Recovery Plan for

Pitkin Marsh Lily

(*Lilium pardalinum* subsp. *pitkinense*)

Photo credit: Mark Skinner

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Purpose and Disclaimer

This document presents the U.S. Fish and Wildlife Service's (Service) plan for the conservation and recovery of Pitkin Marsh lily. The recovery plan is the second part of the Service's 3-part recovery planning framework and includes the statutorily required elements pursuant to section 4(f) of the Endangered Species Act (Act). This recovery plan is informed by the first part of the framework, a Species Status Assessment (SSA). The SSA report delivers foundational science for informing decisions related to the Act and includes an analysis of the best available scientific and commercial information regarding a species' life history, biology, and current and future conditions that characterizes the species' viability (i.e., ability to sustain populations in the wild over time) and extinction risk. We have also prepared a Recovery Implementation Strategy (RIS), the third part of the framework. The RIS is an easily updateable operational plan that is separate and complementary to the recovery plan that details the on-the-ground recovery activities needed to complete the recovery actions contained in the recovery plan.

Recovery plans describe the envisioned recovered state for a listed species (when it should no longer meet the Act's definitions of a threatened species or endangered species) and include a recovery strategy, recovery criteria, recovery actions, and the estimates of time and cost needed to achieve it. Plans are published by the Service and are often prepared with the assistance of recovery teams, contractors, State agencies, and others. Recovery plans do not necessarily represent the views, official positions, or approval of any individuals or agencies involved in plan formulation, other than the Service. They represent the official position of the Service only after they have been signed by the Regional Director as approved. Recovery plans are guiding and planning documents only; identification of an action to be implemented by any public or private party does not create a legal obligation beyond existing legal requirements. Nothing in this plan should be construed as a commitment or requirement that any Federal agency obligate or pay funds in any one fiscal year in excess of appropriations made by Congress for that fiscal year in contravention of the Anti-Deficiency Act, 31 U.S.C. 1341, or any other law or regulation. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and completion of recovery actions.

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An electronic copy of this recovery plan will be made available at:

https://ecos.fws.gov/ecp/species/570

1. Introduction

This recovery plan describes criteria for determining when Pitkin Marsh lily should be considered for downlisting and delisting, lists site-specific actions that will be necessary to meet those criteria, and estimates the time and cost to achieve recovery. The recovery plan is based on the Species Status Assessment (SSA) for Pitkin Marsh lily (Service 2024a, entire), which describes the life history and biology of the species, the current status of the species, and the threats that impact the species. The SSA is summarized below. Detailed on-the-ground activities implementing recovery actions can be found in the Recovery Implementation Strategy (RIS; Service 2024b, entire). The RIS and the SSA are finalized separately from the Recovery Plan and will be updated on a routine basis. These supplemental documents are available at https://www.fws.gov/species/pitkin-marsh-lily-lilium-pardalinum-ssp-pitkinense.

2. Summary of Species Status Assessment

Pitkin Marsh lily is an herbaceous perennial plant that was federally-listed as endangered in 1997 under the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. § 1531 *et seq*.; Service 1997, p. 55791). The species has a recovery priority number of 6C, indicating a subspecies with a high degree of threat, low recovery potential, and conflict with construction or other development projects or other forms of economic activity. At the time of federal listing, the species was known from two freshwater marshes in western Sonoma County. The population in the southern marsh (Cunningham Marsh) is protected under a conservation easement, and the current extant population is scattered throughout small fenced exclosures over a 3-acre (1.2 hectare) area. Over the years, surveys at Cunningham Marsh have varied in timing and type of data collected. Some have occurred during the flowering period, while others occurred in fall to document seed capsules. Between 2010–2019, the number of stems with capsules ranged between 15–236 (Service 2024, p. 16). The two populations in the northern marsh (Pitkin Marsh) have not been surveyed since 2001 and 1977 because of a lack of access to the private property where the populations occurred.

Resilient Pitkin Marsh lily populations need marsh habitat with the following: sufficient amount of space/soil to grow; appropriate hydrology and inundation; appropriate levels of sunlight; and a sufficient number of pollinators, including butterflies and hummingbirds. Demographic needs include the following: sexual reproduction, including pollination and germination; genetic diversity; asexual reproduction; and abundance. At the species level, Pitkin Marsh lily needs to maintain multiple resilient populations, distributed throughout its historical range in Sonoma County, that contain the breadth of ecological and genetic diversity within the species (representation and redundancy). Resilient populations in multiple marshes in Sonoma County will help to decrease risk from potential catastrophic events and will help to preserve representation for the species.

At the time of listing, habitat destruction and modification due to urbanization, land use changes, and alterations in hydrology were the most serious threats to the species (Service 1997, p. 55798). Collection for horticultural use, herbivory pressure, and competition with other plant species were also included as threats at the time of listing, and climate change was added as a threat in a subsequent status review (Service 1997, p. 55794; Service 2009, p. 22). All of these

threats continue today, with competition with other plants and climate change acting as primary threats to the currently monitored population in Cunningham Marsh. A plant pathogen recently detected near Pitkin Marsh, *Phytophthora*, has the potential to negatively modify habitat in the future if it gets into either of the marshes inhabited by Pitkin Marsh lily. Conservation factors that influence viability of the species include land protection, habitat management, fencing, propagation and subsequent outplanting, and seed banking.

3. Recovery Strategy

The Pitkin Marsh lily recovery strategy is the primary course of action designed to achieve recovery of the species, so that the threats are ameliorated, and risk of extinction is lowered to negligible levels. The recovery strategy will focus on increasing the resiliency of existing occurrences, maintaining representation by preserving the genetic and ecological diversity of the species, and increasing redundancy by outplanting to new habitat areas to increase the chances of the species withstanding catastrophic events. The condition of two populations in Pitkin Marsh are currently unknown, thus the actual trajectory of the recovery strategy has been designed to be flexible depending on the actual status of these populations. A primary management goal is to assess the conditions of the Pitkin Marsh populations, and assuming that they are still extant, protect and ensure their survival. Immediately following secondary goals are to increase abundance in the Cunningham Marsh population and to establish additional self-sustaining populations on protected lands. Recovery of Pitkin Marsh lily will likely rely on successful coordination with partners and private landowners to implement recovery actions.

4. Recovery Criteria

According to the definitions provided in the Act, an endangered species is a species that is in danger of extinction throughout all or a significant portion of its range and a threatened species is one that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. When we evaluate whether or not a change in the species status is warranted, such as downlisting or delisting, we consider if the species continues to meet either of these definitions or not. A recovered species is one that no longer meets the definitions of endangered or threatened because the threats to that species have been ameliorated and its viability has been restored to levels expected to be sustainable into the foreseeable future.

Recovery criteria outline the conditions of resiliency, redundancy, representation, and threat abatement that indicate when a species may no longer meet the Act's definition of endangered or threatened. Recovery criteria are statutorily required, under 4(f)(1)(b)(ii) of the Act, and serve as the performance measures or targets to track the species' progress towards achieving recovery. Recovery criteria are our best assessment at this time of what needs to be completed so that Pitkin Marsh lily may be removed from the list of threatened and endangered species. We cannot predict the exact course that recovery may take and our understanding of the species' vulnerability to threats is likely to change as more information becomes available; therefore, it is possible that a status review may indicate that delisting is warranted even though not all of the recovery criteria have been met. Conversely, it is possible that the recovery criteria could all be met, and a status review may indicate that delisting is still not warranted because, for example, a new threat emerged that is not addressed in the current recovery criteria. The recovered state

envisioned by the recovery criteria may differ from our assessment in a later status determination.

Downlisting and Delisting Criteria

Downlisting criteria describe conditions that, when achieved, suggest a reclassification of Pitkin Marsh lily from an endangered species to a threatened species may be appropriate. Delisting criteria build from the downlisting criteria. When delisting criteria are met, a removal from the list of threatened and endangered species may be warranted.

Downlisting Criteria

Pitkin Marsh lily may be considered for downlisting when the following criteria are met:

1. Occupied habitat includes at least three self-sustaining populations of Pitkin Marsh lily, with at least one population in either Pitkin or Cunningham Marshes. This total may include any of the three known occurrences, any newly discovered populations, or outplanted populations within the wetlands of Sonoma County. For the purposes of this recovery plan, populations shall be considered separate if they are separated by at least 0.25 mile (0.4 kilometer; km).
2. Each population described in downlisting criteria 1 has an average of at least 1,000 flowering stems within a minimum occupied area of 0.4 acre over a 10-year period of demographic monitoring.
3. The occupied land inhabited by the populations in downlisting criterion 1 is protected via a conservation easement, deed restriction, by sale of fee title to a conservation organization, through a Memorandum of Understanding with the Service, or other durable agreement.
4. Each of the three populations described in downlisting criterion 1 are being managed in a way, currently and into the future, that will support continued existence of Pitkin Marsh lily and its habitat, including management of non-native plant species and protection from herbivory.

Having three resilient populations increases redundancy and reduces the risk of extinction from a catastrophic event. An average of at least 1,000 flowering stems in each population over a 10-year period demonstrates the ability to be self-sustaining in years with both above- and below-average hydrology; ten years of monitoring typically encompasses the full range of wet and dry year variation in coastal California. The metric of individual stems is used rather than attempting to estimate the number of individual plants; because of the clonal nature of the species, the relationship between number of individual stems vs. individual plants is not known. This number was also used as a recovery metric in the recovery plan and amendment for the congeneric (belonging to the same genus) Western lily (*Lilium occidentale*; Service 1998, p. 21; Service 2019, p. 3), a rare California species noted to be ecologically similar to the Pitkin Marsh lily (Baye 2005, p. 18). A minimum occupied area of 0.4 acre will reduce the chance of population extirpation from small-scale events such as a mature oak tree falling within the occupied area. Long-term protection of habitat for each of the populations increases the resiliency of each population and overall species viability. The ongoing threat of herbivory and competition with both native and invasive plant species

warrant long-term management for this species.

Delisting Criteria

Once the downlisting criteria have been met, Pitkin Marsh lily may be considered for delisting when all the following criteria are met:

1. Occupied habitat includes at least four self-sustaining populations of Pitkin Marsh lily, with at least one population in either Pitkin or Cunningham Marshes. This total may include the three known occurrences, any newly discovered populations, or outplanted populations within the wetlands of Sonoma County. For the purposes of this recovery plan, populations shall be considered separate if they are separated by at least 0.25 mile (0.4 km).
2. Each population described in delisting criterion 1 has an average of at least 1,000 flowering stems within a minimum occupied area of 0.4 acre over a 10-year period of demographic monitoring.
3. The number of seed capsules in each population exhibits a stable or increasing trend throughout the monitoring period described in delisting criterion 2.
4. All occupied habitat of the populations in delisting criterion 1 is protected via a conservation easement, deed restriction, by sale of fee title to a conservation organization, through a Memorandum of Understanding with the Service, or other durable agreement.
5. Each of the four populations described in delisting criterion 1 is being managed in a way, currently and into the future, that will support continued existence of Pitkin Marsh lily and its habitat, including management of non-native plant species and protection from herbivory.
6. Seeds, representative of the breadth of the species' genetic diversity, are stored in a facility that maintains certification from the Center for Plant Conservation. Stored seeds are replenished every ten years in order to ensure seed viability, unless storage techniques and/or research show otherwise.

Having four resilient populations would further increase the species redundancy and representation, so that it is better equipped and more able to withstand catastrophic events and potential environmental changes. Threats to Pitkin Marsh lily from climate change, including changes in vegetation, hydrology, and temperature are predicted to be persistent in ways that the species has not experienced in the past, warranting targeted recovery actions to increase redundancy and representation and mitigate extinction risk. Documentation that the number of seed capsules shows a stable or increasing trend will demonstrate advancement through all stages of the life cycle, including pollination/sexual reproduction, which will also suggest that the threat of herbivory has been sufficiently reduced and/or removed. Preservation of seeds in seed banks helps to ensure that the breadth of genetic diversity, and species representation, is maintained.

5. Recovery Actions

Recovery actions are the statutorily required, site-specific interventions that need to be taken to conserve, manage, restore, and enhance the current condition of Pitkin Marsh lily and its habitat

to meet the recovery criteria, as described in section 4(f)(1)(B)(i) of the Act. The Service assigns recovery action priority numbers (1–3) to rank recovery actions. Priority 1 actions are defined as those actions that currently available information suggests, must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future. Priority 2 actions are those that must be taken to prevent a significant decline in population size or habitat quality, or some other significant negative impact short of extinction. Priority 3 actions are all other actions necessary to provide for full recovery of the species. The assignment of priorities does not imply that some recovery actions are of low importance, but instead implies that lower priority items may be deferred while higher priority items are being implemented.

The specific operational tasks and activities required to implement the proposed recovery actions outlined within this plan are presented in the Pitkin Marsh lily RIS, which is a separate document that can be easily adjusted, therefore maximizing the flexibility of species recovery implementation. Table 1 below crosswalks the identified actions with the criteria, threats, and listing factors.

1. Protect extant populations and newly established or identified populations of Pitkin Marsh lily via a conservation easement, deed restriction, by sale of fee title to a conservation organization, through a Memorandum of Understanding with the Service, or other durable agreement (Priority 1).
2. Manage habitat that supports the species to reduce or eliminate threats throughout the range, including control of competitive native and non-native vegetation, and supplemental seeding or planting (Priority 1).
3. Monitor all known populations of Pitkin Marsh lily and ensure that the monitoring protocol informs management of the taxon and allows us to accurately assess population trends (Priority 2).
4. Conduct a genetic study to describe the genetic make-up and confirm taxonomic identity of the Cunningham Marsh population and any living collections at botanic gardens. Use this information to ensure that any seeds or bulbs to be used to establish new populations or augment existing populations are genetically appropriate (Priority 2).
5. Outplant seeds, seedlings, or bulbs to establish additional populations in appropriate habitat within the wetlands of Sonoma County (Priority 2).
6. Collect seeds from all populations and store in certified facilities. A subset of seed may be withheld and planted to establish additional populations (Priority 2).
7. Conduct experimental research to inform management actions that further Pitkin Marsh lily recovery. Examples include those that examine Pitkin Marsh lily habitat needs, propagation and germination techniques, and how to effectively use grazing for long-term vegetation management (Priority 3).

Table 1. Crosswalk of listing factors, threats under those factors, recovery criteria, and recovery action numbers for Pitkin Marsh lily. Listing factor D does not apply to the species at this time.

Listing Factor	Threat Description	Downlisting Criteria	Delisting Criteria	Recovery Actions
Factor A *The present or threatened destruction, modification, or curtailment of its habitat or range*	-Development/urbanization -Land use changes -Alterations to hydrology	3 – Land protection 4 – Habitat management	4 – Land protection 5 – Habitat management	1 – Land protection 2 – Habitat management 3 – Monitoring program 7 – Research
Factor B *Overutilization for commercial, recreational, scientific, or educational purposes*	-Collection for horticultural use	2 – Average of 1,000+ flowering stems per population 3 – Land protection 4 – Habitat management	2 – Average of 1,000+ flowering stems per population 3 – Number of seed capsules shows stable or increasing trend 4 – Land protection 5 – Habitat management	1 – Land protection 2 – Habitat management 3 – Monitoring program 6 – Seed banking
Factor C *Disease or predation*	-Herbivory	1 – Minimum of three populations 2 – Average of 1,000+ flowering stems per population 4 – Habitat management	1 – Minimum of four populations 2 – Average of 1,000+ flowering stems per population 3 – Number of seed capsules shows stable or increasing trend 5 – Habitat management	1 – Land protection 2 – Habitat management 3 – Monitoring program 6 – Seed banking
Factor E *Other natural or manmade factors affected its continued existence*	-Competition with native and non-native vegetation -Climate change	1 – Minimum of three populations 2 – Average of 1,000+ flowering stems per population 3 – Land protection 4 – Habitat management	1 – Minimum of four populations 2 – Average of 1,000+ flowering stems per population 3 – Number of seed capsules shows stable or increasing trend 4 – Land protection 5 – Habitat management 6 – Seed banking	1 – Land protection 2 – Habitat management 3 – Monitoring program 4 – Genetic study 5 – Outplanting 6 – Seed banking 7 – Research

6. Estimated Time and Cost of Recovery

Estimates of time and cost, as defined in section 4(f)(1)(B)(iii) of the Act, must reflect, to the maximum extent practicable, the total amount of time and costs it will take to achieve the recovery (delisting) of Pitkin Marsh lily. The cost estimates provided do not account for possible future inflation.

Table 2 below summarizes the estimated time and costs to achieve recovery of Pitkin Marsh lily based on the recovery actions described in this plan. The costs include financial, volunteer, and in-kind support as well as other conservation endeavors likely to be supported by other cooperating agencies. We estimate that the cost of completing the recovery actions such that the criteria have been met and Pitkin Marsh lily may be considered for delisting to be between $1,985,000 and $5,985,000. The cost to protect suitable Pitkin Marsh lily habitat in Pitkin Marsh is largely unknown at this time, thus accounting for the range in total cost.

We estimate that completion of these actions could lead to delisting approximately 30 years after suitable habitat for four populations is secured in perpetuity. This time frame allows for seed multiplication and outplanting, if necessary, or habitat management such that threats are removed to allow all populations to grow freely through both sexual and asexual reproduction of flowering plants. However, we acknowledge that the initial steps to secure land protection will not be instantaneous, thus adding an unknown number of years towards recovery for this species.

We note that the recovery program may change over time, or the timeframe estimated to implement the recovery actions to achieve recovery of the species may take longer than expected. The recovery of Pitkin Marsh lily will depend largely on the commitment and the ability of the Service and partners to implement the recovery actions necessary to achieve the recovery criteria.

Table 2. Pitkin Marsh lily recovery actions and estimated costs.

Recovery Action Number	Summary of Recovery Action	Estimated Time to Achieve	Estimated Cost
1	Protect extant populations and newly established or identified populations	15 years	$500,000 – $4,500,000
2	Manage habitat that supports the species	30 years	$950,000
3	Develop and implement a monitoring program for all populations	30 years	$50,000
4	Conduct a genetic study to confirm the taxonomic status of all known Pitkin marsh lily plants.	5 years	$15,000
5	Outplanting within the historical range of the species	20 years	$160,000
6	Seed banking	5–10 years	$10,000
7	Conduct experimental research projects	20 years	$300,000
	TOTAL ESTIMATED COSTS		**$1,985,000 – $5,985,000**

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