

Draft Recovery Plan for Listed Species of the Rogue Valley Vernal Pool and Illinois Valley Wet Meadow Ecosystems



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**Draft Recovery Plan for Listed Species
of the Rogue Valley Vernal Pool and
Illinois Valley Wet Meadow Ecosystems**

(June 2006)

**Region 1
U.S. Fish and Wildlife Service
Portland, Oregon**

Approved: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Regional Director, Region 1, U.S. Fish and Wildlife Service

Date: _____

U.S. FISH AND WILDLIFE SERVICE'S MISSION IN RECOVERY PLANNING

Section 4(f) of the Endangered Species Act of 1973, as amended, directs the Secretary of the Interior and the Secretary of Commerce to develop and implement recovery plans for species of animals and plants listed as endangered or threatened unless such plans will not promote the conservation of the species. The U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration-Fisheries have been delegated the responsibility of administering the Endangered Species Act. Recovery is the process by which the decline of an endangered or threatened species is arrested or reversed, and threats to its survival are neutralized, so that its long-term survival in nature can be ensured. The goal of this process is the maintenance of secure, self-sustaining wild populations of species with the minimum necessary investment of resources. A recovery plan delineates, justifies, and schedules the research and management actions necessary to support recovery of a listed species. Species of conservation concern are not federally listed but have a critical degree of threats and/or rarity and could potentially become federally listed in the future. These species are not required to have recovery plans; however, some are included in this draft recovery plan because a community-level strategy provides opportunities for pre-listing conservation of species with needs similar to those of listed species.

Recovery plans do not, of themselves, commit manpower or funds, but are used in setting regional and national funding priorities and providing direction to local, regional, and State planning efforts. Means within the Endangered Species Act to achieve recovery goals include the responsibility of all Federal agencies to seek to conserve endangered and threatened species (section 7), and the Secretary's ability to designate critical habitat (section 4), to enter into cooperative agreements with the states (section 6), to provide financial assistance to the respective State agencies (section 6), to acquire land, and to develop Habitat Conservation Plans with applicants (section 10).

We are committed to applying an ecosystem approach to conservation to allow for efficient and effective conservation of our Nation's biological diversity (U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration 1994). In terms of recovery plans, ecosystem considerations are incorporated through the development and implementation of recovery plans for communities or ecosystems where multiple listed species and species of conservation concern occur, in a manner that restores, reconstructs, or rehabilitates the structure, distribution, connectivity, and function upon which those listed species depend. In particular, these recovery plans shall be developed and implemented in a manner that conserves the biotic diversity of the ecosystems upon which the listed species depend. Recovery plans detail the actions necessary to achieve self-sustaining, wild populations of listed species so they will no longer require protection under the Endangered Species Act.

DISCLAIMER

Recovery plans delineate actions which the best available science indicates are necessary to recover and protect listed species. We, the U.S. Fish and Wildlife Service, publish recovery plans, sometimes preparing them with the assistance of recovery teams, contractors, state agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery actions in this plan should not be construed as a commitment or requirement that a Federal agency or other party obligate or pay funds in contravention of the Anti-Deficiency Act, 31 U.S.C. 1341, or any other law or regulation. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation other than us. They represent our official position *only* after they have been signed by the Director or Regional Director as approved. Approved recovery plans are subject to modification as dictated by new information, changes in species status, and the completion of recovery actions.

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An electronic version of this recovery plan will also be made available at <http://endangered.fws.gov/recovery/index.html>. Please check for updates or revisions to this recovery plan at this web address before using.

ACKNOWLEDGMENTS

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EXECUTIVE SUMMARY

Introduction: This draft recovery plan addresses 12 species of plants and animals of seasonally wet habitats in southern Oregon. Two federally endangered plant species that are endemic to southern Oregon are the primary focus of the plan: *Limnanthes floccosa* ssp. *grandiflora* (large-flowered woolly meadowfoam; also known as big-flowered woolly meadowfoam or Agate Desert meadowfoam) and *Lomatium cookii* (Cook's lomatium; also known as Cook's desert-parsley or Agate Desert lomatium). Site-specific information and recovery actions are also provided for one federally threatened animal, the vernal pool fairy shrimp (*Branchinecta lynchi*). In addition, site-specific information and provisions for long term conservation are provided for nine species of conservation concern, including eight plants (*Agrostis hendersonii* [Henderson's bentgrass], *Plagiobothrys figuratus* ssp. *corallicarpus* [coral-seeded popcornflower], *Limnanthes floccosa* ssp. *pumila* [dwarf woolly meadowfoam], *Limnanthes gracilis* ssp. *gracilis* [slender meadowfoam], *Navarretia heterandra* [Tehama navarretia], *Plagiobothrys austinae* [Austin's popcornflower], *Plagiobothrys glyptocarpus* var. *glyptocarpus* [sculptured allocarya], and *Plagiobothrys greenii* [Greene's popcornflower]) and a newly discovered aquatic invertebrate species, the hairy water flea (*Dumontia oregonensis*).

The 12 species addressed in this draft recovery plan occur in vernal pool, swale, or seasonal wet meadow habitats within southern Oregon and are largely confined to limited areas by topographic constraints, soil types, and climatic conditions. Surrounding (or associated) upland habitat is critical to the proper ecological function of these vernal pool habitats. Most of the vernal pool plants and animals addressed in the draft recovery plan have life histories adapted to the short period for growth and reproduction within inundated or drying pools and meadows interspersed with long dormant periods and extreme year-to-year variation in rainfall.

Current Species Status: *Limnanthes floccosa* ssp. *grandiflora* is known from 21 extant populations in the Rogue River Valley. Four populations occur on State-administered lands, 2 occur on Jackson County lands, 2 occur on municipal lands, and 12 occur on private lands. *Limnanthes floccosa* ssp. *grandiflora* populations often overlap ownership boundaries and property lines. *Lomatium cookii* is known from 13 populations in the Rogue River Valley and 24 populations in the Illinois Valley. The vernal pool fairy shrimp occurs in vernal pools in the Agate Desert, White City, and Table Rocks areas in the Rogue River Valley, as well as various localities in the Central Valley and Coast Ranges of California.

Recovery Priority Numbers: *Limnanthes floccosa* ssp. *grandiflora*: 3C
Lomatium cookii: 2C
vernal pool fairy shrimp: 2C

These priority rankings, on a scale from 1C (highest) to 18 (lowest), are determined in accordance with our guidelines for assigning recovery priorities (U.S. Fish and Wildlife Service 1983; see also Appendix C) and are based upon a high degree of threat, a high potential for recovery, and taxonomic level (classification as a species for *Lomatium cookii* and vernal pool fairy shrimp, and as a subspecies for *Limnanthes floccosa* ssp. *grandiflora*). The “C” indicates the potential for conflict with construction or other development projects or other forms of economic activity.

Scope of the Recovery Plan: This plan addresses *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii* in the Rogue River Valley of Jackson County, Oregon, and *Lomatium cookii* populations that are found in the Illinois Valley of Josephine County, Oregon. This plan also provides site-specific information regarding the vernal pool fairy shrimp (occurring in the Rogue River Valley), the eight plant species of concern, and the hairy water flea.

The recovery of the vernal pool fairy shrimp is primarily guided by the Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon (U.S. Fish and Wildlife Service 2005), which addresses recovery actions and criteria for the vernal pool fairy shrimp and 19 other listed species endemic to vernal pool habitats across a broad geographic range in California and Oregon. The present recovery plan presents recovery actions specific to the Oregon range of the vernal pool fairy shrimp, which refine the actions identified in the broader Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon (U.S. Fish and Wildlife Service 2005).

The nine species of concern are included in this recovery plan because they are closely associated with seasonal wetland ecosystems and may co-occur with the three listed species in southwestern Oregon. Proactive implementation of conservation measures for these species may avoid the need for listing them in the future.

Habitat Requirements and Limiting Factors: All species included in the plan occur, or historically occurred, in seasonally wet habitats in southwestern Oregon. Both federally listed plant species occur within the Agate Desert of the Rogue River Valley in Jackson County, where they are associated with vernal pools. *Lomatium cookii* also occurs in the Illinois Valley of neighboring Josephine County, in seasonally wet serpentine-derived grassland meadows. The majority of the extant and historical sites for the two federally listed plant species within the Rogue Valley occur on soil formations characterized by Agate-Winlo silty clay loam series (deep, poorly drained soils present in depressions in alluvial stream terraces). *Lomatium cookii* additionally occurs on seasonally wet meadows on soil formations characterized by Brockman clay loam, Abegg

clay loam, Eightlar extremely stony clay, Josephine Gravelly loam, Pollard loam, Takilma cobbly loam, and Newberg loam in the Illinois Valley (Natural Resources Conservation Service 1999).

Most of the sites are moderately to highly disturbed due to agricultural and development activities. Urban and agricultural development, invasion of nonnative species, habitat fragmentation and degradation, and other human-caused disturbances have resulted in substantial losses of seasonal wet meadow habitat throughout the species' historical ranges. Conservation needs include establishing a network of protected populations in natural habitat distributed throughout their native range.

Recovery Goals:

The goals of this draft recovery plan are to:

- Achieve and protect, in perpetuity, self-sustaining populations throughout the full ecological, geographical, and genetic range of *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii* by minimizing or eliminating the threats that caused the species to be listed.
- Contribute to the recovery of the vernal pool fairy shrimp as stated in the Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon (U.S. Fish and Wildlife Service 2005). This is accomplished by providing site-specific recovery actions for vernal pool fairy shrimp within the Klamath Mountains Recovery Unit.
- Remove the two endangered species, *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii*, and the threatened vernal pool fairy shrimp from the Federal List of Endangered and Threatened Wildlife and Plants.

The interim goals of this draft recovery plan are to:

- Reclassify *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii* to threatened (*i.e.*, downlist). Reclassification will be appropriate when each species is no longer in danger of extinction throughout a significant portion of its range. Because data upon which to base decisions about reclassification and recovery are mostly lacking, downlisting and recovery criteria in this draft recovery plan are necessarily preliminary and may be revised as necessary data is obtained.

Recovery Objectives:

- Stabilize and protect populations of the three listed species so further decline in species status and range are prevented.
- Minimize or eliminate the threats that caused the species to be listed, and any other newly identified threats in order to be able to delist these species.
- Conduct research necessary to refine reclassification (i.e., downlisting) and recovery criteria.
- Ensure the long-term conservation of the nine nonlisted species of conservation concern.
- Promote natural ecosystem processes and functions by protecting and conserving intact vernal pool-mounded prairie complexes and seasonally wet meadows within the recovery planning area.

These objectives will be accomplished through implementation of a variety of recovery measures including habitat protection, management and restoration; monitoring; reintroduction, introduction, and enhancement; research and status surveys; and public participation, outreach, and education.

Recovery Criteria: Individual recovery criteria are presented in the recovery plan to ensure genetic diversity and demographic stability of *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii*. In order to track recovery progress and needs for recovery, species health indicators (such as population size, extent, and habitat quality) will be monitored to determine appropriate adaptive management techniques. The downlisting and delisting of the two species is conditional on the following recovery criteria:

Downlisting Criteria for *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii*

Reclassification to threatened status may be considered for *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii*, when the following criteria are met:

- a. For *Limnanthes floccosa* ssp. *grandiflora*, at least 95 percent of suitable vernal pool habitat acreage (existing as of 2006) within each Priority 1 core area has been protected from development and covered under a management plan. Also, at least 85 percent of suitable vernal pool habitat acreage within Priority 2 core areas has been protected from development and covered under a management plan. Introduced or newly discovered populations outside of currently known core areas may be substituted if deemed equivalent in their contribution to recovery.
- b. For *Lomatium cookii*, at least 95 percent of suitable vernal pool and wet

meadow habitat acreage (existing as of 2006) within each Priority 1 core area (including three core areas in the Rogue Valley Recovery Unit and eight core areas in the Illinois Valley Recovery Unit) has been protected from development and covered under a management plan. Also, at least 85 percent of suitable vernal pool habitat acreage within one Priority 2 core area in the Illinois Valley Recovery Unit (or an equivalent population discovered or reintroduced in a Priority 3 core area) has been protected from development and covered under a management plan. Introduced or newly discovered populations outside of currently known core areas may be substituted if deemed equivalent in their contribution to recovery.

- c. Management plans based on current research and developed for species protection and conservation have been approved and implemented by local governments, area planners, and nongovernment organizations, as appropriate. Management plans should address vegetation control, including thatch buildup and noxious weeds; monitoring of threats and population levels in detail sufficient to quantitatively assess population trends; maintaining hydrological functions; and outreach to neighboring landowners.
- d. At least 3 years of threats assessments indicate threats have been eliminated or effectively reduced by measures incorporated in area management plans.
- e. Monitoring indicates population levels of existing species are stabilized or increased from baseline conditions for each population. Populations must be measured over at least one multi-year period that includes above average, average, and below average local rainfall, a multi-year drought, and a minimum of 5 years of post-drought monitoring to ensure reproduction and recruitment is achieved following the drought. Population trends must be shown to be stable or increasing for a minimum of 10 consecutive years prior to consideration for reclassification.
- f. A Recovery Implementation Team is established and functioning to oversee range-wide recovery efforts of the species.

Delisting Criteria for *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii*

Delisting *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii* may be considered when the following criteria are met, in addition to the above downlisting criteria:

- a. Status surveys, status reviews, and population monitoring show population levels within each population are viable for 10 years following downlisting (*e.g.*, evidence of reproduction and recruitment) and have been determined to

be stable or increasing, and implementation of management plans is effectively managing or eliminating threats. Populations must be measured over at least one multi-year period that includes above average, average, and below average local rainfall, a multi-year drought, and a minimum of 5 years of post-drought monitoring to ensure reproduction and recruitment is achieved following the drought.

- b. Any necessary research on life history, population viability, genetics, and land management strategies has been completed and incorporated into management plans where appropriate.
- c. A post-delisting monitoring plan has been developed for these species.

Delisting Criteria for Vernal Pool Fairy Shrimp

The Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon (U.S. Fish and Wildlife Service 2005) presents delisting criteria regarding this species. Please refer to that recovery plan for specific delisting criteria regarding the vernal pool fairy shrimp.

Actions Needed:

1. Protect vernal pool and wet meadow habitat.
2. Manage and restore vernal pool and wet meadow habitat.
3. Conduct rangewide population status surveys and monitoring.
4. Conduct research essential to the conservation and recovery of the species.
5. Enhance public awareness and participation in the recovery of the species.

Total Estimated Cost of Recovery: \$2,613,000 plus additional costs that cannot be determined at this time.

Estimated Date of Delisting: Delisting of the two plant species may be considered in 2026 if the recovery criteria have been met.

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I. Introduction

A. OVERVIEW

Jackson and Josephine Counties, in the Klamath/Siskiyou region of southwestern Oregon (Figure I-1), are hosts to unique assemblages of plant communities. Based on a rare plant population assessment, Kaye *et al.* (1997) identified this area as the largest “hot spot” for a high density of rare plants in Oregon. Smith and Sawyer (1988) identified the Klamath/Siskiyou region as having high concentrations of species diversity, disjunction, and endemism.

This draft recovery plan addresses two federally endangered plant species that are endemic to seasonal *wetlands** in southwestern Oregon, as well as Oregon populations of the federally threatened vernal pool fairy shrimp and nine nonlisted species of concern that co-occur with these listed species in southwestern Oregon†.

Listed Species. *Limnanthes floccosa* ssp. *grandiflora* (large-flowered woolly meadowfoam; also known as big-flowered woolly meadowfoam or Agate Desert meadowfoam) and *Lomatium cookii* (Cook’s lomatium; also known as Cook’s desert-parsley, Agate desert lomatium, or Agate desert-parsley) are plant species that were both listed as endangered on November 7, 2002 (U.S. Fish and Wildlife Service 2002) under authority of the Endangered Species Act (16 United States Code [U.S.C.] 1531 et seq.). The two plants are also listed as endangered by the State of Oregon. The vernal pool fairy shrimp (*Branchinecta lynchi*) was listed as threatened on September 19, 1994 (U.S. Fish and Wildlife Service 1994). The vernal pool fairy shrimp and two plants are endemic to one or two types of seasonally wet *habitats*, namely vernal pools and wet meadows. This draft recovery plan will guide the recovery of the two federally listed plant species and aid in the recovery of the vernal pool fairy shrimp in southwest Oregon using an *ecosystem* approach (Table I-1).

Extant populations of *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii* occur in the vernal pool-mounded prairie complex of the Rogue River Valley of Jackson County, Oregon, including the summits of Upper and Lower Table Rock. *Lomatium cookii* populations also occur in the Illinois Valley of Josephine County, Oregon (Figure I-1). This draft recovery plan will provide a strategy for recovery of these species in the interim period between its publication and the approval of the final recovery plan.

The Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon (U.S. Fish and Wildlife Service 2005) developed by our Sacramento Fish and

* Certain technical or scientific terms are italicized in boldface, and are defined below in the Glossary (Appendix A)

† Scientific and common names of species referred to in this draft recovery plan are summarized in Appendix B.

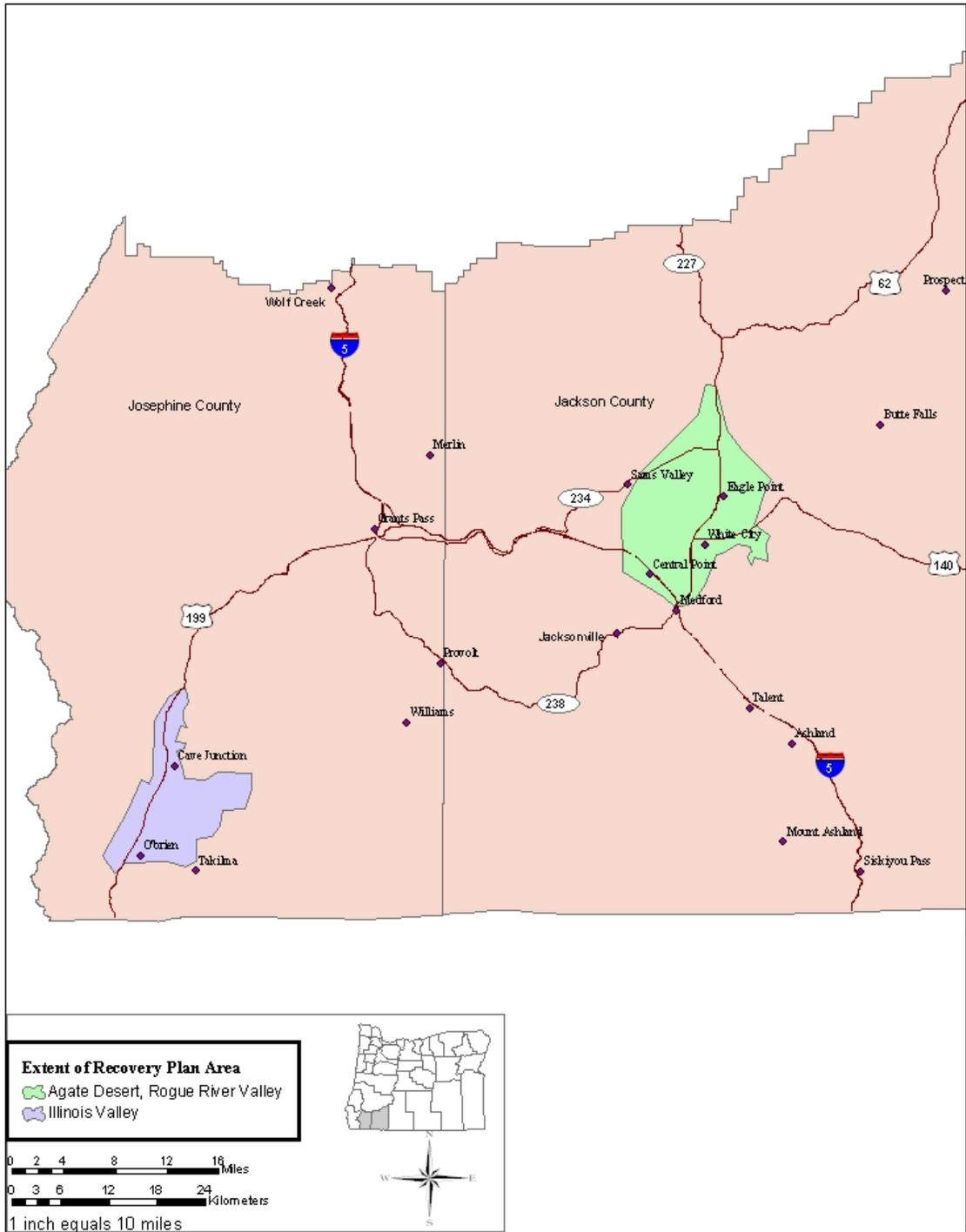


Figure I-1. Map of draft recovery plan area, showing the Rogue River Valley and Illinois Valley Recovery Units.

Table I-1. Species addressed in Draft Recovery Plan for Listed Species of the Rogue Valley Vernal Pool and Illinois Valley Wet Meadow Ecosystems

Species	Status ¹	Recovery Priority ²	Federal Listing Date	Recovery Status
<i>Agrostis hendersonii</i> (Henderson's bentgrass)	OR1	Not Applicable	Not Applicable	Extirpated from Oregon
<i>Limnanthes gracilis ssp. gracilis</i> (slender meadowfoam)	SC, OR1	Not Applicable	Not Applicable	Unknown
<i>Limnanthes floccosa ssp. grandiflora</i> (large flowered woolly meadowfoam)	FE without critical habitat, SE, OR1	2C	11/07/02	Stable
<i>Limnanthes floccosa ssp. pumila</i> (dwarf woolly meadowfoam)	ST, OR1	Not Applicable	Not Applicable	Stable
<i>Lomatium cookii</i> (Cook's lomatium)	FE without critical habitat, SE, OR1	3C	11/07/02	Stable
<i>Navarretia heterandra</i> (Tehama navarretia)	OR2	Not Applicable	Not Applicable	Unknown
<i>Plagiobothrys austiniiae</i> (Austin's popcornflower)	OR2	Not Applicable	Not Applicable	Unknown
<i>Plagiobothrys figuratus ssp. coralliscarpus</i> (coral-seeded popcornflower)	SC, OR1	Not Applicable	Not Applicable	Unknown
<i>Plagiobothrys glyptocarpus</i> var. <i>glyptocarpus</i> (rough-seeded popcornflower)	OR2	Not Applicable	Not Applicable	Unknown
<i>Plagiobothrys greenii</i> (Green's popcornflower)	OR2	Not Applicable	Not Applicable	Unknown
Vernal pool fairy shrimp (<i>Branchinecta lynchi</i>)	FT with critical habitat, OR1	2C	9/19/94	Declining
Hairy water flea (<i>Dumontia oregonensis</i>)	Newly discovered	Not Applicable	Not Applicable	Unknown

¹ FE: federally endangered. FT: federally threatened. SE: State endangered. ST: State threatened. SC: State Candidate. OR1: Oregon Natural Heritage Information Center List 1 – Taxa threatened with extinction or presumed extinct through their entire range. OR2: Oregon Natural Heritage Information Center List 2 – Taxa threatened with extirpation or presumed extirpated within Oregon.

² Recovery Priority: See Appendix C for description of how recovery priorities are established for listed species. Only federally listed species are assigned a recovery priority number.

Wildlife Office, presents recovery goals, objectives, and strategies for 20 listed species associated with vernal pool habitats in California and Oregon, including the vernal pool fairy shrimp. Recovery criteria for the vernal pool fairy shrimp are presented for 13 vernal pool regions throughout the range of the species, from the Western Riverside Vernal Pool Region in southern California to the Klamath Mountains Vernal Pool Region in southwestern Oregon. By contrast, the present draft recovery plan provides more detailed site-specific recovery actions specific to the vernal pool fairy shrimp within its range in the Rogue River Valley of Jackson County, Oregon (corresponding to the Klamath Mountains Vernal Pool Region as described in the Vernal Pool Ecosystems Recovery Plan). Because both recovery plans address vernal pool ecosystems in southwestern Oregon, goals, objectives and strategies for all concerned listed species in this draft recovery plan will be coordinated with the broader Vernal Pool Ecosystems Recovery Plan.

Selected vernal pool habitats in the Agate Desert region of the Rogue River Valley have been designated as vernal pool fairy shrimp critical habitat (U. S. Fish and Wildlife Service 2003). A significant portion of *Limnanthes floccosa* ssp. *grandiflora* habitat and several *Lomatium cookii* populations overlap with this designated critical habitat in Jackson County.

Species of Concern. This recovery plan addresses eight plants and one aquatic invertebrate that are not federally listed but have been previous candidates for Federal listing, are currently State listed, are recognized by the Oregon Natural Heritage Information Center as rare, and/or are newly described species (Table I-1). These species share similar habitats and ranges with the three listed species described in the scope of this recovery plan. The eight nonlisted plant species are *Agrostis hendersonii* (Henderson's bentgrass), *Limnanthes floccosa* ssp. *pumila* (dwarf woolly meadowfoam), *Plagiobothrys figuratus* ssp. *corallicarpus* (coral-seeded popcornflower), *Limnanthes gracilis* ssp. *gracilis* (slender meadowfoam), *Navarretia heterandra* (Tehama navarretia), *Plagiobothrys austinae* (Austin's popcornflower), *P. glyptocarpus* (sculptured allocarya), and *P. greenii* (Green's popcornflower). The hairy water flea (*Dumontia oregonensis*) is a newly described species recently identified at the Agate Desert.

Efforts to recover and stabilize *Limnanthes floccosa* ssp. *grandiflora*, *Lomatium cookii*, and vernal pool fairy shrimp populations and their habitat will directly benefit these currently unlisted but rare species, as well as other associated species of vernal pools and seasonally wet meadows.

B. BIOTIC COMMUNITIES REPRESENTED

The two biotic ecosystems featured in this recovery plan are the vernal pool-mounded prairie complex of the Agate Desert and the seasonally wet meadows of the Illinois River Valley. While *Limnanthes floccosa* ssp. *grandiflora* is associated only with the Agate Desert vernal pools, *Lomatium cookii* inhabits both the Agate Desert vernal pool-mounded prairie complex and the Illinois Valley seasonally wet meadows.

The Rogue and Illinois River Valleys of southwest Oregon are part of the Klamath Mountains *Ecoregion*, which supports a variety of plant assemblages that are derived from the merging of larger *floristic* provinces and adapted to unique geologic features (Oregon Biodiversity Project 1998). Both valleys support grasslands that historically represented a small component of the vegetation of the Klamath Mountain Ecoregion. Grasslands are now becoming rare due to accelerated urban, industrial, and agricultural growth. Moreover, natural grassland habitat has been permanently altered by the introduction of aggressive, nonnative plants, which now dominate much of the remaining undeveloped areas in the Agate Desert and the Illinois Valley.

1. Vernal Pool-Mounded Prairie Complex

The vernal pool-mounded prairie complex is the dominant natural landscape feature of the Rogue River Valley's Agate Desert. The complex is characterized by small irregularly shaped mounds and depressions with agriculturally unproductive, Agate-Winlo complex soils, abundant agates, sparse prairie vegetation, and a relative scarcity of trees (Oregon Natural Heritage Program 1997). The Agate Desert is actually an extensive Pleistocene *alluvial* fan terrace, where a *duripan* soil layer allows formation of shallow, often interconnected vernal pools (Borgias and Patterson 1999). Vernal pools are an important link in the food chain for migrating waterfowl, shorebirds, birds of prey, frogs, toads, salamanders, pollinating insects, and a variety of invertebrates. Animals common to the Agate Desert vernal pool-mounded prairie complex include such species as Botta's pocket gopher (*Thomomys bottae*), black-tailed jackrabbit (*Lepus californicus*), western meadowlark (*Sturnella neglecta*), and red-winged blackbird (*Agelaius phoeniceus*).

Vernal pools are a unique type of wetland ecosystem characterized by seasonal ponding during the winter and early spring. They are wet long enough to be different in character and species composition from the surrounding upland habitats, yet their prolonged annual dry phase prevents the establishment of species typical of more permanent wetlands. Unique animal and plant species have become specially adapted to the unusual ephemeral conditions existing in these vernal pool habitats. Associated with vernal pools are upland prairie mounds which support plant communities that cannot

tolerate extended wet conditions and animals that depend on seasonal pools for forage, temporary shelter, spawning grounds, or water. Vernal pools are renowned for their showy displays of spring wildflowers which bloom in concentric rings around the drying pools.

Vernal pool habitat in the Agate Desert of southern Oregon historically occupied approximately 12,950 hectares (32,000 acres) (Oregon Natural Heritage Program 1997). Recent studies of the Agate Desert vernal pool hydrology and vegetation indicate that no intact vernal pool habitat remains (Oregon Natural Heritage Program 1997, 1999). The Oregon Natural Heritage Program (1997) estimated that the highest quality remaining Agate Desert vernal pool habitat (that with intact hydrology and altered vegetation) occurred on 23.1 percent of the area. A subsequent study (Oregon Natural Heritage Program 1999) indicated that this highest quality habitat type was present on approximately 17.6 percent of the area. This reported decrease in the amount of best available habitat is partially due to better-refined mapping techniques, but there is evidence that additional land leveling also occurred between the two studies (Oregon Natural Heritage Program 1999). Both reported and unreported fills of Agate Desert vernal pool wetlands are occurring continually (C. Tuss, U.S. Fish and Wildlife Service, pers. comm. 2001). Over 19 percent of Agate Desert vernal pool habitat has been leveled, and development (structures, roads, and other impermeable surfaces) has occurred on an additional 41 percent of this area (Oregon Natural Heritage Program 1999). Thus, over 60 percent of the habitat of these plants in the Agate Desert had been destroyed (versus just under 60 percent reported by Oregon Natural Heritage Program [1997]) and none of the remaining habitat had escaped the invasion of weedy competitors.

a) Climate and Soils.

Specialized soil and climatic conditions are necessary for the formation of vernal pools. Vernal pools are often found in Mediterranean climates, where winters are cool and wet and an early spring rainy season is followed by a hot, dry summer. Air temperatures may reach 42 degrees Celsius (108 degrees Fahrenheit) in the summer, with a high average of 32 degrees Celsius (89 degrees Fahrenheit) and can get as low as -6 degrees Celsius (22 degrees Fahrenheit) in the winter, with a low average of -1 degree Celsius (30 degrees Fahrenheit). Rainfall averages 19 inches per year in Medford.

Vernal pools form where a soil layer below or at the surface, known as a *hardpan*, *duripan*, or *claypan*, is partially to completely impermeable to water. Precipitation and surface runoff become trapped or “perched” above this layer. Water from fall and winter rains collects in shallow depressions where downward percolation of water is prevented by the hardpan. A soil hardpan layer develops gradually over thousands of years, and can be a meter (3 feet) or more thick. Up to 48 centimeters (18 inches) of rainfall may fill pools during the winter and spring. Later in the spring, when rains decrease and the weather warms, the water evaporates, and the pools are generally

dry by May. The shallow depressions remain relatively dry until late fall and early winter when greater precipitation and cooler temperatures allow soil recharge to begin again. Claypans are formed by the transportation and accumulation of fine clay particles to the B horizon (soil formation beneath the surface soil layer) and accumulate there. The claypans may be augmented by redeposition of saline or alkaline compounds (Keely and Zedler 1998).

Vernal pools typically occur in landscapes that, on a broad scale, have a shallow slope or are nearly level, but on a fine scale may be quite bumpy. Vernal pool landscapes are dotted with numerous, rounded soil mounds, which have been attributed to burrowing and disturbance by gophers over millennia or to soil swelling and shrinkage during wetting and drying cycles (U.S. Fish and Wildlife Service 2002b).

b) Vegetation and Ecology.

Vegetation Associations. An estimated 14 different vegetation associations have been classified at the vernal pool-mounded prairie complex in the Agate Desert landform. Vegetation associations in portions of the range of the two listed plant species may differ significantly from other locations depending on local soil composition, past land use, local topography, seed bank composition, and hydrology (D. Borgias, pers. comm. 2004). For example, at the Agate Desert preserve, managed by The Nature Conservancy, an *Acnatherum lemmonii* (Lemmon's needlegrass)-*Festuca roemerii* (Roemer's fescue) grassland community is being restored on the mounded prairies. Although native bunchgrasses have been largely displaced by the nonnative *Poa bulbosa* (bulbous bluegrass) and *Taeniantherum caput-medusae* (medusahead) as a result from the introduction of livestock and commercial hay production, remnant populations of native plants still exist in portions of the Rogue River Valley.

Other spring-blooming plants common to the vernal pool mounded prairie complex include *Balsamorhiza deltoidea* (bitterroot), *Clarkia purpuria* (purple clarkia), *Camassia quamash* (common camas), *Collinsia sparsiflora* (few-flowered collinsia), *Lasthenia californica* (goldfields), *Lasthenia glaberrima* (smooth goldfields), *Hemizonia fitchii* (Fitch's tarweed), *Plagiobothrys fulvus* (fulvous popcornflower), *P. nothofulvus* (rusty popcornflower), *P. austiniae* (Austin's popcornflower), *Myosurus minimus* (least mousetail), *Eryngium petiolatum* (coyote thistle), *Navarretia leucocephala* (white-flowered navarretia), and *Pseudoroegneria spicata* (bluebunch wheatgrass). A common summer-blooming plant common to vernal pools is *Eremocarpus setigerus* (turkey mullein). One of the most dramatic adaptations of vernal pool plants to their unique environment is their ability to remain dormant in the soil seedbank for years or even decades. While dormant, these seeds must resist extreme heat, drought, and repeated wetting and drying, and be able to reactivate their metabolism and life cycle when conditions are appropriate. The cues they use to emerge from dormancy are poorly understood. Studies and models of other seed banks in highly variable environments

suggest that dormancy is a strategy to spread offspring across many years. In this way, not all seeds are lost in a climatically unfavorable year and at least some encounter more favorable conditions in future years (Jain 1978).

Biological Soil Crusts. Occupying primarily within the inundated portions of vernal pools in the Rogue River Valley are commonly found unique soil communities often referred to as biological soil crusts, or cryptogamic, cryptobiotic, microbiotic, or microphytic soil crusts (Belnap *et al.* 2001). These communities of highly specialized **autotrophic** organisms occupy open spaces between higher plants in arid and semi-arid lands throughout the world. Biological soil crust communities are a complex mosaic of *cyanobacteria*, green algae, lichens, mosses, microfungi, and other bacteria. Cyanobacterial and microfungi filaments weave through the top few millimeters of soil, gluing loose particles together and forming a matrix that stabilizes and protects soil surfaces from erosive forces (Friedman and Ocampo-Paus 1976, Belnap and Gardner 1993). Although these crusts commonly occur, and may constitute up to 70 percent of the living cover in some plant communities (Belnap 1994), they have only recently been recognized as having a major influence on terrestrial systems.

On the Agate Desert, the crust functions as living mulch by retaining soil moisture and discouraging annual weed growth. Biological crusts can also reduce wind and water erosion, fix atmospheric nitrogen, and contribute to soil organic matter. All crustal species are capable of drying out and temporarily suspending respiration without negative effects, unlike vascular plants, but can become photosynthetically active again very quickly after wetting. Because they lack a waxy epidermis, crustal organisms also tend to leak nutrients into the surrounding soil upon wetting and drying. Both above-ground and below-ground biomass are significantly increased in the presence of crust material (Pendleton *et al.* 2004).

The dominant components of biological soil crusts are *photosynthetic* and therefore require sunlight. When soils are dry, the bulk of the cyanobacterial biomass is 0.2 to 0.5 millimeter (0.008 to 0.02 inch) below the soil surface, where sufficient light for net carbon gain is available but ultraviolet exposure is reduced. The common cyanobacteria *Microcoleus vaginatus*, which lacks ultraviolet-screening pigments, migrates to the surface for short time periods when soils are moistened, and returns to subsurface zones as they dry. Populations of *Nostoc* sp. cyanobacteria containing ultraviolet-screening pigments are commonly found directly on the Agate Desert soil surface.

Morphological groups similar in shape and general appearance are currently being explored as a method for monitoring rangeland health because of their close association with surface soils. Normally only one or two groups will dominate the crust. On the Agate Desert cyanobacterial, green algal, and moss crusts seem to be most common, if a crust persists. Liverworts have also been encountered within the plant crust mosaic, and

a variety of lichens may be present on undisturbed cobble surfaces. The crust morphology can determine its ecological function relative to water infiltration, erosion, water retention, and resistance and resiliency to disturbance. A Biological Soil Crust Suitability Index integrating the surface cover of biological soil crust with their ability to protect the soil against erosion has been developed for patterned grasslands and shrublands where cryptogamic crusts are a major component of the soil matrix (Eldridge and Rosentreter 1999).

Nonbiotic soil surface crusts are a major structural component on the Agate Desert because they can reduce water infiltration and prevent the emergence of vascular plant seedlings. These physical crusts are structurally different from the material immediately beneath them, however, and are not the basis for the vernal pools themselves.

c) Past Land Practices.

Historically, fires in the Agate Desert region of the Rogue River Valley are likely to have been a frequent occurrence due to evidence of annual lightning-caused fires in the region and surrounding hillsides. However, the current abundance of thatch buildup on vernal pool mounded prairie complexes in the Agate Desert indicates a lengthy gap in the fire cycle in recent decades. Widespread grazing by black-tailed jackrabbits, rabbits, deer (*Odocoileus* sp.), and antelope (*Antilocapra americana*), suggested by the United States Exploring Expedition report in 1841, may also have historically controlled thatch buildup (Wilkes 1844).

Grasslands in the Agate Desert landform are assumed to have also been maintained historically by Native American-ignited wildfires (Oregon Blue Book 2004). Early accounts of fire from the pre-settlement period to the mid-1800s document the prevalence of fire and account in part for the pattern of grassland savanna and woodland on the landscape. The Takelma Indians frequently visited the Agate Desert area during pre-settlement times and likely utilized fire to assist in hunting and gathering (Oregon Blue Book 2004).

The present condition of the vernal pools vegetation has been largely shaped by historical grazing practices and past and current development. Soon after gold was discovered in California, miners came into the Rogue and Illinois Valleys. Jacksonville, the first town in southern Oregon, was founded in 1851. Agricultural possibilities were recognized and permanent settlers located along the small streams of the valley. Early settlers raised common field crops and livestock, using adjacent hills and mountains for rangeland.

Undeveloped land in the Agate Desert, near what is now White City, was acquired and subdivided around 1910. A system of irrigation ditches across the landform

was planned and offered parcels for orchard tracts to agrarians and speculators. The pear industry was booming, and undeveloped orchard land was selling for over \$400 an acre. As irrigation began to divert water from the Rogue River and its tributaries, large portions of vernal pool mounded prairie complexes within the Agate Desert area were flooded for water reservoirs, leveled for planting, and irrigated for fruit tree production. On the Agate Desert landform, orchards failed on the poorly drained soils, and most of the irrigation ditches were abandoned (Elliot and Sammons 1996).

Sheep were also introduced with the first settlers to colonize the Rogue River Valley and were given free range of the area. Today, cattle are the primary livestock grazed throughout the area, but sheep are still present (Oregon Blue Book 2004). Typical cattle stocking rates in the Agate Desert are about one cow/calf pair for each 1 to 1.6 hectares (2.5 to 4 acres) (D. Borgias, pers. comm. 2004). Much of the vegetation has become dominated by exotic grasses, such as *Taeniatherum caput-medusae*, *Thinopyrum ponticum* (= *Agropyron elongatum*) ('largo' tall wheatgrass) that was introduced for recreational fowl hunting, and forbs such as *Erodium cicutarium* (filaree, crane's bill), which was spread through contaminated cattle feed.

The Nature Conservancy is monitoring the effects of rest and rotation of cattle on portions of their vernal pool habitat preserves. Preliminary results indicate early fall grazing may be beneficial by reducing nonnative plant competitors in the plant community (Borgias 2004). However, concerns remain that improper grazing regimes could be detrimental to the viability of listed species (Kagan 1986, Brock 1993). Precise management recommendations to benefit the listed species are in development while research continues.

The Rogue River Valley in the vicinity of Medford and White City is a rapidly developing area (Oregon Blue Book 2004). White City has a population of only 6,000 people, but industrial development is rapidly expanding within an Urban Containment Boundary nearly equal to Medford's Urban Growth Boundary. Since 1990, over 70 percent of Jackson County's population growth has taken place in Medford, Ashland, and Central Point, and Medford continues to expand northward toward White City. Jackson County as a whole has had a growth rate of about 2 percent per year for the last 15 years. Between 1990 and 2000, Medford's growth rate was 23 percent (Medford Chamber of Commerce 2004).

Currently there is a trend in the Rogue River Valley for conversion from agricultural land to housing, commercial, and industrial development. From 1992 to 1997, 3,480 hectares (8,600 acres) of land in the southern Oregon coastal basin (10 percent of all converted agricultural land in Oregon) was converted to nonagricultural lands; a large portion of this conversion occurred in the Rogue River Valley (Oregon Department of Agriculture 2004).

A function and value assessment of vernal pool quality, abundance, and distribution in 1999 accounted for an estimated 10 percent, or 850 hectares (2,100 acres), of vernal pool landform remaining in the Agate Desert (Borgias and Patterson 1999). Residential, commercial, and industrial developments, along with land leveling, have claimed over 60 percent of the historical range of this Agate Desert landform. The remainder of the habitat is either severely altered by historical and continuing land uses, or occurs along the fringes of the landform where vernal pools are weakly expressed (U.S. Fish and Wildlife Service 2002a).

2. Illinois Valley Seasonally Wet Meadows

Seasonally wet meadows are underlain by patches of impermeable hardpan soils, creating pockets of differing *mesic* plant communities that flower and seed later in the year than the surrounding grasslands. In the Illinois Valley, wet meadows are formed by alluvial wash from a variety of geologic sources. Because of this, many unique and disparate plant associations can be found in the valley.

a) Climate and Soils.

The climate of the Illinois Valley is characterized as Mediterranean with a pronounced cool-wet yet mild winter and spring and a hot-dry summer. Rainfall at Cave Junction averages 60 inches per year. In response to these conditions, the vegetation responds with rapid growth in the warming weather of spring that will carry on until the arrival of hotter weather in summer. Characteristic vegetation of the valley has adapted to extended periods of drought and an extreme vulnerability to fire.

The soils of the Illinois Valley grasslands are largely derived from a mixture of serpentine and nonserpentine alluvium parent material of the surrounding hills. Brockman clay loam, Josephine gravelly loam, Pollard loam, Eightlar extremely stony clay, Takilma cobbly loam, Abegg clay loam, and Newberg loam soils are typical soils occurring in the Illinois Valley. Brockman clay loam soils in the French Flat area average 60 to 90 centimeters (24 to 35 inches) in depth. Serpentine soils, derived from serpentinite, are mineral producing, dry, nutrient-poor soils deadly to plants that are not specially adapted to its unusual chemistry. High levels of magnesium in the soil block a plant's ability to take in soil nutrients, especially calcium. Because the serpentine soils are shallow and low in organic material and clay, they also cannot hold water or nutrients well.

Serpentine soils are normally acidic near the surface, but less so in deeper layers. As wind and water erode the soil, nonacidic layers are exposed, creating varied habitat for plants. Although serpentine soils are present throughout the seasonally wet meadows, their distribution, depth, and degree of decomposition varies greatly throughout the valley, creating an unusual and varied distribution of interesting plant communities and associations.

The Illinois Valley slopes and plains are underlain with floodplain bench deposits that contain sufficient clay to form a clay pan at 60 to 90 centimeters (24 to 35 inches) below the soil surface (Soil Conservation Service 1983). The claypan creates seasonally wet areas similar to the vernal pools of the Agate Desert, but often lacks the latter area's distinctive mound-swale topography. These soils are responsible for the seasonally wet patches along hill slopes and valley bottoms that may support occurrences of *Lomatium cookii*.

b) Vegetation and Ecology.

The plant community type that occupies flats and gentle slopes in the Illinois Valley was designated *Danthonia californica* (California oatgrass)-*Deschampsia cespitosa* (tufted hairgrass) grassland by Kaye and Blakely-Smith (2002). These grasslands feature only a few *Pinus jeffreyi* (Jeffrey pine) and *Pinus ponderosa* (ponderosa pine) trees scattered within the dominant *Danthonia californica* and *Deschampsia cespitosa* grasslands. Moisture levels in the soils of this community-type generally range from mesic to **hydric**. *Danthonia californica* tends to dominate in more mesic soils, while *Deschampsia caespitosa* is more common on hydric soils. The drier sites also host more grass species, such as *Melica geyeri* (oniongrass) and *Festuca roemerii*, and are transitional to Jeffrey pine savannah. The diverse forb community includes *Achillea millefolium* (yarrow), *Aira caryophylla* (silver hairgrass), *Calochortus uniflorus* (large-flowered tulip star), *Camassia quamash*, *Hesperochiron californica* (California hesperochiron), *Horkelia daucifolia* (carrot-leaved horkelia), *Isoetes nuttallii* (quillwort), *Microseris howellii* (Howell's microseris), *Micropus californicus* (slender cottonweed), *Prunella vulgaris* (self-heal), *Senecio hesperius* (western senecio), and *Viola hallii* (Hall's violet) (Kaye and Blakely-Smith 2002).

Fire has played a significant role in shaping the grassland habitat of the Illinois Valley. The occurrence of fire in this area is extremely variable. A 30-year average fire cycle for the mixed conifer forest type was determined by Agee (1993) from forest survey work done in the 1940s by Andrews and Cowlin. For the entire Illinois Valley watershed, the natural fire cycle was determined at 20 and 50 years for low to moderate intensity fires, 60 to 100 years for moderate to high intensity fires, and 100 to 200 years for large stand replacement fires. But in reality, a single fire at any time may burn across a landscape with a patchwork of all three intensities. For instance, the Biscuit Fire, which burned large portions of the Illinois Valley watershed in 2002, burned in a mosaic of large stand-replacement burns, patches of moderate intensity burns, low intensity burns, and unburned areas.

Native American use of fire as a management tool is considered to have had a profound influence on the ecology of most of the forest land in southwest Oregon, the west coast, and the nation. In the absence of Native American burning, natural lightning fires in many forested landscapes have become less common yet more intense. Native

American burning is assumed to have reduced the numbers of high intensity fires that would have been caused by lightning. As Native American-initiated burning ceased in North America, about 1880, a rapid change took place in forest ecology: prairies became woodlands, savannas became dense forests, and open forests became choked with dense undergrowth (MacCleery 1997).

In 1939, a 40-man crew was assigned to fight fires in the Siskiyou National Forest and in the early 1940s a smokejumper base became established in Cave Junction, Oregon. Since then fire exclusion has significantly affected vegetation in the Illinois Valley by disrupting the current disturbance-dependent cycle of southwest Oregon wildland areas (U. S. Forest Service 2004). Many former grassland areas in the Illinois Valley are overgrown with such fire-susceptible plants as *Ceanothus cuneatus* (wedge-leaved buckbrush), *Arctostaphylos hispidus* (manzanita), *Toxicodendron diversiloba* (poison oak), *Pseudotsuga menziesii* (Douglas fir), and *Rubus discolor* (Armenian or Himalayan blackberry). The existing natural grassland communities of the Illinois Valley are often disjunct, highly fragmented, and marginal habitats due to agricultural development, mining, and fire exclusion.

c) Past Land Practices.

By 1880, the Illinois Valley had become home to a vigorous mining industry, as gold was discovered there. By 1920, mining claims were still producing gold ore, but timber was becoming an established industry. Agriculture and grazing were only minor industries. In recent years, agriculture, particularly grape production, has become a prominent part of the commerce in the area, although mining and timber harvests continue to exist. Currently, such tourist attractions as outdoor recreation, a wild animal park, and the Oregon Caves National Monument have begun to support the community in earnest (Cave Junction.com 2004, Oregon Blue Book 2004).

C. PRESENT CONSERVATION AND REGULATORY MEASURES

1. Federal Actions

The development of a federally administered project must be coordinated with the U.S. Fish and Wildlife Service for actions that may affect listed species or their critical habitat. By these regulatory measures, additional protection of *Limnanthes floccosa* ssp. *grandiflora*, *Lomatium cookii*, and the vernal pool fairy shrimp can be achieved. Federally listed plants and animals and designated critical habitat are protected on all federally administered lands under the Endangered Species Act. Under the same act, Federal agencies are required to conduct conservation programs for federally listed species.

a) Federally Administered Lands.

Bureau of Land Management. The Bureau of Land Management manages several populations of *Lomatium cookii* in the Illinois Valley as required under section 7(a)(1) of the Endangered Species Act by ensuring protection of the plant near roadside timber harvests, restricting off road vehicle access, maintaining a long term population inventory program, and monitoring existing populations. The Medford District of the Bureau of Land Management has designated 320 hectares (792 acres) of French Flat, a pristine and largely undisturbed, seasonally wet grassland meadow in the Illinois Valley plain, as an Area of Critical Environmental Concern. This area receives special management for habitat conservation due to the outstanding botanical, ecological, and geological values in an area largely undisturbed by roads or development.

French Flat is one of only a few population centers for *Lomatium cookii* on federally administered lands. The site also hosts a number of plant communities considered rare or vulnerable by the Oregon Natural Heritage Program (Kagan 1994). Equally valuable is the very low abundance of nonnative, invasive plants at French Flat, and the extensive wetlands that cover much of the flat terrain, providing for a near pristine condition.

French Flat has four documented and nine suspected special status wildlife species. In addition, it has potential habitat characteristics required by 12 other special status wildlife species not yet detected in the Area of Critical Environmental Concern.

Other important natural systems and processes include fire, succession, and evolution. Atzet and Wheeler (1982) indicated that fire has been a significant and important part of the environment, shaping plant communities in the region, and evidence of past fire is common on the landscape of the Area of Critical Environmental Concern. French Flat presents an array of plant communities which display successional processes. Evolutionary processes, in the form of species hybridization such as in the case of the *Triteleia howellii* (Howell's brodiaea) × *T. multiflora* (multiflowered brodiaea) complex, have been documented at the site.

The management objective for French Flat is to protect, conserve, and enhance the values for which it was designated, which includes ensuring that ecological processes can be preserved. Mining activities, recreation, and authorized land uses must be managed in such a way as to avoid negative impacts to designated Area of Critical Environmental Concern values.

The large population of *Lomatium cookii* occurring at French Flat is the focus of a collaborative conservation effort between the U.S. Fish and Wildlife Service and Bureau of Land Management. A Conservation Agreement signed in January 2003 by both agencies facilitates protection for the species from illegal trespass and vandalism (Bureau of Land Management and U.S. Fish and Wildlife Service 2003). Action items on the

agreement include plant population monitoring, seed collecting, blocking roads to deter off-road-vehicle damage, managing the area to enhance habitat suitability, seeking to acquire adjacent lands, and notifying the Fish and Wildlife Service of new mining claims.

Bureau of Reclamation. The Bureau of Reclamation administers approximately 174 hectares (430 acres) adjacent to Agate Lake. In 2000, the Bureau of Reclamation prepared a Resource Management Plan (Title 28 of Public Law 102-575, [106 Statute 4690]) for Agate Lake in cooperation with Jackson County Roads and Parks Services (Bureau of Reclamation 2000). The Resource Management Plan for Agate Lake is intended to direct the management of Agate Lake resources to maximize overall public and resource benefits for 10 years (2000 through 2010). The plan provides a conceptual framework for conserving, protecting, developing, using, enhancing, and managing Agate Lake resources.

The overall objectives that guided the development of the Resource Management Plan include:

- Determine the most appropriate uses of all Bureau of Reclamation-administered and Jackson County Parks-managed recreation lands around Agate Lake, considering the use of adjacent private lands.
- Explore ways to enhance and protect the natural, recreational, aesthetic, and cultural resources.
- Identify long-term programs to address public health and safety, fish and wildlife, and recreation.
- Identify financially feasible opportunities or partnerships to assist Jackson County Parks in managing recreational facilities.

On pages 4-12 through 4-15 of the Resource Management Plan under Section D, Natural Resources, there are several goals and objectives focused on enhancing wildlife habitat, including, but not limited to, waterfowl use areas and raptor nesting sites; and identifying and protecting vernal pool habitat, while minimizing adverse impacts to wildlife when designing and constructing facilities. Specifically, goal D.3, Identify and protect vernal pool habitat, lists specific management actions (page 4-15 of Resource Management Plan). These include:

- Complete a regional vernal pool survey to determine the location, condition, and value of vernal pool habitat; and,
- As appropriate, the Bureau of Reclamation and Jackson County Parks will partner with the U.S. Fish and Wildlife Service, Oregon Department of Fish and Wildlife and the Oregon Natural Heritage Information Center to develop a management plan that protects and enhances vernal pool habitat. The plan will accomplish the following:
 - Determine the most appropriate regional site for interpretive displays and trails; and

- Determine the feasibility of using prescribed burns or cattle grazing to improve vernal pool habitat value.

b) Vernal Pool Fairy Shrimp Critical Habitat.

Within the Rogue Valley, 3,035 hectares (7,500 acres) have been designated as critical habitat for the vernal pool fairy shrimp (U.S. Fish and Wildlife Service 2003). Approximately 98 percent of known *Limnanthus floccosa* ssp. *grandiflora* populations and 20 percent of known *Lomatium cookii* populations occur on designated critical habitat for the vernal pool fairy shrimp. Critical habitat requires Federal agencies to evaluate the effects of any activities they fund, authorize, or carry out on listed species. This designation will also provide protection for the two listed plants in the Rogue River Valley. Federal actions that most often affect vernal pools are actions covered under issuances of Clean Water Act permits, administered by the U.S. Army Corps of Engineers.

Designation of critical habitat does not constitute a land management plan nor does it signal any intent by the government to acquire or control the land. Therefore, if there is no Federal involvement, activities of a private landowner, such as farming, grazing or constructing a home, generally are not affected by a critical habitat designation, even if the landowners' property is within the geographical boundaries of critical habitat. Without a Federal *nexus* to a proposed action, designation of critical habitat does not require that landowners of state or other non-Federal lands do more than they would otherwise do to avoid harming, harassing, or removing listed species under section 9 provisions of the Endangered Species Act.

Federal agencies are required to ensure that their activities are not likely to jeopardize the survival of a listed species or adversely modify (*e.g.*, damage or destroy) its critical habitat. By consulting with the U.S. Fish and Wildlife Service, Federal agencies can usually minimize or avoid any potential conflicts and, thus, activities usually proceed in some form. It should be noted that critical habitat designation does not create a wilderness area, preserve, or wildlife refuge. It applies only to activities sponsored at least in part by Federal agencies. Such federally-permitted land uses as grazing and recreation may take place if they do not adversely modify critical habitat.

c) Clean Water Act.

Some protection is afforded to populations of *Limnanthus floccosa* ssp. *grandiflora* and *Lomatium cookii* in vernal pool complexes on private and public lands through section 404 of the Clean Water Act (33 U.S.C. 1344) regulated by the Army Corps of Engineers. Clean Water Act permits for the discharge of dredged or fill materials into navigable waters of the U.S. require consultation with the U.S. Fish and Wildlife Service when threatened or endangered species may be affected. Clean Water Act permits are circulated through government agencies and the public for review and

projects can be planned ahead of time to avoid impacts to threatened or endangered species.

A general regulatory condition that accompanies all permits under the Clean Water Act requires that if at any time the applicant becomes aware of the presence of a listed species within the authorized project area that was not previously addressed in the permit application, all work activity must cease immediately. The Army Corps of Engineers must be notified and approve a plan before any other work can proceed. If an applicant discovers the presence of an endangered species after a Clean Water Act permit has been issued, they must cease work and notify the Army Corps of Engineers. The Army Corps of Engineers cannot require them to stop working but failure to do so may result in a violation of Federal law. Violators may be subject to enforcement action or civil and criminal penalties (D. Yballe, pers. comm. 2004).

In one example of compensatory mitigation for a county removal-fill activity and consultation with the U.S. Fish and Wildlife Service, a Jackson County Clean Water Act compensatory mitigation project recently burned 10 hectares (25 acres) of vernal pool habitat near a Jackson County School to reduce thatch buildup and control invasive plants. In 2003, topsoil was added to one vernal pool at the site as an inoculum from a vernal pool containing *Limnanthes floccosa* ssp. *grandiflora* at the adjacent development site. During a spring 2004 visit, observers noted presence of *L. floccosa* ssp. *grandiflora* at the site (S. Friedman, pers. obs. 2004).

Compensatory mitigation in the form of restoration for permitted wetland development is appearing in several areas on municipal and private lands in the Rogue Valley. Several acres of poorly functioning and moderately degraded vernal pools have been restored to functioning systems by re-contouring land to restore vernal pool formations based on historical aerial photos and restore hydrology. Approximately 26 hectares (65 acres) of vernal pool habitat was recently protected as compensatory mitigation for wetland impacts associated with the filling of 2.7 hectares (6.6 acres) of degraded (altered topography/hydrology and severely altered vegetation) vernal pool habitat within the Agate Desert area. Although early observations of these mitigation sites appear promising, the long term success or failure of these sites has not been determined.

d) Grants.

The Oregon Department of State Lands received a \$143,000 grant through the U.S. Fish and Wildlife Service to assist in the development of a wetland/habitat conservation plan for the vernal pool wetlands within the White City area of the Agate Desert. The Oregon Division of State Lands applied for the grant on behalf of Jackson County, the Rogue Valley Council of Governments, and other local interests to help guide development and wetland conservation in the area.

Approximately 1,480 hectares (3,650 acres) of vernal pool fairy shrimp habitat is considered for inclusion within the wetland/habitat conservation plan study area. Approximately 230 hectares (568 acres) (16 percent) are in the development category, 536 hectares (1,325 acres) (36 percent) are in the protection category, and 799 hectares (1,757 acres) (48 percent) are in the incentive category. The 258 hectares (568 acres) slated for development would likely be permanently lost and the fate of the 711 hectares (1,757 acres) in the incentive category may depend on funding of conservation incentive programs. None of the 3,035 hectares (7,500 acres) of vernal pool fairy shrimp critical habitat is included in the development category. Approximately 486 hectares (1,200 acres) of fairy shrimp critical habitat are included in the protection category with another 405 hectares (1,000 acres) included in the incentive category. These figures are preliminary.

This wetland/habitat conservation plan will identify the best places for protection of wetlands and the three listed species and potential development sites. It also will coordinate the legal requirements of Federal and State laws, resulting in faster permitting for developable lands. The planning process will take up to 2 years to complete and will include many opportunities for public participation and comment (Oregon Department of State Lands 2003).

2. Oregon State Agency Actions

Under Oregon State law, any Federal or State listed plant species receives protection on State, County, and municipally administered lands (Oregon Administrative Rules 603.73-070). Although federally listed and State endangered plants are protected from collection, harm, transportation, or ‘take’ on these lands under State law, enforcement is limited by lack of personnel, and is rarely enforced (R. Mienke, pers. comm. 2004). State, County, and municipal agencies and governments are required to protect, conserve, and develop management plans for plants occurring on State, County, and municipally owned lands.

a) Oregon Division of State Lands.

The Oregon Division of State Lands is responsible for ensuring that any wetlands impacted by fill and removal are compensated in function and value, usually through mitigation. Several wetland mitigation projects in White City and Medford are restoring old vernal pool systems to compensate for development and habitat degradation within known listed species populations. Although populations of the three listed species will be lost to development and habitat fragmentation, newly restored vernal pools systems will be required in the Rogue River Valley to offset these losses. Ongoing vernal pool function monitoring and plant assessment will determine whether compensation of this kind can restore vernal pools and populations of listed species to intact, functioning, and self-sustainable systems.

b) Oregon Department of Fish and Wildlife.

The development of a management plan for several large populations of *Limnanthes floccosa* ssp. *grandiflora*, *Lomatium cookii*, and vernal pool fairy shrimp is underway at the Oregon Department of Fish and Wildlife's Ken Denman Wildlife Management Area in the Agate Desert. The management plan will guide conservation of the three species for the 769-hectare (1,900-acre) wildlife management area. Conservation measures likely to be included in the plan are removal of log decking and debris, prescribed burns, biological weed control, removal of exotic grasses, and native seed introduction. Populations of the two listed plant species and the vernal pool fairy shrimp occur at the management area.

A prescribed burn, an introduction of *Lomatium cookii* seed, and vernal pool restoration were accomplished on 4.9 hectares (12 acres) of the Denman Military Slough as part of compensatory mitigation by the Medford International Airport in 2003.

c) Oregon Department of Transportation.

Populations of State and federally listed plants occurring within Oregon Department of Transportation ownership or right-of-ways receive special management through maintenance activity restrictions (no herbicides, delayed mowing), regular monitoring, and coordination between State staff and the U.S. Fish and Wildlife Service for potential restoration planning. These areas are designated as Special Management Areas and are managed as required under State law. Special Management Areas are established along roads and highways by the Oregon Department of Transportation where road maintenance is managed for the protection of the plants. Annual or semi-annual monitoring is conducted to evaluate population trends. Results of monitoring are intended to facilitate understanding of how maintenance actions can be improved to better protect and conserve the species while maintaining roadside safety conditions. Two Special Management Areas are designated in the Agate Desert area for *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii* and two Special Management Areas are designated in the Illinois Valley for *Lomatium cookii*.

In the Agate Desert, the Oregon Department of Transportation monitors two Special Management Areas. The Highway 62 site in White City has an extirpated occurrence of *Lomatium cookii*. The site has been monitored bi-yearly but the plant has not been observed for the past 5 years. The Highway 140 site has several dispersed populations of *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii*. The population is fenced and situated several meters away from the highway so that is not directly affected by regular roadside maintenance.

In the Illinois Valley, the Oregon Department of Transportation monitors two populations of *Lomatium cookii* within State highway easements near Cave Junction. At one area, a *L. cookii* population occurs on both sides of the State highway and also extends onto private lands on either side of the right-of-way (K. Cannon, pers. comm.

2004). The site is monitored regularly and roadside signage directs maintenance crews to suspend herbicide application and to avoid mowing, disking, or blading. Heavy equipment on the site is restricted except for emergency situations (K. Cannon, pers. comm. 2004).

Conservation activities have not yet been implemented at these special management areas; however, the Oregon Department of Transportation is planning potential mowing and/or prescribed burning to reduce buildup of competing vegetation. By burning or mowing the sites, excess thatch can be removed and the spread of invasive nonnative plants can be curtailed. These effects should provide more openings for the *Lomatium cookii* plants to grow and spread and permit more water to reach the roots.

d) Oregon Parks and Recreation Department.

The Oregon Parks and Recreation Department manages a population of *Lomatium cookii* at the River Forks State Park in the Illinois Valley. At the park, a *L. cookii* population is currently fenced off from the road and picnic areas. This fence appears to deter unintentional disturbance by park visitors. A park management plan for the plant is currently being developed (M. Michaud, pers. comm. 2004).

3. County and Municipal Actions

Several populations of *Lomatium cookii* occur at the Rogue Valley International-Medford Airport. The airport is managed by Jackson County and administered by the Federal Aviation Authority. The largest population of *L. cookii* on the airport grounds occupies 15.4 hectares (38 acres) and contains over 5,000 flowering plants. Required security measures at the airport are stringent and restrict casual trespassing or vandalism. The entire airport runway grounds are fenced-off with 2.6 meter (8 foot) high steel fencing and are monitored with video cameras and vehicle patrols (R. Russell, pers. comm. 2004). The airport grounds are mowed regularly to meet airport safety regulations.

4. Private Lands

The only private lands that are managed specifically for the benefit of the three listed species in the Rogue River Valley or the Illinois Valley are three parcels managed by The Nature Conservancy. The Nature Conservancy owns and manages three preserves in the Agate Desert, all of which support extant populations of *Limnanthes floccosa* ssp. *grandiflora*, *Lomatium cookii*, and/or the vernal pool fairy shrimp. The Nature Conservancy monitors populations of the three species annually. All three properties carry restrictive covenants on the deed that mandate protection of the land in perpetuity. The covenant limits development and prescribes management of grazing, but permits owners to have full access to the land (D. Borgias, pers. comm. 2004).

a) Agate Desert Preserve.

The Agate Desert Preserve contains 21 hectares (53 acres) of some of the most hydrologically and vegetationally intact vernal pool-mounded prairie habitat in the Agate Desert. When cattle were removed from the preserve in 1987, populations of *Lomatium cookii* rapidly increased in number for the first several years, then stabilized. When fire was introduced to the area in 1989, *Limnanthes floccosa* ssp. *grandiflora* responded well with increased numbers and local distribution; it has since stabilized. In the 17 years of monitoring at the preserve, populations of the two species appear stable, but fluctuate depending on the annual weather patterns (D. Borgias, pers. comm. 2004).

b) Whetstone Savanna Preserve.

The Nature Conservancy's 58-hectare (144-acre) Whetstone Savanna Preserve is located at the western edge of the Agate Desert and supports several populations of *Lomatium cookii*, *Limnanthes floccosa* ssp. *grandiflora*, and vernal pool fairy shrimp. The site is at 366 meters (1,200 feet) elevation in the Rogue River floodplains and supports extensive vernal pool-mounded prairie with a perennial native bunchgrass component. The Nature Conservancy has been implementing rest/rotation cattle grazing and prescribed burning as conservation measures for the two species. In 9 years of monitoring, the populations of all three species appear to be stable (D. Borgias, pers. comm. 2004).

c) Rogue Plains Preserve.

The Rogue Plains Preserve contains the largest population of *Limnanthes floccosa* ssp. *grandiflora* of any known site. Approximately 40.4 hectares (100 acres) are currently protected and managed on this preserve, of which approximately 8 hectares (20 acres) are occupied by the plant. Cattle are permitted to graze the preserve while The Nature Conservancy annually monitors the health of the rangeland and status of the endangered plant populations. Based on 4 years of monitoring, the species appears to be stable and compatible with moderate cattle activity and grazing (D. Borgias, pers. comm. 2004).

II. Species Accounts

A. *LIMNANTHES FLOCCOSA* SSP. *GRANDIFLORA*

Overview. *Limnanthes floccosa* Howell ssp. *grandiflora* (M.E. Peck) Arroyo, (Family Limnanthaceae), was listed as an endangered species on November 7, 2002 (U.S. Fish and Wildlife Service 2002a) under the authority of the Endangered Species Act of 1973, as amended. Although we determined that critical habitat designation for *L. floccosa* ssp. *grandiflora* is prudent, a proposal for designation has been deferred due to insufficient funding and higher priority listing actions.

Recovery Priority. *Limnanthes floccosa* ssp. *grandiflora* has a recovery priority number of 3C. Recovery priority rankings, on a scale from 1C (highest) to 18 (lowest), are determined in accordance with our guidelines for assigning recovery priorities (U.S. Fish and Wildlife Service 1983). This ranking is based upon a high degree of threat, a high potential for recovery, and a taxonomic classification as a subspecies for *Limnanthes floccosa* ssp. *grandiflora*. The “C” indicates the potential for conflict with construction, development projects, or other forms of economic activity.

1. Description and Taxonomy

Limnanthes floccosa ssp. *grandiflora* (Figure II-1) is a delicate annual herb in the meadowfoam or false mermaid family (Limnanthaceae). In his monograph of the genus *Limnanthes*, Mason (1952) described three varieties of *Limnanthes floccosa*, but did not recognize ssp. *grandiflora* as distinct. Kalin-Arroyo (1973) elevated Mason’s varieties to subspecies based on her study of specimens grown under controlled conditions from field-collected seed and described two additional subspecies, *californica* and *grandiflora*. Kalin-Arroyo (1973) distinguished *grandiflora* from the other subspecies of *Limnanthes floccosa* by a combination of 7.5- to 9-millimeter (0.30- to 0.35-inch) petal length, 8.5- to 9-millimeter (0.33- to 0.35-inch) *sepal* length, sepal pubescence (dense hairs on inner surface and sparse to absent on outer surface), sparsely hairy stems and leaves, two lines of hairs at the petal base, relative flowering time, and occurrence relative to soil moisture (Kalin-Arroyo 1973). Over much of its range, ssp. *grandiflora* is *sympatric* with *Limnanthes floccosa* ssp. *floccosa*; however, ssp. *floccosa* grows on the slightly drier, outer fringes of the pools, whereas ssp. *grandiflora* grows on the relatively wetter, inner fringe of the pools (Kalin-Arroyo 1973).

Limnanthes floccosa ssp. *grandiflora* grows 5 to 15 centimeters (2 to 6 inches) tall; with 1- to 5-centimeter (0.4- to 2-inch) leaves divided into five to nine segments. The leaves, stems, and lower sepals (flower segments below the petals) are sparsely covered with short white, fuzzy hairs. The off-white petals have two rows of hairs near



a.



b.

Figure II-1. *Limnanthes floccosa* ssp. *grandiflora* a) growth form; b) close-up of flower.
Photographs by Norm Jensen.

their base and are nearly even with the sepals, unlike the more common *L. floccosa* ssp. *floccosa*, which has hairless petals that exceed the sepals in length. The plant produces one to three flowers per peduncle (flower stalk), unlike the many-flowered ssp. *floccosa*. Each flower will produce a cluster of one to five hard nutlets by mid-May, which will quickly drop in the drying mud.

Over much of its range, *Limnanthes floccosa* ssp. *grandiflora* is often associated with ssp. *floccosa*. Whereas ssp. *grandiflora* is restricted to the relatively wetter, inner fringe of vernal pools in the Rogue Valley plains, ssp. *floccosa* grows on the slightly drier, outer fringes of the pools. While ssp. *floccosa* ranges from the Rogue River Valley to as far south as Tehama County, California (Kalin-Arroyo 1973, Hickman 1993), ssp. *grandiflora* occurs solely in the upper Rogue River basin.

2. Distribution and Population Status

The range of *Limnanthes floccosa* ssp. *grandiflora* is endemic to the Rogue River Plains of Jackson County at elevations of 366 to 400 meters (1,200 to 1,310 feet), within an 8,300-hectare (20,510-acre) landform within the Agate Desert, and within the vicinity of Eagle Point and White City, Oregon (Figure II-2).

The plant occupies the Upper and Middle Rogue sub-basins (fourth-field hydrological unit codes) of the Rogue River. *Limnanthes floccosa* ssp. *grandiflora* has no significant ecological, genetic, or geographic barriers separating its 21 extant populations, apart from development and road systems. The historical distribution of *L. floccosa* ssp. *grandiflora* in the Rogue Valley is grouped into nine core areas that are separated by at least 1 kilometer (0.7 miles). The Rogue Plains core area includes two populations of *L. floccosa* ssp. *grandiflora* while the other four north Rogue River Valley core areas (Shady Cove, Staley Road, Table Rock Terrace, and North Eagle Point) have one population each. An additional population was recorded in Eagle Point vicinity in 1927, but the approximate site location has been developed and suitable vernal pool habitat in the approximate area does not appear to be present. Eight populations of *L. floccosa* ssp. *grandiflora* occur in the central Agate Desert core area, four populations occur at the Whetstone Creek core area, and the Rogue Airfield and Agate Lake core areas include one population each (Figure II-2). In the Agate Desert, all known populations of *L. floccosa* ssp. *grandiflora* comprise 80 hectares (198 acres). Three new locations were identified in the spring 2004, all at wetland mitigation sites. The species is currently known to occur from 6 occurrences north and 14 occurrences south of the Rogue River in populations ranging from under 100 to 100,000 (Oregon Natural Heritage Information Center 2004a).

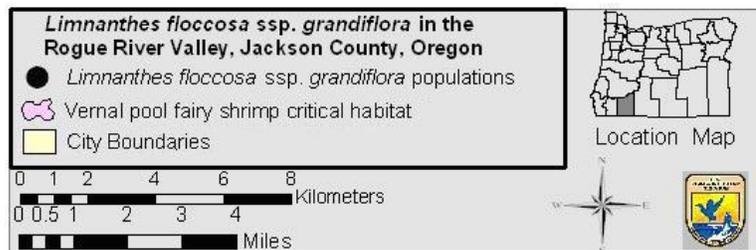
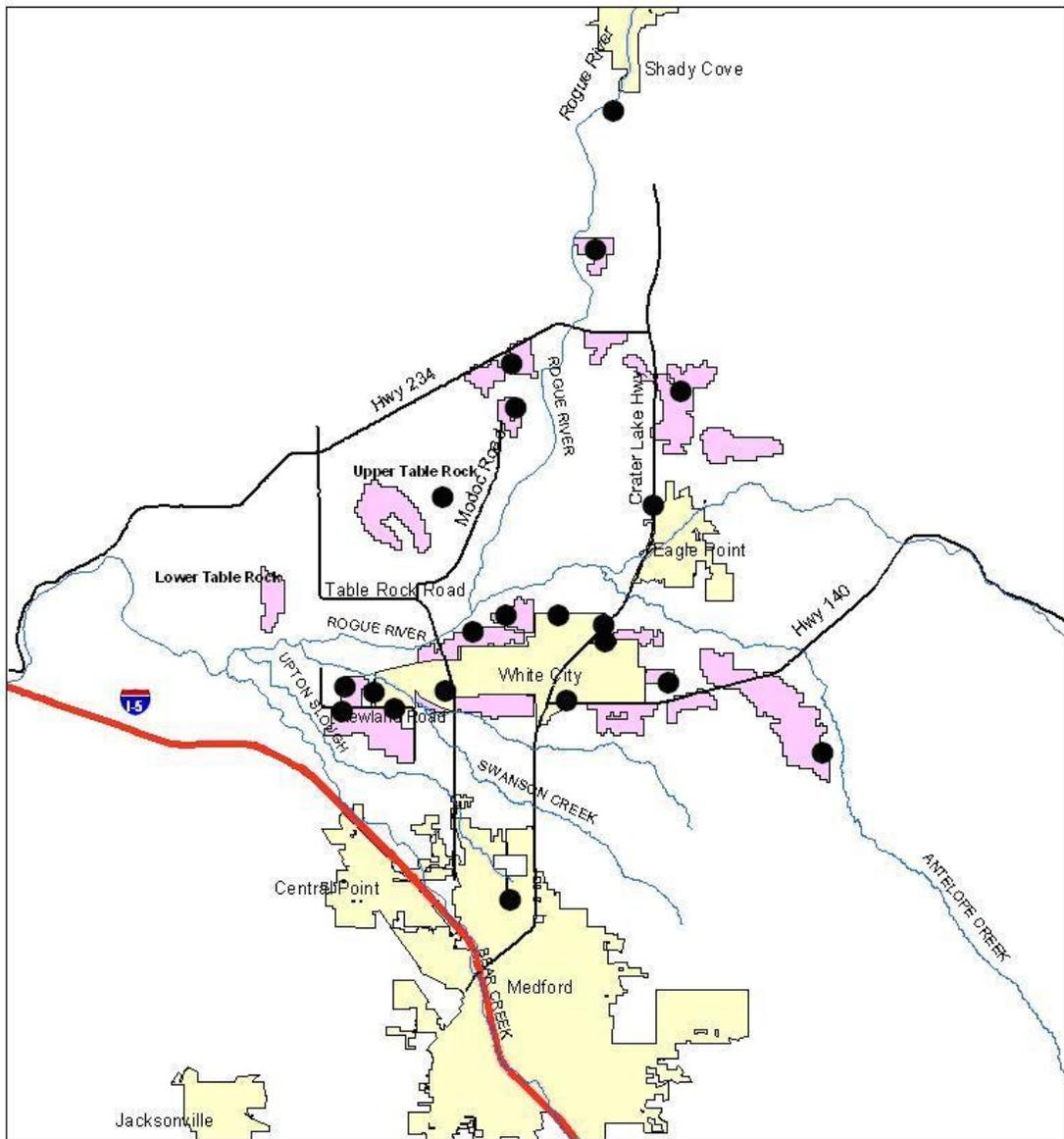


Figure II-2. Distribution of *Limnanthes floccosa* ssp. *grandiflora* in Jackson County, Oregon.

a) Administrative Lands.

In the Agate Desert, the majority of extant *Limnanthes floccosa* ssp. *grandiflora* occurrences are on privately owned lands. The following estimates represent data provided by the Oregon Natural Heritage Information Center (2004a) and U.S. Fish and Wildlife Service records. All reported population areas are described, which may or may not have been recently revised depending upon accessibility for inventory and monitoring, especially on private lands.

There are no parcels occupied by *Limnanthes floccosa* ssp. *grandiflora* under Federal management in Jackson County. Five populations of the species on 6 hectares (15 acres) occur on State administered land. One 30-hectare (74-acre) population of *L. floccosa* ssp. *grandiflora* overlaps both State and private land.

Limnanthes floccosa ssp. *grandiflora* occurs on 14 parcels of privately owned lands, constituting 49 hectares (121 acres) within Jackson County. Within the privately owned parcels, five populations of *L. floccosa* ssp. *grandiflora*, totaling 20 hectares (50 acres), exist on three preserves managed by The Nature Conservancy. The three preserves contain the only large populations on private land specifically managed for the protection of these endangered plants.

b) Population Status.

Limnanthes floccosa ssp. *grandiflora* numbers fluctuate annually depending on the seasonal precipitation and temperature, therefore the population status of the species will vary from year to year as well. In grazing allotments, sudden increases or declines in population density may be due to intensity, seasonality, and duration of grazing. In general, numbers of annual plants, such as *Limnanthes floccosa* ssp. *grandiflora*, may fluctuate more widely than those of perennial plants, such as *Lomatium cookii*. The year 2000 was a productive year for the species due to the wet conditions, but in 2001, a dry year, population numbers of the plant declined in many areas. In 2000, with average winter precipitation, numbers of plants recorded at selected vernal pools in the Agate Desert Preserve totaled 68,111, but in 2001, with an unusually dry winter, numbers of recorded plants dropped to 39,031. However, in 2002, average rainfall figures were still below normal, and the population increased to 63,752 plants (D. Borgias, pers. comm. 2003). An occurrence in the Agate Desert Preserve core area on City of Medford administered land contained some 10,000 *Limnanthes floccosa* ssp. *grandiflora* individuals in the year 2000, while only 112 individuals were noted at this site in 2001 (D. Borgias, pers. comm. 2001). Year-to-year changes of this magnitude may be within the normal range of variation for this annual plant, but if the habitat is reasonably protected from degradation or fragmentation and the seed source protected, a population should persist.

3. Habitat Description

Limnanthes floccosa ssp. *grandiflora* is typically associated with vernal pools. The plant occurs generally near the wetter, inner edges as opposed to the drier outer fringes, which harbor the more common ssp. *floccosa*. The deeper basins are dominated by *Plagiobothrys stipitatus* (stipitate popcornflower), *Eryngium petiolatum*, *Navarretia leucocephala*, and *Myosurus minimus*. *Hordeum murinum* ssp. *gussoneanum* (Mediterranean barley), *Alopecurus saccatus* (saccate foxtail), and *Deschampsia danthonioides* are common plant associates. The inner vernal pool edges occupied by *L. floccosa* ssp. *grandiflora* often have up to 10 to 15 percent exposed soil, due partly to gopher or vole foraging activity.

Current vernal pool and mounded prairie habitat in the Rogue River Valley is characterized by the presence of invasive exotic herbs and grasses as well. On much of the vernal pool-mounded prairie habitat in Jackson County, four exotic plant species (*Centaurea solstitialis* [yellow starthistle], *Taeniatherum caput-medusae*, *Poa bulbosa*, and *Erodium cicutarium*) are often found on uplands surrounding vernal pool edges.

4. Life History

Requirements for survival. *Limnanthes floccosa* is an annual plant that is self-compatible (capable of self fertilization) and capable of **autogamy** (self-pollination). The structural adaptation to self-pollination is the placement of anthers above the ovaries. Self-compatibility and autogamy along with relatively few visits from pollinators suggest that reproduction in *L. floccosa* involves high levels of inbreeding. Kalin-Arroyo (1973) however, believed that *L. floccosa* ssp. *grandiflora* has only modest levels of autogamy due to observations of insect activity and the presence of a larger flower size and nectar guides to facilitate pollination.

Limnanthes floccosa ssp. *grandiflora* typically begins flowering in March, reaches peak flowering in April, and may continue into May if conditions are suitable. Nutlets are produced in late April, and the plants begin to die back by mid-May or when the soil becomes dry (D. Borgias, pers. comm. 2004). Nutlets of *L. floccosa* ssp. *grandiflora* apparently are dispersed by water; they can remain afloat for up to 3 days. However, the nutlets of the plant are normally dispersed only short distances. Thus, *L. floccosa* ssp. *grandiflora* nutlets would not be expected to disperse beyond their pool or swale of origin. Birds and livestock are potential sources of long-distance seed dispersal, but specific instances of dispersal have not been documented (Jain 1978). It is likely that *Limnanthes floccosa* ssp. *grandiflora* has always been confined to the Rogue River Plains.

Limnanthes floccosa ssp. *grandiflora* is associated exclusively within the margins around shallow vernal pools. Plants adapted to these ephemeral wetlands, such as

Plagiobothrys spp., *Navarretia* spp., and *Downingia* spp. are capable of growing, flowering, and setting seed during the short time that water is available in the spring, and finish their life cycle before the dry hot summer.

5. Reasons for Decline and Threats to Survival

Nearly 50 percent of *Limnanthes floccosa* ssp. *grandiflora* sites have been severely altered. The highest quality habitat remaining in the Agate Desert, with intact hydrology but altered vegetation, is now present on only approximately 17.6 percent of the area that historically contained vernal pools (Borgias and Patterson 1999).

Specific threats to *Limnanthes floccosa* ssp. *grandiflora* are road construction, housing, commercial, and industrial development, fragmentation, invasion of nonnative annual grasses and herbs, off-road vehicle damage, fill and contaminant dumping, herbicide spraying, and poorly managed livestock grazing (U.S. Fish and Wildlife Service 2002a). Recently a known *L. floccosa* ssp. *grandiflora* population in the Agate Desert near Table Rocks Road was lost due to disposal of contaminants (perhaps herbicide) that removed native vegetation from a 0.3-hectare (0.75-acre) portion of vernal pools. The source of the spill has not yet been determined. Recreational off-road vehicle activities have impacted two *L. floccosa* ssp. *grandiflora* populations in the White City area. Threats are described in more detail below in section III of this recovery plan.

6. Conservation Efforts

Through conservation easements and agreements with various parties, protection of *Limnanthes floccosa* ssp. *grandiflora* and its habitats is currently being pursued. The Nature Conservancy owns and manages three preserves in the area. The Agate Desert Preserve, the Whetstone Savanna Preserve, and the Rogue River Plains Preserve total 140 hectares (346 acres) in the Agate Desert, of which 102 hectares (252 acres) are vernal pool habitat (D. Borgias, pers. comm. 2002). Within these preserves are two 3-hectare (7-acre) populations of *Lomatium cookii* and three populations of *Limnanthes floccosa* ssp. *grandiflora* totaling 19 hectares (47 acres).

Limnanthes floccosa ssp. *grandiflora* seed collected from several areas in the Agate Desert is currently stored at the Berry Botanic Garden in Portland, Oregon. However, the plant is not yet a sponsored species and not fully funded for germination trials or augmented seed collection (E. Geurrant, pers. comm. 2004).

B. LOMATIUM COOKII

Overview. *Lomatium cookii* Kagan (Family Apiaceae) was listed as an endangered species on November 7, 2002 (U.S. Fish and Wildlife Service 2002a) under the authority of the Endangered Species Act of 1973, as amended. Although we

determined that critical habitat designation for *L. cookii* is prudent, a proposal for designation has been deferred due to insufficient funding and higher priority listing actions.

Recovery Priority. *Lomatium cookii* has a recovery priority number of 2C, based upon a high degree of threat, a high potential for recovery, and a taxonomic classification as a species. The “C” indicates the potential for conflict with construction, development projects, or other forms of economic activity (Appendix C).

1. Description and Taxonomy

Lomatium cookii is a small perennial plant in the parsley family (Apiaceae). James Kagan first collected *L. cookii* in 1981 from vernal pools in the Agate Desert, Jackson County, Oregon, and subsequently described the species (Kagan 1986). Additional populations were found at French Flat in the Illinois Valley, Josephine County, Oregon in 1988 (Oregon Natural Heritage Information Center Database 2004a). Slight morphological differences exist between *L. cookii* populations in the Agate Desert and French Flat, but these differences are not considered significant enough to separate the species into subspecies (M. Gitzendanner, pers. comm. 2002).

Lomatium cookii grows 15 to 50 centimeters (6 to 30 inches) tall with a slender, twisted taproot (Figure II-3). The taproot often branches at or below ground level, forming multiple stems. The leaves are smooth, minutely inter-divided, glossy bluish-green, and strictly basal (growing directly from the root crown, out of the ground, not along the stems). The pale yellow flowers are clustered into 5-centimeter (2-inch) umbels (umbrella-like formation of flowers). Each flowering stalk produces either primarily male or female flower clusters. Through one flowering season, *L. cookii* may produce up to eight male or female (sometimes both) flowering stalks. An umbel of female flowers will develop boat-shaped fruits 8 to 13 millimeters (0.3 to 0.5 inches) long with thickened margins. The flowering stalk very rarely forms leaves, unlike the closely associated *L. utriculatum* (foothills desert parsley). The branching taproot distinguishes *L. cookii* from *L. bradshawii* (Bradshaw’s lomatium), indigenous to wet prairies from southern Willamette Valley, Oregon to southwest Washington, and *L. humile* (alkali desert parsley), found in vernal pools in northern California (Kagan 1986).



a.



b.



c.



d.

Figure II-3. Diagrams of *Lomatium cookii* a) growth form, b) bracts of fruiting umbel, c) first year seedling, and d) flowering umbel. Photographs Courtesy of Sam Friedman (a), Norm Jensen (b-c) and Ken Cannon (d).

L. utriculatum, a similar plant found commonly on mounds adjacent to pools in the Agate Desert, is distinguished from *L. cookii* by its more intense yellow flowers, the different shape of its involucre bractlets (leaf-like structures below the flowers), and thin-winged fruits (Kagan 1986). *Lomatium tracyi* (Tracy's desert parsley), occurring in California and the Illinois Valley, has a similar appearance to *L. cookii*, but *L. tracyi* has slender-margined fruits and can grow on dry sites. *Lomatium cookii* has boat- or pumpkin-shaped fruits and grows on seasonally wet sites (U.S. Fish and Wildlife Service 2002a). Recent genetic research has shown *L. cookii* to be most closely related to *L. bradshawii*. *Lomatium marginatum* and probably *L. tracyi* are likely the next closely related species (M. Gitzendanner, pers. comm. 2003).

2. Distribution and Population Status

In the Agate Desert, *Lomatium cookii* occurs in 13 populations comprising 63 hectares (158 acres) (Figure II-4). The 2002 Oregon Natural Heritage Information Center database showed that the area of known occupied habitat had decreased to an estimated 28 hectares (69 acres) within the Agate Desert area. The historical range for this species may have encompassed over 12,950 hectares (32,000 acres) (U.S. Fish and Wildlife Service 2002a). An estimated 850 hectares (2,100 acres) of potential *L. cookii* habitat is present within the Agate Desert area (U.S. Fish and Wildlife Service 2004). In the Illinois Valley, an additional 24 populations of the plant comprise 67 hectares (16 acres) (Figure II-5). An estimated 513 hectares (1,312 acres) of potential *L. cookii* habitat are present within the Illinois Valley area.

a) Distribution.

The following estimates represent data provided by the Oregon Natural Heritage Information Center database (Oregon Natural Heritage Information Center 2004a) and U.S. Fish and Wildlife Service data. All reported population areas may or may not have been recently revised depending upon accessibility for inventory and monitoring, especially on private lands.

In the Illinois Valley, the 24 populations of *Lomatium cookii* are closely associated with the lower valley floor. Populations range from the Selma area south to the French Flat area. Throughout the Illinois Valley range of *L. cookii*, 15 populations occur on Bureau of Land Management administered land, comprising 14 hectares (35 acres). Eight of these populations occur at the French Flat Area of Critical Environmental Concern, four near Eight Dollar Mountain, and four near the Rough and Ready Botanical Area. Two populations of *L. cookii* overlap both Bureau of Land Management and State lands in the Illinois Valley comprising 1 hectare (2.47 acres). Four populations of *L. cookii* overlap both Bureau of Land Management and private lands comprising 40 hectares (99 acres) in the Illinois Valley. Four populations of *L. cookii*, comprising 5 hectares (12 acres), occur on State land. There are 10 populations

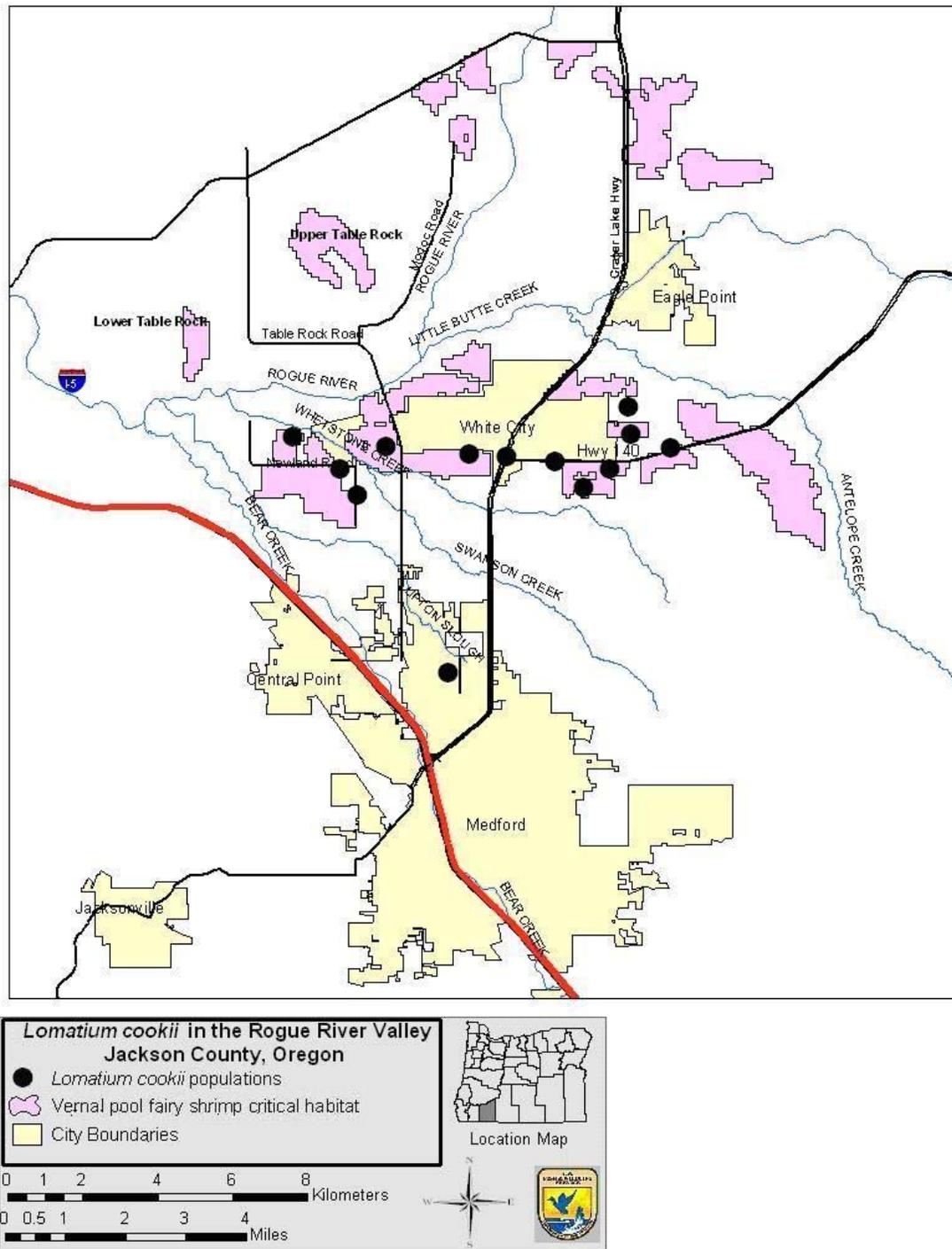


Figure II-4. Distribution of *Lomatium cookii* in the Agate Desert, Jackson County, Oregon.

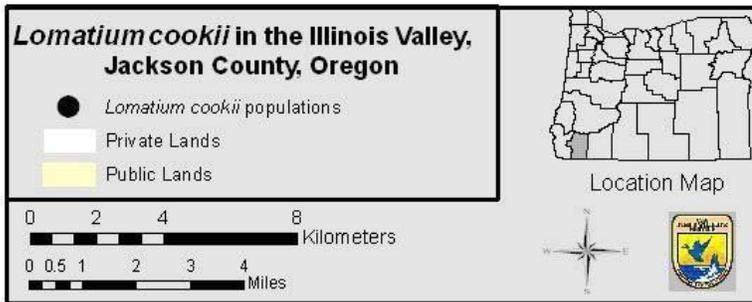
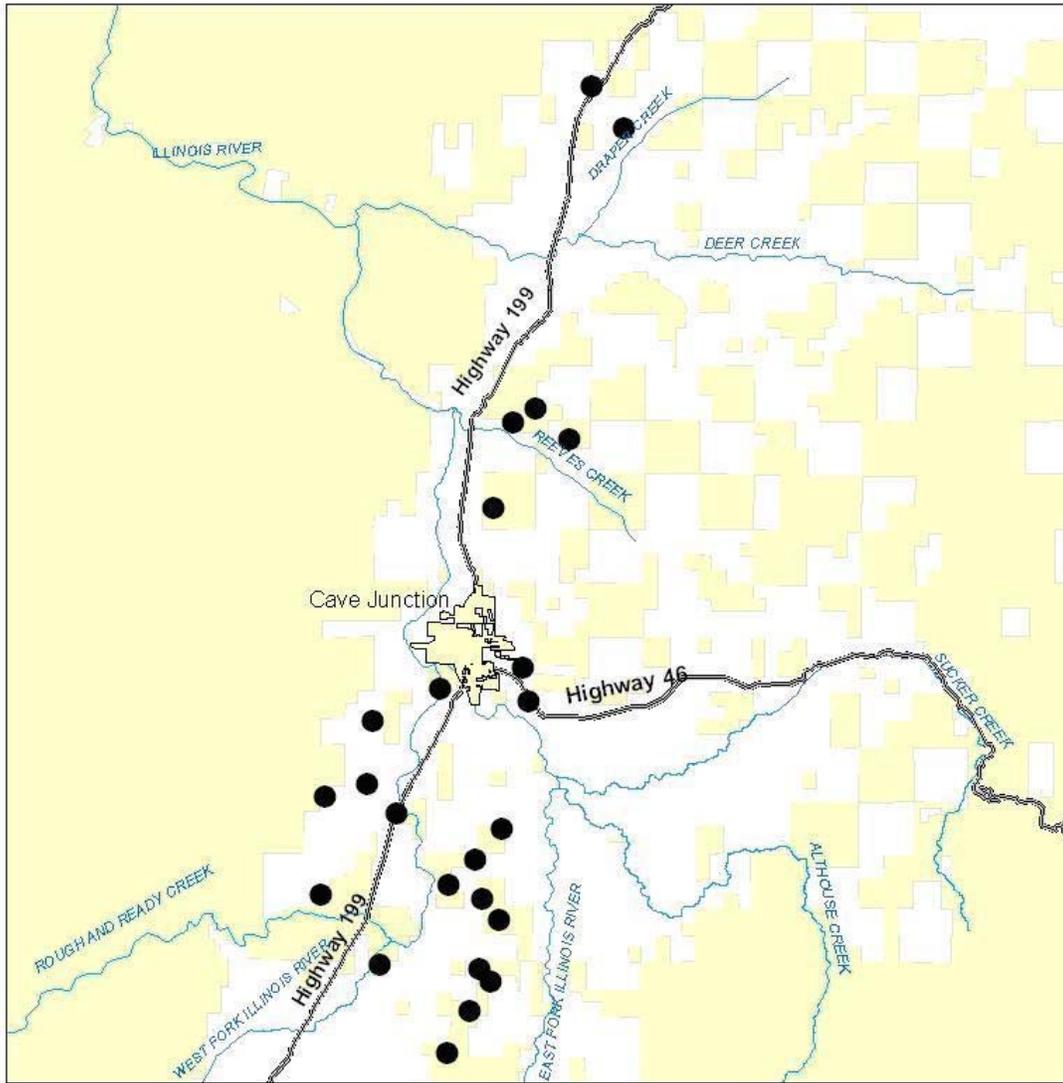


Figure II-5. Distribution of *Lomatium cookii* in the Illinois Valley, Josephine County, Oregon.

of *L. cookii* on both State and private lands in the Illinois Valley, comprising 5 hectares (12 acres).

In the Rogue Valley, 13 *Lomatium cookii* populations are located primarily in the central Agate Desert area with one large population occurring near the Rogue Valley Airport. One population of *L. cookii* (0.87 hectares [2 acres]) occurs on city of Medford land. Five populations of *L. cookii* comprising 3 hectares (7 acres) are located on County managed lands. A population of *L. cookii* comprising 5 hectares (12 acres) overlaps both County and private land. Seven populations of *L. cookii* occur on 45 hectares (111 acres) on private lands (Oregon Natural Heritage Information Center 2002). A 7-hectare (17-acre) population of *L. cookii* occurs on the Agate Desert Preserve and a 19-hectare (47-acre) population occurs at the Whetstone Savanna Preserve, both of which are managed and owned by The Nature Conservancy.

b) Population Status.

Lomatium cookii in the Rogue River Valley is estimated to number 34,000 plants in 13 populations. Population censuses at the Agate Desert Preserve and the Whetstone Savannah Preserve in 2004 recorded that populations have declined in recent years, but are stable overall (M. Sullivan, pers. comm. 2004). A survey at an Oregon Department of Transportation Special Management Area along Highway 140 in 2003 reported approximately 60 plants, which was up from the 26 plants observed in 2000 but down from the 200 plants observed in 1992. A population numbering 2,000 individuals occurred on private land west of Highway 62 near the Highway 140 intersection in 1992, but was extirpated due to parking lot development. Several populations on the Hall Tract of the Denman Wildlife Refuge have decreased in size from an original estimate in 1992 of 700 to 1,000 plants to an estimate of 500 plants in 2000. In White City during 2001, roughly 500,000 individuals were observed in larger populations of *L. cookii* on private property (Oregon Natural Heritage Information Center 2002). These populations have not been observed in several years and may have been impacted by recent excavation and leveling for agricultural development. The current estimated population size at the Rogue Valley International Airport is 2,000 plants.

In the Illinois Valley, *Lomatium cookii* numbers at Bureau of Land Management monitoring sites in Rough and Ready Creek and French Flat have recently declined due to environmental conditions, but fall within a stable range compared to baseline conditions (Kaye 2002; T. Kaye, pers. comm. 2004). A *L. cookii* population along Highway 46 that is monitored by the Oregon Department of Transportation was reported as stable (K. Cannon, pers. comm. 2005).

3. Habitat Description

Lomatium cookii populations grow on seasonally wet soils in both the Rogue River Valley and the Illinois Valley. For much of its range in the Rogue River Valley,

the plant occurs on upland mounds, at the bottom of rocky vernal pools, and on flanks of vernal pools. It occurs in either strongly expressed or weakly expressed vernal pool formations, but it appears to occur in greater concentrations on more level, weakly expressed vernal pool formations (S. Friedman, pers. obs. 2004).

In the Rogue River Valley, populations of *Lomatium cookii* are found in shallow Agate-Winlo complex soils in sparse prairie vegetation. Common plant associates include *Lupinus bicolor* (bicolor lupine), *Collinsia sparsiflora* (sparse-flowered collinsia), *Clarkia purpurea*, *Erodium cicutarium*, *Lomatium utriculatum*, *Achnatherum lemmonii*, *Poa bulbosa*, *Brodiaea elegans* (elegant brodiaea), *Madia* spp. (tarweed), *Lasthenia californica*, *Hemizonia fitchii*, and *Plagiobothrys* spp.

In the Illinois Valley, *Lomatium cookii* occurs in open wet meadows and along roadsides adjacent to meadows on Brockman clay loam, Josephine gravelly loam, Pollard loam, Eightlar extremely stony clay, Takilma cobbly loam, Abegg clay loam, and Newberg loam soils. Brockman clay loam soils in the French Flat area average 60 to 90 centimeters (24 to 35 inches) in depth. These seasonally wet soils have the ability to block water permeability through the soil, similar to the Agate Desert vernal pools, but lack that region's distinctive mound and swale topography.

Soils in the Illinois Valley are partially derived from serpentine formations that occur on surrounding slopes and hilltops. Common species in the Illinois Valley associated with *Lomatium cookii* include *Danthonia californica* (California oatgrass), *Chlorogalum pomeridianum* (soap plant), *Plagiobothrys bracteatus* (bracted popcornflower), *Hesperochiron* sp. (hesperochiron), *Horkelia californica* (California horkelia), *Calochortus uniflorus* (short-stemmed mariposa lily), and *Ceanothus cuneatus* (narrowleaf buckbrush). Two plants that may occasionally occur with *L. cookii* in the Illinois Valley are *Senecio hesperius* (western senecio) and *Microseris howellii* (Howell's microseris). Both species were recently removed from an Oregon species of concern list. New information indicates that these plant populations are stable and are not significantly threatened.

4. Life History

Lomatium cookii is an herbaceous perennial with a thickened taproot reaching up to 30 centimeters. The plant flowers from late March to May and is pollinated entirely by insects. The first umbels (grouping of flowers) produced are on shorter pedicels (umbel stalks) and composed entirely of male flowers. The second umbels produced are a combination of both male and female flowers that extend beyond the withering male umbel. Third and fourth flower sets will alternate between predominantly male and female umbels. This flowering strategy promotes plant-to-plant intercrossing by visiting insects and hinders self-crossing.

Lomatium cookii produces abundant **viable** seeds that will often drop within close proximity to the parent plant. A single large adult plant has occasionally been found with up to 100 seedlings growing within 30 centimeters (12 inches) of its leaf base (M. Sullivan, pers. comm. 2004). As seeds are buoyant, a probable mode of seed dispersion is via surface water flow. Other possible modes of dispersal are through gopher and mole subsurface excavations, ingestion by birds, insects, and small mammals, and human associated transportation of seeds via muddy shoes, tires, and farm equipment. A 9-year *L. cookii* transition study conducted on Bureau of Land Management administered lands indicated that populations experience substantial dynamics with high rates of seedling mortality. A viability assessment based on the 9-year life stage transitional matrix for two *L. cookii* populations at French Flat indicated a 100 percent chance for a catastrophic decline at one smaller population and a less than 1 percent chance for a catastrophic decline at one larger population (Kaye *et al.* 2001). It is unclear what factors account for the reduced viability at the one smaller population, and more studies are needed.

Lomatium cookii is closely related to the endangered *L. bradshawii* (Bradshaw's lomatium) of the Willamette Valley in central Oregon. Because these species share many life history qualities and needs, their populations are likely to share similar survival models. A **demographic** model of *L. bradshawii* based on field calculated data suggested that 2,000 flowering plants associated in a native plant community, which is managed with prescribed burning, would have a greater than 90 percent probability of survival for 100 years (U.S. Fish and Wildlife Service 1993a).

Fire has played a significant historical role in the shaping of Klamath Mountain grassland habitats. Such woody early successional shrubs as *Ceanothus cuneatus*, *Arctostaphylos* spp. (manzanita), and the exotic *Cytisus* spp. (broom) compete for space and sunlight with *Lomatium cookii* in the Illinois Valley. Eventually these shrubs will completely shade out populations of *L. cookii* and effectively fragment habitat or displace the plant entirely. An historical fire cycle had most likely prevented such shrubs from colonizing the majority of the species' habitat in the past.

5. Reasons for Decline and Threats to Survival

Specific threats to *Lomatium cookii* are off-road vehicle use, mining, road construction, logging in surrounding forests and meadows, livestock grazing, woody plant encroachment, invasion of nonnative annual grasses and herbs, herbicide spraying, and dredging for gold in surrounding hills (U.S. Fish and Wildlife Service 2002a). When driven in moist areas, off-road vehicle tires create large ruts and can fracture the clay hardpan layer. This allows water to drain, affecting plant survival. It is estimated that off-road vehicle use had caused the drainage of 6 hectares (15 acres) at French Flat in 2000 (U.S. Fish and Wildlife Service 2002a) and by 2004 had drained an additional 4 hectares (10 acres) (M. Mousseaux, pers. comm. 2004). Threats are described in more detail below in section III of this recovery plan.

6. Conservation Efforts

a) Education and Outreach.

Efforts in the Illinois Valley community to prevent or reduce impacts to native habitat in the surrounding forests, seasonal wet meadows, and serpentine plant communities has recently become intensified and expanded by a multi-group effort. Off-road vehicle shop owners, off-road vehicle club members, U.S. Forest Service staff, local schools and educational institutions, local law enforcement, lumber mill staff, and concerned members of the community have formed a group called the Illinois Round Table and are developing a network of communication in the community to discuss and solve local problems. One potential problem facing the group is the loss of native plant habitat and the introduction of noxious weeds that can result from unrestricted off-road vehicle use in forests and meadows. Members of a multi-group effort called the Community Response Team in the Illinois Valley are working to proactively stop damages caused by off-road vehicles to natural plant communities in the area. Several botanically rich focus areas in the community are wet meadows with populations of *Lomatium cookii*. Members of the group are speaking at public schools, engaging in outreach to members of the off-road vehicle clubs and shop owners, and reporting license plates of vehicles observed by community members and neighbors in an effort to prevent unrestricted and illegal off-road vehicle use in some of these botanically rich wet meadows (C. Shohet, pers. comm. 2004).

b) Conservation.

Of the four *Lomatium cookii* populations formerly known on Oregon Department of Transportation Administered lands, one has become extirpated. The Oregon Department of Transportation has developed three Special Management Areas for the three remaining populations. The largest known populations of this species are at The Nature Conservancy's Agate Desert Preserve (7 hectares [17 acres]) and at the Rogue Valley Airport (10 hectares [25 acres]). The largest locations of *L. cookii* in the Illinois Valley occur at French Flat (7 hectares [17 acres]). One site in French Flat is designated as an Area of Critical Environmental Concern by the Bureau of Land Management.

Seeds from three locations in the Rogue River Valley and two locations in Josephine County (French Flat) are stored at the Berry Botanic Garden in Portland, Oregon. Germination requirements of the plant are largely unknown, and initial attempts by the Berry Botanical Garden to determine these requirements were inconclusive. Protocols for propagation and reintroduction should likely be similar to those for *Lomatium bradshawii*, but still need to be developed.

The Nature Conservancy protects *Lomatium cookii* at two preserves. Stabilization and expansion of endangered plants has been a conservation objective at the Agate Desert and Whetstone Savanna Preserves. Furthermore, monitoring the effects of cattle grazing has been a conservation objective for the Conservancy at the Whetstone Savanna

Preserve and is under consideration at the Agate Desert Preserve (D. Borgias, pers. comm. 2004).

The Oregon Department of Transportation protects a *Lomatium cookii* population near Cave Junction in the Illinois Valley by limiting maintenance activities during the growing season, restricting herbicide use, and finding solutions to future impacts to the plants (K. Cannon, pers. comm. 2002).

The Bureau of Land Management protects 21 populations of *Lomatium cookii* in the Illinois Valley by restricting off-road vehicle access, maintaining a long-term population inventory program, and monitoring existing populations.

Additionally, the U.S. Fish and Wildlife Service signed a Conservation Agreement with the Bureau of Land Management in early January 2003. The Conservation Agreement will further enable protection of the species on Federal lands by cooperative spending on fencing and staff time for monitoring and other technical assistance.

C. VERNAL POOL FAIRY SHRIMP

(This section is, in part, adapted from the Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon [U.S. Fish and Wildlife Service 2005].

Overview. The vernal pool fairy shrimp (*Branchinecta lynchi* Eng, Belk and Eriksen) (Order Anostraca) was discovered in California in 1982, described as a new species in 1990, federally listed as threatened in September 19, 1994 (U.S. Fish and Wildlife Service 1994) and discovered in Oregon in 1998. In Oregon, 30,351 hectares (75,000 acres) of critical habitat was designated for the species in 2003.

Recovery Priority. The vernal pool fairy shrimp has a recovery priority number of 2C, based upon a high degree of threat, a high potential for recovery, and a taxonomic classification as a species. The “C” indicates the potential for conflict with construction, development projects, or other forms of economic activity.

1. Description and Taxonomy

The vernal pool fairy shrimp is included in this recovery plan because it is sympatric with several populations of the two listed plants in the Rogue River Valley. For more information regarding vernal pool fairy shrimp please refer to the Recovery



Figure II-6. Vernal Pool Fairy Shrimp (male). (Oregon Department of Fish and Wildlife)

Plan for Vernal Pool Ecosystems of California and Southern Oregon (U.S. Fish and Wildlife Service 2005) developed by our Sacramento Fish and Wildlife Office.

a) Description.

Vernal pool fairy shrimp vary in size, ranging from 11 to 25 millimeters (0.4 to 1.0 inch) in length (Eng *et al.* 1990) (Figure II-6). Vernal pool fairy shrimp closely resemble Colorado fairy shrimp (*Branchinecta coloradensis*) (Eng *et al.* 1990). However, there are differences in the shape of a small mound-like feature located at the base of the male's antennae, called the pulvillus. The Colorado fairy shrimp has a round pulvillus, while the vernal pool fairy shrimp's pulvillus is elongate. The vernal pool fairy shrimp can also be identified by the shape of a bulge on the distal, or more distant end, of the antennae. It has a smaller and less spiny bulge than the Colorado fairy shrimp. The female Colorado fairy shrimp's brood pouch is longer and more cylindrical than the vernal pool fairy shrimp's. Female vernal pool fairy shrimp also closely resemble female midvalley fairy shrimp (*B. mesovallensis*). These two species can be distinguished by the number and placement of lobes on their backs, called dorsolateral thoracic protuberances. Vernal pool fairy shrimp have paired dorsolateral thoracic protuberances on the third thoracic segment that are lacking in the midvalley fairy shrimp (Belk and Fugate 2000).

b) Taxonomy.

The vernal pool fairy shrimp (*Branchinecta lynchi*) was first described by Eng, Belk, and Eriksen in 1990. The type specimen was collected in 1982 at Souza Ranch, Contra Costa County, California. Although not yet described, the vernal pool fairy shrimp had been collected as early as 1941, when it was identified as the Colorado fairy shrimp by Linder (1941).

2. Historical and Current Distribution

a) Historical Distribution.

Vernal pool fairy shrimp were identified relatively recently, in 1990, and there is little information on the historical range of the species. However, the vernal pool fairy shrimp is currently known to occur in a wide range of vernal pool habitats in the southern and Central Valley areas of California and in two vernal pool habitats within the Agate Desert area of Jackson County, Oregon. The vegetation and land use are similar to those of northern California's inland valleys (Pater *et al.* 1998).

The historical and current distribution of vernal pool fairy shrimp in the Rogue River Valley can only be inferred from the loss of vernal pool habitat. Based on estimates by the Oregon Natural Heritage Program (1997), it is estimated that the range of vernal pool fairy shrimp in Oregon has most likely declined by 75 percent. However, because the presence of vernal pool fairy shrimp was first documented in 1998, it is possible that additional locations for the species will be found in Oregon in the future.

b) Current Distribution.

Vernal pool fairy shrimp are currently found in 27 counties across the Central Valley and coast ranges of California, and in Jackson County in southern Oregon (Figure II-7). The species occupies a variety of vernal pool habitats and occurs in 12 of the 17 vernal pool regions identified in California. Although the vernal pool fairy shrimp is distributed more widely than most other fairy shrimp species, it is generally uncommon throughout its range and rarely abundant where it does occur (Eng *et al.* 1990, Eriksen and Belk 1999). In California, Helm (1998a) found vernal pool fairy shrimp in only 16 percent of pools sampled across 27 counties, and Sugnet (1993) found this species in only 5 percent of 3,092 locations sampled. In Oregon, surveys conducted by The Nature Conservancy have shown a variable range in occurrence, with vernal pool fairy shrimp occurring in 50 percent of the pools sampled at the Agate Desert Preserve and 8 percent of the pools sampled at the Denman Wildlife Management Area possessing vernal pool fairy shrimp.

The Agate Desert and nearby Table Rocks area of Jackson County, Oregon, comprises the northern extent of the range of the vernal pool fairy shrimp (Figure II-7). Here vernal pool fairy shrimp are known from the vernal pools within the Agate-Winlo soils of the Agate Desert landform and the Randcore-Shoat soils underlain by lava bedrock on top of Upper and Lower Table Rock (Helm 1998b). In California, the vernal pool fairy shrimp occurs in the Northwestern Sacramento Valley, Northeastern Sacramento Valley, Southeastern Sacramento Valley, Solano-Colusa, San Joaquin Valley, Southern Sierra Foothills, Livermore, Central Coast, Santa Rosa, Carrizo, Santa Barbara, and Western Riverside Vernal Pool Regions (see U.S. Fish and Wildlife Service [2005] for details).

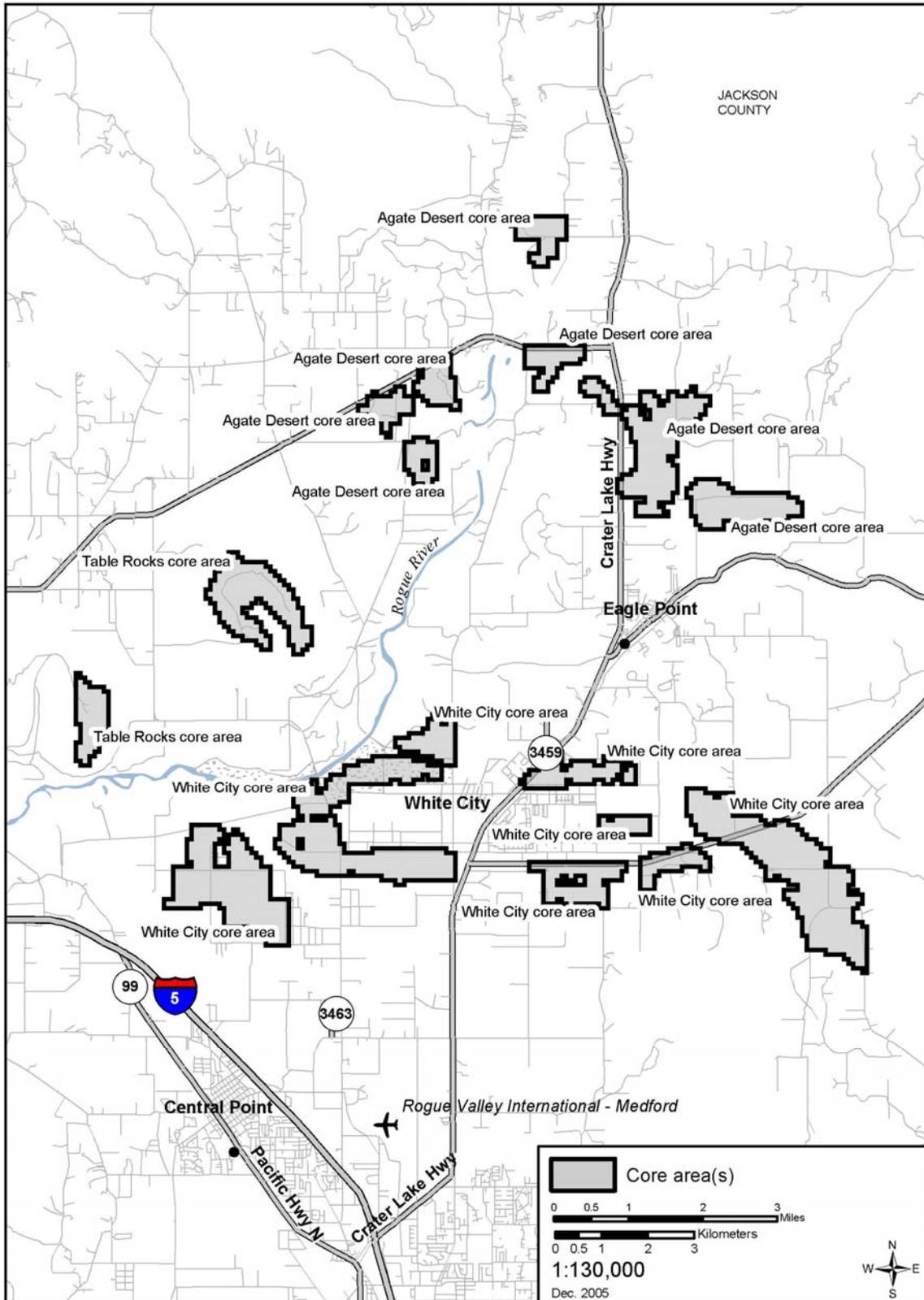


Figure II-7. Distribution of vernal pool fairy shrimp within the Rogue River Valley. (Reproduced from Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon [U.S. Fish and Wildlife Service 2005]). Core areas identified refer to vernal pool fairy shrimp only, not to listed plant species addressed in this recovery plan.

3. Life History and Habitat

a) Life History.

Vernal pool fairy shrimp are uniquely adapted to the environmental conditions of their ephemeral habitats. One adaptation is the ability of the vernal pool fairy shrimp eggs, or cysts, to remain dormant in the soil when their vernal pool habitats are dry. Another important adaptation is that the vernal pool fairy shrimp has a relatively short life span, allowing it to hatch, mature to adulthood, and reproduce during the short time period when vernal pools contain water. The vernal pool fairy shrimp can reach sexual maturity in as few as 18 days at optimal conditions of 20 degrees Celsius (68 degrees Fahrenheit), and can complete its life cycle in as little as 9 weeks (Gallagher 1996, Helm 1998a). However, maturation and reproduction rates of vernal pool crustaceans are controlled by water temperature and can vary greatly (Eriksen and Brown 1980, Helm 1998a). Helm (1998a) observed that vernal pool fairy shrimp did not reach maturity until 41 days at water temperatures of 15 degrees Celsius (59 degrees Fahrenheit) and observed six separate hatches of vernal pool fairy shrimp in a single pool within a single wet season. Gallagher (1996) observed three separate hatches of vernal pool fairy shrimp in vernal pools in Butte County, California. Helm (1998a) found the mean life span of the vernal pool fairy shrimp was significantly shorter than the California fairy shrimp (*Linderiella occidentalis*), but not significantly different from mid-valley, longhorn (*Branchinecta longiantenna*), or Conservancy fairy shrimp (*B. conservatio*) observed under the same conditions. In larger pools that hold water for longer durations, vernal pool fairy shrimp are capable of hatching multiple times if water temperatures drop to below 10 degrees Celsius (50 degrees Fahrenheit), a necessary environmental cue for vernal pool fairy shrimp cyst hatching (Gallagher 1996, Helm 1998a). Helm (1998a) observed vernal pool fairy shrimp living for as long as 147 days.

b) Habitat.

Vernal pool fairy shrimp exist only in vernal pools or vernal pool-like habitats. Individuals have never been found in riverine, marine, or other permanent bodies of water. Vernal pool habitats form in depressions above an impervious soil layer or duripan. Due to local topography and geology, the depressions are part of an undulating landscape, where soil mounds are interspersed with basins, swales, and drainages. Water movement within complexes allows vernal pool fairy shrimp to move between individual pools. These movement patterns, as well as genetic evidence, indicate that vernal pool fairy shrimp populations exist within and are defined by entire vernal pool complexes, rather than individual vernal pools (Simovich *et al.* 1992, King *et al.* 1996).

The vernal pool fairy shrimp occupies a variety of different vernal pool habitats, from small, clear, sandstone rock pools to large, turbid, alkaline, grassland valley floor pools (Eng *et al.* 1990, Helm 1998a) Although the vernal pool fairy shrimp has been collected from large vernal pools, including one exceeding 10 hectares (25 acres) in area (Eriksen and Belk 1999), it tends to occur in smaller pools (Platenkamp 1998), and is

most frequently found in pools measuring less than 0.02 hectare (0.05 acre) in area (Gallagher 1996, Helm 1998a). The vernal pool fairy shrimp occurs at elevations from 10 meters (33 feet) to 1,220 meters (4,003 feet) (Eng *et al.* 1990), although two sites in the Los Padres National Forest have been found to contain the species at an elevation of 1,700 meters (5,600 feet). The vernal pool fairy shrimp has been collected at water temperatures as low as 4.5 degrees Celsius (40 degrees Fahrenheit), however, the species has not been found in water temperatures above about 23 degrees Celsius (73 degrees Fahrenheit) (Helm 1998, Eriksen and Belk 1999). The species is typically found in pools with low to moderate amounts of salinity or total dissolved solids (Collie and Lathrop 1976, Keeley 1984, Syrdahl 1993).

Vernal pools are mostly rain fed, resulting in low nutrient levels and dramatic daily fluctuations in pH, dissolved oxygen, and carbon dioxide (Keeley and Zedler 1998). Although there are many observations of the environmental conditions where vernal pool fairy shrimp have been found, there have been no experimental studies investigating the specific habitat requirements of this species. Platenkamp (1998) found no significant differences in vernal pool fairy shrimp distribution between four different geomorphic surfaces studied at Beale Air Force Base.

In Oregon, the vernal pool fairy shrimp is found on two distinct vernal pool habitats (Helm 1998b). The species occurs on alluvial fan terraces associated with Agate-Winlo soils on the Agate Desert, and in the Table Rocks area on Randcore-Shoat soils underlain by lava bedrock. These vernal pool habitats represent the northernmost extent of the range of the vernal pool fairy shrimp.

c) Community Associations.

In California, the vernal pool fairy shrimp occupies the same vernal pool habitats as many of the plant species addressed in the Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon. (U.S. Fish and Wildlife Service 2005). In Oregon, the vernal pool fairy shrimp is found in the same vernal pool habitats as *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii*.

The vernal pool fairy shrimp has rarely been collected from the same pools as other fairy shrimp species (Eng *et al.* 1990, Maeda-Martinez *et al.* 1997, Eriksen and Belk 1999). When the species do coexist, it is in longer-lived pools, and the vernal pool fairy shrimp are often less abundant than other fairy shrimp species (Eng *et al.* 1990, Gallagher 1996, Eriksen and Belk 1999). Given the apparently wide distribution of this species and its tolerance for a wide range of conditions, it is possible that the absence of the vernal pool fairy shrimp in certain habitats is explained by competitive exclusion by other fairy shrimp (Helm 1998a, Eriksen and Belk 1999). Vernal pool tadpole shrimp are predators of vernal pool fairy shrimp, whereas vernal pool fairy shrimp feed on algae, bacteria, protozoa, rotifers, and bits of detritus.

Vernal pool fairy shrimp are also a key prey item for waterfowl, such as ducks (Proctor and Malone 1965, Krapu 1974, Swanson 1974). In turn, waterfowl and other migratory birds are important dispersal agents for this and other vernal pool species.

5. Reasons for Decline and Threats to Survival

In Oregon, vernal pool fairy shrimp occurring on the Agate Desert are threatened by commercial and industrial development, agricultural conversion, and utility projects (Oregon Natural Heritage Program 1997, U.S. Fish and Wildlife Service 2002a). Over 40 percent of the vernal pool habitats remaining in Oregon have been degraded (Borgias and Patterson 1999).

Although habitat loss is the principal danger to vernal pool fairy shrimp, water supply conditions can be a disturbance factor that may affect a substantial portion of the populations. Introduction of water during summer can disrupt the life cycles of vernal pool crustaceans by subjecting them to greater levels of predation by animals such as bullfrogs and predatory fish that require more permanent sources of water.

Vernal pool crustaceans are very sensitive to the water chemistry of their habitats. Pools where fairy shrimp have been found have low total dissolved solids, low conductivity, low alkalinity, and low chloride concentrations (U.S. Fish and Wildlife Service 1994). Contamination of vernal pools from adjacent areas may injure or kill vernal pool crustaceans.

Certain pesticides are registered by the Environmental Protection Agency for use on rangelands and these may be sprayed directly on vernal pools. Mosquito abatement activities sometimes also include direct application of pesticides to pools including vernal pools. Some compounds do not degrade in a season, resulting in long-term accumulation. Fertilizer runoff may lead to eutrophication of vernal pools, which can kill fairy shrimp by reducing the concentration of dissolved oxygen. Fairy shrimp breathe through lobes similar to gills. Fairy shrimp living in pools with a high amount of siltation may suffocate (U.S. Fish and Wildlife Service 1994, 2003).

The timing, frequency, and length of inundation of the vernal pool habitat are critical to survival of vernal pool fairy shrimp. Any substantial hydrologic change in these factors adversely affects this species (U.S. Fish and Wildlife Service 1994). Diversion (or blockage) of surface runoff feeding the pools can result in premature dry-down before the life cycle of these animals is completed. Supplemental water from outside the natural watershed into vernal pools can change the habitat into a marsh-dominated or a permanent aquatic community that is unsuitable for the vernal pool fairy shrimp.

Physical barriers such as roads and canals unsuitably deepen a vernal pool upstream from a barrier and can isolate a fairy shrimp population from a portion of its aquatic habitat. Surface runoff is altered by disturbance from trenching and other activities that change amounts, patterns, and direction of surface runoff to ephemeral drainages.

Human activities, such as urban development and conversion of land to agricultural use, eliminated much of the original vernal pool habitat and threaten remaining habitat (U.S. Fish and Wildlife Service 1994, Belk 1998). Vernal pool habitats that are protected on the Agate Desert by The Nature Conservancy are threatened by the indirect effects of adjacent land use, including alteration of hydrology (David Evans and Associates 2001).

Some of the vernal pool fairy shrimp populations in the Table Rocks area, managed by the Bureau of Land Management, are also threatened by indirect influences of incompatible land uses. Because the portion of Table Rocks managed by the Bureau of Land Management is an Area of Critical Environmental Concern, the pools are in an area that is not available for timber harvest and closed to off-road vehicle use. The current trend for vernal pool fairy shrimp on Bureau of Land Management land is believed to be stable. There has been no major change to habitat on either Upper or Lower Table Rock and grazing is allowed for one month in the spring on Upper Table Rock only. The area is open to mineral entry; however no claims are currently active. There is a single access road to the summit of each of the Table Rocks from adjacent private lands, and an old airplane landing strip is present on Lower Table Rock. The tops of the Table Rocks are closed to motorized vehicles, including aircraft. Threats to the vernal pools on the Table Rocks are primarily a result of recreation use: human trampling in the wet areas near pools and potential change in subsurface or surface flow runoff patterns due to trail construction and/or improvement. The Bureau of Land Management has conducted preliminary vernal pool surveys of Upper and Lower Table Rock in 2005, and will subsequently develop a formal management plan (Marcia Wineteer, pers. comm. 2005).

6. Conservation Efforts

On September 19, 1994, the final rule to list the vernal pool fairy shrimp as threatened was published in the Federal Register (U.S. Fish and Wildlife Service 1994). In 2003, critical habitat was designated for vernal pool fairy shrimp and several other vernal pool species (U.S. Fish and Wildlife Service 2003).

Conservation efforts for the vernal pool fairy shrimp are divided into five broad categories; regulatory and legal protections, education and outreach, research, conservation planning and habitat protection, and species specific management and monitoring. A brief description of each type of conservation action is provided below.

a) Regulatory and Legal Protections.

The vernal pool fairy shrimp is protected as a threatened species under the Endangered Species Act. The species is also listed by the California Department of Fish and Game. The International Union for the Conservation of Nature and Natural Resources listed the vernal pool fairy shrimp as vulnerable in the 1996 Red list (<http://www.redlist.org/>).

Oregon Natural Heritage Information Center. Created by The Nature Conservancy in 1974 and in cooperation with the State of Oregon and Federal agencies, the Oregon Natural Heritage Information Center became the State agency responsible for rare and endangered invertebrates in Oregon. As such, the U.S. Fish and Wildlife Service has granted the program limited authority to administer and manage a program for federally threatened and endangered invertebrate species, as provided under section 6 of the Endangered Species Act. The Oregon Natural Heritage Information Center has three objectives for the rare and endangered invertebrate program:

- 1) To gather as much information as possible on those invertebrates that are currently considered rare, threatened or endangered in order to enable managers to protect critical habitat or populations;
- 2) To promote inventory and taxonomic work on undescribed or poorly known species that may face significant threats; and
- 3) To assist in the U.S. Fish and Wildlife Service recovery efforts for the three invertebrates already protected under the Endangered Species Act. This includes coordination, inventory, management and research projects for the Oregon silverspot butterfly, the Fender's blue butterfly and the vernal pool fairy shrimp (Oregon Natural Heritage Information Center 2004b).

b) Education and Outreach.

The Inland Invertebrate Working group distributes Anostracan news, and works toward disseminating information about the species. The U.S. Fish and Wildlife Service has published recovery plans for endemic vernal pool species of Southern California (U.S. Fish and Wildlife Service 1998) and for vernal pool species of California and southern Oregon (U.S. Fish and Wildlife Service 2005).

c) Research.

Vernal pool habitats have been the focus of much research, and scientific interest in this unique habitat type has continued to grow. Although there are numerous anecdotal accounts of the habitat requirements of the vernal pool fairy shrimp, little specific information about the conservation needs of the vernal pool fairy shrimp has been accumulated.

d) Conservation Planning and Habitat Protection.

Approximately 5,261 hectares (13,000 acres) of vernal pool habitats, including mitigation banks, have been specifically set aside for the vernal pool fairy shrimp throughout its range as terms and conditions of consultations under section 7 of the Endangered Species Act. These areas are scattered throughout the current range of vernal pool fairy shrimp, and represent important building blocks toward recovery of the species. They include approximately 28 hectares (65 acres) of vernal pool habitat that was recently protected as compensatory mitigation for wetland impacts associated with the filling of 3 hectares (6.6 acres) of degraded vernal pool habitat within the Agate Desert area of Jackson County Oregon.

Vernal pool habitats supporting populations of vernal pool fairy shrimp have been protected through a variety of other means. In Oregon, vernal pool fairy shrimp populations are protected on The Nature Conservancy's Agate Desert and Whetstone Savanna preserves, containing approximately 80 hectares (197 acres) of vernal pool habitats. It is also protected from development on property administered by the Bureau of Land Management (129 hectares [320 acres] of vernal pool habitat) and the Bureau of Reclamation (61 hectares [150 acres] of vernal pool habitat). The Bureau of Land Management is preparing to develop a management plan for Upper and Lower Table Rock. A Wetland Conservation Plan is currently being developed to protect vernal pool habitats in the White City region of the Agate Desert.

D. ASSOCIATED SPECIES OF CONSERVATION CONCERN

Several other species of conservation concern due to their global rarity or Federal or State status share seasonally wet habitats occupied by *Limnanthes floccosa* ssp. *grandiflora*, *Lomatium cookii*, and the vernal pool fairy shrimp. *Agrostis hendersonii*, *Limnanthes floccosa* ssp. *pumila*, and *Plagiobothrys figuratus* ssp. *corallicarpus*, which were formerly included in the list of Federal candidate species, are known from the vernal pools of the Agate Desert. *Plagiobothrys austiniae*, *P. glyptocarpus* var. *glyptocarpus*, *P. greenii*, and *Navarretia heterandra* are other nonlisted species that are of special conservation interest to this recovery plan in that they occur within vernal pool habitat in the vicinity of the Agate Desert and have a global or state elevated imperiled or rarity status (Table 1). The hairy water flea (*Dumontia oregonensis*) is a newly described arthropod species that is of elevated conservation interest due to its taxonomic distinctness and apparently endemic occurrence in the vernal pools of the Agate Desert Preserve. *Limnanthes gracilis* ssp. *gracilis* is a plant species of concern that co-occurs with *Lomatium cookii* in the seasonally wet meadows of the Illinois Valley.

1. *Agrostis hendersonii*

Agrostis hendersonii (*Agrostis microphylla* var. *hendersonii*) (Henderson's bentgrass) was first described by A. S. H Hitchcock from a collection in the Rogue River Valley near Gold Hill in 1945 (Hitchcock 1971). This species was previously a Category

2 candidate for Federal listing (U.S. Fish and Wildlife Service 1993b). The Oregon Natural Heritage Program has identified it as a List 1 taxon (threatened with extinction or presumed extinct throughout its range). *Agrostis hendersonii* is an annual grass in the family Poaceae. It is 6 to 70 centimeters (3 to 40 inches) tall with 1- to 4-centimeter (0.2- to 2-inch) lower blades, and with *awned lemmas* (Figure II-8). It is known from vernal pools of California's Cascade Range, Sierra Nevada Foothills, and Sacramento and San Joaquin Valleys. It inhabits vernal pool margins at elevations less than 300 meters (900 feet).

Agrostis hendersonii was collected one time in the Sam's Valley area of the Agate Desert in 1945, and it is likely that the collection site could have been within or near the Table Rock Terrace or the Rogue Plains areas. Threats to this plant are mainly loss or degradation of habitat by development activities, grazing, agricultural production, displacement by un-managed native and non-native vegetation, and loss of hydrology. These threats are likely to have caused its apparent disappearance in Oregon for the last 60 years. The plant lacks formal research on the specific habitat requirements for its continued viability.

2. *Plagiobothrys figuratus* ssp. *corallicarpus*

Plagiobothrys figuratus ssp. *corallicarpus* (coral-seeded popcornflower) is in the borage family (Boraginaceae). This taxon was first recognized and described by Piper in 1924 as *Allocarya corallicarpa* from a collection in the upper Rogue River Valley, Oregon. I.M. Johnston revised the name to *Plagiobothrys scouleri* var. *corallicarpus* in 1932, and then to *Plagiobothrys hirtus* var. *corallicarpus* in 1935 based on difference of flower size. Abrams revised the name to *Allocarya hirta* ssp. *corallicarpa* in 1951 (Abrams 1951). The current combination of the taxon, *Plagiobothrys figuratus* ssp. *corallicarpus* was introduced by Chambers in 1989 (Chambers 1989). This taxon is in the borage family (Boraginaceae).

This plant is an annual herb with white flowers and smooth leaves (Figure II-9) that grows up to 30 centimeters (12 inches) tall. The plant is distinguished from nearby, related species by its large flowers (8 to 11 millimeters [0.3 to 0.4 inches] wide), and deeply ridged nutlets (fruits) with small attachment scars. It also has white flowers that are much larger than other closely related *Plagiobothrys* species. The flowering period is from June to July.

Plagiobothrys figuratus ssp. *corallicarpus* is known from only 30 occurrences within southwest Oregon. With approximately 14 occurrences known from the Rogue River Valley near Grants Pass, 13 occurrences of *P. figuratus* ssp. *corallicarpus* have been recorded in the Sam's Valley area of the Rogue River Valley, about 1.6 kilometers (1 mile) outside of the Rogue Plains and Table Rock Terrace core areas and one 0.1 kilometer (0.06 miles) outside the Whetstone Creek core area. Two other populations occur in the Jenny Creek watershed in southeast Jackson County. The populations

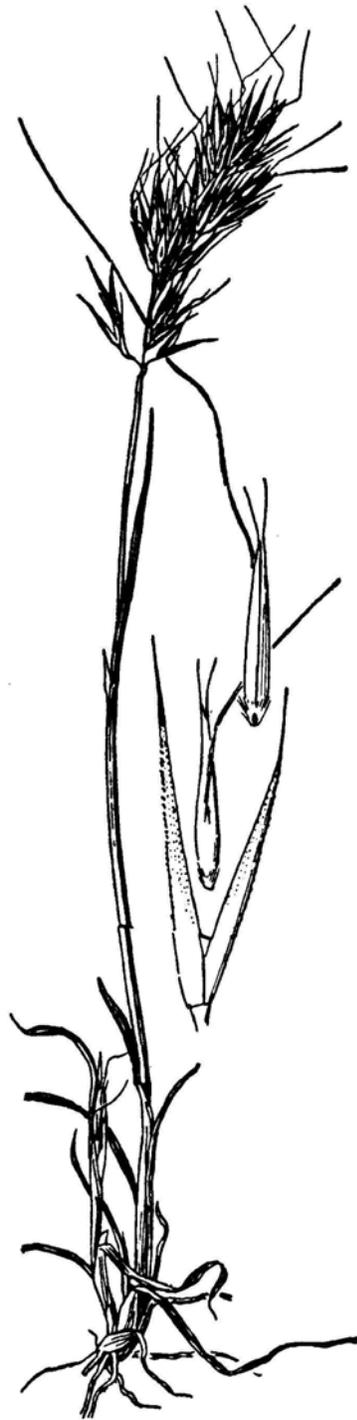


Figure II-8. Illustration of *Agrostis hendersonii* (Henderson's bentgrass). Reprinted from Hitchcock (1971).



Figure II-9. *Plagiobothrys figuratus* ssp. *corallicarpus* (coral-seeded popcornflower). Photograph courtesy of Richard Brock. Used with permission.

range from as few as 11 to 50 individuals to as many as 1,000 to 10,000. Three populations in the Sam's Valley area occur on Medford Bureau of Land Management administered land while the remainder occurs on private lands. *Plagiobothrys figuratus* ssp. *corallicarpus* occurs in vernal pools, stream banks, and rocky, open areas in seasonal wet meadows. The areas are usually inundated by water in the winter and spring and are dry in the summer (Knight and Seevers 1992). This subspecies was previously a Category 2 candidate for Federal listing (U.S. Fish and Wildlife Service 1993b). The Oregon Natural Heritage Program has identified it as a List 1 taxon (threatened with extinction or presumed extinct throughout its range), and it is currently a State of Oregon candidate taxon.

Because identification of *Plagiobothrys figuratus* ssp. *corallicarpus* requires close examination of the tiny nutlet with a lens during the proper season, the plant is difficult to survey. Perhaps for this reason, this species was once thought extinct. It was first collected and described in the early 1920's, but no collections were made from 1946 until its rediscovery in 1991 (Brock 1993). Extensive searches for the plant in 1993, conducted over its entire range, resulted in many newfound populations mostly in seasonally wet areas in Jackson and Josephine counties (Brock 1993). Seeds from three locations are stored at the Berry Botanic Garden (E. Geurrant, pers. comm. 2005).

The following are research needs for the plant: 1) work with private property owners to conserve habitat, 2) continue surveying private and public lands in order to determine the full extent of the species' range and accurate population numbers, 3) collect and store seeds throughout the species' range, 4) determine germination requirements, 5) determine propagation and reintroduction protocols, and 6) determine longevity of seeds in soil seed bank.

Threats to this plant are primarily loss or degradation of habitat by development activities. Observations indicate that changes in local hydrology by rechanneling or removal of water from seasonal springs can lead to degradation of habitat. Heavy grazing by cattle has a strong negative effect on *Plagiobothrys figuratus* ssp. *corallicarpus* (R. Brock, pers. comm. 2004). Parcels of land that receive continuous grazing appear to have no *P. figuratus* ssp. *corallicarpus* plants while adjacent properties with little or no grazing support vigorous populations (Brock 1993).

It appears that populations are able to rebound or recolonize an area when grazing is removed if there is a soil seed bank or nearby seed source (Brock 1993). Most sites (all but two) are on private land and therefore would not be much better protected if this species were to be federally listed. The plant lacks formal research on its specific habitat requirements for its continued viability.

3. *Limnanthes floccosa* ssp. *pumila*

Limnanthes floccosa ssp. *pumila* (dwarf woolly meadowfoam) is in the false mermaid family (Limnanthaceae). It was first collected from the top of Table Rock, Jackson County, Oregon, and then described by Howell in 1897 as *Limnanthes pumila*. M.E. Peck revised the name to *Limnanthes bellingeriana* in 1937 (Abrams 1951). The current name, *Limnanthes floccosa* ssp. *pumila*, was assigned by Kalin-Arroyo in her treatment of *Limnanthes* in 1973. This taxon is a narrow endemic, known only from the summits of Upper and Lower Table Rocks in Jackson County, Oregon. This subspecies was previously a Category 1 candidate for Federal listing (U.S. Fish and Wildlife Service 1993b), but was removed from candidate status (U.S. Fish and Wildlife Service 1996). The plant is also a State of Oregon Threatened species. The Oregon Natural Heritage Program has identified it as a List 1 taxon (threatened with extinction or presumed extinct throughout its range). The plant is a hairy annual herb with hairy sepals (Figure II-10). Its flowers are yellow to white in color, and 2 to 2.5 centimeters (0.8 to 1.0 inch) in size.

Limnanthes floccosa ssp. *pumila* occurs on shallow soils with a volcanic-derived duripan layer. The plant community is short prairie and is almost devoid of trees. The Table Rock vernal pools are micro-ecosystems of habitat that support this species. This plant is endemic to the Bureau of Land Management's Area of Critical Environmental



Figure II-10. *Limnanthes floccosa* ssp. *pumila* (dwarf woolly meadowfoam). Photograph courtesy of Norm Jensen. Used with permission.



Figure II-11. *Limnanthes gracilis* ssp. *gracilis* (slender meadowfoam). Photograph courtesy of Norm Jensen. Used with permission.

Concern on both Upper and Lower Table Rock and has not been seen anywhere else. The primary threats to this plant are grazing, recreational disturbance, and displacement by seral and invasive species. Research is necessary to understand its biology, rarity, genetic similarity to associated *Limnanthes* spp., seed germination, and propagation needs.

4. *Limnanthes gracilis* ssp. *gracilis*

Limnanthes gracilis ssp. *gracilis* (slender meadowfoam) is in the false mermaid family (Limnathaceae). It was described in 1897 by Howell from a collection in the Rogue River Valley, Oregon, as *Limnanthes gracilis* (Abrams 1951). A new subspecies was added to this taxon by Beauchamp (1986) and the name became a subspecies according to taxonomic standards. This plant is an annual herb that reaches 10 centimeters (4 inches tall) (Figure II-11). It has white flowers that appear from April to May. *Limnanthes gracilis* ssp. *gracilis* often co-occurs with *Lomatium cookii* in seasonally wet meadows of the Illinois Valley. Its range is spread across Josephine County from Takilma, in the southern portion of the county, to northeast of Grants Pass. Only 40 documented occurrences of this plant are recorded within the Illinois Valley landform, but numbers of the plant throughout its range are estimated at 7,000,000. At least two populations occur on Bureau of Land Management administered lands. This subspecies was previously a Category 2 candidate for Federal listing (U.S. Fish and Wildlife Service 1993b). The Oregon Natural Heritage Program has identified it as a List 1 taxon (threatened with extinction or presumed extinct throughout its range). It is also a State of Oregon candidate species. The primary threats to the plant are road construction, aggregate and mineral mining, and recreational disturbance.

Research on this plant has been primarily conducted by the commercial meadowfoam oil seed industry. Hybrid crosses between this plant and several other *Limnanthes* sp. were conducted to determine optimal characteristics for hardiness, oil seed quality, and seed set.

5. *Navarretia heterandra*

Navarretia heterandra (Tehama navarretia) is in the phlox family (Polemoniaceae). This taxon was first described by H. L. Mason in 1946 from a collection near Cottonwood, California. The name has retained its combination (Abrams 1951). The Oregon Natural Heritage Program has identified it as a List 2 taxon (threatened with extirpation or presumed extirpated in Oregon). The plant is an annual herb 3 to 11 centimeters (1.3 to 4 inches) tall, with hairy sepals (outer flower parts) and 6- to 8-millimeter (0.2- to 0.3-inch) white flowers with purple spots below the lobes (Figure II-12). The plant produces only 1 to 2 seeds.



Figure II-12. *Navarretia heterandra* (Tehama navarretia). Photograph courtesy of Carol W. Witham. Used with permission.

Navarretia heterandra is known to colonize newly disturbed areas and occurs in vernal pools (M. Wineteer, pers. comm. 2004). It is known from 3 sites in Jackson County, Oregon, and 12 sites in California. At least two populations occur on Bureau of Land Management administered lands. Research is necessary to understand its unique biology, rarity, genetic similarity to associated *Navarretia*, seed germination, and propagation needs.

6. *Plagiobothrys austiniae*

Plagiobothrys austiniae (Austin's popcornflower) (Figure II-13) is an herbaceous annual in the borage family (Boraginaceae). Greene first recognized *Plagiobothrys austiniae* as a new species in 1887, assigning the name *Allocarya austiniae* to the plant from a collection in Butte County, California. After a revision to *Allocarya cristata* by Piper in 1920, *Echinoglochin austiniae* by Brand in 1925, and *Allocarya austiniae* var. *cristata* by Jepson in 1925, I.M Johnston in his 1932 monograph on *Plagiobothrys*, assigned the name by which Austin's popcorn flower is known currently, *Plagiobothrys austiniae* (Abrams 1951).

The Oregon Natural Heritage Program has identified this species as a List 2 taxon (threatened with extirpation or presumed extirpated in Oregon). In Oregon it is known from 12 sites in Jackson County. This species germinates in early February, flowers from March to May, and goes dormant in July. The flowers are white with yellow centers. This plant may reach 40 centimeters (16 inches), but averages about 15 centimeters (6 inches). This species is best identified by the midrib prickles on the lateral ribs of the nutlets. The prickles are stouter than the other species of *Plagiobothrys* in vernal pool mounded prairie habitat. This plant is known to occur in the Bureau of Land Management's Area of Critical Environmental Concern on both Upper and Lower Table Rock and in The Nature Conservancy's Agate Desert Preserve.



Figure II-13. Illustration of *Plagiobothrys austiniae* (Austin's popcornflower).
Reprinted from Abrams and Ferris (1960).



Figure II-14. Illustration of *Plagiobothrys glyptocarpus* (sculptured allocarya).
Reprinted from Abrams and Ferris (1960).

Research is necessary to understand its biology, rarity, genetic similarity to associated *Plagiobothrys* spp., seed germination, and propagation needs.

7. *Plagiobothrys glyptocarpus* var. *glyptocarpus*

Plagiobothrys glyptocarpus var. *glyptocarpus* (sculptured allocarya)(Figure II-14) is an herbaceous annual in the borage family (Boraginaceae). Piper first assigned this species the name *Allocarya glyptocarpa* in 1920 from a collection 8 miles north of Oroville, California. The species was revised by Brand in 1931 to a new genus *Glyptocaryopsis glyptocarpa*. I.M. Johnston provided the currently recognized name of *Plagiobothrys glyptocarpus* in his 1932 monograph of *Plagiobothrys* (Abrams 1951).

The Oregon Natural Heritage Program has identified it as a List 2 taxon (threatened with extirpation or presumed extirpated in Oregon). In Oregon the plant is known from 22 sites in Jackson County, and occurs on top of both Upper and Lower Table Rock and in The Nature Conservancy's Agate Desert Preserve. The plant averages 20 centimeters (9 inches) tall and has 5- to 9-millimeter (0.2- to 0.4-inch) wide flowers. The ovoid, slightly toothed nutlets have narrow cross and lateral ribs with deep interspaces and a triangular concave scar. It is identified from other *Plagiobothrys* spp. by an absence of prickles and a concave triangular scar on the nutlets.

Research is necessary to understand its biology, rarity, genetic similarity to associated *Plagiobothrys* spp., seed germination, and propagation needs.

8. *Plagiobothrys greenei*

Plagiobothrys greenei (Greene's popcorn flower) is in the borage family (Boraginaceae). This species was first collected in Yreka, California and described in 1877 by Asa Gray as *Echinosperrum greenei*. Greene changed its name in 1887 to *Allocarya echinoglochin* and again in 1894 to *Allocarya greenei*. I.M. Johnston gave the species its current name, *Plagiobothrys greenei*, in his 1932 *Plagiobothrys* monograph (Abrams 1951).

Habitat for *Plagiobothrys greenei* occurs in small seasonally wet gravelly areas in openings of white oak/manzanita woodland on gentle slopes with sandstone substrates and vernal wet edges of seasonal creeks, generally on very shallow soils.

Plagiobothrys greenei is an annual herb that may reach 40 centimeters (16 inches) but averages 15 centimeters (6 inches) (Figure II-15). The Oregon Natural Heritage Program has identified it as a List 2 taxon (threatened with extirpation or presumed extirpated in Oregon). In Oregon it is known from nine sites in Jackson and Josephine Counties, and occurs on top of both Upper and Lower Table Rock as well as The Nature



Figure II-15. Illustration of *Plagiobothrys greenei* (Greene's popcorn flower); plant and nutlet. Reprinted from Abrams and Ferris (1960).

Conservancy's Agate Desert Preserve. *Plagiobothrys greenei* is distinguished from other *Plagiobothrys* spp. in the vernal pool-mounded prairie complex of the Agate Desert by the presence of numerous thin bristles on the nutlets. The nutlets are more or less smooth, lacking the lateral- and cross-ribs of most other *Plagiobothrys* species. The ovate or triangular scar is located near the base of the nutlet and is concave. The flower is white, sometimes with a yellow center, and is 1 to 2.5 millimeters (0.04 to 0.1 inches) wide. Research is necessary to understand its biology, rarity, genetic similarity to associated *Plagiobothrys* spp., seed germination, and propagation needs.

9. Hairy water flea

The hairy water flea (*Dumontia oregonensis*) is a small crustacean in the order Cladocera (water fleas), suborder Anomopoda. It is less than 3 millimeters (0.12 inch) long (Figure II-16). This species was first described in 2003. The species was collected from one vernal pool in The Nature Conservancy's Agate Desert Preserve in January 1998. The species was collected again in March 2001 from two pools (rediscovered in one of the pools) within the Preserve. The collected specimens are mature and immature females. The hairy water flea is morphologically unique within the suborder Anomopoda, and is believed to represent a previously undescribed family. The proposed family is Dumontiidae. Due to the recent discovery, very little information exists regarding the species' habitat or life history requirements (Santos-Flores and Dodsén 2003). Santos-Flores and Dodsén (2003) suggested that the hairy water flea occupies a particular, but limited, habitat type. The authors further recommended ecological studies of this species.

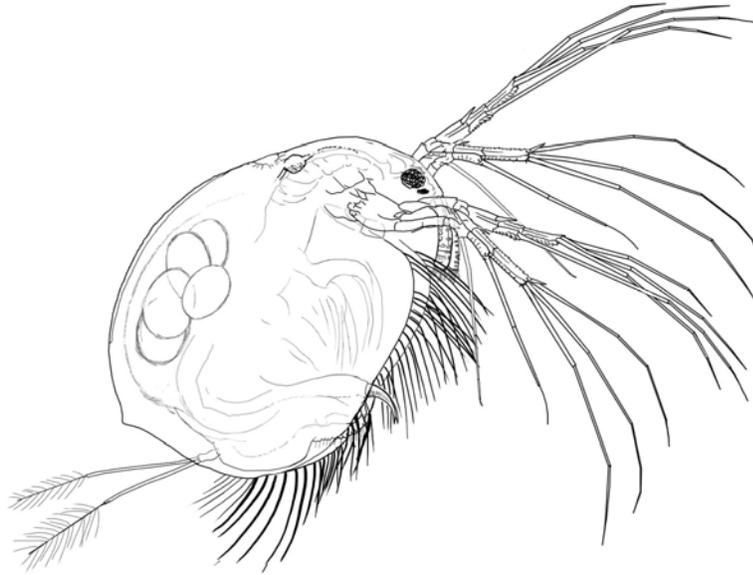


Figure II-16. Hairy water flea (*Dumontia oregonensis*). Illustration by Kandis Elliot, Botany, University of Wisconsin, February 2004. Used with permission.

One of the primary goals of the Oregon Natural Heritage Information Center's Rare and Endangered Invertebrate Program is to promote inventory and taxonomic work on undescribed or poorly known invertebrate species which may face significant threats. *D. oregonensis*, as a newly discovered invertebrate, is suitable for such work.

10. Additional Species

Several other State of Oregon listed species and former candidate species now considered species of concern have been recorded in the periphery of the Rogue River Valley area, including the California wolverine (*Gulo gulo luteus*), Lewis woodpecker (*Melanerpes lewis*), northwestern pond turtle (*Clemmys marmorata*), common kingsnake (*Lampropeltis getula*), and California kingsnake (*Lampropeltis zonata*). These species occur in many parts of southwest Oregon and have recorded occurrences in many areas of the Illinois Valley and Agate Desert.

The California wolverine was recorded within a 7-mile radius of the greater Agate Lake area. The Lewis woodpecker is associated with open forests at lower elevations and has been observed within a 7-mile radius of the Agate Desert Preserve and Table Rocks areas. Lewis woodpecker nests in Oregon white oak woodlands and mixed oak/pine woodlands, and has declined due to increased competition for nest cavities from introduced European starlings. Several occurrences of northwestern pond turtle have been observed within 5 miles of the Hoover Pond core area.

The California kingsnake, common kingsnake, and northwestern pond turtle have also been recorded within various areas of the Illinois Valley. In addition, *Erythronium howellii* (Howell's fawn lily), *Phacelia leonis* (Leo's phacelia), and Del Norte Salamander (*Plethodon elongatus*) have recorded occurrences within a 7-mile radius of the French Flat core area. *Microserius howellii* (Howell's microseris) and *Senecio hespereus* (western senecio) are two State listed plant species that are often located adjacent to *Lomatium cookii* habitat near the French Flat, Rough and Ready Creek, and Reeves Creek areas in the Illinois Valley. These two plant species have restricted ranges and were once considered critically imperiled by the State, but now have more documented occurrences than previously thought and are no longer on the species of concern list.

Efforts to protect and conserve *Lomatium cookii*, *Limnanthes floccosa* ssp. *grandiflora*, and vernal pool fairy shrimp occurrences in the Rogue River and Illinois Valleys will also afford protection for the associated peripheral species.

III. Reasons For Listing

A. THE PRESENT OR THREATENED DESTRUCTION, MODIFICATION, OR CURTAILMENT OF HABITAT OR RANGE.

The primary threat to *Limnanthes floccosa* ssp. *grandiflora*, *Lomatium cookii*, and the vernal pool fairy shrimp is habitat loss and degradation. Vernal pool habitat, formerly widespread south of the Rogue River, has been almost completely eliminated (Brock 1987, Borgias and Patterson 1999). In the Agate Desert, recent studies of vernal pool hydrology and vegetation indicate that no undisturbed vernal pool habitat remains (Borgias and Patterson 1999). The ranges of all species have declined by roughly 50 percent in this area, and while the majority of vernal pool wetlands have likely been altered prior to the 1980s, habitat alterations are continuing at a rapid rate (D. Borgias, pers. comm. 1999). Over 60 percent of the habitat in the Agate Desert is estimated to have been destroyed, and none of the remaining habitat has escaped the invasion of weedy competitors. The primary threats to the vernal pool habitat of *Lomatium cookii* and *Limnanthes floccosa* ssp. *grandiflora* in the Agate Desert are industrial, commercial, and residential development. Related road and utilities construction and maintenance activities including mowing, herbicide spraying, and firebreak construction, as well as altered hydrology, particularly through the conversion of nonirrigated land to irrigated agricultural use, all contribute to the deterioration of habitat quality for these plants (D. Borgias, pers. comm. 2001). Nonnative annual grasses also pose a threat, as *Lomatium cookii* tends to decrease over time if these nonnative competitors are not controlled through mowing, managed grazing, or prescribed burns (D. Borgias *in litt.* 2002). Any activities that result in altered hydrology, either inundation of the normally shallow vernal pools, or conversely, draining of these pools, will adversely impact the habitat for these species.

Many of the same threats occur at the *Lomatium cookii* populations in the Illinois Valley. In addition to threats at the Rogue River Valley, habitats in the Illinois Valley have been altered by gold mining operations, the uncontrolled use of off road vehicles, certain timber sale activities, inappropriate grazing practices, tree and shrub encroachment as a result of fire suppression, and the potential direct impacts of fire management activities. As an example, off road vehicle use is estimated to have destroyed at least 20 percent of the remaining *L. cookii* habitat on federally managed land in the Illinois Valley, and gold mining operations threaten approximately 600 plants at the French Flat site within the Valley (M. Mousseaux, pers. comm. 2003).

B. OVERUTILIZATION FOR COMMERCIAL, RECREATIONAL, SCIENTIFIC, OR EDUCATIONAL PURPOSES.

Lomatium cookii and vernal pool fairy shrimp have no known commercial, recreational, or scientific use at this time. However, *Limnanthes floccosa* ssp. *grandiflora* may be of interest to collectors and researchers since some members of the genus possess seed oil with potential for industrial applications (Knapp and Crane 1999, Oelke *et al.* 2004). About 80 percent of the remaining populations of *Lomatium cookii* and 40 percent of the extant populations of *Limnanthes floccosa* ssp. *grandiflora* are concentrated in small areas of 2 hectares (5 acres) of land or less. Access is open to many sites occupied by these species in the Agate Desert, and to *Lomatium cookii* sites in the Illinois Valley, and the species often occur near heavily traveled roads. Most sites for these species lack fences, barriers, or appropriate signs to discourage collectors or others from accessing the sites, making the plants vulnerable to collection (U.S. Fish and Wildlife Service 2002a).

C. DISEASE OR PREDATION

Poorly managed cattle grazing can have serious deleterious consequences for *Lomatium cookii* and *Limnanthes floccosa* ssp. *grandiflora*. Tracts heavily grazed from October to April are less likely to support these taxa, as the majority of plant growth occurs during this time period. Plants grazed during fall, winter, and spring are less likely to survive to produce seed in the spring or early summer (Brock 1987). If properly timed and managed, however, grazing may potentially benefit these species by reducing competition with introduced grasses (D. Borgias, pers. comm. 2002). Preliminary survey results indicate that early fall grazing and proper rotation may be beneficial by reducing the populations of nonnative competitors (D. Borgias, pers. comm. 2004).

Although disease (fungus) and herbivory have been identified as potential problems, no data exists to suggest that these factors pose a substantial threat to either species at this point in time.

D. THE INADEQUACY OF EXISTING REGULATORY MECHANISMS.

Lomatium cookii and *Limnanthes floccosa* ssp. *grandiflora* are listed as endangered species under the State of Oregon Endangered Species Act (Oregon Administrative Rules 603-73-070). The vernal pool fairy shrimp has no State listing by the Oregon Department of Fish and Wildlife. In general, State-listed plant populations on private lands are not subject to this law. The law prohibits the “take” of State-listed plants only on State, county, and city-owned or leased lands. However, the State law does not guarantee the protection of State-listed plants on these lands because it allows

for the loss of populations if a proposed project or activity is considered to be a public benefit (T. Kaye, pers. comm. 1999).

In accordance with the Clean Water Act of 1977 (91 Statutes At Large 1566; 33 U.S.C. 1251 *et seq.*), the Agate Desert vernal pools are classified as jurisdictional wetlands. The Clean Water Act does not regulate drainage of wetlands unless that action results in the discharge of dredged or fill material into a wetland. Normal farming, silviculture, and ranching activities do not require permits for discharge or fill activities (see 33 Code of Federal Regulations § 323.4), all of which could potentially damage vernal pool habitats. Furthermore, the Nationwide Permit Program (33 Code of Federal Regulations § 330) allows the discharge of fill in nontidal wetlands up to 0.2 hectare (0.5 acre) in size. Since many of the vernal pools are very small in size, such an activity could have a measurable impact on these systems. A similar problem arises under State of Oregon wetland laws. The Removal-Fill Law of 1989 (Oregon Revised Statutes 196.800-196.990), administered by the Oregon Division of State Lands, does not regulate activities that involve less than 38 cubic meters (50 cubic yards) of fill. Such an amount of fill could seriously impact many smaller vernal pool wetlands in which *Lomatium cookii*, *Limnanthes floccosa* ssp. *grandiflora*, and vernal pool fairy shrimp occur.

When considering compensatory mitigation for activities such as filling of wetlands, it is important to note that vernal pools are highly site specific, and most likely cannot be created, but only restored.

E. OTHER NATURAL OR MANMADE FACTORS AFFECTING ITS CONTINUED EXISTENCE.

Herbicide spraying, mowing, grading, and other road maintenance activities threaten small *Lomatium cookii* sites adjacent to roads on private lands near Cave Junction in the Illinois Valley. In the Agate Desert, *Lomatium cookii* and *Limnanthes floccosa* ssp. *grandiflora* individuals in road or powerline rights-of-ways could be accidentally destroyed by local public works departments, highway districts, fire departments, or private citizens carrying out maintenance activities (K. Cannon, pers. comm. 2004).

Fire suppression may affect the species in two ways. First, fire suppression activities may cause trampling of plants or habitat degradation when equipment is mobilized or fire lines are created. Second, the ongoing suppression and exclusion of fire may allow succession of woodland habitats and render formerly open areas unsuitable for growth of *Lomatium cookii* or *Limnanthes floccosa* ssp. *grandiflora* due to the encroachment of trees and shrubs.

The invasion of nonnative annual plants in the Agate Desert has altered the native perennial plant communities (Brock 1987). Native bunch grasses on mounds between vernal pools have been replaced by introduced Eurasian herbs and grasses. The dense thatch produced by these introduced annuals prevents the germination of *Lomatium cookii* and *Limnanthes floccosa* ssp. *grandiflora* seed.

Catastrophic events, such as severe fire, could eliminate the large patches of *Lomatium cookii* and *Limnanthes floccosa* ssp. *grandiflora* located on the Agate Desert Preserve (J. Kagan, pers. comm. 1998). Nine patches of *Lomatium cookii* in the Illinois Valley are vulnerable to demographic extinction because of their small size (fewer than 100 plants).

Industrial, commercial, and residential development, road and power-line construction and maintenance, livestock grazing, agricultural conversion, weed competition, mowing, and roadside spraying have all contributed to the decline of these plant species. In Josephine County, *Lomatium cookii* is also threatened by gold mining, logging, fire suppression, and uncontrolled off-road vehicle use. Indirect effects stemming from off-road vehicle use, road maintenance, utility construction, or mining can disrupt the hydrology of an area and redirect natural water sources away from small *Lomatium cookii* populations and introduce, scatter and bury noxious weed seed. Similarly, vernal pool fairy shrimp can be adversely affected by fragmentation of habitat, introduction of pesticides and other contaminants into vernal pools, and disruption of hydrological patterns.

IV. Recovery

A. RECOVERY STRATEGY

The continued existence of the federally listed species included in this recovery plan and the prevention of future listing for the species of conservation concern will be ensured when their populations and subpopulations are protected in perpetuity from future habitat loss and degradation. Additionally, all other threats to these species' survival need to be minimized or eliminated prior to delisting.

Recovery and long-term conservation actions contributing to the recovery strategy emphasized in this draft recovery plan are: (1) habitat protection, (2) adaptive habitat management and monitoring, (3) status surveys, (4) research, and (5) public participation and outreach. To meet the objective of delisting *Limnanthes floccosa* ssp. *grandiflora*, *Lomatium cookii*, and vernal pool fairy shrimp and ensuring the long-term conservation of associated vernal pool and seasonally wet meadow species, long term protection of vernal pool-mounded prairie and seasonally wet meadow communities in Jackson and Josephine Counties of southwest Oregon is necessary.

Specifics of each strategy are provided in this chapter and in the Stepdown Narrative of this document. Because this draft recovery plan focuses on a collection of listed species and species of conservation concern, emphasis is placed on specific strategies that will benefit several species (*e.g.*, an ecosystem approach). Since many of these species co-occur, this approach is most feasible. Where species do not co-occur, recovery and long-term conservation strategies will focus on a single species.

1. Habitat Protection

All habitat occupied by the species addressed in this recovery plan is important for recovery or conservation for two reasons: (1) habitat loss and degradation is the primary reason that vernal pool and seasonally wet meadow species are threatened with extinction, so additional habitat loss is counterproductive to recovery; and (2) genetic diversity within each species must be retained to increase the likelihood of species persistence through unpredictable events (*e.g.*, drought). Genetic composition has not been investigated for the taxa addressed in this recovery plan, so protection of remaining populations is prudent. By retaining the full range of site diversity and genetic diversity, in which a taxon currently or historically occurred, the likelihood of genetic persistence under *stochastic* conditions is maximized. Habitat protection includes the preservation of the geographic, topographic, and *edaphic* features that support aggregations, or complexes, of hydrologically interconnected vernal pools, seasonally wet meadow systems, and other ephemeral wetlands and depressions within a matrix of surrounding uplands that together form hydrologically and ecologically functional ecosystem complexes. The Stepdown Narrative includes actions to identify and protect or secure

larger vernal pool-mounded prairie and seasonally wet meadows within the recovery planning area as well as a series of research actions to characterize, maintain, and restore these functional ecosystems.

Amounts and locations of habitat. Additional research is needed to evaluate appropriate reserve and buffer sizes necessary to minimize threats of adjacent incompatible land uses, current and historical distributions of species, basic biological needs and life histories of species, upland habitat requirements of pollinators of vernal pool plants, amount of upland habitat (*i.e.*, watersheds) contributing to, and necessary for the maintenance of, vernal pool hydrological function, and landscape distribution of vernal pools and vernal pool complexes needed to provide for dispersal and genetic exchange. Consequently, the recovery criteria, strategies, and actions recommend the protection of a diverse range of vernal pool and wet meadow habitats (protecting the diversity of vernal pool types, soil types, geographic distribution, and species diversity) and protection of habitat in blocks as large as possible, including the associated uplands, buffers, and contributing local watersheds.

Protection of the majority of suitable habitat within core areas is recommended to provide corridors and dispersal habitat, support metapopulation dynamics, provide for reintroduction or introduction sites, and to protect currently undiscovered populations until the actual habitat needs of the species addressed in this recovery plan can be better defined. Actions intended to address the gaps in information on amount and location of habitat to be protected include research on reserve design and ecological function of seasonal wetlands, basic biology of the covered species to better determine habitat requirements, habitat mapping and analysis to better define distribution of seasonal wetland habitats, and status surveys to determine if populations are stable, declining or increasing, and/or determine the presence of additional populations or habitat areas that are needed to contribute to recovery.

The recovery strategy, actions, and criteria recommend protection of populations over the entire geographic and ecological distribution of each species in order to ensure representation of genetic variation. Identification of prioritized core areas is intended to assist in protecting species and supports the recovery strategy. Reintroductions and/or introductions also are recommended for recovery units and soil types from which a species has been extirpated. Actions intended to improve knowledge about adequate numbers and distribution of populations to protect include: research on population genetic structure (genetic variation within and among populations), habitat mapping and status surveys to identify additional populations, and research on species biology (*i.e.*, dispersal mechanisms and pollination biology that would contribute to genetic exchange among populations).

2. Adaptive Habitat Management and Monitoring

The most effective habitat management, restoration, and monitoring techniques for vernal pool-mounded prairie and seasonally wet grassland ecosystems are not yet fully understood, although some research and management is in progress. Until site- and species-specific research is completed, management strategies must remain adaptive (*i.e.*, flexible) and must be tied to population trends of featured species. Where populations are currently stable or increasing, existing habitat management should be continued if possible, and species monitoring should be instituted. If such populations begin to decline, changes in management may be indicated. For populations that are declining, other habitat management techniques should be attempted, based on the best available scientific data.

The recovery strategy, actions, and criteria recommend conducting standardized habitat site-assessments to identify site-specific threats, conducting interim management and monitoring, conducting reviews and revisions of existing management plans to ensure their adequacy, and ultimately developing and implementing comprehensive long-term management plans for vernal pool habitats and species. The current strategy is to base management on existing information and observed outcomes of ongoing management, but also to incorporate new information resulting from research and monitoring. The recovery criteria recommend that monitoring indicates ecosystem function has been maintained over at least one multi-year period that includes above average, average, and below average local rainfall, a multi-year drought, and a minimum of 5 years of post-drought monitoring to ensure reproduction and recruitment is achieved following the drought. Actions intended to improve our understanding of appropriate management of habitat include conducting monitoring and incorporating results into habitat management plans (*i.e.*, adaptive management), and research on habitat management, restoration, monitoring techniques, and basic species biology and ecology.

3. Status Surveys

A status survey is a detailed process beginning with a literature review and examination of herbarium or museum specimens. All historical localities of a species are identified, and additional sites where the species may occur are predicted based on distributional and ecological data. The historical and predicted sites are visited at the appropriate time of year to evaluate if the species have persisted. Population size and threats at those sites are evaluated, and recommendations for conservation are made. The purpose of the status survey for recovery purposes is to determine the species presence on a range wide basis, whether it warrants reclassification or delisting, and to identify the locations within appropriate habitat which could be suitable for introduction or reintroduction efforts. Additionally, status surveys can be used to identify additional sites for protection and to identify additional management actions necessary to minimize or eliminate remaining threats to the species. Status surveys are recommended for all taxa

featured in this draft recovery plan to update distribution information and assess local threats.

4. Research

Development of specific recovery criteria and prescriptive recovery actions in this draft recovery plan is complicated by a lack of specific and quantitative information about the biology and ecology of the species. While many threats to species are well known, how to ameliorate or eliminate those threats are not. Thus, research to further understand the effects of threats and the effectiveness of our measures to reduce or eliminate those threats is necessary to recover and conserve the taxa featured in this draft recovery plan. Research needed to develop effective habitat management techniques includes studies related to habitat protection (*e.g.*, appropriate preserve size and location), habitat management and restoration techniques (*e.g.*, appropriate levels of burning, grazing, or mowing), and species ecology and biology (*e.g.*, genetic relatedness, species interactions, and controlled propagation methods). Development and implementation of genetic management plans will be facilitated by research into breeding systems and patterns of gene flow.

Population Viability Analysis. It is preferable to refine recovery criteria based on population viability analyses. A thorough population viability analysis for any given species requires the determination of the appropriate analysis parameters and an assessment of current population sizes, status, distribution, historical population sizes, demographic characteristics (such as survivorship, reproductive rates, recruitment, and dispersal capabilities), and metapopulation dynamics (extinction and colonization rates of populations). In addition, developing models of population viability may be hindered by the complicated life histories that involve long-lived seed and cyst stages. The demographic characteristics of these life stages may be very difficult to adequately measure and characterize. Additionally, year-to-year environmental variability and the ephemeral nature of habitats and populations may add to the difficulty of measuring population sizes, demographic characteristics, and metapopulation dynamics necessary to model population viability. Actions intended to supply information necessary to develop parameters and values to determine population viability include development of standardized species monitoring protocols, conducting periodic status surveys and reviews to develop information on changes in species status over time, and research actions to measure demographic characteristics and/or metapopulation dynamics.

The recovery strategy, actions, and criteria recommend that populations must be stable or increasing over at least one multi-year period that includes above average, average, and below average local rainfall, a multi-year drought, and a minimum of 5 years of post-drought monitoring. Monitoring populations over this multi-year period should capture the range of variability in environmental conditions and variability in population numbers and demographic characteristics.

5. Public Participation and Outreach

Public participation and outreach are critical to the survival and recovery of the listed species and species of concern addressed in this draft recovery plan. Vernal pool-mounded prairie and seasonally wet grassland species occur on many parcels of property owned and/or managed by numerous different stakeholders (private landowners, Federal agencies, State agencies, and local governments). Early ownership in the recovery implementation process requires that landowners and land managers be informed so they can become effective participants in the recovery process. Many private landowners, and local agencies, are willing participants in recovery implementation efforts, but many do not have the information necessary to make informed decisions. Developing working relationships with all stakeholders, including public land management agencies and private landowners, to secure and recover those ecosystems covered under this recovery plan is essential. Public land management agencies and private landowners should be informed of the presence or potential presence of listed species, species of concern, or special status species and their habitat on their property. The ecological requirements of the species, and incentives to compensate landowners for any conservation efforts should also be provided to help recover the species.

Outreach and awareness programs should be developed and implemented to enhance compliance with existing regulations and to take advantage of opportunities within existing Federal, State, and local laws, regulations, and policies to conserve vernal pool resources.

B. GOALS

The goals of this recovery plan are to:

- Achieve and protect, in perpetuity, self-sustaining populations of *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii* in identified core areas throughout their full ecological, geographical, and genetic range, by minimizing or eliminating the threats that caused the species to be listed.
- Contribute to the recovery of the vernal pool fairy shrimp as stated in the Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon (U.S. Fish and Wildlife Service 2005). This is accomplished by providing site-specific recovery actions for vernal pool fairy shrimp within the Klamath Mountains Recovery Unit.
- Remove the two endangered species, *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii* and the threatened vernal pool fairy shrimp from the Federal List of Endangered and Threatened Wildlife and Plants.

An interim goal of this draft recovery plan is to:

- Reclassify *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii* to threatened (*i.e.*, downlist). Reclassification will be appropriate when each species is no longer in danger of extinction throughout a significant portion of its range. Because data upon which to base decisions about reclassification and recovery are mostly lacking, downlisting and recovery criteria in this draft recovery plan are necessarily preliminary and may be revised as necessary data is obtained.

C. OBJECTIVES

The objectives of this recovery plan are to:

- Stabilize and protect populations of the three listed species, in core areas, so further decline in species status and range are prevented.
- Minimize or eliminate the threats that caused *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii* to be listed as endangered and minimize any other newly identified threats in order to be able to delist these species.
- Minimize or eliminate the threats that caused the vernal pool fairy shrimp to be listed as threatened and minimize any other newly identified threats in order to be able to delist this species.
- Conduct research necessary to refine reclassification (*i.e.*, downlisting) and recovery criteria.
- Ensure the long-term conservation of the nine nonlisted species of conservation concern.
- Promote natural ecosystem processes and functions by protecting and conserving, in identified core areas, intact vernal pools, vernal pool-mounded prairie complexes, and seasonally wet meadows within the recovery planning area (Figure 1) to maintain viable populations of listed species and species of concern, and prevent additional threats from emerging over time. By doing so, other vernal pool species considered common and additional species that have not yet been identified or described, will be conserved so that they may not need the protection of the Endangered Species Act.

D. RECOVERY CRITERIA

Recovery criteria set forth for species included in this recovery plan are based on the most current information concerning needs and requirements for the species. Often empirical data is lacking on minimum requirements for assured survival of these species. For all species, a management plan based on current research and developed for species protection and conservation must be approved and implemented in each core area. Threats in each core area should be reduced or eliminated. Research in plant augmentation, fire, and grazing techniques for habitat management is needed and new methods implemented.

Recovery core areas for the following criteria were determined based on known population centers of listed species included in this recovery plan. The designation of recovery core areas is not subject to Federal regulation or implied legal responsibility. Maps of recovery core areas are presented in Figures IV-1 and IV-2 below.

1. Downlisting Criteria

Reclassification to threatened status may be considered for *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii*; when the following criteria are met:

- a. For *Limnanthes floccosa* ssp. *grandiflora*, at least 95 percent of suitable vernal pool habitat acreage (existing as of 2005) within each Priority 1 core area (4 core areas within the Rogue Valley) has been protected from development and covered under a management plan. Also, at least 85 percent of suitable vernal pool habitat acreage within Priority 2 core areas (4 core areas within the Rogue Valley) has been protected from development and covered under a management plan. Introduced or newly discovered populations outside of currently known core areas may be substituted if deemed equivalent in their contribution to recovery.
- b. For *Lomatium cookii*, at least 95 percent of suitable vernal pool and wet meadow habitat acreage (existing as of 2005) within each Priority 1 core area (including 3 core areas in the Rogue Valley Recovery Unit and 8 core areas in the Illinois Valley Recovery Unit) has been protected from development and covered under a management plan. Also, at least 85 percent of suitable vernal pool habitat acreage within one Priority 2 core area in the Illinois Valley Recovery Unit (or an equivalent population discovered or reintroduced in a Priority 3 core area) has been protected from development and covered under a management plan. Introduced or newly discovered populations outside of currently known core areas may be substituted if deemed equivalent in their contribution to recovery.

- c. Management plans based on current research and developed for species protection and conservation have been approved and implemented by local governments, area planners, and nongovernment organizations. Management plans should address vegetation control, including thatch buildup and noxious weeds; monitoring of threats and population levels in detail sufficient to quantitatively assess population trends; maintaining hydrological functions; and outreach to neighboring landowners. Management plans should take an ecosystem approach to management, setting conservation goals for the nine species of conservation concern that occur within the area as well.
- d. At least 3 years of threats assessments indicate threats have been eliminated or effectively reduced by measures incorporated in area management plans.
- e. Monitoring indicates population levels of existing species are stabilized or increased from baseline conditions for each population. Populations must be measured over at least one multi-year period that includes above average, average, and below average local rainfall, a multi-year drought, and a minimum of 5 years of post-drought monitoring to ensure reproduction and recruitment is achieved following the drought. Population trends must be shown to be stable or increasing for a minimum of 10 consecutive years prior to consideration for reclassification.
- f. A Recovery Implementation Team is established and functioning to oversee range-wide recovery efforts of the species.

2. Delisting Criteria for *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii*

Delisting *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii* is contingent upon meeting the downlisting criteria above and the following delisting criteria:

- a. Status surveys, status reviews, and population monitoring show population levels within each population are viable for 10 years following downlisting (*e.g.*, evidence of reproduction and recruitment) and have been determined to be stable or increasing, and implementation of management plans is effectively managing or eliminating threats. Populations must be measured over at least one multi-year period that includes above average, average, and below average local rainfall, a multi-year drought, and a minimum of 5 years of post-drought monitoring to ensure reproduction and recruitment is achieved following the drought.

- b. Any necessary research on life history, population viability, genetics, and land management strategies has been completed and incorporated into management plans where appropriate.
- c. A post-delisting monitoring plan has been developed for these plant species.

Delisting Criteria for Vernal pool fairy shrimp

The Vernal Pool Ecosystem Recovery Plan (U.S. Fish and Wildlife Service 2005) presents delisting criteria regarding this species. Please refer to the Vernal Pool Ecosystem Recovery Plan for specific delisting criteria regarding the vernal pool fairy shrimp.

New knowledge of the species' biology, range, taxonomy, and viable population size in the next 20 years may provide more accurate information to refine these criteria.

E. RECOVERY UNITS AND CORE AREAS

A recovery unit is a special unit of a listed species range that is geographically or otherwise identifiable and is essential to the recovery of the listed species. Recovery units are individually essential to the recovery and conservation of the listed species addressed in this draft recovery plan for conservation of unique biotic and abiotic factors (such as genetic robustness, demographic robustness, important life history stages, or other features) for long-term sustainability provided for the species within the recovery unit. Recovery units are not listed as separate entities and cannot be delisted individually. Each recovery unit designated must be recovered before a species can be delisted.

Core areas in the Rogue and Illinois Valleys were selected for focused restoration including protection, research, and monitoring efforts for species covered in this recovery plan (Table IV-1). Core area boundaries were identified based on the location of listed plant occurrences, the distribution of appropriate vernal pool and wet meadow habitat, and examination of aerial photographs of the region. Core areas in the Rogue Valley in certain cases correspond with vernal pool areas previously identified as core habitat for vernal pool fairy shrimp (U.S. Fish and Wildlife Service 2005), but may diverge due to variations in occurrences of *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii*.

1. *Limnanthes floccosa* ssp. *grandiflora*

Because the distribution of *Limnanthes floccosa* ssp. *grandiflora* populations is restricted to a portion of the Rogue Valley, without major geographic or distance barriers, the range of the species is not further subdivided into recovery units. Nine core areas have been identified for protection and concentrated recovery efforts in the Rogue Valley

(Figure IV-1). These core areas are defined by size and presence of populations, vernal pool function and value, and placement and distance of known populations within the range of the species. A strategic focus to protect and restore these areas will be crucial in the recovery of the species.

2. *Lomatium cookii*

The Illinois Valley in Josephine County at Cave Junction is roughly 60 kilometers (37 miles) west of the Rogue River Valley in the vicinity of White City. Dividing the two valleys are the Applegate Mountain Range cresting 1,370 meters (4,494 feet) at Mt. Isabelle and the northern extent of the Siskiyou Mountain Range cresting 1,388 meters (4,555 feet) at Mungers Butte. This disjunct range comprises two recovery units for *Lomatium cookii*, corresponding to the two major watersheds of the Rogue River Valley and middle Illinois Valley (Figure I-1).

Three core areas for *Lomatium cookii*, identified based on presence of populations, vernal pool or wet meadow function and value, and connectivity and distribution of known populations, occur in the Rogue River Valley Recovery Unit (Figure IV-1) while 13 core areas have been identified in the Illinois Valley Recovery Unit (Figure IV-2). Protection and restoration of these core areas will be the focus of preliminary recovery efforts of the species.

We have divided the range of *Lomatium cookii* into two recovery units because: 1) the Rogue River and Illinois Valleys are separated by a wide geographical distance comprising significant topography; 2) the ecological habitat of each recovery unit is unique in microclimate, soils, and plant associations; and 3) based on aerial photos, no suitable habitat signatures similar to the Rogue River Valley or Illinois River Valley appear to exist on landforms between the two units.

The Illinois Valley *Lomatium cookii* populations comprise a distinct unit because they occur only on seasonally wet meadows among and between forested woodlands on deeper Brockman clay loam, Josephine gravelly loam, Pollard loam, Eightlar extremely stony clay, Takilma cobbly loam, Abegg clay loam, and Newberg loam soils averaging 60 to 90 centimeters (24 to 35 inches) in depth. The Rogue River Valley populations are unique in that they occur on Agate Winlow soils averaging 25 to 36 centimeters (10 to 14 inches) deep, in vernal pool mounded prairie, which is also seasonally moist but is not distinguished by mounded vernal pool formations and has a unique characteristic vegetation association. It is likely that *L. cookii* populations within the two recovery units are genetically adapted to environmental conditions in the distinct habitats, such that conservation of populations within both recovery units is necessary to full recovery of the species.

Table IV-1. Core Areas in the Rogue River and Illinois Valley Recovery Units

Core Area Sites	Priority Level	Threats	Recommendations	Ownership	Area	Listed or rare species known from site
Illinois Valley Recovery Unit						
Anderson Creek	1	Succession – development	Lease/Easement	3% federal, 97% private	94 ha (232 ac)	<i>Lomatium cookii</i>
Democrat Gulch	3	Succession	Lease/Easement	100% private	163 ha (403 ac)	none
Draper Creek	1	Succession	Lease/Easement	6% federal, 94% private	109 ha (271 ac)	<i>Lomatium cookii</i>
Eight Dollar Mtn	3	Succession/Mining/ORV	Lease/Easement; Management plan	100% private	168 ha (414 ac)	none
French Flat	1	Mining/ORV/succession	BLM. Finalize mgt. plan. Seek accession of adjacent property. Deter ORV traffic.	32% federal, 1% state, 67% private	1,110 ha (2719 ac)	<i>Limnanthes gracilis</i> ssp. <i>gracilis</i> , <i>Lomatium cookii</i>
Granny’s Run	3	Succession – development	Lease/Easement	100% private	76 ha (178 ac)	none
Indian Hill	1	Succession – development	Lease/ Easement	90% federal, 10% private	23 ha (56 ac)	<i>Limnanthes gracilis</i> ssp. <i>gracilis</i> , <i>Lomatium cookii</i>
Laurel Road	1	Development /succession	Lease/Easement	15% federal, 5% state, 80% private	265 ha (654 ac)	<i>Limnanthes gracilis</i> ssp. <i>gracilis</i> , <i>Lomatium cookii</i>
Reeves Creek East	1	Succession	Mech. or natural shrub removal, lease, easement	50% federal, 50% private	34 ha (83 ac)	<i>Limnanthes gracilis</i> ssp. <i>gracilis</i> , <i>Lomatium cookii</i>
Reeves Creek West	1	Succession	Mech. or natural shrub removal, lease, easement	50% federal, 50% private	265 ha (655 ac)	<i>Limnanthes gracilis</i> ssp. <i>gracilis</i> , <i>Lomatium cookii</i>
River Forks State Park	1	Succession	Prepare Mgt. Plan. Mech. or natural shrub removal	33% federal, 34% state, 33% private	64 ha (157 ac)	<i>Limnanthes gracilis</i> ssp. <i>gracilis</i> , <i>Lomatium cookii</i>
Rough and Ready Creek	2	Succession – development	Private Mech. or Lease/ Easement natural shrub removal	16% federal, 84% private	659 ha (1628 ac)	<i>Limnanthes gracilis</i> ssp. <i>gracilis</i> , <i>Lomatium cookii</i>
Sucker Creek	3	Succession – development	Lease/Easement	25% federal, 75% private	124 ha (307 ac)	none

Core Area Sites	Priority Level	Threats	Recommendations	Ownership	Area	Listed or rare species known from site
Rogue River Valley Recovery Unit						
Agate Desert	1	Succession/ Invasive weeds	Monitoring, weed control, native plant introduction, Lease/easement	32% State, 8% County, 10% city, 50% private	497 ha (1,228 ac)	<i>Limnanthes floccosa</i> ssp. <i>grandiflora</i> , <i>Lomatium cookii</i> , vernal pool fairy shrimp, hairy water flea
Agate Lake	2	Development/ invasive weeds	Management plan	10% federal, 2% county, 88% private	536 ha (1,324 ac)	<i>Limnanthes floccosa</i> ssp. <i>grandiflora</i> , vernal pool fairy shrimp
North Eagle Point	2	Development	Lease/Easement	100% Private	575 ha (1,421 ac)	<i>Limnanthes floccosa</i> ssp. <i>grandiflora</i> , vernal pool fairy shrimp
Rogue Airfield	1	Airport development - fragmentation	Management plan development	1% state, 80% county, 19% private	157 ha (388 ac)	<i>Limnanthes floccosa</i> ssp. <i>grandiflora</i> , <i>Lomatium cookii</i>
Rogue Plains	1	Grazing, invasive weeds	Monitoring, weed control, native plant introduction	100% Private	318 ha (786 ac)	<i>Limnanthes floccosa</i> ssp. <i>grandiflora</i> , <i>Navarretia heterandra</i> , vernal pool fairy shrimp
Shady Cove	2	Unknown	Monitoring,	100% Private	63 ha (156 ac)	<i>Limnanthes floccosa</i> ssp. <i>grandiflora</i>
Staley Road	2	Unknown	Monitoring,	100% Private	81 ha (201 ac)	<i>Limnanthes floccosa</i> ssp. <i>grandiflora</i> , vernal pool fairy shrimp
Table Rock Terrace	2	Grazing	Monitoring, weed control, native plant introduction	100% Private	82 ha (203 ac)	<i>Limnanthes floccosa</i> ssp. <i>pumila</i> , <i>Plagiobothrys austini</i> , <i>Plagiobothrys glyptosperma</i> , <i>Plagiobothrys greenei</i> , vernal pool fairy shrimp
Whetstone Creek	1	Invasive weeds	Monitoring, weed control	13% city, 87% private	339 ha (837 ac)	<i>Limnanthes floccosa</i> ssp. <i>grandiflora</i> , <i>Lomatium cookii</i> , vernal pool fairy shrimp

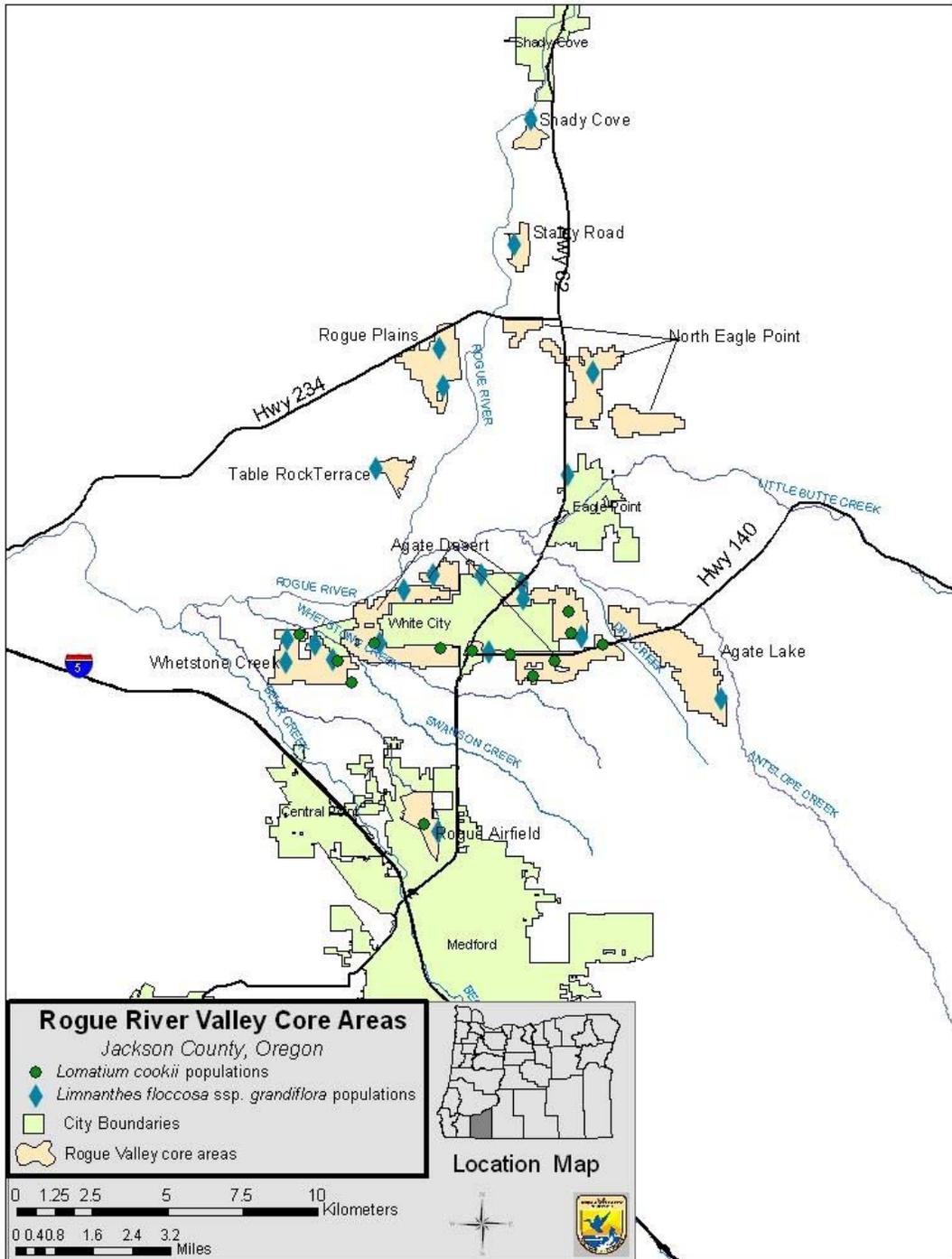


Figure IV-1. Rogue River Valley Core Areas for *Lomatium cookii* and *Limnanthes floccosa* ssp. *grandiflora*.

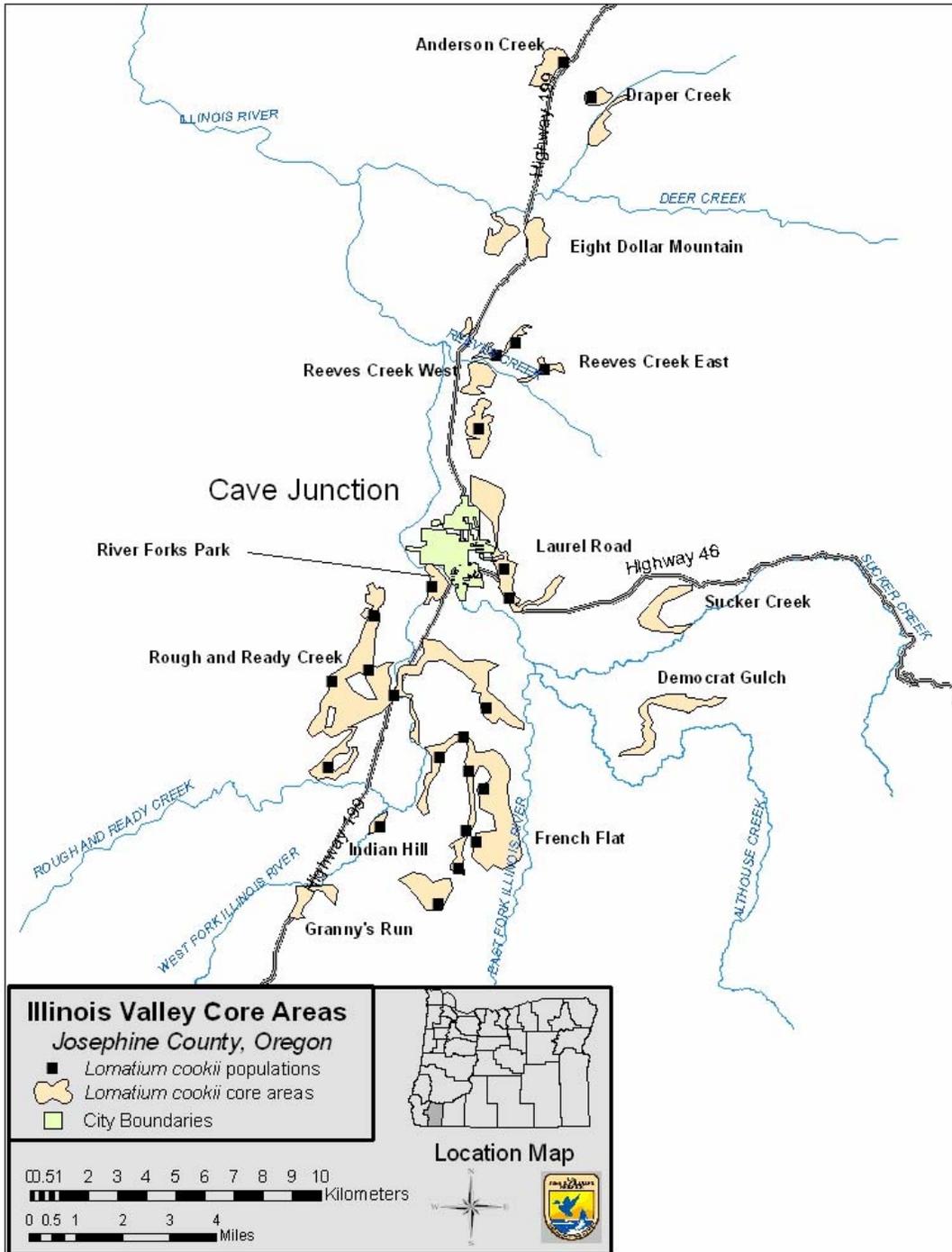


Figure IV-2. Illinois River Valley Core Areas for *Lomatium cookii*

F. NARRATIVE OUTLINE OF RECOVERY ACTIONS

Implementation Participation. Although we have the statutory responsibility for implementing this draft recovery plan, and only Federal agencies are mandated to take part in the effort, the participation of various stakeholders is the key to successful recovery of these species. This draft recovery plan recommends the establishment of regional recovery implementation working groups representing all stakeholders and interested parties to develop participation plans, coordinate education and outreach efforts, assist in developing economic incentives for conservation and recovery, ensure that adaptive management is practiced, and overseeing the recovery of the species covered in this draft recovery plan.

1. Protect vernal pool and wet meadow habitat

All actions to protect habitat address the most critical threat (loss of habitat by development) and are highest priority actions. The amounts and locations of habitat to protect cannot be precisely defined because we lack refined information to determine appropriate reserve size, buffer sizes necessary to minimize the threats of adjacent incompatible land uses, current and historical distributions of species, basic biological needs and life histories of species, upland habitat requirements of pollinators of vernal pool plants, amount of upland habitat (*i.e.*, watersheds) contributing to, and necessary for the maintenance of, vernal pool hydrological function, and landscape distribution of vernal pools and vernal pool complexes needed to provide for dispersal and genetic exchange.

The recovery strategy, actions, and criteria recommend protection of populations over the entire geographic and ecological distribution of each species in order to ensure representation of genetic variation. Designation of recovery units for each species and identification of prioritized core areas is intended to assist in protecting species across their full geographic and ecological distributions and thus ensure preservation of the range of genetic variation. Reintroductions and/or introductions also are recommended for recovery units and soil types from which a species has been extirpated.

- 1.1 Perform standardized site assessments to determine priority areas for protection within core areas for conservation of the species.

A standardized site assessments guide should be developed prior to actual assessments so that the critical areas can be prioritized for conservation and protection, threats can be eliminated or reduced, and population dynamics can be better understood.

- 1.1.1 Develop standardized site assessment guide and protocol to determine priority criteria for site evaluation. (Priority 1)

This guide will determine which aspects best determine highest priority habitat within core areas and a protocol to follow. Aspects of the assessment should include habitat function, number of target species, presence of listed species (priority will be given to rarest species found), connectivity to other populations, condition of habitat for function and value, historical listed species presence, and level of threats.

- 1.1.2 Perform assessments for listed and rare species suitable habitats based on agency and state database records, herbarium records, geo-referenced data including hydrology, soils, and land use and aerial photos.

- 1.1.2.1 Create or refine Geographic Information Systems spatial data files identifying currently occupied habitat patches for all concerned vernal pool and wet meadow species.

Spatial data files will enable population surveys to focus concerted efforts on known species sites and refine boundaries and extents of recovery core areas. (Priority 2)

- 1.1.3 Perform site and species assessment surveys in Rogue River Valley vernal pool areas that are focused on core areas (“Klamath Mountains vernal pool region” in Vernal Pool Ecosystems Recovery Plan). (Priority 1)

Site and species assessment surveys will include field surveys during the appropriate season as defined in the protocol established under Action 1.1.1.

- 1.1.4 Perform site and species assessment surveys in Illinois Valley wet meadow areas focused on core areas. (Priority 1)

Site and species assessment surveys will include field surveys during the appropriate season as defined in the protocol established under Action 1.1.1.

- 1.2 Refine recovery core areas for focused conservation efforts based on new biological and geographic data as site assessment information becomes available. (Priority 1)

Results of site assessments will greatly refine recovery core areas in the Rogue River and Illinois Valley to direct and focus recovery actions. In order to maintain stable and viable populations and achieve adequate geographic distribution and representation of the species, refinement of recovery core areas is necessary to achieve realistic recovery goals.

- 1.3 Protect known species occurrences, newly identified species occurrences, potential species occurrences, and their vernal pool or wet meadow habitat.

Standardized vernal pool species surveys and standardized vernal pool habitat site assessments should be used to identify sites for protection. The network of conservation areas will include small, large, and intermediate-sized reserves. Large reserves are preferred because they minimize per-acre management costs, make it possible to preserve historic management regimes, where appropriate, for listed and special status species, reduce edge effect, and increase the likelihood of survival for their resident species by maintaining more ecosystem functions. However, small reserves also can contribute to recovery. Often, small areas are all that remain of formerly large vernal pool ecosystems and represent unique genotypes or ecological conditions. Results of research into habitat needs will help determine minimum reserve size and optimal buffer size.

Much of the natural land that contains species covered in this draft recovery plan needs to be protected in perpetuity. Protection in perpetuity of these lands includes the permanent reduction or elimination of the threats and application of appropriate and adaptive management to ensure species survival and recovery. In other cases, there may be lands that can contribute to the recovery or long-term conservation of vernal pool species that does not need protection in perpetuity. For example, for some vernal pool plant species, including some plants and shrimp, lands that occur within modern urban areas may need to be preserved only until species occurring in those areas can be translocated, providing that scientifically collected data have shown that translocation of these species is successful and will benefit the species, appropriate habitat is available, and that strict success criteria have been developed.

- 1.3.1 Coordinate with Federal agencies and other Fish and Wildlife Service programs through consultation or conservation agreements to use their authority to establish new protection areas for the listed

species based on new information from site assessments and add lands to existing special protection areas. (Priority 1)

Based on information from range-wide site assessments, areas on Federal lands could be identified and protected to promote species conservation and ensure their long term viability.

Federal agencies can enter into cooperative partnerships, ensure adequate management plans are developed and implemented, develop conservation programs through section 7(a)(1) of the Endangered Species Act, and minimize and avoid habitat loss through section 7(a)(2) consultations.

- 1.3.2 Establish new preserves and add lands to existing preserves for the listed species through coordination with local, county and state agencies. (Priority 1 and 2)

Based on information from range-wide site assessments, areas could be identified and protected that promote species conservation and ensure their long term viability. See Table IV-1 for priority levels of specific core areas.

- 1.3.3. Pursue protection of known or newly discovered listed species occurrences based on new information from site assessments and add lands to existing preserves through coordination with private landowners and private land trust organizations. (Priority 1 and 2)

Many of these occurrences contain numerous discrete sub-occurrences scattered over a few square kilometers in an area of mixed ownership. The land supporting these occurrences is owned and managed by various parties, including the Bureau of Land Management, industrial timber companies, nonindustrial companies, and ranch owners (*i.e.*, from tens to hundreds of hectares), and relatively small-property residential owners (approximately 2 to 8 hectares [5 to 20 acres]). Protection agreements and strategies will likely vary depending on the particular owner or manager and the specific location of the species occurrence or sub-occurrence. See Table IV-1 for priority levels of specific core areas.

2. Manage and restore vernal pool and wet meadow habitat.

Management plans will be developed to conserve the listed species occurring at each site. Elements of plans may include: Restriction of off-road vehicle use by fencing access roads into preserves using proper signage to restrict vehicle access and inadvertent habitat destruction; habitat restoration and noxious weed prevention programs; use of mowing, burning, or managed grazing to reduce density of native and nonnative vegetation; monitoring effects of management actions for effectiveness, employing adaptive modification; continued monitoring of known *Lomatium cookii*, *Limnanthes floccosa* ssp. *grandiflora*, and vernal pool fairy shrimp populations on extant sites; surveys for new sites in appropriate habitat; or population introductions into unoccupied habitat. Management plans should identify responsibilities of the management agency or organization to protect species.

- 2.1 Develop a recovery implementation team to guide the recovery of the Rogue RiverValley vernal pool ecosystem species. (Priority 1)

A recovery implementation team should be assembled that incorporates stakeholders, nongovernment organization staff, and species and habitat experts with local government agency staff to direct and prioritize recovery actions, track the status of the species and management plans, and present informed and scientifically-based solutions to resolve potential complications in recovery implementation.

An implementation team should work cooperatively to implement specific actions necessary to recover the listed species and conserve the species of concern addressed in this draft recovery plan. Additionally, working groups should provide the recovery implementation team with a participation plan and with annual reports of activities including recommendations for future recovery actions or changes to existing actions to benefit species.

- 2.1.1 Develop a recovery working group to guide the recovery of the Rogue Valley vernal pool ecosystem species. (Priority 1)
- 2.1.2 Develop a recovery working group to guide the recovery of the Illinois Valley wet meadow ecosystem species. (Priority 1)

- 2.2 Develop long term management plans at State and Federal administrative units with extant populations or suitable habitat for these species.

Long-term, comprehensive habitat management and monitoring plans are necessary to ensure that protected lands are managed to reduce and eliminate the threats that caused the species addressed in this draft recovery plan to become listed or species of concern. Long-term,

comprehensive habitat management and monitoring plans should be developed and implemented to address habitat management activities (e.g., prescriptions for control or removal of invasive species), existing threats (e.g., habitat degradation due to inappropriate levels of recreational use), species and habitat responses to habitat management activities, incorporation of monitoring results into habitat management plans, and schedule for the completion of operations and maintenance of ongoing routine tasks and one-time tasks.

Often resource assessments conducted prior to plan development are necessary to prepare management plans that more realistically address threat reduction and management activities.

2.2.1. Revise the management plan for the Oregon Department of Fish and Wildlife Denman Wildlife Area. (Priority 2)

The Denman Wildlife Area is currently revising its management plan address conservation for vernal pool fairy shrimp, *Limnanthus floccosa* ssp. *grandiflora* and *Lomatium cookii*. A revised management plan could address threats of nonnative weeds and planted nonnative grasses, species population monitoring, and habitat restoration.

2.2.2 Finalize the management plan for the Bureau of Land Management Table Rock Area of Critical Environmental Concern. (Priority 2)

A management plan is under preparation for the Table Rock area by the Bureau of Land Management that will establish vernal pool habitat protection for threats from grazing and pedestrian usage. Site assessments are underway to evaluate vernal pool quality, presence of vernal pool fairy shrimp to prioritize management actions and determine focal areas.

2.2.3 Finalize the management plan for the Bureau of Reclamation Agate Lake Area. (Priority 2)

An Agate Lake management plan is under development in order to conserve and better protect vernal pool habitats. Management actions may include restoration of vernal pool habitat, reduction of nonnative weed threats, habitat assessments, and procedures to reduce impacts from maintenance activities. Monitoring efforts will determine if *Lomatium cookii* occurs at the

area and will attempt to relocate a historical record of *Limnanthes floccosa* ssp. *grandiflora*.

2.2.4 Develop a management plan for Oregon Parks Department River Forks State Park.

A River Forks State Park management plan will be prepared following a resource assessment to determine areas of *Lomatium cookii* that are most threatened by succession of native woody vegetation, noxious weeds, or visitor impacts. The assessment will also establish a baseline to track population changes and determine plant's status.

2.2.4.1 Complete a resource assessment for Oregon State Parks Department, River Forks State Parks. (Priority 2)

A resource assessment to determine resources needs and concerns is necessary to refine management strategies, objectives, and actions.

2.2.4.2 Develop a *Lomatium cookii* management plan for River Forks State Park. (Priority 2)

A species specific management plan will be prepared to reduce or eliminate threats to park plant populations and track changes in population status.

2.2.5 Develop a management plan for Oregon Department of Transportation Special Management Areas in Jackson and Josephine Counties. (Priority 2)

A management plan for the Oregon Department of Transportation Special Management Areas would include site habitat assessments, threat reduction practices, population monitoring, and conservation measures to reduce or eliminate impacts from road maintenance actions.

2.2.6 Revise the species management plan for the Rogue Valley International Airport. (Priority 2)

A revised species management plan for the Rogue Valley International Airport could incorporate new information to reduce

threats and install conservation measures to reduce or eliminate impacts from airport maintenance actions.

2.2.7 Finalize the Agate Desert Wetland Conservation Plan/Habitat Conservation Plan. (Priority 2)

An area assessment is underway that will guide the Agate Desert Wetland Conservation Plan and Agate Desert Habitat Conservation Plan. The final conservation plans will manage for approximately 1,477 hectares (3,650 acres) of vernal pool fairy shrimp habitat. The Rogue Valley Council of Governments has secured grants from U.S. Fish and Wildlife Service and Environmental Protection Agency to support a coordinated planning effort to address the increasing conflicts between continuing development pressure particularly within and near urbanizing areas, and vernal pool wetland protection.

2.3 Revise existing management plans to reflect new research findings or information as it becomes available. (Priority 2)

This recovery action can be accomplished through coordination with State and Federal agencies, city managers, landowners, and private land trust organizations. The following actions specifically address threats for the two species.

2.4 Enhance, restore, and create vernal pool habitats, as necessary, to promote the recovery and long-term conservation of the species addressed in this draft recovery plan. (Priority 2)

Degraded or destroyed vernal pool habitat may require rehabilitation in order to improve habitat to support species' populations. Restoration and creation of vernal pool habitat will play an important part in the recovery of the species. In all cases practicable, existing pools should be used as a model for enhancement, restoration, and creation. Vernal pool creation should only be accomplished when enhancement and restoration are not possible. Following successful restoration, the feasibility of listed species introduction can be considered.

2.4.1 Develop scientifically based site specific criteria to measure restoration, enhancement, or creation success. (Priority 3)

Both the actual mechanisms and the success criteria for enhancement, restoration, and creation of vernal pool habitat may

differ in various vernal pool areas based on geographic, topographic, and edaphic characteristics of the individual pools. However, they should be developed as uniformly as possible (*i.e.*, standardized) to minimize ambiguity between areas. Also, mechanisms and success criteria should have both Federal and State interagency endorsement to ensure they are regionally applicable and accepted.

- 2.4.2 Identify and prioritize areas of historically occupied habitat with potentially suitable habitat for restoration and management for *Lomatium cookii*, *Limnanthes floccosa* ssp. *grandiflora*, and vernal pool fairy shrimp. (Priority 1)

Historical plant and vernal pool fairy shrimp populations that are currently declining or extirpated can potentially be restored or enhanced using wetland restoration techniques currently in the process of development.

- 2.4.3 Develop an augmentation plan to collect and propagate seed that can later be utilized for population restoration, augmentation, and introduction.

- 2.4.3.1 Identify and prioritize appropriate seed collection sites with the permission and cooperation from both public and private landowners.

Range wide population surveys coupled with outreach may be necessary to identify appropriate seed collection sites.

Plant taxa for which seed banking is necessary are given priority by their listing status. Priority 1 taxa are federally listed species, Priority 2 taxa are State listed species, and Priority 3 taxa are State candidate and other nonlisted species.

Ideally, seeds should be banked from at least one population in each core area. For plant taxa with 10 extant occurrences or fewer, seeds should be banked from every known occurrence. After genetic studies are completed, additional collections should be made from each population that contains unique genotypes. Repeated, small collections of seed may be necessary over several years to avoid

contributing to the decline of very small populations. The Center for Plant Conservation (1991) detailed the considerations for seed collection in its “Genetic Sampling Guidelines for Conservation Collections of Endangered Plants.” Seed collections from each population of each taxon should be stored in at least two sites, including the National Center for Genetic Resources Preservation in Fort Collins, Colorado, and a facility certified by the Center for Plant Conservation.

2.4.3.2 Secure seed source at offsite locations and nurseries through land leases, partnerships, or agreements. (Priority 1)

An available supply of seeds retained through conservation easements, partnerships, and agreements will facilitate introductions and population augmentations for the listed and conservation species in protected areas. Conservation agreements and easements will also promote partnerships and sharing of conservation goals.

2.4.3.3 Collect and store seeds from extant sites. (Priority 2)

2.4.4 Introduce or reintroduce listed species populations to suitable habitat.

Introductions into suitable protected localities may be considered for specific sites following assessment of feasibility and likely population viability.

3. Conduct rangewide population status surveys and monitoring

A status survey is a detailed process comprising a literature review, and examination of herbarium or museum specimens, and a series of surveys conducted throughout a species’ range. All historical localities of a species are identified, potential locations where the species may occur are predicted based on distributional and ecological data, all historical and potential locations are surveyed for presence of a species at the appropriate time of year, all known and newly identified locations are surveyed to determine species population sizes and status of threats, and recommendations for improving conservation efforts are made for each locality.

An on-going, long term monitoring plan has been implemented in the Illinois Valley on Bureau of Land Management administered lands and in the Agate Desert on The Nature Conservancy lands.

- 3.1 Develop and expand a standard monitoring protocol to be used by all entities conducting monitoring programs beginning with core areas . (Priority 2)

Existing Nature Conservancy and Bureau of Land Management monitoring efforts for listed species conducted annually should be utilized so that data can compare with future surveys, assessments, and monitoring results.

- 3.2 Continue ongoing survey efforts for all taxa in this recovery plan. (Priority 1)

In order to develop and update species status and refine recovery actions, continuing survey efforts of known populations used with Geographic Information Systems mapping will be necessary to track recovery and refine recovery actions. Data sets collected from previous listed species surveys in the Rogue River and Illinois Valleys will be utilized as baselines for comparisons and refined for a more up to date population status.

- 3.3 Survey for additional occurrences of the listed plant species. (Priority 1)

Areas of potential habitat for *Limnanthes floccosa* ssp. *grandiflora*, *Lomatium cookii*, and vernal pool fairy shrimp remain unsurveyed, particularly on private land. Recently identified occurrences (Jackson School District and Commerce Street) on county and private lands indicate the potential for discovering additional occurrences.

- 3.4 Perform core area site assessments for the 22 core areas. (Priority 1)

The core areas include historical listed plant occurrences and represent the full range and distribution of the species. At these core areas focused conservation actions and site assessment surveys should be conducted to refine and prioritize recovery actions.

- 3.5 Establish an outreach program to facilitate access on private lands for surveys. (Priority 1)

Private landowners may be wary of permitting agency biologists or contractors to examine their property due to fear that use restrictions may be placed on their land if a listed species is identified. Agency outreach efforts can enable landowners to take advantage of Safe Harbor agreements, conservation agreements, and easements so that *Limnanthes floccosa* ssp. *grandiflora*, *Lomatium cookii* and vernal pool fairy shrimp conservation is compatible with ongoing land uses (e.g., ranching).

- 3.6 Periodically review progress toward listed species recovery and long-term conservation of nonlisted species and identify those species warranting a change in status (downlisting, delisting, uplisting, or listing).

These reviews should be based on results of standardized status surveys and other information from research, habitat protection, management, and monitoring actions.

- 3.6.1 Conduct status reviews of listed species in this recovery plan and identify those species warranting a change in status. (Priority 2)
- 3.6.2 Conduct status reviews of nonlisted species in this recovery plan. (Priority 3)

4. Conduct research essential to the conservation of these species.

In addition to or in conjunction with current monitoring and research efforts, provide opportunities for further research with schools, State and local governments, or private endeavors. The following are areas for critical research needed for effective management of these species:

- 4.1 Conduct viability assessments based on the most recent data and apply the results to refine recovery actions and criteria, habitat management, and threat reduction actions for both *Lomatium cookii* and *Limnanthes floccosa* ssp. *grandiflora*. (Priority 1)

A population viability assessment will refine criteria for recovery and management goals. An understanding of the species viability will also guide restoration and enhancement practices within the range of the two listed species. Population viability analysis and demographic modeling is the use of quantitative methods to analyze the environmental and demographic factors that affect the survival of populations. Population viability analyses and demographic modeling usually require detailed and

specific life history information such as recruitment, survival, reproductive rates, mortality, and immigration and emigration rates.

During this preparation, rarity of species, risk of losing them, management sensitivity/conflicting uses, suitability of the species to the techniques, and availability of monitoring and research resources should be considered. Also considered should be species life histories and whether species demographics are easily monitored and characterized (difficult for species with long-lived seedbanks, very short or very long life-spans, episodic reproduction, or large populations on heterogeneous habitats).

- 4.2 Implement standardized monitoring to document ecosystem and species responses to interim habitat management activities. (Priority 2)

It is necessary to conduct effectiveness monitoring to habitat management activities to enable adaptive management practices. Monitoring will also help guide our understanding of management activities effects so that management plan activities can be fine-tuned to meet success criteria.

- 4.3 Research associated micro and macro flora and fauna (crypto-biotic crusts) as indicators for vernal pool health and function. (Priority 3)

Understanding of the relationship between soil crusts and vernal pool ecosystem health will enable managers to establish additional success criteria in vernal pool restoration and enhancement evaluations. The research may provide clues to better understand ecosystem dynamics of vernal pools.

- 4.4 Study pollination vectors between and among populations. (Priority 2)

Pollination vectors are often used to define how populations are linked as pollinators establish a genetic link between populations. Genetically isolated populations may be considered to be a higher conservation priority. This information can refine protection boundaries in core areas and managers may utilize pollination information to form conservation measures.

- 4.5 Research role of mammals, insects, birds, and wind as seed dispersal vectors. (Priority 2)

The understanding of how seed is dispersed for these species is not fully understood. The rate that animals and wind distributes seed may lead to

an entirely new understanding of how populations become distributed and why they persist only in localized areas. For a population to survive, individuals must pass their genes on to subsequent generations and colonize appropriate habitat. For plants, this entails dispersal of seeds and pollen. In the absence of data regarding dispersal mechanisms for vernal pool species, there is no appropriate manner to ensure decisions about reserve size and location, habitat management activities, and corridor establishment between reserves function properly to provide for adequate gene flow to promote population viability.

- 4.6 Evaluate techniques to reduce impacts from encroachment of native woody plant succession. (Priority 3)

Lomatium cookii populations in the Illinois Valley are largely threatened by succession of woody plants due to fire exclusion. Restoration techniques need to be studied to determine the most feasible methods of habitat restoration. Thinning, brushing, burning or combinations of these should be evaluated for cost effectiveness, efficiency, and greatest benefit to species long term viability.

- 4.7 Conduct research on prescribed burning, mowing, and native planting of introduced annual grasses. (Priority 3)

In the Rogue Valley, exotic grasses such as *Taeniatherum caput-medusae* have infested extensive tracts of vernal pools. The success of techniques such as prescribed burning, mowing, native grass and forb cultivation, and combinations thereof to achieve pre-grazing conditions should be evaluated to formulate an exotic grass reduction protocol that can be readily available to land managers and landowners.

- 4.8 Refine research on appropriate grazing practices. (Priority 2)

Appropriate grazing can be a surrogate for historical fires that periodically reduced the grass cover to enable germination of listed plants. Appropriate grazing may facilitate seed distribution and stimulate ecosystem health. This information will provide a tool to area managers to aid in conservation and promote ecosystem health.

- 4.9 Research genetic and morphologic traits among individuals and populations. (Priority 1)

Priorities for genetics studies are as follows: 1) species that require reintroduction and/or introduction; 2) species that will require seed or cyst

banking because of high risk of extirpations due to random events; 3) species/populations that have experienced extreme reductions in range and/or population numbers that may now require genetic management to offset deleterious effects of genetic drift, bottlenecks and inbreeding depression, etc.

- 4.10 Investigate restoration and recovery of historical or current plant populations that were subject to biosolids, fill, and log debris application. (Priority 2)

Restoration of historical vernal pool habitat is being pursued in the Rogue River Valley on habitat that was partially leveled, filled with woody debris or biosolids. Research can assess various techniques to achieve faster restoration of vernal pool and wet meadow habitats while stimulating ecosystem health. This information can also provide a tool to area managers to aid in conservation and promote ecosystem health.

- 4.11 Conduct research on community habitat criteria including distribution of plants and the local plant associations, microgeographic locations, hydrology, and moisture and edaphic regimes that the species prefer or will best tolerate. (Priority 2)

This recovery action will determine distribution of plants, local plant associations, microgeographic locations, hydrology, and elevations that the species prefer or will best tolerate. Information will help area managers to better conserve habitat and promote ecosystem health.

- 4.12 Develop offsite and onsite cultivation and propagation techniques for *Lomatium cookii* and *Limnanthes floccosa* ssp. *grandiflora*. (Priority 1)

A necessary step to restore and recover populations for the two listed plants is to evaluate cultivation and propagation techniques to establish standardized procedures and protocols. Success criteria should be established prior to commencing cultivation and propagation studies. A standardized protocol will enable a larger number of nurseries to participate in recovery so that species genetics can be better preserved.

5. Enhance public awareness and participation in recovery of the species.

Through schools, local community meetings, county, city, and State fairs, or other venues, establish contacts with private landowners to provide information about the three listed species. We will seek to involve stakeholders in the recovery planning and implementation process. Stakeholders are those parties that may be affected by proposed

recovery actions, and may include, but are not limited to, Federal and State agencies, Tribal governments, county and city governments, nongovernmental organizations, and private landowners.

- 5.1 Prepare and implement an outreach strategy for enlisting stakeholder involvement in the implementation of the recovery plan. (Priority 2)

An outreach strategy with success criteria should be prepared to better focus outreach efforts. Options for outreach should be pursued so that all possible sources and assistance can be utilized for creating outreach opportunities and with a goal to enlist stakeholder involvement and participation in the recovery plan.

- 5.2 Establish contacts with the public to provide information about these species.

Participation in public community or municipal planning events will enable the public to understand our mission towards forming partnerships to conserve and protect threatened and endangered species and their habitat. By meeting new people, we can increase opportunities to encounter willing landowners who are interesting in contributing to endangered species conservation on their properties.

- 5.2.1 Create and distribute plant and animal identification and habitat restoration guides to landowners and the general public regarding plant and animal species included in this recovery plan. (Priority 2)

The general public will be given the opportunity to know how the listed species look, be made aware the reasons for the decline of these species, their original ranges, and be encouraged to participate in recovery efforts. Additionally, we should assist in developing distributing identification and information guides. Circulation of these guides will help the local public to recognize plant species. As vernal pool fairy shrimp are difficult to identify and view during most of the year, the guide will describe intact vernal pool mounded prairie complexes and what kinds of factors enable functioning habitats.

- 5.2.2 Participate at local wildflower and outdoor shows (Glide Wildflower Show, Shady Cove Wildflower Show, Jackson County Outdoor Show, and other public events). (Priority 3)

Vernal pool displays at the annual Jackson County Outdoor Show in Medford, Oregon in February and the Glide Wildflower Show in Glide, Oregon in late April should be continued. A vernal pool display should be presented at the Shady Cove Wildflower Show in Shady Cove, Oregon in May. When feasible, staff from various regulatory and management agencies (U.S. Fish and Wildlife Service, Oregon Department of Fish and Game, Bureau of Land Management, etc.) should be available to discuss vernal pool ecosystems with interested attendees of the show. In addition to the general information contained in the display, updated information on conservation activity should also be included as recovery efforts continue. Through participation in outdoor events identification of potential stakeholders with interests in recovery implementation for species covered in this recovery plan can be accomplished.

5.2.3 Invite the public to assist in long term monitoring. (Priority 3)

To the extent feasible, interested members of the public should be invited to participate in long-term monitoring of *Lomatium cookii*, *Limnanthes floccosa* ssp. *grandiflora* and vernal pool fairy shrimp populations. Training of volunteers will foster public awareness of local listed species and local environmental changes, as well as provide a relatively low-cost labor pool to contribute to monitoring efforts.

5.2.4 Provide schools within the area covered by the recovery plan with information about the species and recovery efforts (Priority 3).

To foster interest about special status species among young people, schools within the area covered by the recovery plan should be provided with information about all of the covered species and recovery efforts.

5.3 Identify key stakeholders with potential interest in recovery implementation for these species. (Priority 2)

Identifying key stakeholders is critical step in outreach strategy. Stakeholders often play a dynamic and essential role in the recovery of the listed species. Because many of the core areas for focused conservation efforts are on private lands, it is vital to establish strong bonds with local stakeholders to share in the recovery effort.

- 5.4 Coordinate with stakeholders in the development of management plans and conservation easements. (Priority 1)

Working with stakeholders is vital in the development of local management plans. State and Federal agencies are developing management plans that will affect local stakeholders. Participation of stakeholders in management plan development is important so that more realistic management actions can be pursued. Formation of conservation easements with local stakeholders will be an important and a crucial step towards building networks of protected habitat and establishing important seed sources.

6. Develop a post-delisting monitoring plan for *Lomatium cookii* and *Limnanthes floccosa* ssp. *grandiflora*.

Prior to delisting a five-year monitoring plan should be developed and in effect. Monitoring and research results should be used to guide the long-term conservation of the species.

V. IMPLEMENTATION SCHEDULE

The following Implementation Schedule is a guide for meeting the objectives discussed in Part IV of this plan. This schedule indicates recovery action priorities, action numbers, brief action descriptions, duration of actions, the responsible agencies, and lastly, estimated costs. These actions, when accomplished, should bring about the recovery of *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii* and protect their habitat.

Priority. The priority for each recovery action is given in the first column of the implementation schedule. Priorities are defined as follows:

- Priority 1: An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.
- Priority 2: An action that must be taken to prevent a significant decline in the species' population, habitat quality, or some other significant negative impact short of extinction.
- Priority 3: All other actions necessary to meet the recovery or conservation objectives.

Action Number and Description. The action number and description are extracted from the Stepdown Narrative found in Part IV of this recovery plan. Please refer back to this narrative for a more detailed description of each action.

Definition of action durations:

- Continual: An action that will be implemented on a routine basis once begun.
- Ongoing: An action that is currently being implemented and will continue until action is no longer necessary.
- TBD: To be determined.
- Unknown: Either action duration or associated costs are not known at this time.

Threats Addressed. This column addresses the five listing factors that the particular recovery action will eliminate or reduce. The listing factors, represented by A through E in the implementation plan, are presented in the Reasons for Listing section (page III-1-III-5) and reflect the threats found in section 4(a) of the Endangered Species Act.

Responsible Parties. In the implementation schedule, we have identified agencies and other parties that are primary stakeholders in the recovery process. The list of potential

stakeholders is not limited to the list below; other stakeholders are invited to participate. The most logical lead agency or agencies from the list of responsible parties (based on authorities, mandates, and capabilities) has been identified with an asterisk (*). The following abbreviations are used to indicate the responsible party for each recovery action:

Key to Acronyms used in the Implementation Schedule:

Berry	Berry Botanical Garden
BLM	Bureau of Land Management
BOR	Bureau of Reclamation
CITY	Cities of Cave Junction, Medford, and White City
COE	Army Corps of Engineers
DSL	Oregon Division of State Lands
FAA	Federal Aviation Authority
FHA	Federal Highway Administration
FWS	U.S. Fish and Wildlife Service, Roseburg Field Office or Oregon Fish and Wildlife Office
JAC	Jackson County
JOS	Josephine County
ODA	Oregon Department of Agriculture
ODOT	Oregon Department of Transportation
OSP	Oregon State Parks
RVCOG	Rogue Valley Council of Governments
TNC	The Nature Conservancy
Total Cost	Projected cost of each action from start to completion
* - Lead Agency	

Cost Estimates. Estimated total and annual cost for each recovery action for the first 5 years after release of the recovery plan are shown. Total costs for continual and ongoing actions are based on the estimated time to recovery. The costs include estimated salaries for individuals who will carry out identified actions. However, these costs are approximate and based primarily on estimates agreed on by various State, Federal and local government agencies and nongovernment organizations. In most cases these costs were estimated without the benefit of a scope-of-work or any other type of bid process. Typically, the responsible party (or lead agency) bears the largest share of the cost, with other stakeholders as contributors. The inclusion of estimated costs in this recovery plan does not commit any agency or party to an expenditure of funds. Therefore, initiation and completion of these actions is subject to the availability of funds as well as other constraints affecting the stakeholders involved.

Note: See Vernal Pool Ecosystem Recovery Plan (U.S. Fish and Wildlife Service 2005) for implementation schedule requirements for vernal pool fairy shrimp.

Implementation Schedule for Rogue Valley Vernal Pool and Illinois Valley Wet Meadows Ecosystem Recovery Plan											
Priority Number	Action Number	Threats Addressed	Action Description	Action Duration (Years)	Responsible Party	Total Cost	Cost Estimates, in thousands of dollars per fiscal year				
							2006	2007	2008	2009	2010
1	1.1.1	A,E	Develop standardized site assessment guidance.	3	ALL	40	20	20			
1	1.1.3	A,E	Perform site and species assessments for Rogue Valley vernal pool areas.	2	FWS*, ODA, TNC	40		20	20		
1	1.1.4	A,E	Perform site and species assessments for Illinois Valley wet meadow areas.	2	FWS*, ODA, BLM	40		20	20		
1	1.2	A,E	Refine recovery core areas for focused conservation efforts based on new information.	1	FWS*, ODA, TNC	10				10	
1	1.3.1	A	Coordinate with Federal agencies through consultation or conservation agreements to use their authority to establish new preserves for the listed species based on new information.	Continue until delisted	FWS*, BLM, BOR	100	5	5	5	5	5

Implementation Schedule for Rogue Valley Vernal Pool and Illinois Valley Wet Meadows Ecosystem Recovery Plan											
Priority Number	Action Number	Threats Addressed	Action Description	Action Duration (Years)	Responsible Party	Total Cost	Cost Estimates, in thousands of dollars per fiscal year				
							2006	2007	2008	2009	2010
1	1.3.2	A	Establish new preserves and add lands to existing preserves for the listed species through coordination with local, county and state agencies.	Continue until delisted	FWS*, ODA, ODOT, RVCOG, CITY	TBD				34	
1	1.3.3	A,D	Pursue protection of new preserves and add lands to existing preserves through coordination with private landowners and private land trust organizations.	Continue until delisted	FWS*, TNC, RVCOG	200	10	10	10	10	10
1	2.1	A,D,E	Develop a recovery implementation team to guide the recovery of the ecosystem species.	Continue until delisted	FWS*, ODA, ODFW, TNC, BLM	200	10	10	10	10	10
1	2.1.1	A,D,E	Develop a recovery working group to guide the recovery of the Rogue Valley vernal pool ecosystem species.	Continue until delisted	FWS*, ODA, ODFW, TNC, BLM	100	5	5	5	5	5

Implementation Schedule for Rogue Valley Vernal Pool and Illinois Valley Wet Meadows Ecosystem Recovery Plan											
Priority Number	Action Number	Threats Addressed	Action Description	Action Duration (Years)	Responsible Party	Total Cost	Cost Estimates, in thousands of dollars per fiscal year				
							2006	2007	2008	2009	2010
1	2.1.2	A,D,E	Develop a recovery working group to guide the recovery of the Illinois Valley wet meadow ecosystem species.	Continue until delisted	FWS*, ODA, ODFW, TNC, BLM	100	5	5	5	5	5
1	2.4.2	A,E	Identify and prioritize areas of historically occupied habitat with potentially suitable habitat for restoration and management for the listed species.	1	FWS*, TNC, BLM, ODA	20	20				
1	2.4.3.2	A,E	Secure seed sources at offsite locations and nurseries through land leases, partnerships or agreements.	10	FWS, BLM, ODA, Berry*	TBD					
1	3.2	A,D	Continue ongoing survey efforts for all taxa in recovery plan.	Continue until delisted	FWS*, ODA, ODOT, JOS, JAC, CITY, RVCOG	TBD					
1	3.3	E	Survey for additional occurrences of the listed plant species.	Continue until delisted	FWS*, ODA, ODOT, DSL, COE, CITY	200	10	10	10	10	10

Implementation Schedule for Rogue Valley Vernal Pool and Illinois Valley Wet Meadows Ecosystem Recovery Plan											
Priority Number	Action Number	Threats Addressed	Action Description	Action Duration (Years)	Responsible Party	Total Cost	Cost Estimates, in thousands of dollars per fiscal year				
							2006	2007	2008	2009	2010
1	3.4	A,D,E	Perform core area site assessments for the 22 core areas.	10	FWS*, ODA, ODOT, JOS, JAC, CITY, RVCOG	100	10		10		10
1	3.5	A,D,E	Establish an outreach program to facilitate access on private lands for surveys.	Continue until delisted	FWS*, ODA, ODOT, JOS, JAC, CITY, RVCOG	TBD					
1	4.1	A,E	Conduct viability assessment based on most recent data and apply results to refine recovery actions and criteria, habitat management, and threat reduction actions for the listed species.	4	FWS*, ODA, SOU, TNC, BLM,	160		40	40	40	40
1	4.9	A, C, E	Research genetic and morphologic traits among individuals and populations.	4	FWS*, ODA, SOU, TNC, BLM,	80	20	20	20	20	
1	4.12	A,C, E	Develop off and onsite cultivation and propagation techniques for the listed plant species.	5	FWS*, ODA, BLM, SOU, TNC	40	8	8	8	8	8

Implementation Schedule for Rogue Valley Vernal Pool and Illinois Valley Wet Meadows Ecosystem Recovery Plan												
Priority Number	Action Number	Threats Addressed	Action Description	Action Duration (Years)	Responsible Party	Total Cost	Cost Estimates, in thousands of dollars per fiscal year					
							2006	2007	2008	2009	2010	
1	5.4	A,D,E	Coordinate with stakeholders in the development of management plans and conservation easements.	4	FWS*, BLM, ODA	20	5	5	5	5		
2	1.1.2.1	A,E	Refine Geographic Information Systems spatial data file identifying currently occupied habitat patches for all concern vernal pool and wet meadow species.	2	FWS*	40		20	20			
2	2.2.1	E	Revise species management plan for the Oregon Department of Fish and Wildlife Denman Wildlife Area.	3	FWS, ODA, ODFW*	10	10	10				
2	2.2.2	E	Finalize species management plan for the Bureau of Land Management Table Rock Area of Critical Environmental Concern.	2	FWS, BLM*	50	25	25				
2	2.2.3	A,C,D,E	Finalize species management plan for the Bureau of Reclamation Agate Lake Area.	1	FWS, BOR*	50						

Implementation Schedule for Rogue Valley Vernal Pool and Illinois Valley Wet Meadows Ecosystem Recovery Plan											
Priority Number	Action Number	Threats Addressed	Action Description	Action Duration (Years)	Responsible Party	Total Cost	Cost Estimates, in thousands of dollars per fiscal year				
							2006	2007	2008	2009	2010
2	2.2.4.1	A	Complete a Resource Assessment for Oregon Parks Department River Forks State Park.	1	FWS, OSP*	10					
2	2.2.4.2	A	Develop <i>Lomatium cookii</i> management plan for River Forks State Park.	2	FWS, OSP*	20	10	10			
2	2.2.5	A	Develop species management plan for Oregon Department of Transportation Special Management Areas in Jackson and Josephine counties.	1	FWS, ODOT*, FHA, JAC, JOS	50		50			
2	2.2.6	A	Revise species management plan for Rogue Valley International Airport.	1	FWS, JAC*, FAA	20		20			
2	2.2.7	A,C,D,E	Finalize the Agate Desert Wetland Conservation Plan/Habitat Conservation Plan.	3	FWS, DSL*, ODOT, TNC, RVCOG	75		25	25	25	
2	2.3	A,D,E	Revise existing management plans to reflect new research or information as it becomes available.	Continue until delisted	FWS*, BLM, BOR, OSP, JAC, JOS,	40	2	2	2	2	2

Implementation Schedule for Rogue Valley Vernal Pool and Illinois Valley Wet Meadows Ecosystem Recovery Plan											
Priority Number	Action Number	Threats Addressed	Action Description	Action Duration (Years)	Responsible Party	Total Cost	Cost Estimates, in thousands of dollars per fiscal year				
							2006	2007	2008	2009	2010
2	2.4	A	Enhance, restore, and create vernal pool habitats, as necessary, to promote the recovery and long-term conservation of the species addressed in this draft recovery plan.	Continue until delisted	FWS*, BLM, BOR, OSP, JAC, JOS,	TBD					
2	2.4.3.1	C, D	Identify and prioritize appropriate collection sites with the permission and cooperation from both public and private landowners.	1	FWS, ODA, Berry*	10	10				
2	2.4.3.3	A,E	Collect and store seeds from extant sites.	6	FWS, BLM, ODA, Berry*	8	2		2		2
2	3.1	E	Develop and expand a standardized monitoring protocol used by all entities conducting monitoring programs beginning with core areas.	2	FWS*, BLM, ODA, ODOT, TNC	5	5	5			
2	3.6.1	A,E	Conduct status reviews of listed species in this recovery plan and identify those species warranting a change in status.	Continue until delisted	FWS*, ODA	40	2	2	2	2	2

Implementation Schedule for Rogue Valley Vernal Pool and Illinois Valley Wet Meadows Ecosystem Recovery Plan											
Priority Number	Action Number	Threats Addressed	Action Description	Action Duration (Years)	Responsible Party	Total Cost	Cost Estimates, in thousands of dollars per fiscal year				
							2006	2007	2008	2009	2010
2	4.2	A,E	Implement standardized monitoring to document ecosystem and species responses to interim habitat management activities.	Continue until delisted	FWS*, ODA, TNC, BLM, OSP, ODOT, BOR,	200	10	10	10	10	10
2	4.4	E	Study pollination vectors between and among populations.	3	FWS*, ODA, SOU, TNC, BLM,	TBD					
2	4.5	E	Investigate role of mammals, insects, birds, and wind as seed dispersal vectors.	3	FWS*, ODA, SOU, TNC, BLM,	TBD					
2	4.8	C,E	Conduct research on appropriate grazing practices.	3	FWS*	TBD					
2	4.10	A,C	Investigate restoration and recovery of historical or current plant populations that were subject to biosolids, fill, and log debris application.	10	FWS*, ODA, SOU, TNC, BOR	60	6	6	6	6	6
2	4.11	A, C	Conduct research on community habitat criteria.	5	FWS*, ODA, SOU, TNC, BLM,	75	15	15	15	15	15

Implementation Schedule for Rogue Valley Vernal Pool and Illinois Valley Wet Meadows Ecosystem Recovery Plan											
Priority Number	Action Number	Threats Addressed	Action Description	Action Duration (Years)	Responsible Party	Total Cost	Cost Estimates, in thousands of dollars per fiscal year				
							2006	2007	2008	2009	2010
2	5.1	A,D,E	Prepare and implement an outreach strategy for enlisting stakeholder involvement in the implementation of the recovery plan.	Continue until delisted	FWS	100	5	5	5	5	5
2	5.2.1	A,C,D	Create and distribute plant identification guides, guides for best management practices and habitat restoration opportunities for the species.	Continue until delisted	FWS, ODA, TNC, BLM	70	8	8	3	3	3
2	5.3	A,D,E	Identify key stakeholders with potential interest in recovery planning for these species.	Continue until delisted	FWS*, BLM, ODA, TNC, RVCOG	40	2	2	2	2	2
3	2.4.1	E	Develop scientifically based site specific criteria to measure restoration, enhancement or creation success.	2	FWS*, TNC, ACOE, RVCOG	20		10	10		
3	3.6.2	A,E	Conduct status reviews of nonlisted species in this recovery plan.	10	FWS*, ODA	20	2		2		2

Implementation Schedule for Rogue Valley Vernal Pool and Illinois Valley Wet Meadows Ecosystem Recovery Plan											
Priority Number	Action Number	Threats Addressed	Action Description	Action Duration (Years)	Responsible Party	Total Cost	Cost Estimates, in thousands of dollars per fiscal year				
							2006	2007	2008	2009	2010
3	4.3	A,E	Research associated micro and macro flora and fauna (crypto-biotic crusts) as indicators for vernal pool health and function.	3	FWS*, ODA, SOU, TNC, BLM,	30	10	10	10		
3	4.6	E	Evaluate techniques to reduce impacts of woody plant succession.	4	FWS*	40	10	10	10	10	
3	4.7	E	Conduct research on prescribed burning, mowing, and native planting on introduced annual grasses.	4	FWS*	20	5	5	5	5	
3	5.2.2	A,D,E	Participate at local wildflower and outdoor shows.	Continue until delisted	FWS	20	1	1	1	1	1
3	5.2.3	D,E	Invite the public to assist in long term monitoring.	Continue until delisted	FWS*, TNC, RVCOG, JAC, JOS	20	1	1	1	1	1

Implementation Schedule for Rogue Valley Vernal Pool and Illinois Valley Wet Meadows Ecosystem Recovery Plan

Priority Number	Action Number	Threats Addressed	Action Description	Action Duration (Years)	Responsible Party	Total Cost	Cost Estimates, in thousands of dollars per fiscal year				
							2006	2007	2008	2009	2010
3	5.2.4	D,E	Provide schools within the area covered by the recovery plan with information about the species and recovery efforts.	Continue until delisted	FWS*, TNC, BLM, RVCOG, JAC, JOS	20	1	1	1	1	1
3	6	A,E	Develop post-delisting monitoring plan	TBD	FWS*, ODA	TBD					
Total estimated cost to time of recovery: \$2,613,000 plus additional costs that cannot be estimated at this time.											

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VII. Appendices

APPENDIX A. GLOSSARY OF TECHNICAL TERMS

Alluvial:	Composed of clay, silt, or gravel sediments carried by rushing waters and deposited where the waters slow down.
Autogamy:	Self fertilization, as in such plant species as <i>Limnanthes floccosa</i> .
Autotrophic:	Obtaining carbon and energy from nonliving sources (chemical elements and electromagnetic radiation), rather than from living organisms.
Awn:	A slender, bristle-like extension from the bracts of grasses.
Claypan:	A layer of clay soil that prevents drainage of water.
Cyanobacteria:	Photosynthetic bacteria, also called blue-green algae
Demographic:	Pertaining to the size, growth, and vital statistics of populations.
Duripan:	A hard layer of soils (hardpan) that prevents drainage of water, especially one cemented by silica.
Ecoregion:	A region containing a geographically distinct assemblage of natural communities.
Ecosystem:	A system formed by the interaction of a community of organisms with their physical environment.
Edaphic:	Pertaining to the soil.
Extant:	Still in existence; not extinct, destroyed, or lost.
Floristic:	Pertaining to flowers or a flora.
Habitat:	The type of environment in which an organism or group normally lives or occurs.
Hardpan:	A hard layer of soils (clay, volcanic, or caliche) that prevents drainage of water.
Hydric:	Characterized by excessive moisture.
Lemma:	The outer of the two bracts enclosing the flower in a grass spikelet.

- Mesic: Having or characterized by a moderate supply of water.
- Nexus: Involvement of the Federal government in an action through a governmental role in ownership, funding, licensing, permitting, or regulation.
- Occurrence: An occupied area at least 0.4 kilometers (0.25 mile) away from the next occupied area; usually recorded in a heritage database; see also element occurrence, population.
- Photosynthetic: Able to synthesize carbohydrates from carbon dioxide and water using light as an energy source.
- Population: A group of individuals of the same species that occupy an area small enough to permit interbreeding regularly (herein used interchangeably with occurrence or to represent a group of individuals that is not included in the Oregon Natural Heritage Information Center).
- Sepals: Outer flower bracts.
- Stochastic: Random environmental variable.
- Sympatric: Occupying the same location; co-occurring.
- Viable: Capable of life or normal growth and development.
- Wetlands: Areas that are inundated by surface or ground water with a frequency sufficient to support vegetation or aquatic life that requires saturated soil conditions for growth and reproduction.

**APPENDIX B. PLANT AND ANIMAL SPECIES REFERENCED IN THIS
DRAFT RECOVERY PLAN**

Scientific Name	Common Name
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Rogue River Valley

<i>Acnatherum lemmonii</i>	Lemmon's needlegrass
<i>Agrostis hendersonii</i>	Henderson's bentgrass
<i>Alopecurus saccatus</i>	vernal foxtail
<i>Balsamorhiza deltoidea</i>	bitterroot
<i>Branchinecta lynchi</i>	vernal pool fairy shrimp
<i>Ceanothus cuneatus</i>	wedgeleaf buckbrush
<i>Centaurea solstitialis</i>	yellow starthistle
<i>Clarkia purpurea</i>	purple clarkia
<i>Collinsia sparsiflora</i>	spinster's blue-eyed mary
<i>Deschampsia danthonioides</i>	annual hairgrass
<i>Erodium cicutarium</i>	crane's bill, fillary
<i>Eremocarpus setigerus</i>	turkey mullein
<i>Eryngium petiolatum</i>	coyote thistle
<i>Festuca roemerii</i>	Roemer's fescue
<i>Hesperichiron californicus</i>	California hesperiochiron
<i>Hordeum murinum</i> ssp. <i>gussoneanum</i>	Mediterranean barley
<i>Isoetes nuttallii</i>	quillwort
<i>Lasthenia californica</i>	California goldfields
<i>Lasthenia glaberinna</i>	smooth goldfields
<i>Limnanthes floccosa</i> ssp. <i>floccosa</i>	woolly meadowfoam
<i>Limnanthes floccosa</i> ssp. <i>grandiflora</i>	large-flowered woolly meadowfoam
<i>Lomatium cookii</i>	Cook's lomatium, Cook's desert parsley
<i>Lomatium humile</i>	alkali desert parsley
<i>Lomatium tracyi</i>	Tracy's desert parsley
<i>Lomatium utriculatum</i>	foothills desert parsley
<i>Lupinus bicolor</i>	bicolored lupine
<i>Myosurus minimus</i>	least mousetail
<i>Navarretia heterandra</i>	Tehama navarretia
<i>Navarretia leucocephala</i>	white-flowered navarretia
<i>Pilularia americana</i>	American pillwort
<i>Plagiobothrys austiniiae</i>	Austin's popcornflower
<i>Plagiobothrys bracteatus</i>	bracted popcornflower
<i>Plagiobothrys figuratus</i> ssp. <i>corallicarpus</i>	coral-seeded popcornflower

<i>Plagiobothrys folvus</i>	single-flowered cat's ear
<i>Plagiobothrys glyptocarpus</i>	sculptured allocarya
<i>Plagiobothrys greenii</i>	Green's popcornflower
<i>Plagiobothrys nothofulvus</i>	rusty popcornflower
<i>Plagiobothrys stipitatus</i>	stipitate popcornflower
<i>Poa bulbosa</i>	bulbous bluegrass
<i>Pogogyne zizyphoroides</i>	Sacramento mesamint
<i>Pseudoroegneria spicata</i>	bluebunch wheatgrass
<i>Taeniatherum caput-medusae</i>	medusahead
<i>Trifolium depauperatum</i>	poverty clover
<i>Trifolium willdenovii</i>	tomcat clover

Illinois Valley Seasonally Wet Meadow

<i>Achillea millefolium</i>	yarrow
<i>Aira caryophylla</i>	silver hairgrass
<i>Calochortus uniflorus</i>	large-flowered tulip-star
<i>Camassia quamash</i>	Common camas
<i>Chamaecyparis lawsoniana</i>	Port Orford Cedar
<i>Chlorogalum pomeridianum</i>	soap plant
<i>Danthonia californica</i>	California oatgrass
<i>Deschampsia cespitosa</i>	tufted hairgrass
<i>Festuca roemerii</i>	Roemer's fescue
<i>Hesperochiron californica</i>	California hesperochiron
<i>Horkelia californica</i>	California horkelia
<i>Horkelia daucifolia</i>	carrot-leaved horkelia
<i>Isoetes nuttallii</i>	quillwort
<i>Limnanthes gracilis</i> ssp. <i>gracilis</i>	slender meadowfoam
<i>Lomatium cookii</i>	Cook's lomatium, Cook's desert parsley
<i>Melica geyeri</i>	oniongrass
<i>Micropus californicus</i>	slender cottonweed
<i>Microseris howellii</i>	Howell's microseris
<i>Pinus jeffreyi</i>	Jeffrey pine
<i>Pinus ponderosa</i>	ponderosa pine
<i>Prunella vulgaris</i>	self-heal
<i>Senecio hesperius</i>	western senecio
<i>Viola hallii</i>	Hall's violet

**APPENDIX C. RECOVERY PRIORITIES FOR RECOVERY OF THREATENED
AND ENDANGERED SPECIES**

Degree of Threat	Recovery Potential	Taxonomy	Priority	Conflict
High	High	Monotypic Genus	1	1C 1
	High	Species	2	2C 2
	High	Subspecies	3	3C 3
	Low	Monotypic Genus	4	4C 4
	Low	Species	5	5C 5
	Low	Subspecies	6	6C 6
Moderate	High	Monotypic Genus	7	7C 7
	High	Species	8	8C 8
	High	Subspecies	9	9C 9
	Low	Monotypic Genus	10	10C 10
	Low	Species	11	11C 11
	Low	Subspecies	12	12C 12
Low	High	Monotypic Genus	13	13C 13
	High	Species	14	14C 14
	High	Subspecies	15	15C 15
	Low	Monotypic Genus	16	16C 16
	Low	Species	17	17C 17
	Low	Subspecies	18	18C 18

APPENDIX D. RECOVERY CORE AREAS

The areas presented in this section were evaluated based on functional and value mapping and on-site assessments (Borgias and Patterson 1999). For the sites selected and described below, the vegetation has only slightly altered vernal pools. Upland vegetation is not intact and should be managed for invasive grasses and herbs.

A. SITES IN ROGUE VALLEY

1. Agate Desert Core Area

Agate Desert Preserve

Area Description. This area includes approximately 22 hectares (55 acres) of land west of Table Rocks Road and north of Antelope Road, protected for long term conservation of the listed species. The vernal pool habitat in this area is categorized as topographically intact vernal pools with altered vegetation.

History. This parcel was pasture when acquired by The Nature Conservancy in 1987 as a land trust. The Nature Conservancy has successfully restored and managed the habitat to benefit endangered plants and the vernal pool fairy shrimp that occur there.

Management. The Nature Conservancy performs annual monitoring of the two endangered plants and vernal pool fairy shrimp. They also plant native grasses and herbs, perform periodic burns to remove thatch, and hand remove nonnative weeds.

Objective. Add adjacent parcels to existing protected parcel, including lands currently owned by Ariva and the City of Medford. Restore habitat on City and Ariva owned lands, reduce noxious weed threats, and eventually restore with native vegetation around key areas.

Dutton Creek and Avenue H Mitigation Area

Area Description. This area includes a 20-hectare (50-acre) tract of land south of Dutton Road, north of Avenue H and east of Highway 62 (Crater Lake Highway) and east of Highway 62 just south of Dutton Road. The vernal pool habitat in this area is categorized as topographically intact vernal pools with altered vegetation. An 11-hectare (27-acre) Jackson County mitigation area occurs in the southern portion of the area and an approximately 4-hectare (10-acre) Oregon Department of Transportation mitigation area occurs in the northern portion of the site.

History. The land north of Avenue H Site was used for military practice as part of operations based out of Camp White, a U.S. Army Post. More recently the site has come into county ownership and has been unofficially utilized for off-road recreation. In 2002 the land was burned and sown with native seed to restore vernal pool habitat as on-site compensatory mitigation for a Jackson County school development project with the technical assistance of the U.S. Fish and Wildlife Service. The Oregon Department of Transportation acquired land south of Dutton Road for potential mitigation of wetland impacts along a proposed Highway 62 expansion.

Objective. Secure additional habitat for *Limnanthes floccosa* ssp. *grandiflora* and vernal pool fairy shrimp. Add adjacent parcels to existing mitigation to promote connectivity between Jackson County Mitigation and the Oregon Department of Transportation Highway 62 mitigation site.

Kershaw (East of Atlantic Avenue between Avenues E and H)

Description. This area includes a 90-hectare (223-acre) privately owned vernal pool complex located east of Atlantic Avenue, south of Avenue H, and north of Avenue E. The best tax lots in terms of *Lomatium cookii* population numbers (an estimated 500,000 flowering plants) are included in the area.

Management. Lands are mowed annually, grazed and partly tilled.

Objective. Temporarily protect areas in or adjacent to the parcel with vernal pool fairy shrimp critical habitat or with presence of *Lomatium cookii*. Lease the area for use as a seed bank, until a suitable reserve of seed is established to use in restoring populations to the east of White City in areas better situated for long term habitat conservation and protection with larger intact habitat complex.

Denman Military Slough

Description. This area includes a State-administered parcel located north of Kirtland Road and Avenue G, south of the Rogue River, east of Table Rocks Road and west of Agate Road. The vernal pool-mounded prairie topography is variably altered by fill of log deck debris and vegetation has been severely altered by plantings of intermediate wheatgrass, but the site is occupied by vernal pool fairy shrimp and *Limnanthes floccosa* ssp. *grandiflora*.

History. Land was once military practice and storage grounds for Camp White. After the land was set aside as state wildlife refuge, nonnative grasses were seeded for game bird cover and recreational hunting.

Management. Development of a management plan is currently underway for protection and conservation of vernal pools and the two endangered plants.

Objective. Enhance current condition by removing fill and wood waste and restoring native prairie at least around high priority areas to be identified within the tract. Monitor listed species and utilize fire for control of thick thatch buildup.

Denman Hall Tract

Description. This area includes a State-administered parcel located south of Antelope road, west of Agate Road, and north of Gregory Road. The vernal pool-mounded prairie topography is variably altered by fill of log deck debris and vegetation has been severely altered by plantings of intermediate wheatgrass, but the site is occupied by vernal pool fairy shrimp, *Lomatium cookii*, and *Limnanthes floccosa* ssp. *grandiflora*.

History. Land was once military practice and storage grounds for Camp White. After the land was set aside as a state wildlife refuge, nonnative grasses were seeded for game bird cover and recreational hunting.

Management. Development of a management plan is currently underway for protection and conservation of vernal pools and the two endangered plants.

Objective. Enhance current condition by removing fill and wood waste and restoring native prairie at least around high priority areas to be identified within the tract. Monitor listed species and utilize fire for control of thick thatch buildup.

Hoover Ponds

Description. The Hoover Ponds complex includes 323 hectares (777 acres) of leveled vernal pool habitat principally owned by Jackson County. The complex is located south of Highway 140 and west of Kershaw Road. In this complex the native vegetation plant community health is low and the land has weakly expressed vernal pools. Several *Lomatium cookii* populations occurred in the complex in 2000, but no surveys have been conducted since then. A total of approximately 1,000 plants was estimated to occur at the complex.

Management. Lands are mowed annually, grazed and partly tilled. Off-road recreation occurs over much of the complex.

Objective. Temporarily protect areas in or adjacent to the parcel with vernal pool fairy shrimp critical habitat or with presence of *Lomatium cookii*. Lease the area for use as a seed bank, until a suitable reserve of seed is established to use in restoring

populations in areas better situated for long term habitat conservation and protection with larger intact habitat complex.

2. Agate Lake Core Area

Agate Lake, Bureau of Reclamation

Description. This area, south of Highway 140 along East Antelope Road, includes 363 hectares (896 acres) of both private and Federal lands. The vernal pool habitat in this area is categorized as topographically intact vernal pools with altered vegetation.

History. The land has historically been managed as pastureland. Development of a management plan is currently underway for protection and conservation of vernal pools and the two endangered plants on portions managed by the Bureau of Reclamation.

Objective. Add protected areas to existing parcels within designated vernal pool fairy shrimp critical habitat. Manage noxious weeds and pursue habitat restoration opportunities.

3. North Eagle Point Core Area

North Eagle Point

Description. This area includes a 90-hectare (222-acre) area north of Eagle Point and east of Highway 62, categorized by the functional assessment as topographically intact vernal pools with altered vegetation.

History. Cattle grazing and agriculture are likely to have occurred on the majority of the properties.

Management. A historical site has been designated along with intact vernal pools adjacent to the property. Lands are mowed annually, grazed and partly tilled.

Objective. The site affords opportunities for conservation easements and leases. The historical site can be expanded to afford more habitat protection. A detailed species population assessment should be conducted to locate historical population of *Limnanthes floccosa* ssp. *grandiflora*.

4. Rogue Airfield Core Area

Description: The 157-hectare (388-acre) area includes 1 percent State, 80 percent County, and 19 percent privately owned lands in Medford, Oregon. The largest parcel is managed by Jackson County's Rogue International Airport Authority.

History. This land was formerly a fairground prior to being an airport. In 1922, the City of Medford and Jackson County purchased the Medford field, known as Newell Barber field, which was located where the former fairgrounds were, at the south edge of Medford.

Limnanthes floccosa ssp. *grandiflora* and *Lomatium cookii* occur in localized areas with intact although partially leveled vernal pools. The area has not been revisited since 2004.

Management. The airport authority mows the airfield periodically, maintaining vegetation below 12 inches. No herbicides, grazing, burning, or other management activities occur at the site.

Prior to 2001, a 55-hectare (80-acre) patch of *Lomatium cookii* occurred on the property. In 2001, a new runway and access road were added to the airfield, dividing the population into three parts. Currently plans are underway to construct a new runway which will further divide the largest *Lomatium cookii* population.

Objective. The site may provide opportunities for conservation easements and leases. A long-term conservation agreement with Jackson County for management of the *Lomatium cookii* population would benefit the species as well. A species assessment should be conducted to map the population of *Limnanthes floccosa* ssp. *grandiflora*.

5. Rogue Plains Core Area

Rogue Valley Plains Preserve

Description. This area includes 63 hectares (155 acres) of land south of Sam's Valley Road and east of Modoc Road, as well as other surrounding habitat. The vernal pool habitat in this area is categorized as topographically intact vernal pools with altered vegetation. Vernal pools at this site are more weakly expressed than other areas.

History. The land has been managed as pastureland. The Nature Conservancy acquired the 63-hectare (155-acre) tract of land in 2000. Currently cattle grazing has continued for 3 years and is being monitored. A large population of *Limnanthes floccosa* ssp. *grandiflora* and the vernal pool fairy shrimp continues to thrive at site.

Management. In addition to managing cattle grazing with resting and rotation, The Nature Conservancy performs annual monitoring of *Limnanthes floccosa* ssp. *grandiflora* and periodic monitoring of the vernal pool fairy shrimp. The Nature Conservancy has constructed experimental plot exclosures to monitor native grass introduction using different methods, and is developing a program of livestock grazing that would introduce periodic rest and prescribed burning.

Objective. Continue existing management and protection of the preserve.

6. Shady Cove Core Area

Yet to be evaluated.

7. Staley Road Core Area

Yet to be evaluated.

8. Table Rock Terrace Core Area

Yet to be evaluated.

9. Whetstone Creek Core Area

Whetstone Savanna Preserve (Newland Road)

Area Description. This area includes a 54-hectare (134-acre) area west of Table Rocks Road and south of Newland Road. The vernal pool habitat in this area is categorized as topographically intact vernal pools with altered vegetation.

History. This parcel was pasture when acquired by The Nature Conservancy as a land trust. The Nature Conservancy has successfully restored and managed the habitat to benefit endangered plants and the vernal pool fairy shrimp that occur there.

Management. The Nature Conservancy performs annual monitoring of the two endangered plants and vernal pool fairy shrimp. They also hand remove nonnative weeds.

Objective. Add adjacent parcels to the existing protected parcel, and restore hydrology by containing irrigation overflow to the site and enhance by managing for native vegetation around key areas of the site.

10. Rogue Valley Sites Outside Core Areas for Listed Plants

Upper and Lower Table Rock

Description. This area is identified as recovery habitat for vernal pool fairy shrimp in the Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon (U.S. Fish and Wildlife Service 2005). No occurrences of *Limnanthes floccosa* ssp. *grandiflora* or *Lomatium cookii* are yet known from this site. It includes two remnant volcanic plateaus with topographically intact vernal pools with altered vegetation on top, encompassing 163 hectares (404 acres).

History. Lower Table Rock was grazed historically, and has a grass airstrip. Outside of the clearing and leveling for the airstrip, the vernal pools are relatively intact. Limited grazing occurs on Upper Table Rock.

Management. A portion of the area is managed by the Bureau of Land Management for recreational purposes; private lands are managed for partial recreation and limited grazing. The Bureau of Land Management is working on a management plan for conservation and protection of vernal pool fairy shrimp.

Objective. Add areas to Bureau of Land Management ownership on Upper Table Rock within designated vernal pool fairy shrimp critical habitat. Complete a site assessment and management plan. On Lower Table Rock, re-contour the grass runway and establish native grass in a portion of the complex uplands.

B. SITES IN ILLINOIS VALLEY

1. Anderson Creek Core Area

Yet to be evaluated.

2. Draper Creek Core Area

Yet to be evaluated.

3. Reeves Creek West Core Area

Description. This area includes 265 hectares (655 acres) of mixed oak-pine woodlands and open meadows located 4.82 kilometers (3 miles) northeast of Kerby, Oregon. This area is 50 percent federally owned and 50 percent privately owned. The mesic plant communities that support *Lomatium cookii* occur at margins of oak and fir woodlands. The area is mostly outside of timber sales.

History. Three large patches of *Lomatium cookii* occur at this site and contain between 100 to 200 plants. Due to lack of fire, native vegetation threatens portions of populations and renders otherwise suitable habitat unfavorable to *Lomatium cookii* establishment.

Management. The Bureau of Land Management manages the Federal land in this core area. *Lomatium cookii* populations are periodically monitored. Maintenance of the road will be a concern as well as traffic related disturbances.

Objective. Monitor *Lomatium cookii* populations, augment existing populations, and increase suitable habitat through fire or mechanical thinning management.

4. Reeves Creek East Core Area

Yet to be evaluated.

5. Laurel Road Core Area

Description: This area encompasses 265 hectares (654 acres) and is located just east of Cave Junction, Oregon. This area is 18 percent federally owned, 2 percent State owned and, 80 percent privately owned. The Oregon Department of Transportation manages a Special Management Area within this core area that supports a vigorous *Lomatium cookii* population of approximately 20,000 individuals.

History. The Oregon Department of Transportation has been protecting this site and performing biennial monitoring for this population since 2003. *Lomatium cookii* and *Limnanthes gracilis* have occurrences within this core area. The largest population of *Lomatium cookii* on State owned land occurs along this managed highway right-of-way. Vegetation control has not been an issue for this population.

Management. The population is annually monitored and is protected from inadvertent highway maintenance with signs. Long-term maintenance of the road will be a concern as well as unpredicted traffic related disturbances.

Objective. Monitor *Lomatium cookii* populations, develop and refine maintenance guidelines, augment existing populations, and increase suitable habitat through fire or mechanical thinning management. Pursue conservation easements, conservation banks, or leases on private lands.

6. River Forks Park Core Area

Description. This core area occurs west of Cave Junction, Oregon and includes wet meadow plant communities at margins of oak and fir woodlands area encompassing

64 hectares (157 acres). The River Forks Park core area is 33 percent federally owned, 34 percent State owned, and 33 percent privately owned.

History. In this core area, a *Lomatium cookii* population is located on State owned land managed by the Oregon State Parks and Recreation Department. The department has been protecting the *Lomatium cookii* population and performing sporadic monitoring and performing visits since 2002. Vegetation control has not been an issue for this population. Due to lack of fire, native vegetation threatens portions of populations and renders otherwise suitable habitat unfavorable to *Lomatium cookii* establishment. In addition, *Limnanthes gracilis* occurs within this core area, but its population status has not been evaluated.

Management. The State Park is in the process of developing a management plan to address natural resources occurring at the State owned lands (M. Michaud, pers. comm. 2004).

Objective. Monitor *Lomatium cookii* populations, augment existing populations, and increase suitable habitat through fire or mechanical thinning management. Complete a *Lomatium cookii* management plan for the park. Pursue conservation easements, conservation banks, or leases on private lands.

7. Rough and Ready Creek Core Area

Description. This area encompasses 659 hectares (1628 acres). Sixteen percent of the area is federally owned and 84 percent is private. This area occurs west of the Illinois Valley airport on Bureau of Land Management land and includes oak and fir woodlands that are interspersed with wet meadows and drainages.

History. Four significant *Lomatium cookii* populations occur within this core area numbering approximately 1,180, 4,000, 70, and 50 plants. *Limnanthes gracilis* is documented as occurring within this core area, but the populations have not been evaluated. The Bureau of Land Management has been monitoring the Rough and Ready Creek *Lomatium cookii* population for 10 years. Although the area has been impacted by stream channel improvements and road maintenance, the *Lomatium cookii* populations are intact.

Management: On this Bureau of Land Management land, the area is closed to off-road vehicle use, mineral leases have limits on structure building, and the area is closed to mineral entry.

Objective. Continue to monitor *Lomatium cookii* populations, augment existing populations, and increase suitable habitat through fire or mechanical thinning

management. Pursue conservation easements, conservation banks, or leases on private lands.

8. French Flat Core Area

Description: The French Flat area occupies a large portion of the Illinois Valley Basin south of Cave Junction, east of the East Branch of the Illinois River, north of Waldo that encompasses 1100 hectares (2718 acres). In this core area, 32 percent of the area is federally owned, 1 percent is State owned, and 67 percent is in private ownership. The area is mostly outside of timber sales.

History. *Lomatium cookii* and *Limnanthes gracilis* both occur within the periphery of the core area which is a designated Area of Critical Environmental Concern for the Medford Bureau of Land Management. At least 5 significant *Lomatium cookii* populations numbering approximately 12,000, 92,500, 57,700, 200, and 50 plants occur within the core area.

The Bureau of Land Management performs annual monitoring and a management plan is currently in development. In the past 10 years the area has been vandalized by off-road vehicles that cause damage to the sensitive wet meadow soils. The Fish and Wildlife Service has entered into a Conservation Agreement with the Bureau of Land Management to help limit unlawful access to the property by motorized vehicles and to develop an outreach program to the local community. The Bureau of Land Management staff has attempted several entry deterrents, but access has not effectively been blocked.

Management. The area is not utilized for timber, and off-road vehicles are not permitted to enter Bureau of Land Management sensitive areas. *Lomatium cookii* populations are annually monitored. Due to difficulties with the private land boundaries, the area is not well protected from off-road vehicle usage.

Objectives. Develop an outreach program to communicate with adjacent landowners and local schools the importance of conserving the sensitive habitat occurring at this area. Monitor the effects of off-road vehicle damage at *Lomatium cookii* populations. Continue to monitor *Lomatium cookii* populations, augment existing populations, and increase suitable habitat through fire or mechanical thinning management. Pursue conservation easements, conservation banks, or leases on private lands.

9. Indian Hill Core Area

Description. The Indian Hill core area is located along the West Fork of the Illinois River, approximately 7.5 kilometers (4.7 miles) south-southwest of Cave Junction, Oregon. The 23-hectare (56-acre) area includes oak and fir woodlands that are

interspersed with wet meadows and drainages. In this core area, 90 percent of the land is on Federal lands mostly managed for non-timber, and 10 percent of the parcels are privately owned.

History. One *Lomatium cookii* population occurs within this core area, numbering approximately 12,900 plants. The Bureau of Land Management has nine years of monitoring data of the Indian Hill *Lomatium cookii* population.

Management. The area is not utilized for timber, and off-road vehicles are not permitted to enter Bureau of Land Management sensitive areas. The *Lomatium cookii* population is annually monitored.

Objectives. Continue to monitor *Lomatium cookii* populations, augment existing populations, and increase suitable habitat through fire or mechanical thinning management. Pursue conservation easements, conservation banks, or leases on private lands.

10. Sucker Creek Core Area

Yet to be evaluated.

11. Grannys Run Core Area

Yet to be evaluated.

12. Democrat Gulch Core Area

Yet to be evaluated.

13. Eight Dollar Mountain Core Area

Yet to be evaluated.

**APPENDIX E. THREATS IDENTIFIED FOR *LOMATIUM COOKII* AND
LIMNANTHES FLOCCOSA SSP. *GRANDIFLORA* AND RECOVERY PLAN
RECOMMENDED MANAGEMENT ACTIONS**

SPECIES	LISTING FACTOR	THREAT	ACTION NUMBERS	RECOVERY CRITERIA
Both listed plant species	A	Industrial, commercial, and residential development	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 2.4, 4.10	1a, 1b
Both listed plant species	A, E	Road and utilities construction and maintenance	4.10	1c, 1d, 2a
Both listed plant species	A	Hydrological alteration and conversion to irrigated agricultural use	2.1, 2.2, 2.3, 4.2, 4.3, 4.10	1c, 1d, 2a, 2b
Both listed plant species	A, E	Competition from introduced annual grass species	4.2, 4.3, 4.7	1c, 1d, 2a, 2b
Both listed plant species	A	Fall and winter cattle grazing	2.1, 2.2, 2.3, 4.2, 4.3, 4.8, 5.1, 5.2, 5.3, 5.4	1a, 1b, 1c, 1d, 2a, 2b
<i>Lomatium cookii</i>	A	Proposed gold mining operations	2.1, 2.2, 2.3	1c, 1d, 2a
<i>Lomatium cookii</i>	A	ORV use	2.1, 2.2, 2.3, 4.2, 4.3, 5.1, 5.2, 5.3, 5.4	1a, 1b, 1c, 1d, 2a, 2b
<i>Lomatium cookii</i>	A	Timber sales	2.1, 2.2, 2.3	1c, 1d, 2a
<i>Lomatium cookii</i>	A	Encroachment of woody vegetation due to fire suppression	4.2, 4.3, 4.6, 4.7	1a, 1b, 1c, 1d, 2a, 2b
<i>Limnanthes floccosa</i> ssp. <i>grandiflora</i>	B	Collection related to meadowfoam oil seed development	5.1, 5.2, 5.3, 5.4	1c, 1d, 2a
Both listed plant species	D	Limitations of Clean Water Act protection of small wetlands	N/A	
Both listed plant species	D	Limited protection under State of Oregon Endangered Species Act	N/A	
Both listed plant species	E	Severe fire events	4.7	1a, 1b, 1c, 1d, 2a, 2b
Both listed plant species	E	Vulnerability to stochastic events due to small population size.	2.4.3, 2.4.4, 4.4, 4.5, 4.9, 4.12	1e, 2a, 2b

**Region 1
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