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Best Practice Guidelines for the Reintroduction of Rare Plants from the Center for Plant Conservation

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ABSTRACT

According to recent estimates, one-fifth of all plant species are thought to be in danger of going extinct in the wild. Reintroduction is one option for protecting many endangered plant species, and it shows great potential, especially when carefully managed by adhering to rules and when monitored over an extended period of time. We examine the Best Reintroduction Practice Guidelines from the Center for Plant Conservation and emphasise key elements for organizing plant reintroductions. Practitioners should examine alternate conservation measures, recognize dangers, and make sure that these threats are not present at any recipient sites before trying reintroductions. Target species and recipient site characteristics must be planned for along with logistical and legal considerations. Establishment and population expansion will be influenced by the careful selection of the founder population's genetic make-up, recipient site, and founder population size. Practitioners should experiment with reintroductions as often as feasible and report their findings. Planning a suitable monitoring technique for the taxon must take present and future demands into account because long-term monitoring over decades will be necessary to document if populations are sustainable. The science and practise of plant reintroduction can be advanced by botanical gardens.

Keywords: Founders, Genetics, Optimal site selection, Reintroduction, Monitoring, Managed relocation

INTRODUCTION

General characteristics of studies of procapsid-based nucleic acid packaging

According to recent estimates, one-fifth of all plant species are thought to be in danger of going extinct in the wild. Traditional conservation strategies alone are probably not going to be able to stop species extinction since the rising effects of climate change portend extraordinary risk and rates of endangerment. Plant reintroduction, which is widely hailed as an useful conservation method, will undoubtedly be a solution to stabilize and recover dwindling plant populations that are facing global change in the twenty-first century. Botanical gardens can be extremely important in the reintroduction and recovery of vulnerable plant species in the wild because they are reservoirs of rare plant germplasm and horticultural know-how.

The art and science of gardening, ecology, and evolution are all incorporated into the process of plant reintroduction. Although early attempts to return plants to the wild frequently failed, practitioners have since improved the method and shared their experiences with success and failure in order to improve future practise. The Center for Plant Conservation, which was established in 1984, is a coalition of more than 40 botanical gardens and conservation organizations in the United States committed to preventing the extinction of threatened native plants. In North America, our partner institutions house more than one-third of the world's rarest plant species in their seed banks and garden collections.

We promote science-based best practises and disseminate them globally to promote the importance of plants to humankind. Our original recommendations served as a basis for creating genetically varied conservation collections of endangered plant species without endangering wild populations. These served as the basis for the following set of planning and carrying out reintroduction guidelines. We offered updated recommendations for genetic sampling, seed storage, and ex situ collection management of rare pl-

-ants because ex situ collections in botanical gardens and other institutions are essential to the survival of species in the wild. These collections also contain the majority of plant material used in rare plant reintroductions around the world. The Cpc examined the procedure for reintroducing rare plants to the wild and created updated Center for Plant Conservation Best Reintroduction Practice Guidelines in collaboration with botanical gardens and conservationists inside and outside of our network.

The goal of plant reintroduction is to protect a rare species in its original habitat so that it can continue to evolve within the boundaries of its former native range. The Center for Plant Conservation's Best Reintroduction Practice Guidelines was developed based on the earlier efforts of other plant conservationists and other published standards. Authors of the chapters in Plant Reintroduction in a Changing Climate: Promises and Perils conducted thorough literature reviews about important plant reintroduction topics, which we took into account and incorporated in our revised guidelines. Includes feedback from Cpc conservation officers who have carried out over 100 reintroductions over the previous 30 years, as well as peer-review comments. The majority of these reintroductions employ propagules that were gathered from the wild, kept in ex situ collections, and subsequently multiplied at botanical gardens in accordance with Cpc best-practice genetic and reintroduction criteria.

Best reintroduction practice guidelines from the center for plant conservation

When thinking about a reintroduction, the Center for Plant Conservation Best Reintroduction Practice Guidelines advises using a logical framework. The six elements of the frame work justification, planning, involvement of the public, implementation, aftercare, and monitoring cover every facet of a reintroduction programme and are applicable to the majority of plant species, regions, and ecosystems. With a focus on work done inside the Cpc network, our aim is to highlight essential elements of the guidelines and use case studies to underscore crucial ideas. We recommend that readers consult Maschinski and Haskins for a thorough analysis of the international reintroduction literature and for the entire Center for Plant Conservation Best Reintroduction Practice Guidelines.

Review the status and threats of the species to support the reintroduction

It is crucial to ensure if a reintroduction is warranted before investing the time, money, and labour required. If a species is extinct in the wild or if its range is known and there are just a few, small, diminishing populations, a reintroduction may be acceptable. Additionally, it's crucial to take into account alternative conservation techniques, identify the dangers to the species, and make sure that these concerns don't exist in any recipient sites. Reintroduction is never the first or only stage in the recovery of an endangered species; it always works in tandem with other in situ and ex situ conservation efforts.

Considering when reintroduction should be avoided is also crucial. If any of the following circumstances occur, a reintroduction is not justified: It will negate the need to secure current locations, Plant reproduction and seed germination is impossible, according to earlier experiments. There is a lack of diversified, high-quality source material. Threats already present have not been reduced or controlled. There is a chance that the reintroduced species or how it is managed will negatively affect other species at the recipient site; this could happen as a result of competition, hybridization, or invasion. There is evidence the taxon might harm other endangered and threatened species or interfere with their management if it were to be reintroduced. Legally, administratively, or socially, the reintroduction is not supported, No suitable environment exists or is known to exist.

This rationale approach should be applied to both conventional and conservation introductions. Given that certain species face risks within their range that could lead to extinction, current reintroduction standards only allow conservation introductions if a species' range lacks any feasible habitats. Managed relocation, assisted migration, and assisted colonization are terms used to describe conservation introductions outside of a species' known range. The ecological dangers of relocating species becoming invasive or introducing new illnesses into the recipient group have been the main criticisms leveled against them. The authors looked at the idea of conservation introductions in a review of conservation options for endemic plants and animals from the Florida Keys, an archipelago that is seriously threatened by sea level rise. They discovered that the biggest barrier was the risk of hybridization with congeners in any nearby suitable habitat.

Design the reintroduction as an experiment whenever possible, and ask for peer evaluation

The legal, logistical, and land management concerns pertaining to the recipient site and the target species should be taken into account in the reintroduction plan. Each step of the planning process is guided by a set of questions. The questions assist professionals in evaluating alternatives, implementing best practises, and informing all stakeholders. The long-term effects of the reintroduction, such as the expense of monitoring and the land management needed to sustain the habitat, must be taken into account because the goal of a reintroduction is to build a self-sustaining population, a process that could take decades. A successful or unsuccessful reintroduction can depend on how well these key principles are taken into consideration.

The reintroduction strategy may be impacted by processes that function at both big and local scales. Community and ecosystem level disturbance regimes ought to be studied and understood at large scales. Are you anticipating a fire or flood at your recipient site? What actions can you take to improve the reintroduced population's survivability despite widespread or regular disturbance? Do you comprehend how the recipient site's abiotic circumstances or competition with other plants would affect your species on a lesser scale? How well do you comprehend current and upcoming threats? When done as research, reintroductions can close knowledge gaps in the biology or ecology of the species and advance science. The likelihood of success increases as more is learned about the biology and habitat needs of the species. When making decisions about the genetic make-up of the reintroduction, the spacing of individuals to maximize pollen exchange, or characteristics of the recipient site that can best promote plant growth, survival, and reproduction at various life stages, research into the biology of the species can be helpful. They might also help people comprehend the community as a whole.

Plans for reintroduction might build on known facts or use what is unknown as the basis for an experimental design. Sample inquiries covering horticultural and demographic topics are as follows: Is there a benefit to using huge container plants instead of seeds for your taxon. What differences in survival rates might you expect between the two methods? Which aftercare will be required, for how long, and what sort of microsite is required for the optimal development and recruitment Plans for reintroduction should take into consideration a species' life history while designing experiments and establishing success metrics. Reintroducing the root holoparasite Dactylanthus taylorii to four sites in New Zealand, for instance, showed that the dominant host, the sowing method, and the kind of canopy all had an impact on establishment and flowering. If the reintroduction had not been monitored for ten years and

taken into account this species' growth rates, alternative conclusions could have been made because flowering maturation takes four years.

Pick the right reference material

The reintroduction site's climatic and environmental parameters should be considered when selecting the source material. Studies reveal that for the long-term survival of rare plant reintroductions, matching the source material's plant community and habitat type to the reintroduction. Many reintroductions in the Cpc network rely on source material that is gathered from *wild populations, preserved in botanical gardens, and then produced there. Although genetic problems that influence long-term viability can develop in ex situ situations. When contrasting reintroduced individuals derived from ex situ sourced material with those derived directly from wild populations, Dalrymple discovered comparable survival rates.*

Reintroduce plants of various sizes and life stages for long-lived species to account for the varying success of stages in various microsites

For a number of reasons, using various founders will increase the likelihood of survival. The receiving site's context-specific characteristics, which may be subtle and dynamic over time, are crucial in determining whether the reintroduced population can survive. For instance, not unlike other species, the light conditions that supported the densest populations of recruited seedlings of the critically endangered Tephrosia angustissima var. corallicola in Florida were very different from those that supported whole adult plants that were introduced to a South Florida preserve. By introducing various ages of plants, the recipient site can benefit from growth prospects in all lighting circumstances. Using several age phases can be very helpful in lowering the chance of extinction. A seed collected in 1982, grown at Fairchild Tropical Botanic Garden, and released into the wild in 1992 took an additional 25 years to produce blooms and fruit. The palm can reach reproductive maturity in cultivation in about 14 years. We changed the age structure of the population and raised the number of plants that may be able to reach reproductive maturity more quickly than the majority of the plants growing naturally in the wild by importing the largest plants we could manage.

Use proper horticultural techniques

Using proper horticulture technique is essential both before and during the reintroduction. It is essential to ensure that plants are strong, adapted, and not transporting weeds, pests, or pathogens to the recipient site. To offer transplants the best chance of surviving, it's critical to plant at the spot with appropriate water and space for root growth. Make certain that all individuals who will plant your species have received the instruction and oversight required to adhere to the protocols essential for plant health.

CONCLUSION

The study and practise of plant conservation are being advanced by botanical gardens all throughout the world, including those that are Center for Plant Conservation participants. Botanical gardens have staff with horticultural expertise that maintain meticulous records and healthy collections of plants that may be available for plant reintroductions as guardians of rare plant germplasm that may be extinct in the wild. Reintroduction will play a bigger role in the recovery of endangered species as a result of rising habitat loss, degradation, fragmentation, and rapid climate change, and it will depend on genetically suitable and diverse ex situ collections. We created the CPC standards utilizing the best available knowledge from the global community and years of practical application within the CPC network of botanical gardens in order to improve the design and outcomes of plant reintroduction initiatives. It takes institutional persistence and dedication rather than individual perseverance and dedication to evaluate the success of the comeback because determining whether a reintroduction is viable may take decades.

One of the best things about botanical gardens is how well they keep records as an institution. Reintroductions are currently being conducted by researchers, thus it is crucial that they keep good records so that 10, 25, and 50 years from now, the garden's successors can move the reintroduction, know exactly what was done, and track the progress. We welcome long-term research collaborations between independent or academic researchers and botanical gardens. Reintroduced populations assist rare species by raising the overall number of individuals living in nature, increasing the spatial occupancy of the species, and so lowering the danger of extinction as they grow to levels that would be regarded as sustainable. Botanical gardens can be global leaders in plant reintroduction practise since reintroduction is a conservation technique that only succeeds when combined with ex situ conservation, community involvement, and species biological study. By enhancing information exchange, we can support global initiatives and help practitioners learn from our triumphs and mistakes.