

First phase of the re-introduction of *Silene hifacensis* (Caryophyllaceae) in Cap de Sant Antoni, Valencian Community, Spain

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Introduction

Silene hifacensis (Ifac Champion) is a Spanish endemic plant protected by the Bern Convention and the European Habitats Directive. It is a cushion-shaped perennial shrub up to 50 - 60 cm living on calcareous outcrops and coastal cliffs



Silene hifacensis (Ifac Champion) © E. Laguna

near the Mediterranean sea, forming meta-populations through two isolated areas (Blasco *et al.*, 2011): Balearic Islands (Ibiza: 695 individuals in 14 sub-populations) and the Iberian peninsula (Coast of NE Alicante, Valencian Community: 91 plants, 4 sub-populations). The Iberian population was considered extinct for a long time (Gómez-Campo & Malato-Béliz, 1985). It was rediscovered in 1987 near its original sites, but several unsatisfactory re-introduction projects have been undertaken. The species is absent from the two original sites described in the past (Cap de Sant Antoni [CSA] and Penyal d'Ifac [PDI]). This case-study is focuses on the re-introduction efforts in the CSA site, the native area of the lectotypus designated by Jeanmonod (1984). CSA is a coastal cape with a big vertical cliff (130 m). A decade ago a new 'donor' sub-population (7 individuals) was found on a small islet (Illot de la Mona [IDM],

0.067 ha, 19 m), placed 20 m far from the cliff foot, and 200 m south from the original site.

Goals

- **Goal 1:** Establishment of an *in situ* pool of reproductive individuals of *S. hifacensis*, on a site with recruitment possibilities (habitat availability, low predator pressure, low risk of accidental damages), as a first step for a long-term re-introduction project.
- **Goal 2:** Production of high amounts of seeds, in separated production lines from the Iberian sub-populations, in order to ensure the future sowing activities
- **Goal 3:** Depuration of a tested protocol for future sowing and plantations on vertical rocky falls.
- **Goal 4:** Progressive experimental contrast of plantation techniques (use of seeds vs. seedlings, vertical vs. sub-vertical substrata, best seedling age for plantations, etc.).

Success Indicators

- **Indicator 1:** Number of planted specimens.
- **Indicator 2:** Number of adult plants reaching the adult age (2 - 3 years).
- **Indicator 3:** Number of resistant individuals (2 - 3 years after plantation) undamaged by predators, accidental damages, etc.
- **Indicator 4:** Number of adult plants producing seeds *in situ*.
- **Indicator 5:** For the next re-introduction phases, number of recruited seedlings, to be found below the planted specimens.

Project Summary

Feasibility: The four known native sub-populations of *S. hifacensis* in the Iberian Peninsula are spread on 50 km of coastal cliffs from Xàbia to Calp (NE Alicante). All these sites are strictly protected as Valencian Plant Micro-Reserves (VPMR, see Laguna, 2000 and Laguna *et al.*, 2001), managed by the Biodiversity Service of the Generalitat Valenciana (regional government of the Valencian). *Silene hifacensis* is strictly protected by the Spanish and Valencian laws, and there is an official recovery plan, legally passed by the Valencian government in 2008. Both the receiver site CSA and the donor IDM, are also protected as VPMR, and they also form a part of the Nature Park 'El Montgó'. The species is a self-compatible plant with high germination (65 - 95%) and seed production rates (up to 1,000 - 10,000 seeds per plant in nursery crops).

The Iberian native sub-populations are compound by strictly rock-dwelling plants, living on vertical cliffs facing the sea. All the former re-introduction efforts undertaken on the Iberian native sites since the species re-discovery in 1987, failed to obtain new viable, permanent sub-populations. An artificial population in Denia (3 km north from CSA) introduced in 1992 and reinforced by 2003 on horizontal soils in a mixed rock/grassland/shrubland habitat yielded unsatisfactory results; the plants did not live more than 10 years and the recruited seedlings did not overpass two years in age.

Plants



Planting on the cliffs in Cabo de San

Antonio © E. Laguna

Another unsatisfactory re-introduction attempt in 1999, on vertical cliffs, where 3,200 seeds were sowed on the crevices and low cornices at two VPMRs of the Penyal d'Ifac (ca. 40 km south from the CSA site). Twelve years later the re-introduced population only holds two adult individuals but they are situated very close to the cliff bottom, where the new seeds cannot find available habitats to germinate. Formerly (1993 and 1996), plantation of adult or mid-aged plants completely failed on the same habitats, only remaining for 1 - 2 years.

These experiences gave us lessons on the choice of optimum micro-sites to try the re-introduction in CSA under similar climatic conditions, but advising against the use of combined

techniques (sowing and plantations) and water supplementation. The re-introduction goal for SCA site is to set up a new small viable pool of reproductive individuals of *S. hifacensis* just bordering the cliff crown cornice (130 - 135 m a.s.l.), occupying a unsuitable habitat for rabbits or rats which are exposed to seagull attacks. The site is also risky for human visitors (tourists, etc.) who can cause accidental damage to the plants. In order to ensure that the new seedlings can reach reproductive age, they should be supplemented with a regular water supply. As a long-term expected result, the flowering stems of the re-introduced plants could disperse their seeds on the available habitat, rock crevices and cornices, below them.

Implementation: Since 2008 the regional Biodiversity Service and the Nature Parks Service develops a joint project to produce separated seed pools from each one of the four Iberian sub-populations, in order to ensure future re-introductions using seeds from their native sites. In this way, 240 new adult mother plants have been obtained after cultivation during two years in four separated nurseries, no genetic crossing is possible, but it can be done in the future if advisable. The donor population (IDM) for CSA site only holds four accessible specimens able to harvest seeds, but they have shown a good germination rate. The IDM reproductive pool (50 adult plants) is maintained in the nursery of the same Nature Park El Montgó, and they produced more than 100,000 seeds in 2011.

The re-introduction strategy for CSA has been drafted combining initial sowing in crevices and rock-holes and its regular plant reposition using young seedlings on the failed microsites. The experience frame has been designed to make it possible a long-term monitoring testing the effect of microsite, plant age and predation. From October 2009 to February 2010 the Nature Park keepers, who are experienced rock-climbers, sowed 30 microsites (5 seeds per hole) along 250 m of the cliff crown. Afterwards regular reposition with seedlings has been required for 10 microsites; seedlings were formerly grown in micro-alveolus containers (1 - 2 cm wide). The regular visits to the site (at least 1 per month) are complemented with water supplementation during the drought periods.

Post-planting monitoring: Until the summer of 2011, 34 monitoring visits have been made, as well as intermediate interventions for water supplementation during the extreme drought periods. More than 200 seedlings have been planted during the reposition operations, apparently affecting the worst microsites for the species installation. During the spring of 2011, a total of 3 individuals (10% of the initial pool) produced flower stems and new seeds. Only sporadic episodes of predation have been reported, apparently made by snails.

Major difficulties faced

- The obtaining of seeds to initiate the pool of reproductive plants, due to the inaccessibility of the donor site.
- The plantation in high-risk conditions (tall vertical cliffs), as well as the periodical monitoring.
- The production of seedlings under new, unusual technical conditions (micro-alveolus, able to plant them afterwards in very tiny crevices or rock-holes).
- The *in situ* maintenance of seedlings with water supplementation, made by climbers.
- The finding of good micro-sites to sow or plant the seedlings. Most good sites are already occupied by other species; in the case of empty sites, we cannot easily know in advance the opportunities that they offer for a successful plantation.

Major lessons learned

- The establishment of a first reproductive pool to re-colonize the cliffs requires a huge human effort (plantation in high-risk conditions, regular assistance for watering and monitoring).
- The external appearance of rock-holes and crevices is not reliable to implant new seedlings (as a future challenge we should find new techniques to test these conditions before planting).
- The crown cornices at the top of tall coastal-cliffs seem to be a good habitat to try future projects (i.e. to enlarge the current population, or to generate close neo-populations).

Plants

Success of project

Highly Successful	Successful	Partially Successful	Failure
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Reason(s) for success/failure:

- The experience has been drafted to be only a first step for a successful re-introduction, in order to overcome the problems found in former re-introduction attempts to establish the first generation (*in situ* seed-producer plants). True success can only be tested after a long period i.e. to make regular monitoring climbing below the current plants along all the cliffs which are 130 m tall.
- The success of this first phase is due to the permanent work of the Nature Park keepers. In natural conditions (without human assistance) the regeneration would need millions of seeds.
- The site conditions, the cornice at the cliff top, is able to ensure a reduced access to predators and human visitors.
- Most micro-sites cannot be tested before the plantation (i.e. to know the soil or rock crevice deep); in this case at least 1/3 of the micro-sites (chosen because of their external good appearance) could really be unsuitable for a re-introduction.

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