the expertise to produce *Dianthus rupicola* subsp. *rupicola* from seed. In addition, plants of *Euphorbia dendroides*, *Matthiola incana*, *Olea europaea* var. *sylvestris*, *Pistacia lentiscus* and *Rhamnus alaternus* have been produced for the habitat restoration.

Before reintroducing the plants, the manual eradication of *Opuntia ficus-indica* from about 10,000 m² of the nature reserve was carried out with the support of a specialized company, CUTGANA personnel and staff from the University of Catania. Eradication of *Opuntia ficus-indica* was not performed on the steepest cliffs, also for not causing slope instability, but the nature reserve is being thoroughly monitored for any establishment or resprouting of *O. ficus-indica* in the eradicated areas. On February 2018 and March 2019 the planting of *Dianthus rupicola* subsp. *rupicola*, as well as of *Euphorbia dendroides*, *Matthiola incana*, *Olea europaea* var. *sylvestris*, *Pistacia lentiscus* and *Rhamnus alaternus* have been carried out.



Transplanting *Dianthus rupicola* plants in cleared sites



Eradicating *Opuntia* cactus (left) and cleared transplant site (right)

Post-planting monitoring:

- The survival rate of introduced individuals is our success indicator both for the introduction of *Dianthus rupicola* subsp. *rupicola* and for the habitat restoration.
- Number of surviving individuals will be periodically counted on sample areas.
- Since the end of the project, the site will be monitored twice a year by the staff of CUTGANA in collaboration with the University of Catania.
- The area where *Opuntia ficus-indica* was eradicated will be also monitored by the staff of the nature reserve and, if necessary, new eradication actions will be implemented.

Major difficulties faced

- Removal of *Opuntia ficus-indica* from the whole reserve.
- Irrigation of the newly planted specimens, due to scarcity of water available in the islet.
- Restoration of the steepest cliffs of the Nature Reserve.
- Excessive presence of rats and seagulls.
- Reachability of the islet in some periods of the year (i.e. autumn - winter).

Major lessons learned

- Before introducing a population to a new site, the habitat has to be restored to the appropriate conditions for the species to be introduced.
- The use of juvenile plants instead of seed is more effective.
- Development of germination and cultivation protocols for the species to be reintroduced is fundamental.
- Occurrence of potential damaging animals has to be monitored.



Success of project

Highly Successful	Successful	Partially Successful	Failure

Reason(s) for success:

- Lack or scarcity of water.
- Excessive summer drought may reduce survival rate of the plants.
- Control of potential damaging animals, e.g. rats.

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