



Hawai'i Rare Plant Restoration Group

Reintroduction Guidelines

March 2000

Introduction

These guidelines deal with the reintroduction of rare plants. Reintroduction should be a part of a rare plant recovery plan and should be a supplement to habitat management, not a substitute. The decision to reintroduce a rare plant is one that should not be taken lightly. The process of reintroduction, even when done with best intentions, puts the wild source population and the new reintroduction site habitat at risk.

The source population is vulnerable to over-collection. In the process of collection of seed and cuttings, the wild population could experience a decline in natural recruitment due to seed collection and loss of vigor from cutting collection. Before a reintroduction, there must be sufficient background information on the population structure of existing populations, pollination biology, habitat characteristics, and genetic variability within and among existing populations. The final goal should be the establishment of a viable reproducing population where cross-pollination can occur and in which genetic variation is maintained. An intermediate goal may be to establish a population for field stock or research reasons. It is expected that derivatives of the material in such field stocks will be outplanted more widely once appropriate habitat is secured and stabilized. These plants can be maintained as sources of seeds, cuttings, or transplants for reintroduction efforts.

Research activities may be intended to identify what factors are causing mortality/decline, to test methods to overcome these factors, or validate planting techniques. Ideally, successful research efforts will be permanent outplantings in their own right. The decision to reintroduce a plant should be made only after careful consideration. Not only should reintroduction be a supplement to habitat management, it should be a last resort. There must be ample material available in the field to allow for collection, appropriate reintroduction sites, and facilities and support staff to handle such an operation properly. Reintroduction may not be an appropriate technique for the many reasons, including when source material is not available, threats have not been controlled at reintroduction sites, and if propagation techniques have not been perfected. Many of the guidelines require coordination with other committees within the HRPRG as well as with agencies that may be collecting and propagating rare species. Included at the end of these guidelines is a list of people/agencies that may be contacted to consult on reintroductions. Regardless of the intent of the planting, the process of reintroduction should consider the following guidelines. These guidelines have been broken into sections- guiding actions before, during, and following the actual transplanting of a plant.

Prior

1. Prior to the reintroduction of a plant, there are some issues that must be considered to ensure the health of the species, the individual transplanted plant, and the surrounding habitat. This must include considerations of the reproductive biology of the species to be reintroduced.

a) Genetic Stock: Coordination with the parties responsible for the collection and propagation of the plant is required. This must be done to ensure a healthy and balanced genetic composition. Collection should be done to keep all individuals distinct and ensure that they are properly labeled throughout the



Hawai'i Rare Plant Restoration Group

propagation process. In addition, a population geneticist may be consulted about strategies and alternatives when dealing with especially rare species or those with specific reproductive qualities. This is, of course, of special concern when dealing with depleted wild populations with remnant genetic stock. It should be the shared responsibility of all agencies and individuals involved to leave an easy-to-follow paper trail back to the source plant (i.e. Rare Plant Monitoring Form, greenhouse accession numbers). Reintroduction is the last chance to make sure what we are propagating and planting represents a sufficient amount of the genetic composition of the species. As a last resort recalcitrant seed-producing plants may be taken as cuttings and helped into seeding in a greenhouse to increase the overall genetic base of the outplantings. Plants used in reintroduction should be as close to the collected field stock as possible. Plants that have been in the greenhouse for multiple generations may have been selected for different conditions than the reintroduction site and may have high attrition rates when planted. The pollination biology of each species must be researched and considered before reintroduction. Of special concern are pollen dispersal, autogamous (capable of self-pollination on a regular basis) and dioecious species, and using propagules or plants from multiple year collections and mixing populations.

When reintroducing a species that is an outcrosser, the method of pollen dispersal must be considered. For example, wind pollinated species need to be planted close enough to ensure successful cross-pollination and species which require a pollinator must be planted in an area where an appropriate pollinator is known to exist. In a situation where one needs to keep a reintroduced population distinct from a wild population the site must be far enough to not allow cross-pollination. How far is enough depends on the method of pollination (i.e. wind, insects, and birds) and will result in a range of probabilities.

Certain species may need special consideration based on their pollination biology. For example, obligatively autogamous species tend to have genetically similar individuals due to their inability to outcross within a population. When collecting propagules for reintroducing an obligatively autogamous species, it is important to collect representatives from as many distinct populations as possible as opposed to getting representation from many individuals in one population as you would for an outcrossing species. If one intends to reintroduce an autogamous species it may be important to maintain those distinct populations and not mix them when reintroducing. When reintroducing dioecious species one should plant equal numbers of male and female plants. If the plants are not yet mature and cannot be sexed, one should plant larger numbers of individuals to increase the effective population size. Regardless of the species and pollination biology it is always necessary to collect and label propagules from each individual as distinct. Valuable information about the individual plants within a population may be lost in collections are not kept distinct.

When selecting the plants to be used in reintroduction, one must consider the age and year the stock was collected. Using propagules or plants from multiple years may or may not ensure a better age class representation and possible genetic variety of stock.

If it is necessary to preserve a distinct population, care should be taken not to mix populations that may be distinct and have local or microhabitat adaptations. This will result in a population that may or may not match the specific microhabitat characteristics. A reintroduction that mixes individuals from two



Hawai'i Rare Plant Restoration Group

different locally adapted or distinct populations may result in progeny that experiences a loss of vigor or is unable to survive in the new reintroduction site. This is known as outbreeding depression. A site with mixed stock should not be close to a population in which you seek to preserve representatives of geographically isolated subsets.

b) Maps: Prior to the reintroduction of a species, the area should be precisely mapped. Maps should include the historical and present range of the species, locations of known populations, and proposed outplanting sites. A GIS database can also be used as a permanent record of the source of a particular population and to track the propagules. This will help ensure a genetic balance throughout the historical range.

c) Threat Abatement: Threats to a population should be noted on the Rare Plant Monitoring Forms used to monitor rare species. An entity involved with reintroduction must obtain copies of the Rare Plant Monitoring Forms to track the genetic composition of their plants. As always, consulting with anyone associated with the monitoring, collection, and propagation of the species is necessary to get any other information. A management strategy addressing the threats compiled from the Monitoring Forms should be in place before plants are reintroduced. Strategies should include measures to control the most likely threats of ungulates and competition with non-native plants. Management activities must be conducted carefully as to not further degrade the habitat for reintroduction. All threat control techniques can be pathways for pathogens and other contaminants and must be executed properly. Weeding around an outplanting site may only proceed after careful considerations of the intent. Changing light regimes and soil composition can negatively impact the habitat for reintroduced plants. Other possible threats include rodents, disease, virus, fungi, and insects both native and non-native. Also, threats to a reintroduced population may be different from those affecting the wild populations. For example, a wild population from which propagules are collected may be fenced and weeded but an ideal outplanting site existing off site within historical range may not have any management. Reintroduction should only proceed once a management strategy for the site has been established.

d) Site Selection: Once the historical range of the species is known and a management strategy is established, a suitable site for outplanting within the range must be selected. Again, coordination with the collectors and propagators is essential. A site should be chosen according to the biotic and abiotic elements that comprise the habitat for the newly transplanted population. A careful review of the Rare Plant Monitoring Forms may provide all the information available on the source population. However, before outplanting, an agency or individuals should seek any additional information from anyone associated with the monitoring, collection, and propagation of the species. When interpreting historical range, one must consider that recent alterations of the habitats may have left the sites inhospitable for reintroduction. Invasion by alien species and other threats may have left the habitat within historical range unsuitable due to changes in moisture regimes and soil composition. In such cases, reintroduction may be most successful in sites outside known historical locations that have maintained the critical biotic and abiotic elements necessary for successful reintroduction.

e) Reintroduction scenario: Sites for reintroduction can be placed in at least three categories each having special considerations.



Hawai'i Rare Plant Restoration Group

i) Reintroduction of a species within historical range: Agencies must consider what distinguishes populations from one another for each species that is to be outplanted. The site must be able to support a distinct population or one is only augmenting the adjacent population which may have different ramifications. Specific information about the habitat characteristics of the source population must be matched as close as possible with the outplanting site to provide the best chance for survival. This should be done by consulting anyone associated with the collection and propagation of the species and referring to the RPFs.

ii) Augmentations: This involves introducing propagules or plants into existing wild populations. This type of reintroduction must be considered on a case by case basis for each species. This reintroduction must be done carefully as to not harm the existing population with contaminants or physically altering the soil structure or existing roots. Augmentation may negatively alter the genetic composition of the population with propagules or plants from a single source or ones that have been domesticated through multiple generations in the greenhouse if not carried out strategically. The complex problems involved with preventing pathogens from invading the wild population require this technique to be used with extreme caution. It is especially important to contact as many individuals or agencies as possible for comments before augmenting a population.

iii) Introduction of a species to a site outside the known historical range: Agencies or individuals considering this type of introduction need also to consider the possible negative effects on the species. Establishment of a healthy viable population may be hindered by loss of genetic variation being at a site away from other populations. Possible hybridization may occur when bringing a species outside its historical range and into the range of another related species. A site outside the known historical range may lack the habitat characteristics necessary for establishing a healthy population. Contrarily a site outside of the known historical range of the species may be the only place safe from the threats that brought the species to the remnant state we find them in today. In some cases, these sites may also offer the best management option for a particular species. It is also possible that the historical range is incomplete or no longer contains the most appropriate habitat including suitable moisture and soil composition.

f) Site Preparation: Once a proper site has been selected there are steps the agency or individuals can take to prepare it for reintroduction. In accordance with the management strategy for the species and site, it may be initially necessary to construct a small-scale enclosure and/or weed non-native competitors around the site. These actions should be taken in concurrence with protection of the greater habitat, and conducted so that no pathogens are transported to the site, which is critical to the success of an established population. The season in which to plant must be considered. Generally mesic and dry plant species would face fewer challenges if planted during a wet season. If drought conditions persist for more than a year, it may be beneficial to wait for a better year if storage conditions allow. Techniques for preparing the soil to receive and support a new plant differ depending on the species. One should consider digging holes in advance and composting material on site to provide a favorable substrate. Composting materials should come from on-site and ideally be from native material. Soils may also be tested to guide soil preparation and future fertilization schemes. Coordination with the propagators is essential to ensure the fertilization and pesticide application schemes used in the



Hawai'i Rare Plant Restoration Group

greenhouse are adopted in the field. A catchment and watering system may also be considered especially in drier areas.

During

2. The successful reintroduction from the greenhouse to the ground requires several issues to be taken into account.

a) Sanitation: Coordination with the propagator and collector is necessary to ensure that all aspects of rare plant handling are done with attention to sanitation. Collection should be done with sanitized tools and proper propagation techniques practiced to eliminate possible contaminants. Agencies and individuals involved with reintroduction need to coordinate with the propagator before the date of planting to make sure the propagules are clean and prepared to go out. This will require the use of pesticides to ensure no pests are transported to the site. The risk of spreading aliens via reintroduction activities must be adequately addressed and effectively eliminated. Seeds, slugs, disease, parasites, fungi, flatworms, and other unintended inoculates must be prevented from being transported to the site by any aspect of the operation: protective management activities, materials, personnel, and the plants themselves must all be completely free of contaminants. Care should be taken to clean all gear (boots, packs, planting tools, etc.) prior to arrival at the site to assure no contaminants are spread unknowingly.

b) Transport: Use caution when transporting fragile plants. Some species may need water or protection from the sun and wind during the transport. The most secure place in a vehicle for transporting plants is directly in back of the driver's seat. The vehicle must be clean and the plants placed in a sterile container when loaded so no pathogens are picked up on the final journey to the reintroduction site.

c) Planting: Those involved in the planting of rare plants should be briefed before heading out to the site. Agencies and individuals directing reintroduction need to consider the techniques to be used in getting the plant from the container to the ground. Of special consideration is the decision to use a fertilizer in or on site composting. In areas of low rainfall initial watering may be essential in easing the shock for the new plantings. Building up a pile of mulch around the base of a new plant can help to slow evaporation and keep water near the roots.

Post

3. Following the reintroduction, monitoring is essential to maintain the health of the plant and the surrounding habitat.

a) Monitoring: Coordination with the agency or individual responsible for monitoring the existing populations may be necessary to see that a reintroduced population gets on a regular monitoring schedule. It is recommended that the site be monitored daily for a week after reintroduction. This close monitoring will insure that if there are problems with pests or other unforeseen threats, such as drought, they can be addressed before they affect the plants. Use of the Rare Plant Monitoring Form (RPMF) will give important information pertaining to the location, phenology, population structure, habitat characteristics, and threats to the new population. Individual plants may be labeled or tagged and tracked using the RPMF. The goal of a successful reintroduction is the establishment of a viable population that maintains the genetic variability of the species and produces successful offspring. Recruitment in the wild is necessary for the reintroduction to be on the road to success. Monitoring a new population is essential to tracking the lineage of the population. A consistent monitoring schedule



Hawai'i Rare Plant Restoration Group

will also reduce the chance of a contaminant affecting the population or surrounding habitat. Recording the watering, fertilization, and pesticide application schemes will help guide future reintroductions. HRPRG is currently working on a database to track safety net species including outplantings. Information on reintroduced populations should be transferred into the database.

b) Maintenance: Watering and pesticide application may be necessary to ensure success. Supplemental watering especially in dry areas will greatly improve chances for a successful reintroduction.

c) Management: Actions after reintroduction must be taken in concurrence with a habitat management strategy. Reducing competition for resources with non-native plants by weeding may be necessary. A necessary ungulate enclosure may require maintenance.

Afterthoughts

Reintroduction of rare plants must be done with care and attention to detail. This should be a team effort bringing together all individuals and agencies responsible for all aspects of rare plant management. There must be coordination between collectors, propagators, landowners, and managers. There must be a plan to ensure that the new population has the highest chance of succeeding as possible. The first consideration should be the decision to reintroduce. This technique is not always beneficial to the species, and in some cases, may harm the wild populations due to over-collection and improper site selection, which may lead to unintended augmentations. The decision to reintroduce can only be made when there is a management plan for the species, which includes ecosystem-level protection and threat abatement. There must be enough propagules to collect without harming the wild population. There must be adequate facilities to grow the plants and ensure that they are free from pests before they are brought to the site. The plants must be carefully labeled and tracked as individuals by propagators. The ramifications of reintroduction strategies concerning genetic stock must be considered before they are carried out. Consultation with experts concerning the pollination biology and effective population size is important to ensure reintroduction scenarios will result in a population suited to the reintroduction site. Regardless of the decision to mix or keep distinct population separate, it is necessary to document your strategy and adopt a regular monitoring schedule. When the plants go into the ground, the learning process begins. The regular monitoring of reintroductions will provide clues as to the vigor and fitness of that particular population. This information must be used to guide future reintroduction scenarios, especially in regards to the decision to mix progeny. Monitoring a reintroduced population carefully and frequently will also enable managers to identify any weeds, pests, or pathogens that may have come in with the plants. Reintroduction is a risky technique that has the potential to really help and harm a species at the same time. It is imperative that those involved in reintroduction open a dialog with as many agencies and individuals as possible. This will ensure that reintroductions will be done responsibly and with all available information.