



Translocation of *Gennari milkvetch* on Mount Albo, Lula, Central-Eastern Sardinia, Italy

Giuseppe Fenu¹, Maria Silvia Pinna¹, Donatella Cogoni¹, Alba Cuena-Lombrana^{1,2}, Mauro Fois¹ & Gianluigi Bacchetta^{1,2}

¹ - Centro Conservazione Biodiversità (CCB), Dipartimento di Scienze della Vita e dell'Ambiente, Università degli Studi di Cagliari, Viale S. Ignazio da Laconi 13, I-09123 Cagliari, Italy gfenu@unica.it; mspinna@unica.it

² - Hortus Botanicus Karalitanus (HBK), Università degli Studi di Cagliari, Viale Sant'Ignazio da Laconi 9-11, I-09123 Cagliari, Italy

Introduction

Astragalus gennarii Bacch. et Brullo (Fabaceae) is a dwarf shrub forming a dense, compact, spiny cushion, 20 - 80 cm tall. It is characterized by woody stems, densely branched, with persistent stipules and rachis in the old parts of the branches. Imparipinnate leaves, raceme 2 - 4 flowered and corolla white to yellowish. Seeds are reniform, brown-olivaceous, often blotched, smooth and laterally compressed. The flowering season of *A. gennarii* occurs from May to June, and fruits mature from June to July (Bacchetta & Brullo, 2006). *Astragalus gennarii* is an extremely narrow endemic plant to CE-Sardinia, with a single population, consisting of approximately 40 - 45 mature individuals, that grows on Mesozoic limestones in a restricted area of Monte Albo (Punta Turuddò, Lula; Bacchetta & Brullo, 2006; Cogoni *et al.*, 2014).

Currently this plant species is not listed in any international, national or local regulations (Cogoni *et al.*, 2014), however, due to the low number of reproductive individuals and for its narrow distribution, *A. gennarii* was assessed as Critically Endangered (CR) at global and regional level (Cogoni *et al.*, 2014; Orsenigo *et al.*, 2018).

Goals

- To introduce plants in sites less affected by landslide phenomena and human disturbance.
- To increase the population size, and specifically, to boost the number of mature individuals.
- To increase the



Astragalus gennarii in typical habitat
© Gianluigi Bacchetta



probability of population survival and the reproductive rate.

- To determine the conditions for a successful reintroduction of this species.
- To make the results of this project available for future plant reintroduction trials in the Sardinian and Mediterranean context.

Success Indicators

- Long-term survival rate of transplanted individuals.
- Plant growth and plant development patterns.
- Flowering and fruiting rates of the established plants (from the third year).
- Number of established seedlings.
- Number of recruited seedlings becoming reproductive (from the third year).

Project Summary

Feasibility: *Astragalus gennarii* is a chamaephytic spiny cushion, whose pulviniform habit is an adaptation to the ecological characteristics of the dry and windy habitats, typical of the Mediterranean mountains where the species occurs at ~700 - 1,055 m a.s.l. (Bacchetta & Brullo, 2006; Cogoni *et al.*, 2014). From a bioclimatic point of view, the species falls in the Mediterranean pluviseasonal oceanic bioclimate, between the upper meso-Mediterranean and lower supra-Mediterranean thermotype and upper sub-humid ombrotype (Bacchetta & Brullo, 2006). *Astragalus gennarii* is an orophilous plant species that grows in dwarf shrub communities belonging to the *Carici caryophylleae-Genistetalia lobelii* Klein 1972 (Bacchetta & Brullo, 2006; Cogoni *et al.*, 2014), associated with other endemic species such as *Cerastium supramontanum* Arrigoni, *Cephalaria mediterranea* (Viv.) Szabó, *Sesleria insularis* subsp. *barbaricina* Arrigoni, *Santolina corsica* Jord. *et* Fourr., *Brassica insularis* Moris, *Dianthus sardous* Bacch., Brullo, Casti *et* Giusso, *Clinopodium sardoum* (Asch. *et* Levier) Peruzzi *et* F.Conti, *Stachys corsica* Pers. (Bacchetta & Brullo, 2006). This plant community can be related to the habitat of community interest "Endemic oro-Mediterranean heaths with gorse" (Code 4090), subtype 31.75 - Cyrno-Sardinian hedgehog-heaths. Secondly, some individuals grow at the edge of the *Quercus ilex* L. forest or in garrigues dominated by *Cistus* spp.

Astragalus gennarii is an extremely narrow endemic plant to central-eastern Sardinia and, according to the regional responsibility criterion, deserve particular interest of conservation. The main threats to the unique small population of *A. gennarii* are principally represented by natural factors (landslides processes), and negative effects of unregulated grazing, and by tourist and recreational activities, in particular hikers. These threats could cause a reduction of the population and modifications in the habitat quality (Cogoni *et al.*, 2014). In order to increase the number of mature plants, the translocation was planned as a reinforcement of the existing population (Fenu *et al.*, 2019).

Implementation: The translocation of *A. gennarii* has been carried out in an ecologically suitable site near the natural population, where the main threats,



related to landslide phenomena, unregulated grazing and human disturbance, were less important. All preparatory activities of *A. gennarii* translocation (e.g. site management actions and fence erection in order to prevent grazing) were started in April 2017, but due to the adverse weather conditions the translocation was postponed for the



Translocation by forestas staff © Giuseppe Fenu

following year. In the first phase, seeds of *A. gennarii* were directly collected in 2016 from the remnant plants and, at the same time, stored in the Sardinian seedbank (BG-SAR) for future recovery or restoration programs and to implement an “active collection”, which might be used in the future for producing further plants.

The plants of *A. gennarii* were multiplied in a public nursery of Forestas Agency (Agenzia Forestale Regionale per lo Sviluppo del Territorio e l'Ambiente della Sardegna, Autonomous Region of Sardinia) located near the natural population, by both vegetative stems and from seeds. In both cases, the substrate of the pots was taken from the natural population area and no horticultural treatments were adopted; all survived plants were cultivated in nursery for 2 years before the transplantation. In February 2018, after a suitable area was selected and fenced in order to reduce the unregulated grazing and the human disturbance; some preliminary management actions (e.g. natural vegetation removal, superficial plowing of the land, etc.) had been done to open suitable spaces to reintroduce the transplants (Fenu *et al.*, 2019). In early March 2018, overall 350 plants were transplanted in the selected site with the support of the staff of the public administration of Forestas. Each transplanted plant has been labelled for following monitoring activities (Fenu *et al.*, 2019).

Post-plantation monitoring: The management actions, in particular the natural vegetation control and the restoration of the protective fence damaged by wild and domestic animals, were regularly continuing. Finally, a species-specific monitoring protocol was planned and implemented for this translocation, in order to ensure its sustainability. In particular, during the first two years, all transplanted plants were monthly monitored from March to December, recording the growth, the survival rate of transplanted plants and the effectiveness of fence protection in the selected site. Flowering and reproduction outputs of the established plants and number of new established seedlings are planned to be monitored after 3 years from the transplanting action. Starting from the second year after the release, the monitoring activities will be carried out six times per year (bimonthly).



From the start of owering of the transplanted individuals, the phenological parameters will be also measured, in order to determine the long-term sustainability of the *in situ* actions. Preliminary results of the monitoring indicated  high survivorship rate of the transplanted individuals.

Major difficulties faced

- *Suitable site selection:* As often happens, the best site falls into private land and the owners are not in favor of carrying out conservation actions like translocations.
- *Grazing and human limitation:* The suitable area is negatively affected by unregulated grazing and human disturbance that require specific protective measures to increase the survival probability of transplants.
- *Natural vegetation control:* The control of natural vegetation after the release often requires periodic management actions.
- *Summer drought:* The summer aridity represents a critical factor for plant persistence, in particular during the first years.
- *Management action post-planting and monitoring activities:* These activities require considerable economic resources, mainly due to personnel and travel costs.

Major lessons learned

- The selection of an appropriate area and microhabitat, often unique to the species, where the probability of plant survival and reproduction is greater, is the key to a successful reintroduction.
- The multiplication in nurseries for this plant species is easier and faster using vegetative stems rather than seeds.
- The plant multiplication in nurseries located near the selected areas reduces the probability of maladaptation of transplants.
- The management actions could be necessary even after the plant release and the related costs should be considered at the beginning of the translocation.
- The inclusion in the translocation program  public authorities, volunteers, and local stakeholders significantly improved  the successful of the program and determined  effective cost reductions .



Success of project

Highly Successful	Successful	Partially Successful	Failure

Reason(s) for success:

- High number of survived transplants.
- Positive impact of the fence to protect transplanted plants from the negative effects of unregulated trampling and grazing.
- Presence of numerous new seedlings.
- Collaborative support of public administrations and local stakeholders.

Acknowledgements

This translocation was carried out in the frame of the Care-Mediflora project (80% financially supported by the MAVA Foundation). The authors wish to thank all Forestas staff who gave an essential contribution to the Care-Mediflora project (<http://www.care-mediflora.eu/>).

References

- Bacchetta, G. & Brullo, S. (2006) Taxonomic revision of the *Astragalus genargenteus* complex (Fabaceae). *Willdenowia* 36: 157-167.
- Cogoni, D., Fenu, G., Porceddu, M. & Bacchetta, G. (2014) Schede per una Lista Rossa della Flora vascolare e crittogamica Italiana, *Astragalus gennarii* Bacch. et Brullo. *Informatore Botanico Italiano* 46: 93-152.
- Fenu, G., Bacchetta, G., Charalambos, S. C., Fournaraki, C., del Galdo, G. P. G., Gotsiou, P., Kyratzis A., Piazza C., Vicens M., Pinna M. S. & de Montmollin, B. (2019) An early evaluation of translocation actions for endangered plant species on Mediterranean islands. *Plant Diversity* 41(2): 94-104.
- Orsenigo, S., Montagnani, C., Fenu, G., Gargano, D., Peruzzi, L., Abeli, T., Alessandrini, A., Bacchetta, G., Bartolucci, F., Bovio, M., Brullo, C., Brullo, S., Carta, A., Castello, M., Cogoni, D., Conti, F., Domina, G., Foggi, B., Gennai, M., Gigante, D., Iberite, M., Lasen, C., Magrini, S., Perrino, E.V., Prosser, F., Santangelo, A., Selvaggi, A., Stinca, A., Vagge, I., Villani, M., Wagensommer, R.P., Wilhelm, T., Tartaglino, N., Duprè, E., Blasi, C. & Rossi, G. (2018) Red Listing plants under full national responsibility: Extinction risk and threats in the vascular flora endemic to Italy. *Biological Conservation* 224: 213-222.