

U.S. Fish & Wildlife Service

Draft Recovery Plan for Oregon Spotted Frog (*Rana pretiosa*)



**Draft Recovery Plan
for
Oregon Spotted Frog
(*Rana pretiosa*)**

U.S. Fish and Wildlife Service
Portland, Oregon

Draft approved:

Regional Director, Pacific Region One

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Recovery plans delineate reasonable actions needed to recover and/or protect listed species. We, the U.S. Fish and Wildlife Service (Service), publish recovery plans, sometimes preparing them with the assistance of recovery teams, contractors, State agencies, and others. Objectives of the recovery plan are accomplished, and funds are made available, subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities with the same funds.

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An electronic copy of this recovery plan is available at:

<https://www.fws.gov/program/recovery/recovery-plans>

and

<https://ecos.fws.gov/ecp/species/6633>.

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RECOVERY PLANNING PROCESS

The Service is now using a three-part framework for recovery planning (see <https://www.fws.gov/endangered/esa-library/pdf/RPI.pdf>). This approach is intended to reduce the time needed for recovery planning, increase the flexibility of recovery planning documents by making them easier to modify as new information or circumstances arise, and thus maintain the relevancy of recovery plans over a longer timeframe. Under this process, a recovery plan includes the statutorily-required elements under section 4(f) of the Endangered Species Act (Act) (objective and measurable recovery criteria, site-specific management actions, and estimates of time and costs), along with a concise introduction and our strategy for how we plan to achieve species recovery. The recovery plan is supported by two supplementary documents: a species status assessment (or, as in this case, a species biological report with slightly different format and structure), which describes the best available scientific information related to the biological needs of the species and assessment of threats; and the recovery implementation strategy, which details the particular near-term activities needed to implement the recovery actions identified in the recovery plan. Under this approach, new information on species biology or details of recovery implementation may be incorporated by updating these supplementary documents without concurrent revision of the entire recovery plan, unless changes to statutorily-required elements are necessary.

Thus, this recovery plan document is one piece of a three-part framework:

1. A **Species Status Assessment (SSA)** or **Species Biological Report (SBR)** informs the recovery plan; it describes the biology and life history needs of the species (includes distinct population segments, subspecies, species groups), includes analysis of the species' historical and current conditions, and includes discussion of threats and conservation needs of the species. This document may be updated as needed based on new information.

The format of this document is structured around the conservation biology principles of resiliency, representation, and redundancy (Shaffer and Stein 2000, pp. 307-310; Wolf et al. 2015, entire; Smith et al. 2018, entire), known as the 3Rs.

Resiliency describes the ability of populations to withstand stochastic events (arising from random factors). We can measure resiliency based on metrics of population health; for example, birth versus death rates and population size. Highly resilient populations are better able to withstand disturbances such as random fluctuations in birth rates (demographic stochasticity), variations in rainfall (environmental stochasticity), or the effects of anthropogenic activities.

Representation describes the ability of a species to adapt to changing environmental conditions. Representation can be measured by the breadth of genetic or environmental diversity within and among populations and gauges the probability that a species is capable of adapting to environmental changes. The more representation, or diversity, a species has, the more it is capable of adapting to changes (natural or human caused) in its environment. In the absence of

species-specific genetic and ecological diversity information, we evaluate representation based on the extent and variability of habitat characteristics across the geographical range.

Redundancy describes the ability of a species to withstand catastrophic events. Measured by the number of populations, their resiliency, and their distribution (and connectivity), redundancy gauges the probability that the species has a margin of safety to withstand or can bounce back from catastrophic events (such as a rare destructive natural event or episode involving many populations).

The Oregon spotted frog SBR ([USFWS 2022](#)) describes the species' viability across its extant range in Canada and the U.S. within 16 hydro-geographic sub-basins (HUC 8) that are nested within 5 ecoregional areas^a and 6 genetic groups^b. The majority of the species' range lies within the U.S., which contains 15 of these sub-basins (representing all 5 ecoregional areas and at least 5 of the genetic groups). Resiliency was determined at the sub-basin scale by assessing population abundance (site-level egg mass counts), the number of populations within each sub-basin, the level of connectivity between populations or sites, and the quantity and quality of habitat. Representation was assessed at the scale of the six genetic groups and the five ecoregional areas, based on the proportion of occupied sub-basins with moderate or high resiliency. Redundancy of the species was assessed at the range scale based on the number of occupied sub-basins with moderate or higher levels of resiliency dispersed across all ecoregional areas of the species range.

2. The **Recovery Plan** contains a concise overview of the recovery strategy for the species (indicating how its recovered state will achieve resiliency, representation, and redundancy), as well as the statutorily-required elements of recovery criteria, recovery actions, and estimates of the time and costs to achieve the plan's goals.

This recovery plan is designed to improve resiliency of Oregon spotted frog populations across the 16 sub-basins within its range. Resiliency is determined at the sub-basin scale using the metrics above, which are described fully in the SBR. The recovery plan aims to maintain representation of existing genetics and ecological adaptive capacity with both genetic groups and ecoregional areas represented by resilient populations across its range. Recovery aims to maintain redundancy of the species by having multiple sub-basins broadly distributed across the range with moderate or higher levels of resiliency.

3. The **Recovery Implementation Strategy (RIS)** outlines how the recovery plan will be implemented. The RIS is a short-term, flexible operational document focused on how, when, and by whom the recovery actions from the recovery plan will be implemented. This document may be updated as needed based on new information, allowing it to be adapted to changing circumstances with greater flexibility and efficiency. The RIS

^a Ecoregional areas are portions of the State with similar climate and vegetation, where ecosystems (and the type, quality, and quantity of environmental resources) are generally similar.

^b Genetic groups for the Oregon spotted frog are based on genetic analyses performed by Blouin et al. (2010) on Oregon spotted frogs from 23 locations in British Columbia, Oregon, and Washington.

outlines the specific recovery actions to be implemented and is developed in cooperation with our conservation partners. The RIS includes timeframes and activities for our partners to best implement recovery actions and achieve recovery goals.

Actions to improve resiliency within each sub-basin are identified in the RIS. The RIS for the Oregon spotted frog ([USFWS 2023](#)) describes the recovery actions to be implemented within each sub-basin and includes a more detailed description of actions at the population or site scale.

EXECUTIVE SUMMARY

Species Status: The Oregon spotted frog is the most aquatic frog species in the Pacific Northwest, occurring in lakes, ponds, wetlands, riverine oxbows and floodplains, and altered habitats such as farmed floodplains and ditches. Reproductive success of the Oregon spotted frog is directly influenced by the timing and availability of water, since all life stages of the species are aquatic. The species' life cycle is tied to shallow-water areas for breeding, oviposition, and egg and tadpole development; perennial water with moderately vegetated pools for adult and juvenile survival in the summer (dry) season; and perennial water for protecting all age classes during cold wet or freezing weather (Watson et al. 2003, p. 298).

The Oregon spotted frog no longer occurs in an estimated 76 to 90 percent of its historical range (USFWS 2014, p. 51663). Currently, Oregon spotted frogs are found within small portions of 16 sub-basins ranging from southwestern British Columbia south through the Puget Trough in Washington, and the Cascade Range from south-central Washington to the Klamath Basin in southern Oregon (79 FR 51662-51663, Table 1; USFWS 2022, pp. 9-11). Of these 16 sub-basins, 15 are located in the U.S. (Table).

Table. Hydrologic Unit Code (HUC) 8 Sub-basins within the current range of the Oregon spotted frog (see map in Figure 1 below).

| Location | HUC 8 Sub-basin Name |
|------------------|-------------------------------|
| British Columbia | Lower Fraser River |
| Washington | Fraser River (Sumas River) |
| | Nooksack River |
| | Straits of Georgia |
| | Nisqually/Puget Sound Frontal |
| | Upper Chehalis |
| | Middle Columbia-Hood River |
| | Klickitat River |
| Oregon | Lower Deschutes River |
| | Upper Deschutes River |
| | Little Deschutes River |
| | McKenzie River |
| | Middle Fork Willamette River |
| | Williamson River |
| | Upper Klamath Lake |
| | Upper Klamath River |

The Oregon spotted frog was listed as threatened under the Act on August 29, 2014 ([79 FR 51658](#)). Critical habitat, which encompasses most of the area occupied by the species, was designated on May 11, 2016 ([81 FR 29336](#)). The Recovery Priority Number for this species is 8, representing a full species with a moderate degree of threat and a high recovery potential (USFWS 1983).

Recovery Vision: Recovery of the Oregon spotted frog will be achieved by having resilient populations within the 16 hydro-geographic sub-basins distributed across the species' range. At the sub-basin scale, Oregon spotted frog resiliency will be determined using metrics for population abundance, distribution, and connectivity as well as habitat quantity and quality. Representation of the species will be supported by genetic groups and ecoregional areas within the extant range being represented by moderate- to high-resiliency sub-basins. Redundancy of the species will be supported by having multiple sub-basins across the range with moderate or higher levels of resiliency, dispersed across all ecoregional areas of the species range.

Recovery Strategy: Historical habitat loss, fragmentation, and degradation due to altered hydrology, invasive vegetation, non-native predators, loss of disturbance processes that set back vegetational succession, and encroachment by tall shading vegetation (e.g., shrubs, trees) have led to population declines across the current range of the Oregon spotted frog. Ongoing habitat degradation threatens the viability of the species, whose remaining populations are increasingly becoming small, isolated, and vulnerable to a heightened risk of extirpation from known threats, stochastic events, loss of genetic diversity, and/or climate-related changes.

The recovery strategy aims to (1) improve Oregon spotted frog population resiliency within sub-basins across its range, (2) preserve representation of the species by having moderate to high resiliency within populations in sub-basins within the known genetic groups and ecoregional areas, and (3) ensure redundancy of the species across its range by having moderate or higher levels of resiliency in more than one sub-basin in each ecoregional area.

Reestablishing and maintaining adequate areas of high-quality, well-connected wetland and aquatic habitat for the Oregon spotted frog will promote recovery. Habitat quantity, quality, and distribution within a sub-basin is described in terms of resiliency in Section 4.1 of the Species Biological Report (SBR; USFWS 2022, p. 22). To facilitate recovery, Oregon spotted frog populations should be large enough and sufficiently distributed within sub-basins across the range to withstand small-scale (site- or population-level) and large-scale (sub-basin, ecoregion, or rangewide level) stochastic events such as drought that could alter the timing and duration of water within habitat over a broad geographic area. Aquatic habitats to support these populations should be spatially distributed within each sub-basin to allow for movement within, and dispersal between, sites and populations.

The recovery strategy for the Oregon spotted frog aims to improve resiliency of populations within each sub-basin. This will be accomplished by restoring and improving aquatic habitats to support the species' life cycle, and improving aquatic connectivity between populations to support dispersal and genetic exchange. Threats to the species and its habitat will be managed or eradicated to improve Oregon spotted frog resiliency. The largest existing populations within each sub-basin will be maintained and enhanced to inhibit continued decline of the species and,

further, to improve resiliency at the sub-basin scale. General actions to address the threats are outlined in the Recovery Actions section below. Specific actions by population and sub-basin will be developed in the Recovery Implementation Strategy with conservation partners.

Because the reproductive success of the Oregon spotted frog is directly influenced by the timing and availability of water, ensuring that the duration and spatial extent of water within aquatic habitats supports the species' life cycle is essential to the recovery strategy. Restoring and enhancing complex wetland habitats of variable water depths with native vegetation structure and diversity will provide quality habitat that is suitable for all life stages of Oregon spotted frogs. Reducing or eliminating invasive reed canarygrass (*Phalaris arundinacea*), or otherwise managing for short-stature vegetation, and controlling non-native predators such as American bullfrogs (*Lithobates catesbeianus*) are also vital to maintaining high-quality Oregon spotted frog habitat. Active and ongoing management of these threats is critical to achieving and sustaining recovery of the species.

Representation indicates the ability of the species to maintain ecological and genetic diversity, providing the ability to adapt to changing environmental conditions. Ecological and genetic diversity of the species will be maintained by having a moderate or higher level of resiliency within sub-basins, representing each of the major genetic groups and the ecoregional areas occupied by the species. The Oregon spotted frog recovery strategy will reduce the risk of a large portion of the species' range being impacted by a catastrophic natural or anthropogenic event by managing for redundancy, with sub-basins at moderate or higher levels of resiliency being broadly distributed across the range of the species.

In particular, five of the occupied sub-basins (Fraser River, Middle Columbia-Hood River, Klickitat River, Lower Deschutes River, and Middle Fork Willamette) support only a single Oregon spotted frog population. Some of these single-population sub-basins represent crucial diversity. For example, the Lower Deschutes River sub-basin supports the only population within the Camas Prairie genetic group, and collectively the Middle Columbia-Hood River and Klickitat River sub-basins comprise the entire Columbia drainage genetic group and East Cascades/Mid-Columbia ecoregional area. Actions that aim to improve population resiliency in these sub-basins are a high priority for recovery of the species.

We note that new or emerging threats may arise over time. If any such issues are so significant as to result in a need to change the recovery strategy or the statutorily-required elements of the recovery plan under section 4(f)(1) of the Act, we will amend or revise the plan as appropriate.

Recovery Criteria:

The Oregon spotted frog should be considered for delisting when the following objectives and criteria have been met. Delisting criteria are subject to change as additional information becomes available about species biology and threats.

Objectives:

- (1) Actively manage threats to improve the resiliency of Oregon spotted frog populations within sub-basins across the species' range to a level adequate to withstand stochastic environmental and anthropogenic disturbances.
- (2) Maintain the ecological and genetic diversity of the Oregon spotted frog and preserve its future adaptive capacity by having multiple redundant sub-basins occupied by populations with moderate or higher levels of resiliency, representing the range of ecoregional areas and genetic groups that characterize the species.

Delisting Criteria:

Criterion 1: Oregon spotted frog populations are maintained or improved to a moderate or higher level of resiliency within a minimum of 12 sub-basins for at least 10 out of 15 years. Metrics used to determine resiliency thresholds for each sub-basin include (1) aquatic habitat acreage, hydroperiod, and connectivity; (2) spatial distribution of the species in suitable habitat; and (3) population abundance metrics and trends.

Criterion 2: The moderate or higher levels of resiliency within sub-basins used to satisfy Criterion 1 represent all six of the currently known genetic groups, and include at least two sub-basins in each of the five ecoregional areas.

Criterion 3: Habitat is conserved and threats are managed with long-term conservation commitments to support sustained resiliency of Oregon spotted frog populations within the sub-basins used to satisfy Criterion 1.

Recovery Actions and their Estimated Cost (in Fiscal Year 2023 dollars):

| Recovery Action | Priority | Estimated Cost |
|--|----------|-----------------|
| 1. Restore and enhance wetland, riverine, and other aquatic habitats to support all life stages of Oregon spotted frogs | 1 | \$499,031,500 |
| 2. Ameliorate threats from predation and disease | 1 | \$1,989,394,000 |
| 3. Increase population size and reduce isolation of Oregon spotted frog populations within sub-basins | 1 | \$89,400,000 |
| 4. Promote awareness and increase conservation partnerships | 2 | \$50,000,000 |
| 5. Utilize regulation and policy tools to protect wetland habitat and promote water availability to support species recovery | 1 | \$81,736,000 |
| 6. Conduct inventory, monitoring, and research to guide and support Oregon spotted frog recovery | 3 | \$74,030,000 |
| Total Estimated Cost | | \$2,783,592,500 |

Date of Recovery: Recovery criteria could be met by 2063, based on the conservative assumption that all recovery plan actions are fully funded and implemented as currently outlined, including cooperative efforts by all partners needed to achieve recovery.

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I. INTRODUCTION

The Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act) protects species of wildlife and plants that are listed as endangered or threatened. Recovery is defined as “the process by which listed species and their ecosystems are restored and their future is safeguarded to the point that protections under the [Act] are no longer needed,” according to the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (Service or USFWS) Interim Recovery Planning Guidelines, Version 1.4 (NMFS and USFWS 2018).

Recovery plans are guidance documents developed to provide recommendations to reduce or alleviate threats to listed species (including distinct population segments, subspecies, and species groups) and ensure self-sustaining populations in the wild. Section 4(f)(1) of the Act stipulates that recovery plans include (1) a description of site-specific management actions necessary to conserve the species; (2) objective, measurable criteria that, when met, will allow the species to be removed from the Federal Lists of Endangered and Threatened Wildlife and Plants (Lists); and (3) estimates of the time and cost required to achieve the plan’s goals and intermediate steps.

The Oregon spotted frog (*Rana pretiosa*) was listed as threatened under the Act on August 29, 2014 ([USFWS 2014](#)). Critical habitat, which encompasses most of the area occupied by the species, was designated on May 11, 2016 ([USFWS 2016](#)). The Oregon spotted frog has been State-listed as endangered in the State of Washington since 1997, and is considered a sensitive species in Oregon. In Canada, the Oregon spotted frog is listed as endangered under the Species at Risk Act and a recovery strategy has been prepared (Environment Canada 2015).

This is the first recovery plan for the Oregon spotted frog. It is based on the Oregon spotted frog species biological report (SBR, USFWS 2022, entire) and the final listing rule (USFWS 2014), which together describe the species’ biology and life history, threats, conservation actions to date, and potential future actions to aid recovery. These and other Service documents on the species are available at its species profile webpage (<https://ecos.fws.gov/ecp/species/6633>).

A. BACKGROUND

Basic Species Information

The Oregon spotted frog has the most aquatic-dependent life history of any frog species in the Pacific Northwest, occurring in lakes, ponds, wetlands, riverine oxbows and floodplains, and altered habitats such as farmed floodplains and ditches. Reproductive success of the Oregon spotted frog is directly influenced by the timing and availability of water, since all life stages of the species are aquatic. The species’ life cycle is tied to shallow-water areas for breeding, oviposition, and egg and tadpole development; perennial water with moderately vegetated pools for adult and juvenile survival in the summer (dry) season; and perennial water for protecting all age classes during cold wet or freezing weather (Watson et al. 2003, p. 298).

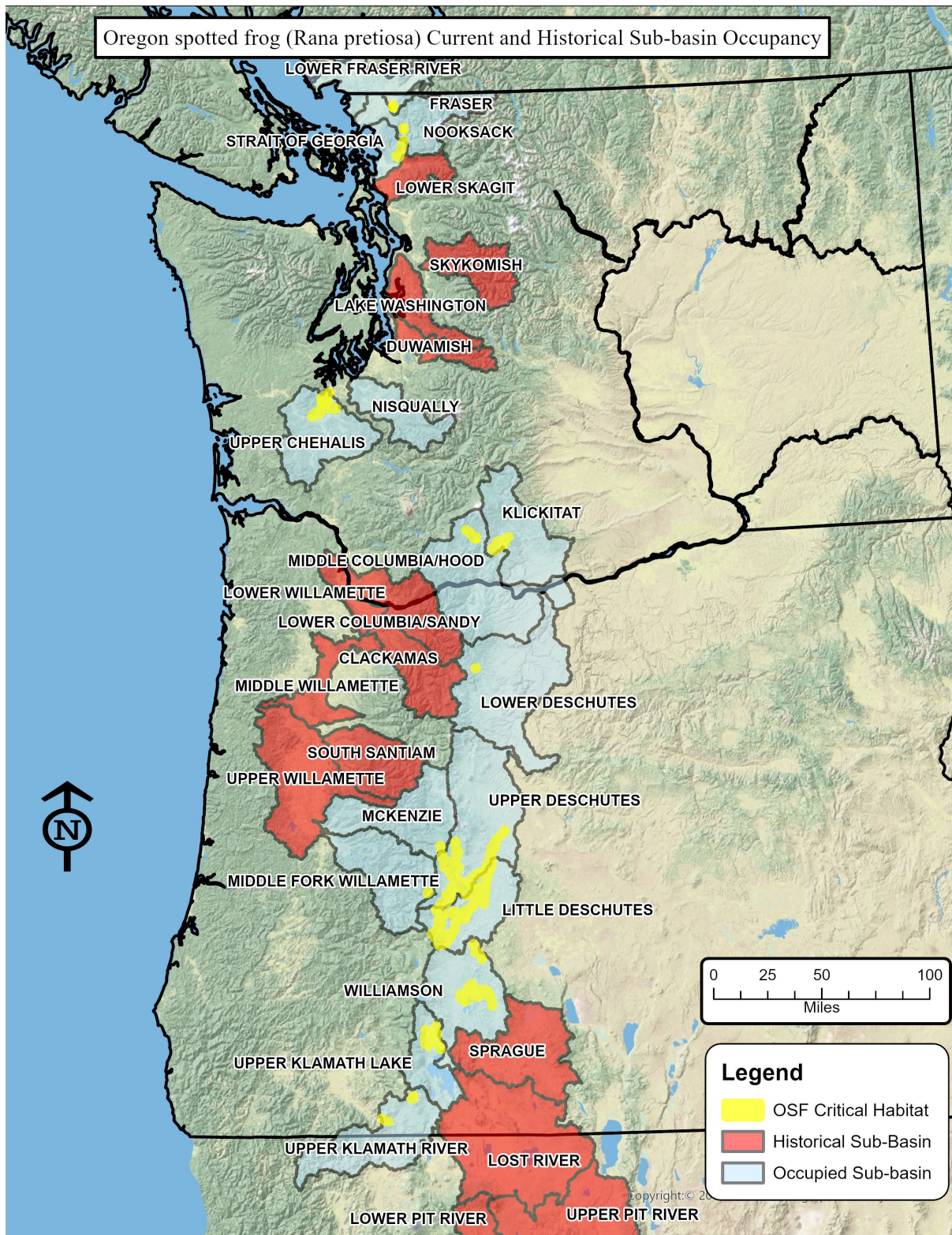


Figure 1. Historical and current range of the Oregon spotted frog by sub-basin (HUC 8) and designated critical habitat, indicating the restricted extent of species distribution within the sub-basins.

The Oregon spotted frog historically occupied a large expanse of wetland and aquatic habitats in the Pacific Northwest within at least 31 hydro-geographic sub-basins (scale equivalent to Hydrologic Unit Code^c (HUC) 8) (Figure 1). The species no longer occurs in an estimated 76 to 90 percent of its historical range (USFWS 2014, p. 51663). Currently, Oregon spotted frogs are found within small portions of 16 sub-basins ranging from southwestern British Columbia south through the Puget Trough in Washington, and the Cascade Range from south-central Washington to the Klamath Basin in southern Oregon (79 FR 51662-51663, Table 1; USFWS 2022, pp. 9-11). Of these 16 sub-basins, 15 are located in the U.S.

Threats

The decline of the Oregon spotted frog across its range is attributed mainly to the historical loss of wetland habitat; the continued degradation of aquatic habitats due to altered hydrology, introduction of non-native plant and animal species, loss of disturbance processes that maintained open-water habitat and vegetation structure to support all life stages; and habitat fragmentation (79 FR 51667-51694; USFWS 2022, pp. 16-17). Because of habitat fragmentation and loss, many small and isolated populations exist throughout the range and are at increased risk of extirpation from identified threats, stochastic events, loss of genetic diversity (e.g., issues leading to inbreeding depression), and/or climate-related changes. Multiple threats to Oregon spotted frog populations within each occupied sub-basin cumulatively pose a risk to viability of the species across its range. Climate change is likely to accelerate or intensify the impacts of many of these threats.

Given the water-reliant life history of the Oregon spotted frog, a shortened hydroperiod (duration of water inundation) can rapidly result in population decline. Water allocation, damming and ditching for agriculture and development have modified hydroperiods that support the Oregon spotted frog life cycle. Loss of beaver via land management has further reduced hydroperiods within aquatic habitats inhabited by the species. Climatic drought exacerbates the reduction in hydroperiod within habitat, compounding impacts from other stressors and threats. Since listing of the species in 2014, multiple years of drought in the Pacific Northwest have resulted in continued decline of many populations across the range. Demographic declines in some of the largest Oregon spotted frog populations in the range since the time of listing highlight the magnitude of these cumulative threats to viability of the species.

Habitats that support the Oregon spotted frog are further degraded by the presence of invasive reed canarygrass (*Phalaris arundinacea*), which unless appropriately managed can grow too tall and dense to provide adequate low vegetation structure and solar exposure in breeding habitat. Oregon spotted frogs are subject to predation by non-native predatory fish (e.g., bass [*Micropterus* spp.], brown trout [*Salmo trutta*], or brown bullhead [*Ameiurus nebulosus*]) and American bullfrogs [*Lithobates catesbeianus*]). Diseases such as *Batrachochytrium*

^c The U.S. is divided into hydrologic units, arranged or nested within each other from the largest geographic area (regions) to the smallest geographic area (cataloging units). Each hydrologic unit is identified by a unique numerical hydrologic unit code (HUC) based on U.S. Geological Survey levels of classification. The Service evaluated and summarized threats to the Oregon spotted frog in the listing rule and the SBR within sub-basins, equivalent to a 4th field watershed and a HUC of 8.

dendrobatidis (*Bd*, chytrid fungus), *Saprolegnia*, and *Ribeiroia ondatrae* have been found in Oregon spotted frogs, but the effects of such diseases on the species are not well understood.

Climate change is likely to exacerbate the impacts from many identified threats on Oregon spotted frog populations. Climate change that results in drying habitats is likely to hasten the spread of reed canarygrass and concentrate predatory fish and bullfrogs within Oregon spotted frog habitat. Climate warming may increase the spread of bullfrogs into high-elevation Oregon spotted frog habitats that are currently unsuitably cold for bullfrogs. Other threats to Oregon spotted frogs, such as disease, are likely to increase and spread in a changing climate. Without management to reduce these threats, Oregon spotted frog populations are likely to continue to decline.

A detailed analysis of threats and summary of the threats to Oregon spotted frogs by sub-basin was provided in the final listing rule in 2014 (79 FR 51694, Table 2) and is further described in the SBR (USFWS 2022, pp. 26-73 and Appendix III). Specific population- or site-level threats within each sub-basin were documented in support of the listing rule at: <https://www.fws.gov/media/or-spotted-frog-final-listing-threat-synthesis>.

Assessing Viability

As described in the Recovery Planning Process (above), the SBR informs this recovery plan. The format of the SBR is structured around the conservation biology principles of resiliency, representation, and redundancy to assess the current viability of the species.

The assessment of Oregon spotted frog viability in the SBR characterizes population resiliency at the sub-basin scale, to account for redundancy across the range and representation within ecoregional areas and genetic groups. To be viable, the Oregon spotted frog needs to have resilient populations within sub-basins distributed across ecoregional areas and genetic groups throughout its geographic range.

Multiple spatial scales^d are used to assess Oregon spotted frog viability. Resiliency of Oregon spotted frog populations was determined at the sub-basin scale in the SBR. Oregon spotted frog distribution and demography vary greatly among the sub-basins within the species' range. Some

^d *Sub-basin scale* – The sub-basin scale refers to the HUC 8 watershed classification, the unit of area used to assess Oregon spotted frogs in the SBR and in the federal listing decision. While the HUC watershed classification system is not used in Canada, we consider the Lower Fraser River watershed equivalent to a HUC 8 sub-basin.

Population and population scale – Populations may be discerned when they occur in waterbodies with discrete boundaries or when they are isolated by distances (typically greater than 5 kilometers, or 3.1 miles) that do not allow for dispersal or movement between them. In Washington, populations have been delineated and Oregon spotted frog breeding data are collated from all sites within a population for the purposes of looking at the abundance metric for population resiliency in the SBR. In Oregon, populations have not been delineated in all areas where the species occurs (see definitions for population and site). Refer to the SBR for a more comprehensive discussion of populations and sites, and how they were delineated across the range of the Oregon spotted frog.

Site and site scale – Sites represent the geographic location, delineated via polygons, where breeding data is gathered. Sites are often located along riverine corridors where there are no clear delineations of what constitutes a population.

sub-basins contain a single large or small population of Oregon spotted frogs. Conversely, some sub-basins contain several populations, or numerous small sites that have not been delineated as a population but could function as one if the habitat conditions and aquatic connectivity were improved. In the SBR, our evaluation of Oregon spotted frog resiliency relied on metrics for population abundance, distribution, connectivity, and habitat quantity and quality within each sub-basin.

The SBR assessed representation of the Oregon spotted frog on the basis of its ability to retain current levels of both genetic and ecological diversity. Genetic groups delineated by Blouin et al. (2010) represent the range of genetic diversity of the species. The six delineated genetic groups (Table 1) are geographically isolated from one another and occupy a variety of habitat types, providing potential for the species to adapt to changing environmental conditions through genetic diversity. Oregon spotted frogs from populations in at least four sub-basins in Washington were not included in this genetic study (Blouin et al. 2010) and are classified as “unknown” with respect to genetic diversity. The SBR discusses these genetic groups and Blouin et al. (2010) in further detail.

Ecoregional areas represent broad geographic regions with similar climate and vegetation, within which occupied sub-basins are nested. Oregon spotted frog populations occur in five ecoregional areas (Table 1) as described in the SBR, based on modified ecoregions delineated in State Conservation Strategy documents (WDFW 2005; ODFW 2016). The various ecoregional areas occupied within the Oregon spotted frog range reflect the ecological diversity of habitats and the adaptive potential of the species over time. Loss of Oregon spotted frogs from any occupied ecoregional area would result in the loss of a large portion of the species’ range, along with local adaptations to unique ecological conditions that could buffer the species’ response to environmental changes over time.

The SBR evaluated redundancy of the Oregon spotted frog by assessing the number of sub-basins with moderate or higher levels of resiliency in ecoregional areas throughout the species’ range. Maintaining a broad distribution of the Oregon spotted frog across all ecoregional areas ensures that the species will withstand localized or broad-scale catastrophic events and prevent the loss of representation from a large portion of the range.

Table 1. HUC 8 Sub-basins, ecoregional areas, and genetic groups within current range of the Oregon spotted frog.

| Location | HUC 8 Sub-basin Name (HUC Code) | Ecoregional Areas | Genetic Grouping |
|------------|--|-------------------------------|-------------------|
| B.C. | Lower Fraser River | Puget Trough | British Columbia |
| Washington | Fraser River (Sumas River*; 17110001) | Puget Trough | Unknown |
| | Nooksack River (17110004) | | |
| | Strait of Georgia (17110002) | | |
| | Nisqually/Puget Sound Frontal** (17110015, 17110019) | | |
| | Upper Chehalis (17100103) | | Chehalis drainage |
| | Middle Columbia-Hood River (17070105) | East Cascades–Mid-Columbia | Columbia drainage |
| | Klickitat River (17070106) | | |
| Oregon | Lower Deschutes River (17070306) | East Cascades–Deschutes Basin | Camas Prairie |
| | Upper Deschutes River (17070301) | | Central Cascades |
| | Little Deschutes River (17070302) | | |
| | McKenzie River (17090004) | West Cascades | |
| | Middle Fork Willamette River (17090001) | | |
| | Williamson River (18010201) | East Cascades–Klamath Basin | Klamath Basin |
| | Upper Klamath Lake (18010203) | | |
| | Upper Klamath (18010206) | | |

*The sub-basin we refer to as “Fraser River” in the final listing and current recovery documents is named “Sumas River” in USGS spatial data. For consistency with previously published documents, the Service has retained “Fraser River” here.

**Nisqually and Puget Sound Frontal are separate HUC 8 sub-basins whose populations have been combined and assessed as a single sub-basin for the purposes of viability assessment and recovery planning. See Section 5.1.5 for further explanation.

II. RECOVERY

A. RECOVERY VISION AND STRATEGY

A recovery vision is an explicit expression of recovery in terms of resiliency, representation, and redundancy. It builds on the description of viability for the species and defines what recovery looks like for the species. The recovery strategy provides a recommended approach for achieving the recovery vision and ultimately the delisting criteria.

Recovery Vision

Recovery of the Oregon spotted frog will be achieved by having resilient populations within the 16 hydro-geographic sub-basins distributed across the species' range. At the sub-basin scale, Oregon spotted frog resiliency will be determined using metrics for population abundance, distribution, and connectivity as well as habitat quantity and quality. Representation of the species will be supported by genetic groups and ecoregional areas within the extant range being represented by moderate- to high-resiliency sub-basins. Redundancy of the species will be supported by having multiple sub-basins across the range with moderate or higher levels of resiliency, dispersed across all ecoregional areas of the species range.

Recovery Strategy

Historical habitat loss, fragmentation, and degradation due to altered hydrology, invasive vegetation, non-native predators, loss of disturbance processes that set back vegetational succession, and encroachment by tall shading vegetation (e.g., shrubs, trees) have led to population declines across the extant range of the Oregon spotted frog. Ongoing habitat degradation threatens the viability of the species, whose remaining populations are increasingly becoming small, isolated, and vulnerable to a heightened risk of extirpation from known threats, stochastic events, loss of genetic diversity, and/or climate-related changes.

The recovery strategy aims to (1) improve Oregon spotted frog population resiliency within sub-basins across its range, (2) preserve representation of the species by having moderate to high resiliency within populations in sub-basins within the known genetic groups and ecoregional areas, and (3) ensure redundancy of the species across the range by having moderate or higher levels of resiliency in more than one sub-basin in each ecoregional area.

Reestablishing and maintaining adequate areas of high-quality, well-connected wetland and aquatic habitat for the Oregon spotted frog will promote recovery. Habitat quantity, quality, and distribution within a sub-basin is described in terms of resiliency in Section 4.1 of the SBR (USFWS 2022, p. 22). To facilitate recovery, Oregon spotted frog populations should be large enough and sufficiently well-distributed within sub-basins across the range to withstand small scale (site- or population-level) and large scale (sub-basin-, ecoregion-, or rangewide-level) stochastic events such as drought that could alter the timing and duration of water within habitat over a broad geographic area. Aquatic habitats to support these populations should be spatially distributed within each sub-basin to allow for movement within, and dispersal between, sites and populations.

The recovery strategy for the Oregon spotted frog aims to improve resiliency of populations within each sub-basin. This will be accomplished by restoring and improving aquatic habitats to support the species' life cycle and improving aquatic connectivity between populations to support dispersal and genetic exchange. Threats to the species and its habitat will be managed or eradicated to improve Oregon spotted frog resiliency. The largest existing populations within each sub-basin will be maintained and enhanced to inhibit continued decline of the species and, further, to improve resiliency at the sub-basin scale. General actions to address the threats are outlined in the Recovery Actions section below. Specific actions by population and sub-basin will be developed in the Recovery Implementation Strategy with conservation partners.

Because the reproductive success of the Oregon spotted frog is directly influenced by the timing and availability of water, ensuring that the duration and spatial extent of water within aquatic habitats supports the species' life cycle is essential to the recovery strategy. Restoring and enhancing complex wetland habitats of variable water depths with native vegetation structure and diversity will provide quality habitat that is suitable for all life stages of Oregon spotted frogs. Reducing or eliminating invasive reed canarygrass, or otherwise managing for short-stature vegetation, and controlling non-native predators such as American bullfrogs are also vital to maintaining high-quality Oregon spotted frog habitat. Active and ongoing management of these threats is critical to achieving and sustaining recovery of the species.

Representation indicates the ability of the species to maintain ecological and genetic diversity, providing the ability to adapt to changing environmental conditions. Ecological and genetic diversity of the species will be maintained by having a moderate or higher level of resiliency within sub-basins, representing each of the major genetic groups and the ecoregional areas occupied by the species. The Oregon spotted frog recovery strategy will reduce the risk of a large portion of the species' range being impacted by a catastrophic natural or anthropogenic event by managing for redundancy, with sub-basins at moderate or higher levels of resiliency being broadly distributed across the range of the species.

In particular, five of the occupied sub-basins (Fraser River, Middle Columbia-Hood River, Klickitat River, Lower Deschutes River, and Middle Fork Willamette) support only a single Oregon spotted frog population. Some of these single-population sub-basins represent crucial diversity. For example, the Lower Deschutes River sub-basin supports the only population within the Camas Prairie genetic group, and collectively the Middle Columbia-Hood River and Klickitat River sub-basins comprise the entire Columbia drainage genetic group and East Cascades/Mid-Columbia ecoregional area. Actions that aim to improve population resiliency in these sub-basins are a high priority for recovery of the species.

We note that new or emerging threats may arise over time. If any such issues are so significant as to result in a need to change the recovery strategy or the statutorily-required elements of the recovery plan under section 4(f)(1) of the Act, we will amend or revise the plan as appropriate.

B. RECOVERY CRITERIA

Section 4(f)(1)(B)(ii) of the Act states that each recovery plan shall incorporate, to the maximum extent practicable, “objective, measurable criteria which, when met, would result in a determination...that the species be removed from the List.” Legal challenges to recovery plans (see *Fund for Animals v. Babbitt*, 903 F. Supp. 996 [D.D.C. 1995]) and a Government Accountability Audit (GAO 2006) also have affirmed the need to frame recovery criteria in terms of threats assessed under the five listing factors.

Recovery criteria serve as objective, measurable guidelines to assist in determining when an endangered species has recovered to the point that it may be considered for downlisting to threatened, or that the protections afforded by the Act may no longer be necessary and the species may be considered for delisting. Downlisting is the reclassification of a species from endangered to threatened. Delisting is the removal of the species from the Lists. The term “endangered species” means any species that is in danger of extinction throughout all or a significant portion of its range. The term “threatened species” means any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Recovery criteria represent our best assessment, at the time the recovery plan is completed, of the conditions that would likely result in a determination that listing under the Act as threatened or endangered is no longer required. However, revisions to the Lists, including delisting or downlisting a species, must reflect determinations made in accordance with sections 4(a)(1) and 4(b) of the Act. Section 4(a)(1) requires that the Secretary determine whether a species is an endangered species or threatened species because of threats to the species, based on an analysis of the five listing factors in section 4(a)(1). Section 4(b) requires that the determination be made “solely on the basis of the best scientific and commercial data available.” Thus, while recovery plans provide important guidance to the Service, States, and other partners on methods of minimizing threats to federally-listed species and measurable criteria against which to measure progress towards recovery, they are guidance and not regulatory documents.

Thus, a decision to delist or downlist a species is informed by the recovery criteria but is ultimately based on an analysis of threats using the best scientific and commercial data then available. When changing the status of a species, we first propose the action in the Federal Register to seek public comment and peer review, after which we announce a final decision in the Federal Register.

The Oregon spotted frog should be considered for delisting when the following objectives and criteria have been met. Delisting criteria are subject to change as additional information becomes available about species biology and threats.

Objectives

- (1) Actively manage threats to improve the resiliency of Oregon spotted frog populations within sub-basins across the species’ range to a level adequate to withstand stochastic environmental and anthropogenic disturbances.

- (2) Maintain the ecological and genetic diversity of the Oregon spotted frog and preserve its future adaptive capacity by having multiple redundant sub-basins occupied by populations with moderate or higher levels of resiliency, representing the range of ecoregional areas and genetic groups that characterize the species.

Delisting Criteria

Criterion 1: Oregon spotted frog populations are maintained or improved to a moderate or higher level of resiliency within a minimum of 12 sub-basins for at least 10 out of 15 years. Metrics used to determine resiliency thresholds for each sub-basin include (1) aquatic habitat acreage, hydroperiod, and connectivity; (2) spatial distribution of the species in suitable habitat; and (3) population abundance metrics and trends.

Criterion 2: The sub-basins with moderate or higher levels of resiliency used to satisfy Criterion 1 represent all six of the currently known genetic groups, and at least two sub-basins represent each of the five ecoregional areas.

Criterion 3: Habitat is conserved and threats are managed with long-term conservation commitments to support sustained resiliency of Oregon spotted frog populations within the sub-basins used to satisfy Criterion 1.

Rationale

The recovery criteria, collectively, will ensure Oregon spotted frog population resiliency within each ecoregional area and genetic group across the species' range. The Service estimates that there are at least 12 sub-basins that could support a moderate or higher level of resiliency in Oregon spotted frog populations if actions are implemented to enhance habitats that support the aquatic life history needs of the species (USFWS 2023, p. 6). The SBR estimates that, as of 2021, 7 of the 16 occupied sub-basins had moderate resiliency or higher (USFWS 2022, p. 71-73).

Within each sub-basin across the range, there is wide variation in population demography, number, distribution, connectivity, and quantity and quality of habitat for the Oregon spotted frog. Considerations for determining population resiliency at the sub-basin scale thus may vary geographically, but generally include: (1) a measure of population size (e.g., egg mass counts as an estimate of minimum adult population size) that supports resiliency and exhibits a stable or increasing trend; (2) broad spatial distribution of the species with multiple populations within suitable habitat and designated critical habitat; (3) functional aquatic connectivity among populations for the purposes of dispersal and genetic exchange; and (4) acreage of aquatic habitat that is sufficiently inundated to support all life stages (USFWS 2022, pp. 19-22). The SBR discusses methodology and rationale for estimation of resiliency, addressing each sub-basin in detail (USFWS 2022, pp. 26-73).

To further support resiliency, the largest Oregon spotted frog populations within each sub-basin should be maintained to ensure that stochastic events do not result in extirpation. Large populations within each sub-basin could serve as source populations in the future if climate

change results in drying of the landscape to a degree that will no longer support the full current distribution of the species.

Criterion 1 sets the timeframe for which resiliency will be determined. Over a period of 15 years, there should be at least 10 years of a high enough abundance within populations to support the moderate level of resiliency or higher at the sub-basin scale.

Throughout the range, Oregon spotted frog population monitoring typically relies on breeding counts of egg masses that directly correlate to the number of adult breeding females. It takes approximately 3 years for a female Oregon spotted frog to reach breeding maturity. Egg mass counts may fluctuate from year to year due to natural variation and climatic events.

Furthermore, egg mass counts are not conducted in every population across the range annually due to resource constraints and access issues. The period of 10 years within a span of 15 years allows for at least three generations of adult breeding frogs to be sustained and consistently reproduce enough egg masses to reach measures of abundance that support a moderate level of resiliency or higher.

Criterion 2 captures the breadth of the ecological and genetic diversity of the Oregon spotted frog. Oregon spotted frog populations occur in five ecoregional areas and are subdivided into six genetic groups (one of which is currently known only from British Columbia). Several sub-basins contain small populations that are at risk of extirpation. Their extirpation would result in a loss of genetic representation, creating gaps in Oregon spotted frog distribution and a loss of adaptive capacity important to the viability of the species. The SBR estimates that, as of 2021, two of the ecoregional areas (Puget Trough and East Cascades-Deschutes) included at least two sub-basins with moderate or higher levels of resiliency; and that four or five of the genetic groups (all but Camas Prairie and perhaps British Columbia) included a sub-basin with moderate or high resiliency (USFWS 2022, pp. 73-76). The British Columbia genetic group could potentially meet this criterion if one of the moderate-resiliency sub-basins in western Washington proves to fall within this group. If appropriate, we may consider updated information from future genetic studies (Recovery Action 6.2) to revisit the delineation of genetic groups.

Criterion 3 for delisting is aimed at ensuring habitats are being sufficiently managed over time to support resiliency. The Oregon spotted frog is a conservation-reliant species and active management of water, habitat, and predators is necessary for recovery. Plans, partnerships and continued coordination among conservation stakeholders to implement active management will support population resiliency over time. Management actions will ensure that water inundation of habitats sustains the species life cycle, vegetation structure and diversity will be maintained, and invasive predators such as bullfrogs and non-native fish species will be reduced and controlled to sustain population resiliency. In many areas within the range, Oregon spotted frogs occur on private lands (approximately 44 percent of occupied area [81 FR 29336; USFWS 2022, p. 78]), and engagement of landowners is necessary to actively manage habitat for Oregon spotted frog conservation and recovery. As climate change, invasive species, disease, and other threats change over time, habitat management plans will need to be updated to respond accordingly.

III. RECOVERY ACTIONS

This recovery plan identifies recovery actions needed to implement the recovery strategy and attain the recovery criteria. Implementation of a recovery action will depend on its priority, availability of funds and resources, coordination with partners, and complexity and logistical constraints. A broad action may have multiple components developed as needed to best coordinate recovery implementation. Specific project-level implementation of these actions will be accomplished through shorter-term activities (collectively described in a Recovery Implementation Strategy document, or RIS). Activities will be implemented in coordination with all partners interested and willing to work on accomplishing them. The RIS is intended to be adaptable and guide all partners to coordinate recovery implementation and further identify those responsible for each action described in the recovery plan. Because recovery activities will be described in the RIS, they can be modified as needed without requiring future revision of this recovery plan, so long as they remain consistent with the recovery actions described here.

As discussed in the Introduction, recovery plans are intended to serve as guidance documents rather than being regulatory in nature. As such, implementation of recovery actions is voluntary and depends on the cooperation and commitment of partners in this conservation effort. Note that all Federal agencies have an obligation under section 7(a)(1) of the Act to carry out programs for conservation of federally-listed species.

These recovery actions focus primarily upon recovery implementation within the United States. Oregon spotted frog populations in British Columbia are likely to require similar recovery actions, but their management is not under the jurisdiction of the Endangered Species Act. Detailed recommendations for Canadian management of the Oregon spotted frog are described in a recovery strategy for the species under the Canadian Species at Risk Act (Environment Canada 2015). We support proactive communication and cooperative efforts with Canadian partners for Oregon spotted frog management, research, and monitoring to the end of achieving species recovery in both countries.

The actions needed to alleviate threats to the species and achieve recovery criteria are organized below into six categories: (1) restore and enhance wetland, riverine, and other aquatic habitats to support all life stages of the Oregon spotted frog; (2) ameliorate threats from predation and disease to improve resiliency; (3) increase population size and reduce isolation of Oregon spotted frog populations within sub-basins to improve resiliency and representation; (4) promote awareness and increase conservation partnerships within the Oregon spotted frog range; (5) utilize regulation and policy tools to protect wetland habitat and promote water availability to support species recovery; and (6) conduct inventory, monitoring, and scientific research to guide and support recovery.

1.0 Restore and enhance wetland, riverine, and other aquatic habitats to support all life stages of the Oregon spotted frog.

Actions that improve the quality of Oregon spotted frog habitat are a high priority for improving resiliency of populations within all sub-basins across the range. As a measure of resiliency, Oregon spotted frog habitats should have sufficient aquatic connections to other habitats in the sub-basin to withstand stochastic events such as drought that could alter the

timing and duration of water over a broad geographic area. These habitats should be large enough that they contain adequate structural complexity, with variable water depths and native vegetation to support breeding, rearing, overwintering, and movement within and between seasonal habitats.

1.1 *Restore and improve hydrological function of all aquatic habitats that support Oregon spotted frog life stages.*

Because all life stages of Oregon spotted frogs remain in water year-round, population demography is strongly tied to the quantity and quality of aquatic habitats (e.g., connectivity, hydrological function, hydroperiod[°]). Without wetland habitats that are inundated long enough (sufficient hydroperiod) to complete the life cycle, populations rapidly decline. Restoration actions will aim to influence the timing and inundation of aquatic habitat to support the Oregon spotted frog's life cycle to enhance population size and improve resiliency within sub-basins. Ensuring availability of enough water to support the entire Oregon spotted frog life cycle is particularly critical in the drier portions of the species' range, including the East Cascades–Mid-Columbia, East Cascades–Deschutes, and East Cascades–Klamath ecoregional areas.

1.2 *Manage encroachment, structure, and diversity of vegetation to improve quality of Oregon spotted frog habitat and support life stages.*

Successful vegetation management actions will ensure that Oregon spotted frogs have aquatic vegetation for breeding and rearing, hiding cover from predators, and protection from extreme temperatures during summer and winter months. Reducing vegetation encroachment from tall, shading vegetation such as reed canarygrass, lodgepole pine (*Pinus contorta*), and cattail (genus *Typha*) will ensure open water with emergent wetland vegetation necessary for breeding, rearing, and movement of all life stages. Where reed canarygrass has spread within Oregon spotted frog habitats (and particularly in the Puget Trough ecoregional area where it results in major habitat impacts), actions to manage vegetation height (e.g., grazing or mowing) are necessary to improve population resiliency. Strategies and best management practices for grazing within Oregon spotted frog habitat should be developed in collaboration with partners to enhance population resiliency and promote recovery.

1.3 *Manage development and recreational use in and near habitats that support the Oregon spotted frog.*

Development and encroachment of residential, commercial, and agricultural properties threaten the integrity of habitats that support Oregon spotted frogs by either physically altering the habitat or introducing stressors such as invasive plants and animals or disturbance mechanisms to frog populations. In several sub-basins within the range of the Oregon spotted frog (e.g., Upper Chehalis, Upper Deschutes, Little Deschutes), human disturbance and habitat damage occurs when housing and infrastructure encroach upon habitats that support Oregon spotted frogs. In areas

[°] A hydroperiod can be defined as the number of days per year that an area of land is wet or the length of time that there is standing water at a location.

that are subject to heavy recreational use, Oregon spotted frog habitats may be trampled or otherwise degraded by human activity. The Service will work with urban planning entities and land management agencies to inform development, management, and recreation use that is sustainable and promotes recovery.

2.0 Ameliorate threats from predation and disease to improve resiliency.

Oregon spotted frog population resiliency is influenced by the presence of predators within their habitat and disease that could affect populations. Recovery actions will aim to reduce threats of predation and disease, which could cause population declines either by themselves or as compounded by other stressors (such as degraded habitat quality from drought events or a changing climate). The following actions are high priority to improve Oregon spotted frog resiliency within sub-basins across the range:

2.1 *Manage American bullfrogs and other introduced predators (e.g., green frogs) within and in proximity to Oregon spotted frog habitat.*

Managing introduced predators (i.e., control and eradication) in and adjacent to Oregon spotted frog populations and preventing introduction of such predators into occupied habitat will support recovery. Bullfrogs are known predators of Oregon spotted frogs and may rapidly decimate Oregon spotted frog populations where the two species co-occur. Climate warming is likely to enhance the spread of bullfrogs into high-elevation habitats that are currently too cold for them. Actions that focus on early detection and reduction or rapid removal of bullfrog populations from Oregon spotted frog habitat are essential to maintaining population resiliency within sub-basins across the range. These actions should also occur where other introduced predators such as green frogs (*Lithobates clamitans*) occur within the range of Oregon spotted frogs. Monitoring for future introductions of invasive and non-native predators within and adjacent to Oregon spotted frog populations will support conservation of the species.

2.2 *Reduce or prevent introduction of non-native predatory fish within aquatic habitats that support Oregon spotted frog.*

Non-native predatory fish are a threat to several populations of Oregon spotted frogs within the species' range. Climate change that results in partial drying of lakes and riparian wetlands is likely to lower Oregon spotted frog population resiliency by reducing water surface area and thus concentrating predatory fish together with Oregon spotted frogs. Actions that reduce or prevent the introduction of non-native predatory fish to Oregon spotted frog habitat are essential to Oregon spotted frog conservation within the species' range.

2.3 *Monitor, assess, and prevent the spread of disease that has the potential to impact Oregon spotted frog viability.*

Diseases that affect Oregon spotted frogs are likely to increase and spread in a changing climate. Such diseases include but are not limited to *Bd* (chytrid fungus), *Saprolegnia*, and *Ribeiroia ondatrae*. Actions to monitor and assess current and novel diseases that could impact Oregon spotted frog are important to preventing

the spread of disease and to maintain resilient populations of Oregon spotted frogs within sub-basins across the range.

3.0 Increase population size and reduce isolation of Oregon spotted frog populations within sub-basins to improve resiliency and representation.

Improving resiliency of Oregon spotted frog populations by increasing population sizes and reducing isolation of populations within sub-basins will improve overall viability of the species across its range. Some sub-basins within the range contain small and isolated Oregon spotted frog populations that must be conserved to maintain the species ecological and genetic diversity (representation).

3.1 Improve reproductive success within sub-basin populations.

Reproductive success can be improved by restoring and enhancing aquatic habitats such that all life stages of the Oregon spotted frog are supported (see Actions 1.0 and 2.0). In some situations, particularly within small populations, periodic intervention may be needed to prevent extirpation. For example, egg masses may need to be moved into deeper water when stranding is consistent or egg masses may need protection from predators.

3.2 Augment small populations.

Augmentation should be considered where habitat restoration is not enough to increase abundance; this may include captive rearing, translocation to new sites, and supplementation of existing populations.

3.3 Improve aquatic connectivity between Oregon spotted frog sites and populations to reduce isolation.

Facilitate dispersal and genetic exchange between populations by enhancing aquatic habitat connectivity. Implement human-assisted dispersal and genetic rescue methods if aquatic habitat connectivity cannot be restored.

4.0 Promote awareness and increase conservation partnerships within the Oregon spotted frog range.

Federal, Tribal, State, and local partnerships will be necessary to guide and implement conservation actions for the Oregon spotted frog across the range. Relationships with external partners, private landowners, and the broader public will be critical to ensuring that successful recovery efforts for the Oregon spotted frog are widespread and lasting.

4.1 Coordinate and collaborate with partners to recover the Oregon spotted frog.

Work with external partners such as non-governmental organizations (NGOs) (e.g., watershed councils) to develop, fund, and implement plans, projects, and initiatives that facilitate Oregon spotted frog recovery actions.

4.2 Promote Oregon spotted frog conservation through outreach and education.

Develop and conduct outreach and education opportunities (e.g., public information and education programs) to convey the importance of Oregon spotted frog conservation and recovery.

4.3 *Develop voluntary agreements and conservation easements to protect and manage Oregon spotted frog populations and habitat.*

Approximately 44 percent of the Oregon spotted frog's occupied range is on private land (81 FR 29336; USFWS 2022, p. 78) and engagement of non-governmental partners is essential to implementing conservation and recovery actions. Working with partners such as but not limited to private landowners, water managers, and NGOs through voluntary conservation agreements and easements will be necessary to protect and manage populations and habitat that is vital to maintaining the species' viability across the range.

5.0 Utilize regulation and policy tools to protect wetland habitat and promote water availability to support species recovery.

Given that the species is reliant on water to meet its life history needs, recovery actions will promote and utilize regulatory and policy tools that influence or modify hydrological conditions and water availability in Oregon spotted frog habitat. The Service will coordinate with Federal, Tribal, State, local managers, and private landowners to assess, design, and implement regulations, policies, agreements, and other land-use decisions that may influence hydrological conditions to better align with the life history needs of Oregon spotted frogs where appropriate and practicable. These regulatory and policy tools will likely provide key support for many other recovery actions in this plan. These tools may include, but are not limited to, continued coordination in implementing Federal legislation to protect and restore inhabited wetlands and riverine areas (e.g., Endangered Species Act, Clean Water Act), identifying where water rights and agreements may influence or modify hydrology and habitat conditions, and supporting land management that improves habitat functionality (e.g., work with agencies that conduct beaver relocation and reintroduction programs).

5.1 *Address water rights and management to improve hydrology of Oregon spotted frog habitat.*

Ensuring availability of appropriate hydrology may involve working with management agencies, irrigation districts, private landowners, and other conservation partners to assess impacts and improve Oregon spotted frog habitat in relation to water management for irrigation, management of beaver populations, or groundwater pumping.

5.2 *Address development and modification of wetland habitats that support Oregon spotted frogs.*

Protect wetland habitat by working with local governments on proposed developments, developing habitat conservation plans and safe harbor agreements, conducting section 7 consultations on wetland impacts, and implementing projects to enhance wetlands

6.0 Conduct inventory, monitoring, and research to guide and support Oregon spotted frog recovery.

Successful Oregon spotted frog recovery efforts will be informed by the latest inventory and monitoring data and ongoing and expanding research. Monitoring and research will continue to guide recovery actions through adaptive management.

6.1 *Conduct inventory and demographic monitoring.*

Surveys to identify Oregon spotted frog breeding areas and demographic monitoring of populations is necessary to understand resiliency of the species and its response to environmental conditions and recovery efforts across the range.

6.2 *Research species demographics, genetics, habitat, demography, disease, movement, and dispersal.*

Research on Oregon spotted frog genetics, habitat suitability and seasonal utilization, population dynamics, disease susceptibility, and movement and dispersal will facilitate the development, implementation, and prioritization of recovery actions.

Table 2, on the following page, correlates the above recovery criteria and recovery actions with threats to the species assessed under the five listing factors in section 4(a)(1) of the Act. Listing factor B (overutilization of the species for commercial, recreational, scientific, or educational purposes) was not determined to be a threat to the Oregon spotted frog at the time the species was listed, nor is it known to be a threat to the species at this time.

Table 2. Crosswalk relating threats, recovery criteria, and recovery actions for the Oregon spotted frog.

| Listing Factor | Threat | Recovery Criteria | Recovery Actions |
|---|---|--------------------------|---------------------------------|
| A Present or Threatened Destruction, Modification or Curtailment of its Habitat or Range | Historical loss of wetland habitat | 1, 3 | 1.1, 1.2, 3.3, 4.1, 4.3, 5.2 |
| | Changes in hydrology - dams, human related modifications to seasonal flooding, water diversions, dams and manipulation, draining for development, drought, loss of beaver | 1, 2, 3 | 1.1, 4.1, 4.3, 5.1 |
| | Changes in vegetation - reed canarygrass invasion, vegetation succession, woody plant encroachment, loss of natural disturbances (e.g., fire, flood) | 1, 3 | 1.2, 1.3, 4.1, 4.3, 5.1, 5.2 |
| | Removal or alteration of habitat for development and agriculture | 1, 3 | 1.3, 4.1, 4.3, 5.1, 5.2 |
| | Livestock grazing | 1, 3 | 1.3 |
| | Recreation impacts to habitat (since Act listing) | 1, 3 | 1.3, 4.1, 4.2, 5.2 |
| B Overutilization | Not known to be a threat at this time. | N/A | N/A |
| C Disease or Predation | Diseases such as chytrid fungus and others | 1, 2, 3 | 2.3, 6.2 |
| | Predatory, introduced fish - brook trout, brown trout, brown bullhead | 1, 2, 3 | 2.2, 4.1, 4.2, 4.3, 6.2 |
| | American bullfrogs and other non-native predators | 1, 2, 3 | 2.1, 4.1, 4.2, 4.3, 6.2 |
| D Inadequacy of Existing Regulatory Mechanisms | Continued risk of habitat loss and degradation under Federal, State, and local laws | 3 | 4.3, 5.1, 5.2, 6.1 |

| | | | |
|---|--|------|--|
| E Other Natural or Manmade Factors | Small and isolated populations - risk of extirpation | 1, 2 | 1.1, 3.1, 3.2, 3.3, 6.1, 6.2 |
| | Water quality | 3 | 1.1, 1.2, 1.3, 4.1, 4.3, 5.1, 5.2, 6.2 |
| | Climate change | 2, 3 | 1.1, 2.1, 2.2, 2.3, 6.2 |

IV. TIME AND COST ESTIMATES

Achieving the recovery criteria for the Oregon spotted frog is expected to require approximately 40 years.

Presented below is a table of site-specific recovery actions and their estimated implementation costs, projected to the estimated date of recovery. Estimated costs include only project specific contract, staff, or operations costs in excess of base budgets. They do not include budgeted amounts that support ongoing agency staff responsibilities. This recovery plan does not commit the Service or any partners to carry out a particular recovery action or expend the estimated funds.

Estimated costs described in Table 3 incorporate planning, design, implementation, research, monitoring, and evaluation associated with specific actions. This table focuses on recovery action implementation within the United States, and does not detail costs outside of U.S. jurisdiction in Canada. Recovery actions will be evaluated to ensure that they are appropriately and effectively addressing threats to the species and meeting the plan's objectives. If the actions are not effective, changes in management should be made and additional planning and scientific research may be necessary.

Costs of Recovery Actions 1 and 2 are calculated primarily based on estimated cost per acre, using the number of acres needing threat management within each subbasin across the range.

Table 3. Priority and estimated cost of recovery actions.

| Recovery Action | Priority | Estimated Cost | Notes |
|--|----------|-----------------|---|
| 1. Restore and enhance wetland, riverine, and other aquatic habitats to support all life stages of the Oregon spotted frog | 1 | \$499,031,500 | Restore hydrological function: 45,366 acres at \$10,000 per acre. Manage vegetation: 45,366 acres at \$1,000 per acre. |
| 2. Ameliorate threats from predation and disease | 1 | \$1,989,394,000 | Bullfrog management: 32,937 acres at \$600 per acre per year over 10 years. Predatory fish management: 41,547 acres at \$4,000 per acre per year over 10 years. Disease management: \$100,000,000. |

| | | | |
|--|---|-----------------|---|
| 3. Increase population size and reduce isolation of Oregon spotted frog populations within sub-basins | 1 | \$89,400,000 | Includes population augmentation. |
| 4. Promote awareness and increase conservation partnerships | 2 | \$50,000,000 | Includes partner coordination, outreach/education, and development of voluntary agreements and conservation easements. |
| 5. Utilize regulation and policy tools to protect wetland habitat and promote water availability to support species recovery | 1 | \$81,736,000 | Includes water allocations and wetland habitat protection. |
| 6. Conduct inventory, monitoring, and research to guide and support Oregon spotted frog recovery | 3 | \$74,030,000 | Demographic monitoring, surveys, and inventory: \$23,730,000. Research on demographics, genetics, habitat, disease, movement, and dispersal: \$50,300,000. |
| Total Estimated Cost | | \$2,783,591,500 | |

Priority 1: An action that must be taken to prevent extinction or prevent the species from declining irreversibly in the foreseeable future.

Priority 2: An action that must be taken to prevent a significant decline in species population or habitat quality.

Priority 3: All other actions necessary to meet the recovery objectives.

Date of Recovery: If all actions are fully funded and implemented as outlined, including cooperative efforts by all partners needed to achieve recovery, then we estimate the earliest that the delisting criterion could be met is 2063. Implementation of recovery actions needed to protect and enhance habitat (e.g., habitat conservation plan implementation) is anticipated to require 20 to 30 years, and monitoring to determine whether recovery criteria are met will require approximately 10 to 15 years.

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