



**OREGON
DEPARTMENT OF
AGRICULTURE**

Threatened and Endangered Plant Recovery Guidance and Recommendations

from the
Native Plant Conservation Program

Table of Contents

Introduction

Prioritization

Section 1: Population Assessment Surveys

- 1.1 Population Status Evaluation
- 1.2 Long-term Population Monitoring

Section 2: Site Protection

- 2.1 Habitat Security
- 2.2 Threat Mitigation

Section 3: Habitat Restoration

- 3.1 Invasive Species Control
- 3.2 Restored Natural Processes
- 3.3 Vegetation Management
- 3.4 Habitat Connectivity
- 3.5 Abiotic Conditions

Section 4: Population Enhancement

- 4.1 Seed Banking and Genetic Conservation
- 4.2 Germination and Propagation Protocols
- 4.3 Population Augmentation
- 4.4 Population Creation

Section 5: Adaptive Management

- 5.1 Management Evaluation and Adjustment
- 5.2 Information Sharing and Learning

Section 6: Research

- 6.1 Species Ecology Research
- 6.2 Management Technique Research
- 6.3 Climate Change and Emerging Threats

Section 7: Partnerships and Coordination

- 7.1 Partner Engagement
- 7.2 Interagency Coordination
- 7.3 Special Site Designations

Section 8: Special Considerations

- 8.1 Climate Change Adaptation
- 8.2 Pollinator Conservation
- 8.3 Ecosystem-Level Conservation

Coordination Responsibilities and Requirements

Conclusion

Contact Information

Glossary

Relevant Sources

Introduction

This document presents recovery actions applicable to most or all of Oregon's threatened and endangered plants and is intended for use by conservation organizations, land managers, and other entities working to support plant species recovery when species-specific recovery plans are not available. Where U.S. Fish and Wildlife Service Recovery Plans exist for federally listed species, the Oregon Department of Agriculture (ODA) defers to those plans as the primary guidance for recovery actions, though ODA may revise or develop additional recovery criteria as needed to address state-specific conservation priorities or changing conditions. The Oregon Department of Agriculture aims to develop species-specific recovery plans for high priority species as time and funding allow. In the interim, or for species where dedicated recovery plans may not be developed, these recommendations provide general guidance based on established conservation principles and successful recovery strategies from existing recovery plans.

The recovery actions outlined in this document are organized around three fundamental conservation principles that together provide a comprehensive framework for species recovery: **representation**, **resiliency**, and **redundancy**. These interconnected principles ensure that conservation efforts create durable, diverse, and distributed populations capable of persisting through environmental challenges and uncertainties.

Representation ensures that the full genetic, ecological, and geographic diversity of a species is conserved across its range. This principle recognizes that populations in different environments may have unique adaptations essential for the species' long-term evolutionary potential. The recovery actions documented below support representation by calling for comprehensive surveys across a species' range, protection of populations in diverse habitat types and geographic locations, maintenance of genetic records that document source populations, and establishment of seed banks that preserve diverse genetic material from multiple populations. Climate change adaptation strategies particularly emphasize representation by protecting habitat heterogeneity and maintaining connectivity among populations to facilitate natural migration and gene flow.

Resiliency refers to a species' ability to withstand and recover from disturbances, environmental stresses, and changing conditions. The actions throughout this document build resiliency by maintaining large, healthy populations with robust reproductive capacity, protecting and restoring high-quality habitat conditions, and implementing adaptive management practices that respond to changing threats. Resiliency can be enhanced through habitat restoration that re-establishes natural processes, population enhancement that increases genetic diversity and population size, and research that identifies and addresses limiting factors before they become critical threats.

Redundancy provides insurance against catastrophic loss by maintaining multiple viable populations distributed across a species' range, ensuring that the loss of any single population does not jeopardize the species' survival. This principle acknowledges that individual populations may face various risks from natural disasters, disease outbreaks, habitat destruction, or management failures. The actions in this document create redundancy through site protection that secures multiple populations under long-term conservation management, population introduction efforts that establish new populations within historical ranges, and coordination strategies that spread conservation efforts across multiple organizations and jurisdictions to avoid single points of failure.

While this document presents policy guidance, it is not law. Oregon State law may require consultation and coordination with the Oregon Department of Agriculture, and potentially the U.S. Fish and Wildlife Service and other relevant agencies and land managers when implementing recovery actions for listed plants in Oregon.

Prioritization

When resources are limited, conservation organizations should prioritize actions in the following order:

1. Immediate threat abatement for populations at imminent risk
2. Protection of existing viable populations through permanent conservation
3. Habitat restoration at sites with existing populations
4. Population augmentation for small or declining populations
5. Population introduction at suitable sites within the plant's historical range
6. Long-term monitoring and adaptive management

Section 1: Population Assessment Surveys

Understanding the current status and trends of threatened plant populations is fundamental to effective conservation. Without accurate population data and standardized monitoring, making informed decisions and determining whether conservation efforts are succeeding may be difficult or impossible.

1.1 Population Status Evaluation

Establishing baseline population data provides the foundation for all conservation planning and helps identify which populations are most critical for species survival.

- Conduct comprehensive surveys to relocate and map all known populations
- Document population size and structure; use standardized methods, if available
- Report the conditions and characterize occupied habitat, including vegetation community composition, soil types, and disturbance history
- Evaluate threats at each population; use standardized threat assessment protocols, if available
- Assess reproductive success by monitoring flowering, fruiting, seed production, and seedling recruitment
- Identify and prioritize populations most in need of conservation support and prescribe corrective measures (new approaches should be tested before being applied broadly)
- Survey potentially suitable habitat to identify unknown populations and better understand the actual extent of the species in the wild

1.2 Long-term Population Monitoring

Consistent monitoring methods allow for reliable comparison of population trends across sites and years, enabling detection of both successes and emerging problems.

- Develop species-appropriate monitoring methods that can be consistently applied across sites and years to inform population trends
- Monitor populations annually or at appropriate intervals to detect changes and determine trends
- Document new threats as they arise and assess their potential impacts on population persistence and habitat quality
- Document management effectiveness by assessing and comparing population responses before and after treatments
- Maintain detailed, shareable records with GPS coordinates and photographic documentation

Section 2: Site Protection

Secure long-term legal protection to ensure that conservation investments will persist and provide the stability needed for population recovery over multiple generations. Site protection forms the foundation upon which all other conservation activities depend.

2.1 Habitat Security

Establishing permanent legal and/or administrative protection for critical habitats provides long-term security needed for species recovery efforts and prevents future habitat loss.

- Secure long-term habitat protection through conservation easements, land acquisition, or management agreements
- Prioritize protection of large, viable populations, unique representatives of the species, and high-quality habitat remnants
- Maintain buffer zones around sensitive populations to minimize edge effects
- Coordinate with adjacent landowners to minimize impacts from neighboring land uses

2.2 Threat Mitigation

Address specific threats that jeopardize populations, prevent further decline, and create conditions necessary for population stability and growth.

- Identify and address active threats to plants and their habitats, such as development pressure, incompatible land uses, or recreational impacts
- Maintain essential abiotic conditions for population persistence (e.g., maintain hydrologic conditions, substrate, exposure or protection, etc.)
- Coordinate with land management agencies to modify maintenance practices near and/or within populations
- Establish protective fencing where necessary to exclude incompatible uses

Section 3: Habitat Restoration

Active habitat management creates and maintains conditions that support healthy plant populations by addressing degradation and restoring natural ecological processes. Habitat restoration can improve site conditions at existing populations and prepare unoccupied suitable habitat for population enhancement activities.

3.1 Invasive Species Control

Removing or controlling non-native invasive plants reduces competition and allows native species to reestablish in their preferred habitats.

- Identify invasive species present at each site, assess their impact on native plant communities, and identify treatment priorities
- Develop species-specific control strategies using appropriate mechanical, chemical, or biological methods
- Time control activities to avoid or minimize impacts on native plants and maximize effectiveness against target species
- Implement integrated pest management, combining multiple control methods for maximum effectiveness
- Monitor treatment effectiveness, and repeat treatments as necessary to prevent reinfestation
- Restore and reestablish native vegetation following invasive species removal to prevent recolonization by weeds

3.2 Restored Natural Processes

Reestablishing natural disturbance regimes and ecological processes maintains the environmental conditions that some rare plants require for long-term persistence.

- Restore natural fire regimes through prescribed burning where ecologically appropriate and feasible
- Reestablish natural hydrology by restoring natural water flow patterns and removing drainage infrastructure (e.g., ditches and drain tiles)
- Implement appropriate grazing regimes using livestock or native herbivores to mimic historical disturbance patterns
- Remove infrastructure such as roads, buildings, or utilities that impair ecological processes (e.g., fragment or degrade habitat)
- Restore natural topography by removing fill material or recontouring sites to historical elevations

3.3 Vegetation Management

Managing the plant community composition can help create optimal growing conditions for rare species while maintaining the ecological integrity of natural habitats.

- Manage woody vegetation and tree canopy cover to restore appropriate light levels while maintaining desirable structural components that provide shelter, protection, or shade
- Control aggressive native species that may outcompete rare plants
- Establish nurse plants or companion plantings that facilitate rare plant establishment and growth
- Manage plant succession to maintain habitat in appropriate seral stages for target species

3.4 Habitat Connectivity

Improving connections between fragmented habitats facilitates plant and pollinator movement, genetic exchange, and natural recolonization processes essential for population persistence.

- Restore corridors of suitable habitat between fragmented populations using appropriate native vegetation
- Remove physical and ecological barriers such as roads, fences, or incompatible land uses that impede plant movement and population expansion
- Create stepping-stone habitats with appropriate plant communities to facilitate plant and pollinator movement across landscapes
- Coordinate restoration activities across property boundaries and ownerships to maximize landscape-level connectivity
- Establish buffer zones around sensitive habitats to reduce edge effects and provide transition areas

3.5 Abiotic Conditions

Addressing degraded physical site conditions restores the environmental foundation necessary for healthy plant communities and successful population enhancement.

- Restore appropriate soil chemistry through amendments, pH adjustment, or removal of contaminated soil
- Improve soil structure by reducing compaction, adding organic matter, or restoring natural soil horizons
- Control erosion through appropriate ground cover, slope stabilization, or water diversion techniques
- Restore appropriate drainage patterns for wetland or upland habitats, as needed
- Remove physical debris such as trash or abandoned infrastructure that degrades habitat quality

Section 4: Population Enhancement

Many threatened plant species exist in populations too small to be viable long-term, making population enhancement critical for recovery. These techniques can increase population sizes, establish new populations, and restore genetic diversity necessary for species persistence.

4.1 Seed Banking and Genetic Conservation

Preserving genetic material in secure facilities provides insurance against extinction while maintaining the genetic diversity needed for future enhancement efforts.

- Collect and bank seeds from multiple populations to preserve genetic diversity; maintain separate maternal line collections for population genetics research and bulk collections that group seeds from multiple individuals for restoration and enhancement activities
- Follow Center for Plant Conservation collection protocols that sample broadly within populations while minimizing impact

-
- Store seeds long-term at approved facilities such as Center for Plant Conservation member institutions
 - Test seed viability and germination requirements through controlled studies
 - Maintain detailed genetic records documenting source populations and collection dates
 - Establish off-site living collections at botanical gardens or other facilities to maintain genetic material through cultivation when seed banking is not feasible or as a complement to seed storage

4.2 Germination and Propagation Protocols

Developing reliable methods for growing plants from seeds ensures that enhancement efforts have the highest possible success rates and can be replicated by different practitioners.

- Develop species-specific germination protocols through controlled testing of different treatments
- Determine optimal germination conditions, including seed pretreatments (e.g., cold stratification, scarification, chemical or smoke treatments) to break dormancy, temperature, light requirements, moisture levels, and substrate types
- Establish greenhouse cultivation methods for growing seedlings into mature plants for seed production or as transplant stock
- Develop alternative propagation methods such as vegetative propagation through cuttings, division, or tissue culture when appropriate
- Document and report propagation methods that can be shared with and replicated by different facilities and practitioners (e.g., RNGR Native Plant Network's Propagation Protocol database)

4.3 Population Augmentation

Adding plants to existing small populations increases their size and may increase their genetic diversity, improving their chances of long-term survival and reproduction. When selecting source material for augmentation, carefully consider both the risks and benefits of mixing genetic material from different populations. Small, isolated populations affected by habitat loss and fragmentation may be suffering from inbreeding depression and loss of genetic diversity due to significant human-induced landscape changes; in these cases, introducing individuals from multiple source populations is likely beneficial because increasing population-level genetic heterozygosity improves adaptability. However, when evidence suggests that genetic diversity in a population is unique and arose through local adaptation rather than genetic drift, mixing plant material from different sources should be avoided, as it could disrupt locally-adapted traits and reduce fitness advantages specific to that population (outbreeding depression). Consultation with geneticists or species experts can help determine the appropriate augmentation strategy for each population.

- Augment small populations with transplants or direct seeding to increase population size and viability; consider using multiple source populations to mitigate inbreeding risk
- Use locally-sourced plant material when conserving local genotypes; source from the same site (preferred), watershed, or ecoregion
- Time introductions appropriately to maximize survival and establishment success
- Prepare planting sites by controlling competing vegetation and addressing soil conditions and other factors, as needed

-
- Consider post-planting support, including supplemental watering, nutrient fertilization, or regular weeding
 - Monitor augmented populations to determine survival, establishment, reproduction, and to guide adaptive management
 - Evaluate augmentation success by comparing survival and establishment rates, growth measurements, reproductive output, and recruitment within and/or among sites

4.4 Population Creation

Establishing new populations within a species' historical range increases the total number of populations and reduces the risk of species extinction from localized catastrophes.

- Identify suitable introduction (or reintroduction) sites within the species' historical range
- Assess site suitability, including habitat quality, land protection status, and threat levels
- Address factors that led to original population extirpation and coordinate future management before attempting reintroduction
- Develop site-specific introduction plans with clear success criteria, supplemental site management and plant care, and monitoring protocols and commitments
- Establish multiple populations to spread risk and increase overall species viability
- Use appropriate plant material sources by focusing on local ecotypes when their conservation is a priority and by maximizing diversity in the founding population
- Implement adaptive site management to maintain suitable habitat conditions post-establishment
- Monitor reintroduced populations for establishment, survival, reproduction, and long-term persistence

Section 5: Adaptive Management

Systematic evaluation and adjustment of management practices based on monitoring results guides conservation efforts toward more effective outcomes over time. Adaptive management transforms conservation from static prescriptions into dynamic, learning-based approaches that improve with experience.

5.1 Management Evaluation and Adjustment

Systematically evaluating management outcomes and modifying approaches based on results ensures that conservation efforts improve over time and resources are used most effectively.

- Test new management treatments in small or confined areas before broader application
- Monitor management outcomes using standardized protocols and success criteria
- Analyze treatment effectiveness through comparison of treatment and control areas
- Adjust techniques based on results when monitoring indicates poor outcomes or unexpected responses
- Scale up successful treatments to additional sites after effectiveness is demonstrated
- Discontinue ineffective treatments and develop alternative approaches when needed

5.2 Information Sharing and Learning

Sharing knowledge and experiences among conservation practitioners accelerates learning and prevents duplication of failed approaches while spreading successful techniques more rapidly.

- Document lessons learned in accessible formats for use by other conservation practitioners
- Share information among practitioners working with the same or similar species
- Participate in professional networks to exchange knowledge about effective techniques
- Contribute to scientific literature by publishing results of management treatments or experiments
- Revise management plans based on new scientific information and monitoring results

Section 6: Research

Scientific research provides the foundation for effective conservation by identifying species needs, evaluating management techniques, and guiding decision-making. Research activities generate the scientific knowledge needed to understand species requirements and develop effective conservation strategies tailored to specific ecological needs.

6.1 Species Ecology Research

Understanding the basic biology and ecological requirements of threatened species provides the scientific foundation necessary for developing effective conservation strategies.

- Study species ecology including habitat requirements, pollination biology, and seed dispersal
- Investigate limiting factors that constrain population growth or reproduction
- Evaluate genetic diversity within and among populations to guide conservation strategies
- Research reproductive biology, including breeding systems, seed production, and dispersal mechanisms
- Study habitat relationships to understand microhabitat preferences and environmental tolerances

6.2 Management Technique Research

Testing and refining management approaches through scientific study ensures that conservation efforts are based on evidence rather than assumptions and identifies the most effective methods.

- Research management techniques to determine optimal methods, timing, and frequency
- Test different approaches for controlling invasive species, managing competing vegetation, and maintaining desirable conditions
- Evaluate site preparation methods for population enhancement activities
- Study optimal growing conditions for propagation and field establishment
- Research pollinator relationships to understand species-specific requirements and identify relationships of critical dependence

6.3 Climate Change and Emerging Threats

Investigating new and changing threats allows conservation practitioners to anticipate and prepare for future challenges rather than simply reacting after problems become severe.

- Monitor climate-related changes in species performance, distribution, phenology, reproduction, and recruitment
- Research assisted migration potential for species at risk from changing conditions
- Investigate novel threats such as emerging diseases or invasive species
- Develop predictive models for species response to environmental change

Section 7: Partnerships and Coordination

Plant conservation requires collaboration among diverse partners because threatened species often occur across multiple ownerships and jurisdictions. Effective partnerships leverage resources, expertise, and authorities necessary for successful recovery while building broad support for conservation efforts.

7.1 Partner Engagement

Building relationships with landowners and communities creates the social foundation necessary for long-term conservation success and expands the capacity for species recovery efforts.

- Build partnerships with private landowners, tribes, government agencies, and conservation organizations
- Provide technical assistance to landowners interested in species conservation
- Develop voluntary conservation agreements, partnering with state and federal agencies to leverage programs and funding that support species conservation (e.g., USFWS Safe Harbor Agreements, Candidate Conservation Agreements, and Partners for Fish and Wildlife Program, and the NRCS Wetland Reserve Program)
- Engage local communities in conservation education and stewardship activities

7.2 Interagency Coordination

Coordinating with government agencies ensures that conservation efforts comply with regulations and leverage available resources while avoiding duplication of efforts.

- Coordinate with regulatory agencies including the Oregon Department of Agriculture and the U.S. Fish and Wildlife Service (when working with federally listed plants)
- Participate in species recovery teams or working groups where they exist
- Share data and monitoring results with relevant agencies and database managers
- Coordinate management activities to maximize conservation benefits across the landscape

7.3 Special Site Designations

Sharing the value of sites and populations that are important for the persistence of a rare plant can help empower the community to make decisions and take actions that benefit conservation and recovery.

-
- Identify relevant administrative site designations available through the land manager or other external partners
 - Assess risks associated with increased public awareness of a target plant, population, or site (e.g., increased recreational impacts, unsanctioned plant material collection, or vandalism)
 - Establish protective measures to address threats associated with increased public awareness of the target plant, population, or site (e.g., obscure target plant locations, install protective barriers, limit visitation and other recreational uses)
 - Petition for special recognition and site designations through the appropriate avenues after addressing threats

Section 8: Special Considerations

Emerging challenges such as climate change and evolving threats require adaptive conservation strategies that go beyond traditional approaches. These considerations help ensure that recovery efforts remain effective under changing environmental conditions and address complex ecological relationships.

8.1 Climate Change Adaptation

Preparing for changing climate conditions helps ensure that conservation investments remain effective as environmental conditions shift beyond historical ranges.

- Protect habitat heterogeneity, including elevational gradients and diverse microsites that may become suitable for plants under future climate conditions
- Maintain connectivity among populations to facilitate natural migration
- Maximize diversity, if circumstances allow, to enhance a population's ability to adapt and thrive under changing conditions
- Consider conservation introductions for populations at risk from changing climate conditions; review decision-making guidance with conservation partners on whether a conservation introduction is the preferred strategy to achieve the desired goal
- Monitor climate-related impacts such as shifts in flowering time or growing season length

8.2 Pollinator Conservation

Healthy pollinator communities can be essential for plant reproduction and supporting them ensures enhanced populations can sustain themselves without facing a barrier of pollinator limitation.

- Maintain diverse native plant communities to support pollinator populations year-round
- Provide nesting habitat for native bees and other pollinators
- Minimize pesticide use that can negatively affect pollinators in and around rare plant populations
- Study pollination ecology to understand species-specific pollination requirements and pollinator relationships

8.3 Ecosystem-Level Conservation

Taking a broader ecological perspective can maximize conservation benefits by addressing multiple species simultaneously and maintaining the natural processes that support entire plant communities.

- Consider community-level restoration that benefits multiple rare species simultaneously
- Maintain natural processes such as fire, flooding, or grazing that sustain plant communities
- Protect source populations that can provide seeds for restoration efforts and propagules for natural establishment
- Address landscape-scale threats such as habitat fragmentation or invasive species

Coordination Responsibilities and Requirements

Before implementing recovery actions, conservation organizations should:

- Consult with relevant agencies, including ODA, USFWS, and any other pertinent entity to ensure actions are appropriately coordinated
- Obtain necessary permits for activities involving listed species
- Coordinate with other ongoing conservation efforts to avoid duplication and maximize benefits
- Follow established protocols for seed collection, propagation, and population monitoring

Conclusion

These general recovery actions provide a framework for supporting the conservation of Oregon's threatened and endangered plant species. Success will depend on sustained commitment, adequate funding, scientific rigor, and effective partnerships among all invested parties. Regular evaluation and adaptive management will ensure that conservation efforts remain effective as new information becomes available and conditions change.

For specific guidance on individual species or questions about implementing recovery actions, conservation organizations should contact the Oregon Department of Agriculture Plant Conservation Program or the U.S. Fish and Wildlife Service Oregon Fish and Wildlife Office.

Contact Information

Oregon Department of Agriculture

Native Plant Conservation Program

Email:

listedplants@oda.oregon.gov

Glossary

Adaptive Management

A systematic approach to improving resource management by learning from management outcomes and adjusting practices based on monitoring results and new scientific information to better attain goals.

Augmentation

The practice of increasing the size of existing plant populations by adding plants or seeds to boost population size, viability, and/or genetic diversity.

Buffer Zone

An area of land surrounding a targeted resource (e.g., sensitive habitat or population) that provides protection via spatial separation from external disturbances and edge effects.

Candidate Conservation Agreement

A voluntary agreement between the U.S. Fish and Wildlife Service and non-federal parties to address conservation needs of species that are candidates for listing under the Endangered Species Act.

Center for Plant Conservation

A network of botanical institutions dedicated to preventing the extinction of native plants in the United States through seed banking and conservation programs.

Conservation Easement

A legal agreement between a landowner and a qualified organization (such as a land trust or government agency) that permanently limits land use to protect its conservation values while the landowner retains ownership and certain rights.

Conservation Introduction

The deliberate placement of a species into an area outside its known historical range or natural distribution for the purpose of conservation.

Ecoregion

A large area of land characterized by distinctive regional ecological factors including climate, soil, water, flora, and fauna.

Edge Effects

Changes to populations or community structure that occur at the boundary between two or more habitats (ecotones) or conditions that result in altered environmental or biological conditions.

Extirpated

Locally extinct; refers to a species that no longer exists in a specific geographic area where it previously occurred naturally, though it may still exist elsewhere.

Genetic Diversity

The variety of genetic material within a species or population that can result in diversity in traits that may be critical for species adaptation and long-term survival.

GPS Coordinates

Global Positioning System coordinates that provide precise geographic location data using latitude and longitude measurements.

Habitat Connectivity

The degree to which the distribution of suitable habitat facilitates or impedes movement of organisms across the landscape.

Historical Range

The geographic area where a species naturally occurred in the past, typically documented through herbarium specimens, scientific literature, or reliable observations.

Hydrologic Conditions

The characteristics of water systems including water levels, flow patterns, seasonal variations, and quality that affect aquatic and wetland habitats.

Invasive Species

Non-native plants or animals that cause harm to the environment, economy, or human health by spreading rapidly and outcompeting native or desirable species.

Partners

Any individual, group, or organization that has an interest in or may be affected by conservation decisions and activities.

Microhabitat

A small, specialized habitat within a larger ecosystem that has distinct environmental conditions and supports specific species or communities.

Population Viability

The ability of a population to persist over time, which can be influenced by factors such as population size, genetic diversity, and environmental pressures.

Propagation

Controlled plant material production, typically in greenhouse or nursery settings.

Redundancy

Sufficient numbers of populations distributed across a species' range to insure against catastrophic loss and ensure the loss of any single population does not jeopardize the species' survival.

Reintroduction

The deliberate placement of a species back into an area where it previously occurred naturally but from which it has been extirpated.

Representation

Sufficient genetic diversity, and ecological and geographic representation of a species across its range that includes unique traits and adaptations essential for maintaining long-term evolutionary potential.

Reproductive Success

The ability to produce viable offspring.

Resiliency

A species' ability to withstand and recover from disturbances, environmental stresses, and changing conditions; large, healthy populations with robust reproductive capacity and high-quality habitat conditions promote resiliency.

Safe Harbor Agreement

A voluntary agreement between the U.S. Fish and Wildlife Service and non-federal property owners that encourages conservation efforts by providing regulatory assurances.

Seed Banking

Long-term seed storage under controlled conditions to preserve genetic material for future conservation, research, or restoration efforts.

Seed Viability

The ability of seeds to germinate and develop into healthy plants under appropriate conditions, which can be affected by factors such as age, storage conditions, and genetic quality.

Source Population

An existing population of a species from which plant material (seeds, cuttings, or whole plants) is collected for conservation purposes.

Standardized Monitoring Protocol

A consistent, repeatable method for collecting data that allows for comparison across sites, years, and practitioners.

Threat Assessment

A systematic evaluation of factors that may negatively impact a species or habitat, including the threat severity, scope, and immediacy.

Viable Population

A population that has sufficient individuals, genetic diversity, and demographic structure to persist over time despite environmental uncertainties and random events.

Watershed

The area of land that drains water, sediment, and dissolved materials to a shared water body.

Relevant Sources

The recovery actions and recommendations in this document are based on established conservation principles and successful strategies documented in existing recovery plans and scientific literature. The following sources provide the scientific and practical foundation for the guidance presented above:

Adaptive Management

Holling, C. S. (ed.). 1978. *Adaptive environmental assessment and management*. John Wiley & Sons, New York, New York.

Williams, B. K., R. C. Szaro, and C. D. Shapiro. 2009. *Adaptive Management: The U.S. Department of the Interior Technical Guide*. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC.

Climate Change Adaptation

Halpin, P. N. 1997. Global climate change and natural-area protection: Management responses and research directions. *Ecological Applications* 7(3):828–843.

Mawdsley, J. R., R. O'Malley, and D. S. Ojima. 2009. A review of climate-change adaptation strategies for wildlife management and biodiversity conservation. *Conservation Biology* 23:1080–1089.

Conservation Biology and Population Genetics

Caswell, H., and T. N. Kaye. 2001. Stochastic demography and conservation of an endangered perennial plant (*Lomatium bradshawii*) in a dynamic fire regime. *Advances in Ecological Research* 32:1–51.

Falk, D. A., and K. E. Holsinger (eds.). 1991. *Genetics and conservation of rare plants*. Oxford University Press, New York, New York.

Gisler, S. D. 2004. Developing biogeographically based population introduction protocols for at-risk Willamette Valley plant species. Report to U.S. Fish and Wildlife Service, Portland, Oregon. Native Plant Conservation Program, Oregon Department of Agriculture, Salem, Oregon.

Guerrant, E. O., Jr., and T. N. Kaye. 2007. Reintroduction of rare and endangered plants: common factors, questions and approaches. *Australian Journal of Botany* 55:362–370.

Hamrick, J. L., M. J. W. Godt, D. A. Murawski, and M. D. Loveless. 1991. Correlations between species traits and allozyme diversity: Implications for conservation biology. Pages 75–86 in: D. A. Falk and K. E. Holsinger, eds. *Genetics and conservation of rare plants*. Oxford University Press, New York, New York.

Kaye, T. N., M. A. Bahm, A. S. Thorpe, E. C. Gray, I. Pflingsten, and C. Waddell. 2019. Population extinctions driven by climate change, population size, and time since observation may make rare species databases inaccurate. *PLOS ONE* 14(10):e0210378.

Kaye, T. N., R. J. Meinke, J. Kagan, S. Vrilakas, K. L. Chambers, P. F. Zika, and J. K. Nelson. 1997. Patterns of rarity in the Oregon flora: implications for conservation and management. Pages 1–10 in T. N. Kaye, A. Liston, R. M. Love, D. L. Luoma, R. J. Meinke, and M. V. Wilson, editors. *Conservation and Management of Native Plants and Fungi*. Native Plant Society of Oregon, Corvallis, Oregon.

Matthies, D., I. Bräuer, W. Maibom, and T. Tschamtkke. 2004. Population size and the risk of local extinction: empirical evidence from rare plants. *Oikos* 105:481–488.

-
- Newman, D., and D. A. Tallmon. 2001. Experimental evidence for beneficial fitness effects of gene flow in recently isolated populations. *Conservation Biology* 15:1054–1063.
- Schemske, D. W., B. C. Husband, M. H. Ruckelshaus, C. Goodwillie, I. M. Parker, and J. G. Bishop. 1994. Evaluating approaches to the conservation of rare and endangered plants. *Ecology* 75:584–606.
- Thorpe, A. S., and T. N. Kaye. 2011. Conservation and reintroduction of the endangered Willamette daisy: effects of population size on seed viability and the influence of local adaptation. *Native Plants Journal* 12(3):289–298.

Conservation Policy and Practice

- Smith, D. R., N. L. Allan, C. P. McGowan, J. A. Szymanski, S. R. Oetker, and H. M. Bell. 2018. Development of a species status assessment process for decisions under the U.S. Endangered Species Act. *Journal of Fish and Wildlife Management* 9(1):302–320.
- U.S. Fish and Wildlife Service. 2024. *A Decision Support Framework for Conservation Introductions*. U.S. Fish and Wildlife Service, Pacific Region. Pacific Region Conservation Introductions Working Group, U.S. Fish and Wildlife Service. <https://doi.org/10.5281/zenodo.10456792>.
- U.S. Fish and Wildlife Service and National Marine Fisheries Service. 2016. Interagency Cooperation – Endangered Species Act of 1973, as amended; Definition of Destruction or Adverse Modification of Critical Habitat. *Federal Register* 81:7214–7226.

Habitat Management and Restoration

- Hamman, S. T., P. W. Dunwiddie, J. L. Nuckols, and M. McKinley. 2011. Fire as a restoration tool in Pacific Northwest prairies and oak woodlands: challenges, successes, and future directions. *Northwest Science* 85(2):317–328.
- Menke, C., and T. N. Kaye. 2003. Effectiveness of seeding and transplanting for augmentation and reintroduction of rare plant species. Pages 159–168 in: C. A. Brigham and M. W. Schwartz, eds. *Population viability in plants*. Springer-Verlag, Berlin.
- Pendergrass, K. L., P. M. Miller, J. B. Kauffman, and T. N. Kaye. 1999. The role of prescribed burning in maintenance of an endangered plant species, *Lomatium bradshawii*. *Ecological Applications* 9:1420–1429.
- Wilson, M. V., and D. L. Clark. 1997. Effects of fire, mowing, and mowing with herbicide on native prairie of Baskett Butte, Baskett Slough NWR. Prepared for U.S. Fish and Wildlife Service, Western Oregon Refuges.
- Wold, E. N., J. E. Jancaitis, T. H. Taylor, and D. M. Steeck. 2011. Restoration of agricultural fields to diverse wet prairie plant communities in the Willamette Valley, Oregon. *Northwest Science* 85(2):269–287.

Recovery Plans and Species Status Assessments

- U.S. Fish and Wildlife Service. 2022. *Species Status Assessment for Fritillaria gentneri (Gentner's fritillary)*. Version 1.0. U.S. Fish and Wildlife Service Pacific Region, Portland, Oregon. v + 99 pp.
- U.S. Fish and Wildlife Service. 2021. *Rough popcornflower (Plagiobothrys hirtus) Species Status Assessment Report*. Version 1.0. U.S. Fish and Wildlife Service, Portland, Oregon. 53 pp. + appendices.
- U.S. Fish and Wildlife Service. 2012. *Recovery Plan for Rogue and Illinois Valley Vernal Pool and Wet Meadow Ecosystems*. Region 1, Portland, Oregon. xvii + 240 pp.
- U.S. Fish and Wildlife Service. 2010. *Recovery Plan for the Prairie Species of Western Oregon and Southwestern Washington*. U.S. Fish and Wildlife Service, Portland, Oregon. xi + 241 pp.

U.S. Fish and Wildlife Service. 1998. *Recovery Plan for the threatened Nelson's checker-mallow (Sidalcea nelsoniana)*. Portland, Oregon. 71 pp.

U.S. Fish and Wildlife Service. 1993. *Bradshaw's lomatium Recovery Plan*. Portland, Oregon. 52 pp.

Seed Banking and Propagation

Center for Plant Conservation. 2019. *Best Plant Conservation Practices to Support Species Survival in the Wild*. Center for Plant Conservation, Escondido, California. Available at: <https://saveplants.org/wp-content/uploads/2020/12/CPC-Best-Practices5.22.2019.pdf>

Gisler, S., and R. Meinke. 2001. Reproductive ecology, seed banking, and cultivation of five at-risk legume species in Oregon. Report to U.S. Fish and Wildlife Service, Portland, Oregon. Native Plant Conservation Program, Oregon Department of Agriculture, Salem, Oregon.

Guerrant, E. O., Jr., K. Havens, and M. Maunder (eds.). 2004. *Ex situ plant conservation: Supporting species survival in the wild*. Island Press, Washington, D.C.

Kaye, T. N., and K. Kuykendall. 2001. Germination and propagation techniques for restoring rare Pacific Northwest prairie plants. Pages 213–224 in: S. H. Reichard, P. W. Dunwiddie, J. G. Gamon, A. R. Kruckeberg, and D. L. Salstrom, eds. *Conservation of Washington's native plants and ecosystems*. Washington Native Plant Society, Seattle, Washington.

Survey and Monitoring Protocols

Currin, R., and R. J. Meinke. 2013. *Willamette Valley Prairie Plant Survey and Monitoring Protocols*. Institute for Applied Ecology and Oregon Department of Agriculture, Corvallis and Salem, Oregon.

Elzinga, C., and D. Salzer. 1999. Measuring and monitoring plant populations. *Journal of Range Management* 52(5):544.