‘Assisted reproduction’ as a tool for enhancing fitness and persistence likelihood of threatened plant populations

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Reproductive constraints and Conservation concern

- Pollen limitation
- Inbreeding depression
- Compatible mating

More severe reproductive limitations in small and isolated populations

Reproductive restrictions are more likely in target populations for conservation actions

Required measures to restore population fitness

ESSAY REVIEW
How general are positive relationships between plant population size, fitness and genetic variation?

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Plant Reproduction Investigation Tools (PRITs)

Fitness comparisons among plant lineages

A basic role is played by hand-pollinations (i.e. experimental breeding)
Commonly used in population biology studies

Not routinely integrated in conservation practices…. but their usefulness is widely encouraged [Maschinski et al. 2013; Orsenigo et al. 2017]
Integrating PRITs in population restoration programs as a form of ‘assisted reproduction’

1) Investigating and restoring pollination efficiency within target populations

2) Evaluating the potential for fitness improvement of intra-population assisted mating

3) Evaluating the potential for fitness improvement of inter-population assisted mating
Applying ‘assisted reproduction’ to rare *Dianthus* species

**D. balbisii** Ser.
- Rare in C-Mediterranean
- Conservation Status: NE
- Major threats: Locally threatened by habitat dynamics and urbanization, increasing fragmentation.

**D. guliae** Janka
- Endemic to Italian peninsula
- Conservation Status: EN
- Major threats: Occurrence in small and fragmented populations, Habitat changes, Declining EOO, AOO
MATING SYSTEM
- PROTERANDRY
- MALE-STERILITY
- SELFCOMPATIBLE BUT LIMITED SELF-FERTILIZATION

POLLINATION SYSTEM
- GENERALIST, INVOLVES MOTHS, BUTTERFLIES, AND FLIES

HABITAT
- EDGE-SPECIALISTS TYPICAL OF BORDERS BETWEEN WOODY AND OPEN PATCHES AT LOW/MIDDLE ELEVATION
1) Using *in situ* ‘assisted reproduction’ to evaluate and buffer habitat-driven fitness loss in *Dianthus balbisii*
- Qualitative and quantitative fitness loss with increasing canopy cover
- Hand-cross pollinations help in filling fitness gaps over the habitat gradient

[Gargano et al., 2017, AoBPlants]
2-3) Using intra- and inter-population assisted mating for restoring a threatened population of *Dianthus guliae*
Mortality patterns in lineages of *Dianthus guliae* obtained by inbreeding (upper side) and cross-fertilization (lower side) from a very small population.

[Gargano et al., 2011, *Plant Biology*]
The fitness gap between inbreed and outbred progenies augments across cultivation protocols simulating increasing ecological harshness.

[Gargano et al., 2011, Plant Biology]

Using experimentally crossed offspring would augment chances of success of a reinforcement program.
‘Assisted reproduction’ to evaluate benefit of inter-population mating

Fitness differences among 4 lineages of *Dianthus guliae*, from 2 source population, subjected to crossing within-population and crossing between population

![Images of LC and SP flowers](image)

[Graph showing variation of survival rates, heterozygosity](image)

[Gargano et al., 2015, Conserv Genet]
Early survival rates in lineages of *Dianthus guliae* obtained from different models of within- and between-population pollinations, showing different heterozygosity and experimentally subjected to a different aridity stress.

[Gargano et al. in prep.]
Why use ‘assisted reproduction’ in conservation practices?

Based on pollen transfer between individuals and populations

**Efficient and cost-effective tools**

Improving reintroduction programs by supporting both planning and realization phases

**Evidencing and mitigating fitness limitations in threatened populations**

!Fitness benefit can increase in more severely depleted populations!
THANK YOU