Conservation Strategy for *Epilobium oreganum, Gentiana setigera, Hastingsia bracteosa* var. *bracteosa, H. bracteosa* var. *atropurpurea,* and *Viola primulifolia* ssp. *occidentalis* in Serpentine *Darlingtonia* Wetlands of Southwest Oregon and Northwest California

USDI Bureau of Land Management
Medford District, OR
Coos Bay District, OR

USDA Forest Service
Rogue River-Siskiyou National Forest, OR
Six Rivers National Forest, CA

Conservation Strategy Approval

The Medford and Coos Bay Districts BLM, Rogue River-Siskiyou and Six Rivers National Forests agree to implement this Conservation Strategy for five rare plant taxa associated with *Darlingtonia* serpentine wetlands, as available funding permits. Development of a Conservation Strategy was one of the primary actions recommended in the parent Conservation Agreement, signed in 2006. The Strategy complements the Agreement by providing specific direction for implementing conservation actions, inventories, monitoring, and research. The Strategy shall become effective with the signature of the last approving agency official and shall remain in effect in perpetuity with periodic review and incorporation of applicable information via an addendum. Any approving agency may remove itself from the Strategy, with a 30 day written notice to all parties. The Strategy would remain in effect for the remaining signatories.

Forest Supervisor, Rogue River-Siskiyou National Forest — Date: 01/19/2018

Forest Supervisor, Six Rivers National Forest — Date: 5/24/18

District Manager, Medford District BLM — Date: 01/19/18

District Manager, Coos Bay District BLM — Date: 01/19/18

Preface

This Conservation Strategy is the product of a cooperative effort between the Bureau of Land Management, U.S. Forest Service, and Evan Frost and Dr. Eric Jules of Wildwood Consulting, Ashland Oregon. Besides the personal familiarity of the authors with these species and habitats, the information contained in this Conservation Strategy was obtained from available scientific literature and unpublished reports written by various parties. Also, several studies funded jointly by the U.S. Forest Service, Bureau of Land Management, California Native Plant Society, Native Plant Society of Oregon and Wildwood Consulting contributed substantial biological information for this document. Representatives from the Oregon Biodiversity Information Center, California Natural Heritage Division, Six Rivers and Rogue River-Siskiyou National Forests, Medford and Coos Bay Districts BLM, Oregon Department of Agriculture, as well as botanists from other agencies generously provided information on reported plant occurrences and shared their professional knowledge of these species and their conservation.

Although the best scientific information available was used and subject experts were consulted in preparation of this document, new conditions and information will arise over time. In the spirit of continuous learning and adaptive management, if you have information that will assist in conserving this plant community and associated taxa, please contact agency botanists at BLM, Medford or Coos Bay Districts, or U.S. Forest Service, Rogue River-Siskiyou or Six Rivers National Forests.

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EXECUTIVE SUMMARY

This Conservation Strategy addresses the biology, management, and conservation of five rare plant taxa associated with serpentine *Darlingtonia* wetlands in southwest Oregon and northwest California. These five species are on the Sensitive species list for the U.S. Forest Service (Regions 5 and 6) and the Bureau of Land Management: *Epilobium oreganum* (Oregon fireweed), *Gentiana setigera* (Mendocino gentian), *Hastingsia bracteosa* var. *bracteosa* (large-flowered rush-lily), *H. bracteosa* var. *atropurpurea* (purple-flowered rush-lily), and *Viola primulifolia* ssp. *occidentalis* (western bog violet). Although not a focus of this strategy, a sixth Sensitive species, *Carex klamathensis* (Klamath sedge), is also associated with these plant communities and will benefit from their conservation and management.

The geographic focus of this Conservation Strategy is the western Siskiyou Mountains in Josephine and Curry Counties of southwest Oregon and Del Norte County in adjacent California. The large majority of known occurrences of the five focal species and their habitat occur within this area. Federal land management units within the assessment area include the Rogue River-Siskiyou and Six Rivers National Forests, and Medford and Coos Bay Districts of the Bureau of Land Management. All five taxa have limited distributions, small population sizes, and occurrences that are primarily found in isolated serpentine *Darlingtonia* wetlands.

Primary threats to the five rare species are changes to the hydrologic regime of serpentine *Darlingtonia* wetlands, including changes that could result from mining and mining-related activities, road construction and maintenance, off-highway vehicle (OHV) use, and fire suppression activities. In addition, the introduction of Port Orford cedar root rot disease (*Phytophthora lateralis*) may pose a threat to these wetlands.

The overarching objective of this Conservation Strategy is to maintain long-term species viability for the five rare plant taxa closely associated with serpentine *Darlingtonia* wetlands. A second objective is to prevent any need for listing of these five taxa under the federal Endangered Species Act. This Conservation Strategy contains management requirements for Essential Wetlands that were identified in a previous Conservation Agreement (USDA and USDI 2006). The requirements include:

1. Protection of essential wetlands from the effects of mining to the extent allowed by law and regulation;
2. Preventing other changes to wetland hydrology that could result from various agency activities and public uses;
3. A long-term monitoring strategy that includes periodic assessments of threats and population trends;
4. Preventing Port Orford root rot disease introductions;
5. Other preventive actions where threats are identified, and habitat restoration where damage is already occurring.

Additional research, inventory, and monitoring opportunities are also outlined, including (1) periodic assessment of population status and habitat conditions of a sub-set of the five taxa, (2) maintaining current population and habitat records in agency databases, (3) inventories of geographic regions that are likely to yield new occurrences, (4) conducting a study on the effects of prescribed burning, and (5) studying cultivation and introduction techniques for the five target taxa.

I. INTRODUCTION, SCOPE AND OBJECTIVES

This Conservation Strategy addresses the biology, management, and conservation of five rare plant taxa associated with serpentine wetlands: *Epilobium oreganum* (Oregon fireweed), *Gentiana setigera* (Mendocino gentian), *Hastingsia bracteosa* var. *bracteosa* (large-flowered rush-lily), *H. bracteosa* var. *atropurpurea* (purple-flowered rush-lily), and *Viola primulifolia* ssp. *occidentalis* (western bog violet). The primary impetus for this Conservation Strategy arose from completion of the interagency "Conservation Agreement for *Hastingsia bracteosa* var. *braceosa bracteosa, H. atropurpurea, Gentiana setigera, Epilobium oreganum*, and *Viola primulifolia* ssp. *occidentalis* and serpentine wetlands and fens from Southwestern Oregon and Northwestern California" (USDA and USDI 2006). One of this agreement's primary recommendations was development of an ecosystem-based interagency Conservation Strategy, identifying specific management actions necessary to protect serpentine wetlands and their associated rare species.

Serpentine wetlands, commonly referred to as serpentine fens or bogs or *Darlingtonia* wetlands, are unique natural communities characterized by a perennial flow of cold water that is either surface or sub-surface, and soils that are derived from ultramafic (e.g. serpentine, peridotite) parent materials (Becking 1997). The mineral and chemical composition of serpentine-derived soils is unusual and extreme, leading to high levels of plant speciation and endemism (Brooks 1987, Coleman & Kruckeberg 1999, Harrison et al. 2006). Serpentine wetlands are particularly noteworthy in this regard and occur as disjunct, relatively small green "islands" surrounded by xeric communities that support strikingly different types of vegetation (Tolman 2006). A number of plant species are essentially restricted to this system, including the five rare taxa of which this Conservation Strategy is focused.

All five species are on the Sensitive species list for the U.S. Forest Service (Regions 5 and 6) and the Bureau of Land Management. The premise behind both agencies' programs is to manage for the conservation of rare taxa and their habitats to ensure that federal actions do not contribute to the need for listing as Threatened or Endangered. Factors such as limited distribution, small population sizes, isolated occurrences, and sensitivity to disturbance render these species vulnerable to extinction (Eastman 1990, Nakamura & Nelson 2001).

In addition to protecting these five species of concern, other important locally rare and regional endemic plant species are also associated with serpentine wetlands. These include *Carex scabriuscula, C.serpentinicola, C. klamathensis, Castilleja miniata* ssp. *elata, Cypripedium californicum, Darlingtonia californica, Lilium pardalinum* ssp. *vollmeri, Perideridia erythrorhiza, Pinguicula vulgaris* ssp. *macroceras, Salix delnortensis*, and *Sanguisorba officinalis.* Management actions resulting from implementation of this Conservation Strategy will also benefit these and other species that occupy serpentine wetland habitats.

Conservation Strategy Objectives

The primary goal of this Conservation Strategy is to synthesize existing scientific information on five rare plant taxa associated with serpentine wetlands in southwest Oregon and northwest California and outline management actions deemed necessary to ensure the long-term conservation of these species and their habitat. The specific conservation objectives are as follows:

1. To maintain and manage the ecological processes in serpentine wetland habitats in such a manner that they are likely to support the long-term viability of five rare, special-status plant species and their natural communities.

2. To avoid destruction or adverse modification of habitat for the five special-status wetland plants.
3. To help avoid the need for future listings under the federal Endangered Species Act.
4. To provide a mechanism for tracking the loss and conservation of serpentine wetland habitat and their associated special-status plant species in the assessment area over time. This will primarily entail the monitoring of habitat conditions, plant population sizes, and threats to the populations in a series of Essential Wetlands.
5. To provide information based on inventory and research for addressing conservation and management of rare plants associated with serpentine wetlands in future federal land management plans.

Assessment Area

The geographic focus of this Conservation Strategy is the western Siskiyou Mountains in Josephine and Curry Counties of southwest Oregon and Del Norte County in adjacent California. The large majority of known occurrences of the five focal species and their habitat occur within this area (Figure 1). Federal land management units within the assessment area include the Rogue River-Siskiyou (OR) and Six Rivers National Forests (CA), and Medford and Coos Bay Districts of the Bureau of Land Management (OR). Other land management units that have populations of one or more special-status species and were included in several analyses include the Shasta-Trinity, Mendocino, and Klamath National Forests in northwest California.

The serpentine wetland habitats that are the focus of this Conservation Strategy are located in the Illinois, Smith, Chetco, Applegate, and Pistol Rivers, and Hunter Creek watersheds in Josephine and Curry Counties in southern Oregon and Del Norte County in northern California. General topography in the area consists of moderate to steep slopes and incised canyons typical of the Klamath-Siskiyou region. Elevation ranges from approximately 600 to 4,300 feet above sea level. The climate is Mediterranean characterized by warm, dry summers and mild, wet winters. Average annual rainfall is relatively high and generally increases with elevation and proximity to the coast, ranging from over 100 inches on the western side of the Siskiyou Mountains in Curry County, OR, to 60 inches in the Illinois Valley. Over 80% of this precipitation falls from November through April. Precipitation in the form of snow occurs at higher elevation sites (> 3,000 feet) during the winter months.

Geologically, this portion of the western Siskiyou Mountains is dominated by over 150 square miles of continuous exposed ultramafic rock (peridotite, serpentinized peridotite, and serpentinite) known as the Josephine ophiolite sheet (Coleman & Kruckeberg 1999). Soils derived from these parent materials are generally neutral to slightly alkaline in reaction, exhibit a high rock content, low ratio of exchangeable calcium to magnesium, low levels of essential nutrients, and unusually high levels of nickel, chromium, cobalt and other heavy metals. These soils are of very low productivity and are classified in the orders Entisol, Inceptisol, Alfisol, and Mollisol. This unique chemical composition gives rise to distinct plant communities composed of species able to tolerate these harsh environments (Brooks 1987, Kruckeberg 1984, Jimerson et al. 1995).

Although considerable variability exists, upland vegetation across the study area is primarily composed of: (1) mixed-conifer woodlands with varying combinations of *Pinus jeffreyi*, *Pseudotsuga menziesii*, *Calocedrus decurrens*, *Chamaecyparis lawsoniana*, *Pinus lambertiana*, *Pinus attenuata* and *Pinus monticola*; (2) open *Pinus jeffreyi* savannah, with scattered pines in species-rich grass-forb meadows (most often associated with gentle slopes and flats); and (3) dense shrublands dominated by *Ceanothus cuneatus*, *Quercus vaccinifolia*, *Q. garryana* var. *breweri*, *Notholithocarpus densiflorus* var. *echinoides*, and *Arctostaphylos* spp. (steep slopes and ridges; Wilson 1988, Jimerson et al. 1995). Serpentine wetlands

are found scattered throughout the serpentine landscape, but most commonly on valley bottom and lower slope positions in association with stream and river courses (Frost 2002, Frost et al. 2004).

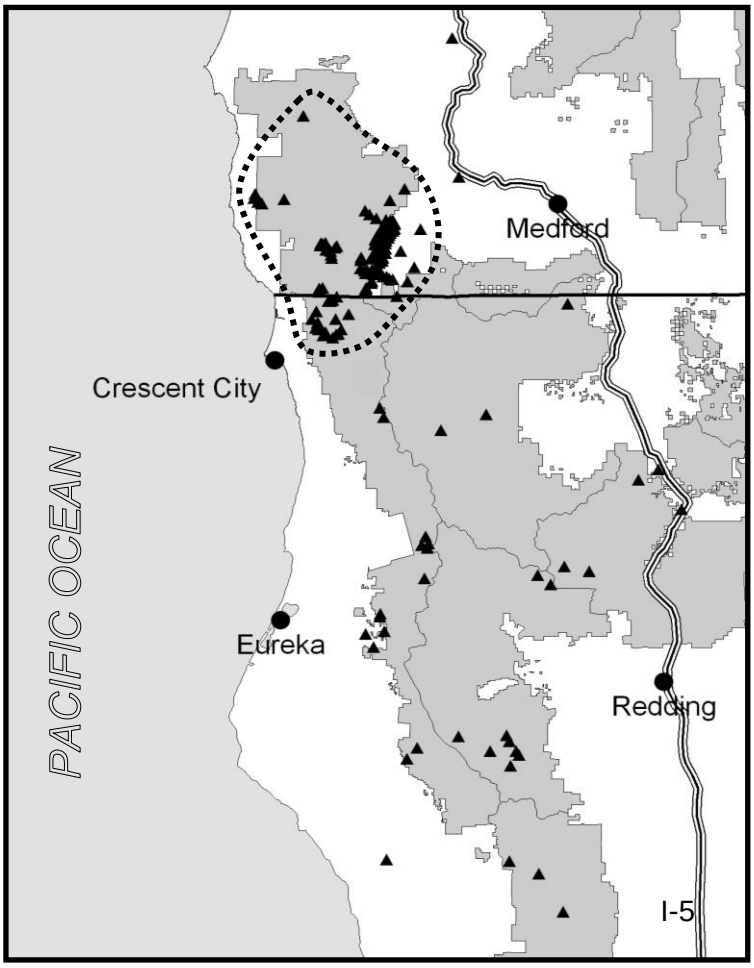


Figure 1: Known occurrences (triangles) of the Conservation Strategy's five rare focal taxa. Not all occurrences are associated with serpentine wetlands. Data were acquired from California Natural Diversity Database (CNDDB) on September 19, 2006 and from Oregon Biodiversity Information Center (ORBIC) on May 17, 2006. Gray areas are National Forests and their boundaries. Area enclosed by the dotted line indicates the approximate area covered in this Conservation Strategy.

Status of Species

All five species are Forest Service Sensitive Species in Regions 5 and 6, BLM-OR/WA Sensitive Species, and Oregon Department of Agriculture listed or candidates (Table 1).

Table 1. The listing status and rarity rankings for the five rare plant taxa included in this Conservation Strategy, at global, federal and state levels, in 2016.

Species	Global Rank [1]	OR Status [2]	ORBIC List [3]	CA Status [4]	CNPS List [5]
Epilobium oreganum	G2	C	1	S2.2	1B.2
Gentiana setigera	G2	C	1	S1.2	1B.2
Hastingsia bracteosa var. *bracteosa*	G2T2	LT	1	_	_
H. bracteosa var. *atropurpurea*	G2T2	LT	1	_	_
Viola primulifolia ssp. *occidentalis*	G5T2	C	1	S2.2	1B.2

[1] Global or G-rank reflects rarity and endangerment of a species throughout its entire range. Subspecific taxa receive a T-rank attached to the G-rank. The G-rank reflects the condition of the entire species, whereas the T-rank reflects the global situation of just the subspecies or variety, where n = 1-5 as follows: 1 = critically imperiled; 2 =imperiled; 3 = vulnerable to extirpation or extinction; 4 = apparently secure; 5 = demonstrably widespread, abundant and secure.

[2] Status under the Oregon Endangered Species Act (OESA), administered by the Oregon Department of Agriculture (ODA), where C = candidate taxa for which sufficient information exists to warrant listing under the OESA; LT = taxa listed as threatened.

[3] Oregon Biodiversity Information Center (ORBIC): List 1 contains taxa that are threatened with extinction throughout their entire range in Oregon.

[4] California status reflects rarity and endangerment within the State of California (CA Dept. Fish & Game 2006). S1 = less than 6 occurrences or less than 1,000 individuals or less than 2,000 acres; S1.1 = very threatened; S1.2 = threatened. S2 = 6-20 occurrences OR 1,000-3,000 individuals or 2,000-10,000 acres: S2.1 = very threatened; S2.2 = threatened. S3 = 21-100 occurrences or 3,000-10,000 individuals or 10,000-50,000 acres; S3.1 = very threatened; S3.2 = threatened.

[5] California Native Plant Society (CNPS) categories: List 1B = taxon is rare, threatened or endangered in California and elsewhere. A decimal extension indicates the degree of endangerment in California, as follows: .1 = seriously endangered (over 80% of occurrences threatened / high degree and immediacy of threat); .2 = fairly endangered (20-80% occurrences threatened); .3 = not very endangered (<20% of occurrences threatened or no current threats known).

II. HABITAT AND ECOLOGICAL CONSIDERATIONS

General Habitat Description

In the assessment area, the majority of serpentine wetlands are found between 1,200 and 1,900 feet in elevation, although sites are known to occur up to 3,800 feet. Most wetlands are located on moderate hill slopes, however their slopes range from 0 to 65 degrees. A disproportionate majority of wetlands occur on east-facing slopes relative to other aspects. Frost et al. (2004) monitored many wetland sites that ranged from 0.07 to almost 10 acres in size. Most wetlands were between 0.25 and 1.25 acres in size. The pH of the surface water is slightly alkaline due to the ultramafic underlying soil and rock substrates. Geomorphologically, most are associated with colluvial material (e.g., landslides) or alluvial deposition along valley bottoms. Water temperatures from the wetlands, particularly where groundwater is being discharged, are slightly cold to cool.

Serpentine wetlands support a unique assemblage of wetland species, a number of which are restricted to nutrient-poor ultramafic substrates. One of the most characteristic and often dominant species is the insectivorous *Darlingtonia californica* (California pitcher plant), after which this habitat type is often named (e.g., Sawyer and Keeler-Wolf 1995, Jimerson et al. 1995). Other common associates include *Helenium bigelovii*, *Triantha glutinosa*, *Sanguisorba officinalis*, *Narthecium californicum*, *Rudbeckia californica*, *Cypripedium californicum*, *Castilleja miniata* ssp. *elata*, *Platanthera sparsiflora*, *Eriophorum crinigerum* and a diverse array of other hydrophytic forbs and graminoids (Appendix A). *Chamaecyparis lawsoniana*, *Pinus jeffreyi*, *P. monticola*, and *Pseudotsuga menziesii* generally occur at relatively low cover in drier microsites in the wetland and immediately adjacent to the wetlands.

Classification of *Darlingtonia* Wetland Communities

Several attempts have been made to classify serpentine wetlands as a means of characterizing the variation in these plant communities. Using a plot-based methodology, Becking (1997) described three general wetland types in the western Siskiyou Mountains that differ in terms of geomorphic setting and vascular floristic composition: 1) hill slope spring or seeps, 2) stream sides and 3) riparian terraces (Figure 2; Becking 1997, Frost et al. 2004). Hill slope wetlands, sometimes referred to as "hanging fens" (Borgias 1993), are generally formed by wet seeps or springs originating from concave landslides or slumps on moderate to steep slopes underlain by serpentine bedrock (Lang & MacDonald 1987). They appear to be associated with fractures in the serpentine or peridotite that allows the lateral movement of ground water to the surface. Hillside wetlands are frequently interrupted by areas of dry soil and surface rock, each supporting different types of vegetation. As a result, fine-scale habitat diversity is often high.

In contrast, streamside wetlands develop in streamside alluvium or on gravel bars formed in stream channels. Typically, *Darlingtonia* and other wetland associates grow among bare rocks or in gravel in and along the streambed. This wetland type is characterized by (1) low to moderate gradient slopes, generally less than 25 degrees, (2) relatively high levels of riparian shrub and tree cover, (3) long and narrow shape, and (4) varied geology which may include metavolcanics, serpentine, and peridotite (Kagan 1990a,1990b).

Terrace wetlands occur where water from smaller serpentine seeps and springs runs across streamside terraces or benches. These sites are typically located in valley bottom settings, are generally low slope gradient (< 10 degrees) and have well-developed organic soils (Frost et al. 2004). In comparison with other wetland types, tree and shrub cover in terrace wetlands is relatively low and graminoid cover high,

Figure 2. Views of three primary serpentine wetland types with respect to geomorphic setting: a) **hill slope wetland**, where springs emerge from the contact zone between the peridotite over-burden and metamorphosed serpentine below; b) **streamside wetland**, where wetland habitat and associated vegetation develops along perennial stream courses. These sites generally exhibit relatively high levels of shrub & tree cover; and c) **terrace wetland**, associated with springs emerging onto stream terraces or valley bottoms. This type includes some of the largest fens & often exhibit relatively high cover levels of grasses & sedges.

often dominated by *Eriophorum criniger*, *Deschampsia cespitosa*, *Danthonia californica*, and *Carex* species.

Frost et al. (2004) identified three distinct wetland groups in the western Siskiyou Mountains that differ in terms of geography, community composition, and presence of special-status species. The largest and most diverse group is referred to as "Illinois Valley / inland wetlands", in reference to their location along the western side of the Illinois River valley in Josephine County, OR. These wetland communities are found at lower elevations (mean 1,533 feet) and can be characterized as "open and meadow-like" with relatively low water flows, high water temperatures, and relatively high graminoid and herbaceous cover. The group includes both hill slope and terrace-type wetlands, although the majority are of the hill slope type. All five special-status species are associated with this group, of which *Epilobium oreganum* and *Hastingsia bracteosa* var. *bracteosa* have their greatest constancy and abundance.

The Josephine Creek group is similar to the Illinois Valley / inland group in terms of elevation, geographic location and moisture regime but is comprised almost exclusively of streamside and terrace wetlands found along the valley bottom of Josephine Creek, a tributary of the Illinois River west of Cave Junction, OR. In comparison to other groups, these serpentine wetlands are characterized by significantly higher tree cover and less graminoid and herbaceous cover. Coarse-textured soils and high rock cover at these sites reflect stream scouring and exposure of serpentine substrates during periods of high water flow. As in the Illinois Valley / inland group, all five special-status species are known to occur in Josephine Creek, but *Hastingsia bracteosa* var. *atropurpurea* is essentially restricted to this group.

In contrast to the two Oregon-based groups, the North Fork Smith River / coastal wetlands are mostly comprised of sites in western Del Norte County, CA, that occur at higher elevations (mean 2,410 feet) and generally exhibit higher water flows and soil moisture levels. The coastal-maritime influence on vegetation is more pronounced here, and herbaceous cover is high, particularly of hydrophilic species such as *Darlingtonia californica*, *Adiantum pedatum*, *Drosera rotundifolia*, and *Symphyotrichum spathulatum* var. *yosemitanum*. Only two of the five special-status species, *Viola primulifolia* ssp. *occidentalis* and *Gentiana setigera*, are associated with this group of wetlands, but both reach their highest levels of constancy and abundance here.

Environmental / Habitat Relations of Special-Status Species

Each of the five special-status plant taxa exhibits a particular affinity for one or more of the three wetland groups as defined by Frost et al. 2004 (Table 2). Of the five special-status species, *Hastingsia bracteosa* var. *atropurpurea* appears to be the most specific, being essentially restricted to the Josephine Creek group of sites. Both *H. bracteosa* var. *bracteosa* and *Epilobium oreganum* are most closely associated with the two inland wetland groups, whereas *Gentiana setigera* and *Viola primulifolia ssp. occidentalis* are well-distributed across all three.

Figures 3-6 show typical sites and habitat characteristics for each of the five species. These relationships can be used to predict where the special-status species might be found during additional field surveys, where each species may be most successful if they were to be introduced or naturally dispersed, and what impacts natural or human-induced environmental changes might have on each species' abundance and distribution.

Table 2. Distribution of the five special-status plant taxa across the three serpentine wetland groups described by Frost et al. 2004.

Species	N.Fork Smith / Coastal	Illinois Valley / Inland	Josephine Creek
Epilobium oreganum	–	A	B
Gentiana setigera	A	A	A
Hastingsia bracteosa var. *bracteosa*	–	A	B
H. bracteosa var. *atropurpurea*	–	A	A
Viola primulifolia ssp. occidentalis	A	A	A

A Species exhibits relatively high constancy and abundance.
B Species occurs in this group but is relatively uncommon and/or populations tend to be smaller than above.
– Species is not known to occur in this wetland group.

b)

a)

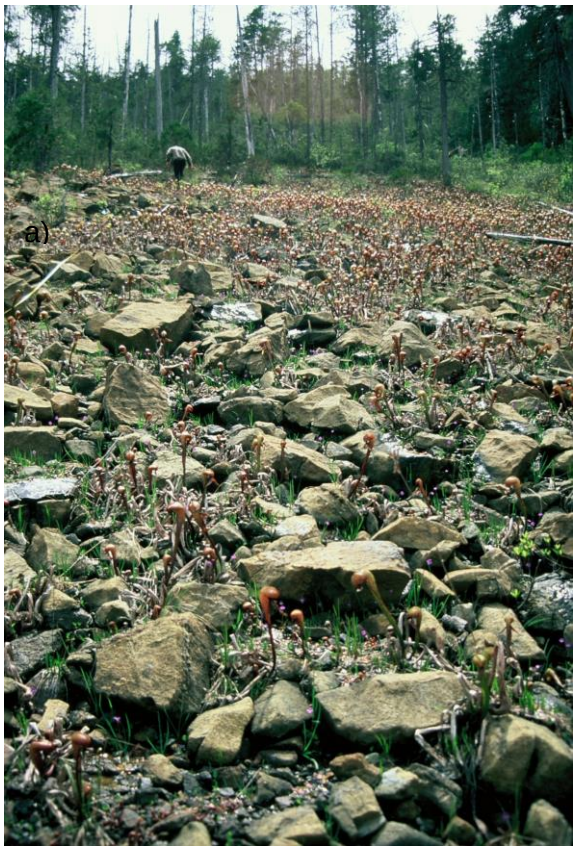
Figure 3. Typical habitat of *Epilobium oreganum*, showing (a) characteristically high shrub cover (here as *Rhododendron occidentalis*) and low gradient slope. A large *E. oreganum* population is scattered throughout, occurring underneath and occasionally emerging above the dominant vegetation.
(b) Underlying soils exhibit a deep organic horizon and are water saturated.

c)

d)

Figure 4. Characteristic habitat of *Gentiana setigera* (c), showing high graminoid cover (primarily *Carex* spp.) and low to moderate slope gradient. Individual gentians are typically widely scattered in these habitats, occurring as spreading rosettes in more open patches or underneath the taller graminoid canopy (d).

a)



b)

Figure 5. Macro- (a) and micro-habitat (b) for *Viola primulifolia* ssp. *occidentalis*, illustrating high rock cover, sparse vegetation, moderate to steep slopes and flowing water. Individuals are clumped to densely scattered amongst the perennial wet peridotite cobble.

c)

d)

Figure 6. Typical macro-habitat of (c) *Hastingsia bracteosa* var. *bracteosa*, exhibiting high graminoid cover and low shrub/tree cover, and (d) *H. bracteosa* var. *atropurpurea*, in rocky, streamside patches of vegetation along Josephine Creek, OR (in far right-center of photo).

Species Dispersal and Distribution

Although available information provides some insight into habitat-species relationships, other factors may be equally important in explaining the rarity and distribution of focal species. Given that serpentine wetland species are confined to isolated "islands" that are fixed in space, it follows that dispersal ability may play a role in limiting the distributions of one or more of these taxa. Little is known about the dispersal ability of any of the five target species. Serpentine wetlands similar in general habitat features, but lacking one or more rare taxa, can occasionally be found in close proximity to occupied sites (E. Frost, pers. comm.). This patchy distribution could be due to the inability of the respective species to colonize unoccupied wetland habitats.

Serpentine wetland communities have an inherently fragmented distribution, and special-status plants associated with this habitat type typically are distributed in small, isolated, or disjunct populations. Dispersal among these patchily distributed populations is key to survival because it permits declining populations to be rescued and vacant habitats to be (re)colonized by immigrants from adjoining populations (Harrison et al. 2000, Wolf et al. 1999). In this case, persistence may be dependent on the existence of many interacting subpopulations within a region (e.g., metapopulation). Depending on life history characteristics and dispersal dynamics, loss of even a modest number of populations or habitats from natural or human-caused disturbances may increase extinction risk.

Epilobium oreganum has the largest overall distribution of the five rare taxa, extending from Josephine County, OR, southward to Trinity County, CA, where it occurs on the Shasta-Trinity National Forest, as isolated patches in wetlands on ultramafic soils with and without *Darlingtonia californica*. Compared to the other target species, this larger, disjunct range may be explained in part by the species' wind-dispersed propagules, which are more likely to colonize isolated habitats over time. While it may be less limited by dispersal, *Epilobium* appears to be more of a habitat specialist than the other target species. Populations tend to be small and are, therefore, more prone to local extinction. In this case, metapopulation dynamics – where local extinction events are to some extent counterbalanced by new establishments – may play a role in determining species viability (Wolf et al. 1999).

Response to Disturbance

The most common natural disturbance in serpentine wetlands is fire. Studies of historic fire frequency in serpentine habitat typical of those surrounding serpentine wetlands suggest fires were frequent before effective fire exclusion began in the early to mid-1900s (Skinner 2006). Two fire-scar studies from Jeffrey pine stands on ultramafics in the Klamath Region revealed median fire-return intervals of 8 to 30 years (Skinner 2003a) and 8 to 15 years (Taylor and Skinner 2003). Fire-scar studies have been conducted within two serpentine wetlands, suggesting median fire-return intervals of 18 and 42 years (Skinner 2003b). Differences in fire frequency between the two sites may reflect differences in abiotic factors. Large numbers of serpentine wetlands burned during the ~500,000-acre Biscuit Fire in 2002, and burn severity varied greatly among the wetlands (E. Frost and E. Jules, personal observation).

Little information is available concerning the response of the five rare taxa to burning. The Nature Conservancy of Oregon monitored the response of *Epilobium oreganum* for three years after a 1997 prescribed burn at a wetland in the Cedar Log Flat RNA of southwest Oregon (Borgias and Biegel 1998, Borgias et al. 2004). They observed a ten-fold increase in the number of *E. oreganum* stems three years after the fire, while only a two-fold increase was observed in unburned portions of the wetland. Although only a single fire at one location was studied, their work suggests that *E. oreganum* is not significantly

harmed by fire, and rather may benefit from periodic burning. None of the other rare plant taxa discussed in this Conservation Strategy were found in the Cedar Log Flat RNA.

In 2002, the Biscuit Fire burned a number of serpentine wetlands and rare plant populations that had been sampled previously by Frost et al. (2004). In an attempt to capitalize on this baseline data, a post-fire study conducted in 2004 compared overall species composition and abundance of the five rare taxa in burned versus unburned wetlands (Cramer et al. 2005). Results suggest that, for the 26 sites sampled, fire had little or no significant adverse effect on individual rare species, but did influence several structural attributes of the habitat (e.g., reduced litter and shrub cover) and the relative abundance of some of the more common species associated with this community. For example, *Darlingtonia californica* showed a trend of reduced cover in burned wetlands while several graminoid species appeared to be more abundant. Overall, it was difficult to detect trends in rare species population due to the lack of permanent plot locations (Cramer et al. 2005).

III. BIOLOGY AND ECOLOGY

Oregon Willow-Herb – *Epilobium oreganum*

Life History

Epilobium oreganum is a tall (4-10 cm), glabrous, short-lived perennial. Based on its size and appearance, it may flower and fruit in its first year. The species blooms from late July to September and probably continues flowering and fruiting until frosts kills it back. The long narrow capsules (25-45 mm) mature and split within two weeks of the first flowering, and continue for the remainder of the season (Kagan 1990a). The species is distinguished from other members of the genus by it glabrous herbage and white, divided (or four-parted) stigma which extends beyond the pink to purplish corolla (Hickman 1993). Other similar-appearing species of *Epilobium* have a club-shaped stigma. Additional description and classification information for all five focal species is presented in Appendix B.

Range and Distribution

Epilobium oreganum is found in serpentine wetlands and stream sides below 6,700 feet elevation in the Klamath Range of southwestern Oregon and northwest California. In Oregon, it is currently known only from Josephine County (along the west edge of the Illinois Valley from Cedar Log Flat south to Oregon Mountain Road). Historically, the species was also known from Nickel Mountain in Douglas County, OR, but this occurrence is believed to be extirpated (Kagan 1990a).

In California, *E. oreganum* populations are found in Siskiyou, Trinity, and Shasta Counties (Figure 7) where they are not associated with serpentine wetlands and, therefore, not included in this strategy. One Del Norte record from 1938 is on the border of Del Norte County with a landmark notation of Illinois River. A relatively recent investigation of this historic occurrence did not locate any suitable habitat in the area (Kagan 1990a). Nine records in Humboldt County, including two records near Mount Lassic on Six Rivers National Forest, were misidentified and are actually *E. ciliatum*. Due to identification uncertainties and need for further study (Kagan 1990a), all Mendocino County populations were excluded from this analysis. In addition, historic populations currently listed in the California Natural Diversity Database (CNDDB) east of Sacramento (Nevada and El Dorado Counties, CA) are not *E. oreganum*. The Forest Botanist on the Eldorado National Forest believes that these occurrences were misidentified and are actually *E. oregonense* (Mike Taylor, personal communication, 2006).

There are 19 valid occurrences on federal lands in California and several others recorded in CNDDB that are either not confirmed or not located on federal land. Confirmed populations of *E. oreganum* are administered by Six Rivers National Forest (4 occurrences), Shasta-Trinity National Forest (12 occurrences), Klamath National Forest (2 occurrences), and Rogue River-Siskiyou National Forest (1 occurrence). The Six Rivers National Forest occurrences are on lands recently acquired from Sierra Pacific Industry on Underwood Mountain in Trinity County, CA. Three occurrences are recorded in CNDDB as being administered by "unknown" parties, which presumably indicates private ownership.

E. oreganum is known from 33 occurrences on both public and private land in Oregon. The Wild Rivers Ranger District of the Rogue River-Siskiyou National Forest and the Medford District BLM harbor most of the extant Oregon populations of *E. oreganum*. There are four known populations on non-federal land, of which two are protected on Eight Dollar Mountain (one by The Nature Conservancy, the other by the Oregon Division of State Lands). The third known population is on private land southwest of Cave

Junction, between Woodcock Mountain and Free and Easy Pass. The two 1984 collections near the historic town of Waldo, which have not been relocated, are also on private lands (Kagan 1990a).

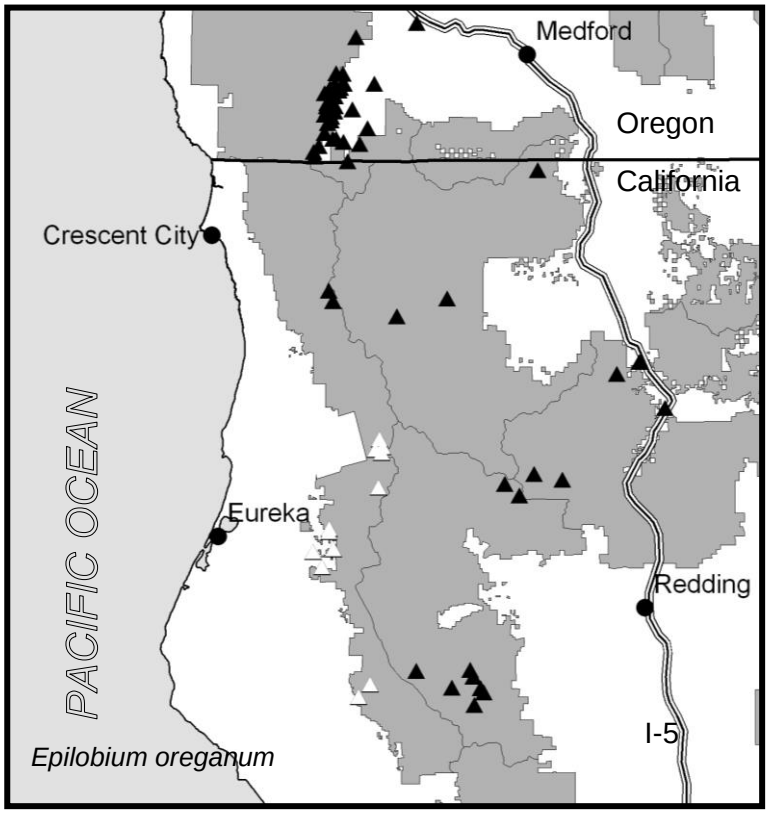


Figure 7: Known occurrences of *Epilobium oreganum* (dark triangles). Data were acquired from California Natural Diversity Database (CNDDB) on September 19, 2006 and from Oregon Biodiversity Information Center (ORBIC) on May 17, 2006. Gray areas are National Forests and their boundaries. Open, white triangles are suspect occurrences.

Abundance and Population Trends

Although extensive and systematic monitoring of all known *E. oreganum* occurrences has not been conducted, Kagan (1990a) notes several apparent population extirpations. Occurrences from the northernmost portion of the range (Nickel Mountain of Douglas County, OR, and north of Grants Pass in Josephine County, OR) could not be relocated in 1990. Also, historic populations located at the southern end of the Illinois Valley in California (Del Norte County) could not be relocated. Kagan (1990a) notes that no suitable habitat can now be found near these sites and he suggests the populations have been extirpated. The occurrence that was observed on a tributary of Grouse Creek in Humboldt County, CA, in 1889 has also likely been extirpated. More than 4,900 *E. oreganum* plants were observed during population assessments in 2015-2017 in seven Essential Wetlands in Oregon, with the largest population of 2,146 plants observed at Cedar Log RNA wetland (Amsberry and Brown 2016, Brown 2017).

Mendocino Gentian – *Gentiana setigera*

Life History

Gentiana setigera is a perennial forb 20-45 cm tall with a characteristic basal tuft of leaves, closely spaced and numerous cauline leaf pairs, and only one relatively large (14-18 mm) funnelform, blue flower per stem (Chambers and Greenleaf 1989). Based on its size and appearance, this species probably does not flower and fruit until its second year. Flowering occurs from late July to September and probably continues until frosts kill it back. Flowers usually close at night and during cloudy or rainy weather (Kagan 1990a). The longevity of individual *G. setigera* is unknown, nor is anything known about its germination syndrome.

Range and Distribution

Gentiana setigera is restricted to serpentine wetlands in the Siskiyou Mountain area of southwestern Oregon and extreme northern California, with one disjunct population from Red Mountain in Mendocino County, CA. It occurs mainly in Josephine and Curry Counties in Oregon, and Del Norte County in California. Most of its habitat is found along the western edge of the Illinois Valley from Eight Dollar Mountain south to Oregon Mountain. However, there are a number of small but important occurrences to the south and west, from Gasquet Mountain in California north to Hunter Creek Bog, just south of Gold Beach, OR (Kagan 1990a). One population in Mendocino County is separated from all other known occurrences by over 100 miles (Figure 8). The population was last collected in 1993 by J. Anthony.

There are 52 recorded occurrences of *G. setigera* in Oregon and another seven in California. In Oregon, most populations of *G. setigera* are administered by the Wild Rivers and Gold Beach Ranger Districts of the Rogue River-Siskiyou National Forest. Other populations, including those at Eight Dollar Mountain, Woodcock Creek, and along Oregon Mountain Road, are administered by the Medford District BLM. The Coos Bay District BLM administers two populations. All California populations, except one, are found on the Smith River Recreational Area of the Six Rivers National Forest. The one exception is a disjunct site administered by the Arcata Office of the BLM on Red Mountain, Mendocino County (Kagan 1990a). The CNDDB database incorrectly describes an occurrence of *Gentiana setigera* in Stoney Creek, Gasquet Ranger District (L. Hoover, personal communication), and it has been omitted from this analysis. Kagan (1990a) suggests there may be *G. setigera* populations that have not been found yet in the south-central portion of the Kalmiopsis Wilderness Area, especially in Madstone, Canyon, Fresno, Brokencot, and Chrome Creeks.

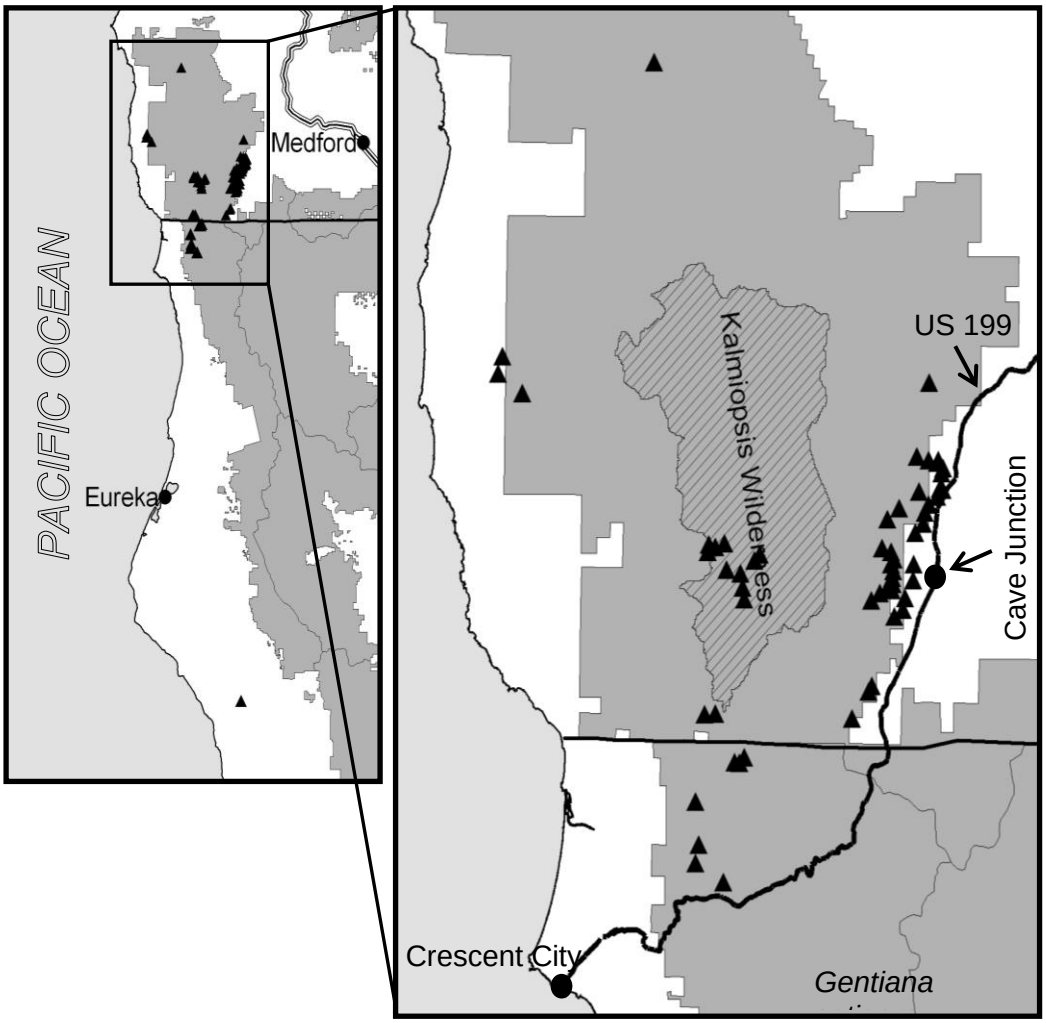


Figure 8: Known occurrences of *Gentiana setigera* (triangles). Data were acquired from California Natural Diversity Database (CNDDB) on September 19, 2006 and from Oregon Biodiversity Information Center (ORBIC) on May 17, 2006. Gray areas are National Forests and their boundaries.

Abundance and Population Trends

Population estimates are recorded for 53 of the 59 occurrences; most of the populations are relatively small (fewer than 500 plants). Kagan (1990a) estimates that the average population size of *G. setigera* is approximately 50 individuals; however, that appears to be a low estimate based on more recent observations. For example, Carothers and Frost (2006) found 998 *G. setigera* across eight wetlands using a more intensive demographic sampling technique. Over 11,400 plants were observed during population assessment in 2015-2017 in six Essential Wetlands in Oregon, including an occurrence of 4,069 at Wimer Road wetlands. Of the 59 known occurrences, little is known about their long-term trends.

Large-Flowered Rush-Lily – *Hastingsia bracteosa* var. *bracteosa*

Life History

Hastingsia bracteosa var. *bracteosa* is a robust, long-lived, polycarpic perennial that blooms in May and June (Lang and MacDonald 1987). Flowers are 10-12 mm long, white in color with inserted stamens. Fruit capsules mature in July and August. Non-flowering individuals are indistinguishable from *Hastingsia bracteosa* var. *atropurpurea*, both of which occur in the same habitats of this region. It is not known how many years it takes an individual to reach the flowering stage, though Kierstead (pers. comm. in Lang and MacDonald 1987) suggests an average of three years is required.

Reproductive individuals of *H. bracteosa* var. *bracteosa* produce 4-15 flowers, with some larger individuals producing 30-40 flowers (Lang and MacDonald 1987). Bumblebees (Becking 1982) and butterflies and wasps (Zika 1987) have been observed visiting *H. bracteosa* var. *bracteosa* flowers. Six seeds can be produced per capsule and have no known long-distance dispersal mechanism, although Lang and MacDonald (1987) suggest that deer might provide occasional dispersal among wetlands.

Range and Distribution

Hastingsia bracteosa var. *bracteosa* is endemic to a small area on the west side of the Illinois Valley in central Josephine County, Oregon. No known occurrences are found in California. Populations are found in association with low-elevation (1,500-2,200 ft) serpentine wetlands and stream sides scattered from Eight Dollar Mountain southwest to Rough and Ready Creek (Figure 9).

Of the total 42 occurrences, 11 are found on Medford District BLM, two on private property, and the remainder on the Wild Rivers Ranger District of the Rogue River-Siskiyou National Forest. One occurrence on private property is administered by The Nature Conservancy (Eight Dollar Mountain Preserve) while the other was found on private property along Waldo Road. This latter population was not relocated in a subsequent survey.

Abundance and Population Trends

Population sizes vary considerably, from very small (11-50 individuals) to large (> 10,000 individuals). The only recorded population of *H. bracteosa* var. *bracteosa* that may now be extinct was found in a wetland along the O'Brien-Waldo Road in 1972 by Benningson and Nelson, but could not be found by Becking (1982; see Lang and MacDonald 1987). Of the 12 subpopulations in monitored by Amsberry and Brown (2016) in four Essential Wetlands in Oregon, eight subpopulations (67%) appeared to decline, while three (25%) may have increased since previous plant counts.

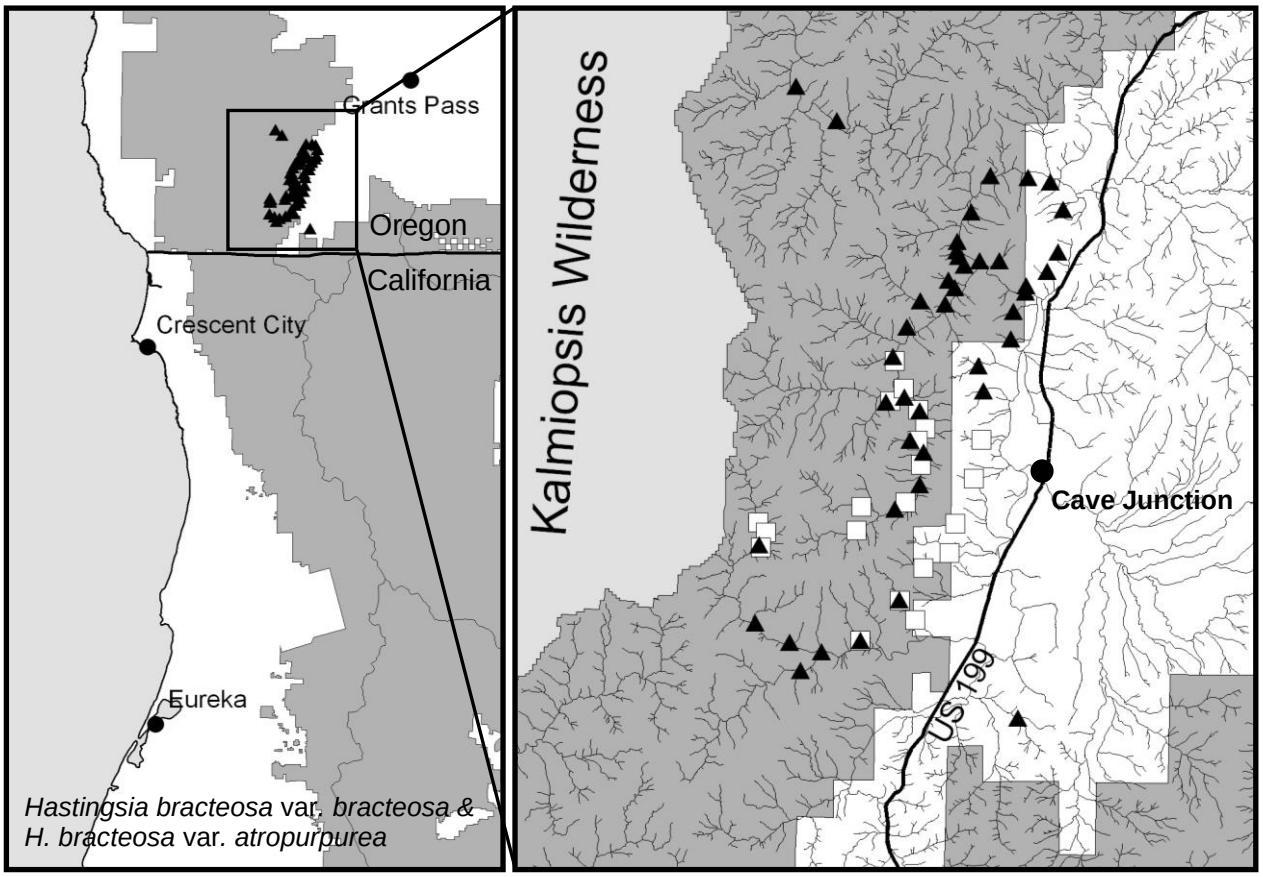


Figure 9: Known occurrences of *Hastingsia bracteosa* var. *bracteosa* (triangles) and *H. bracteosa* var. *atropurpurea* (squares in close-up map). Data were acquired from the Oregon Biodiversity Information Center (ORBIC) on May 17, 2006. Gray areas are National Forests and their boundaries.

Purple-Flowered Rush-Lily – *Hastingsia bracteosa* var. *atropurpurea*

Life History

The life history characteristics of *Hastingsia bracteosa* var. *atropurpurea* are similar to those listed for *H. bracteosa* var. *bracteosa* above. The two species can be distinguished based on morphological characteristics only when flowers are present.

Range and Distribution

Hastingsia bracteosa var. *atropurpurea* is found only on the west side of the Illinois Valley in Josephine County, Oregon, primarily in seeps, wetlands, and stream banks around Woodcock and Tennessee Mountains and on the middle and upper reaches of Josephine Creek. In comparison, *H. bracteosa* var. *bracteosa* is dominant on the northern portion of the range from the middle reaches of Josephine Creek to Eight Dollar Mountain. The two taxa co-occur in a small number of sites, especially in the central portion of the range, where intermediate color forms (pink or purple-striated) suggest hybridization (Zika 1987).

A total of 21 populations of *H. bracteosa* var. *atropurpurea* have been documented. Elevations range from 1,425 feet to 2,860 feet (mean 1,941 feet). Of the 21 populations, all but five are administered by the Wild Rivers Ranger District, Rogue River-Siskiyou National Forest. Four are on lands administered by Medford District BLM and one by a private landowner (Parker Creek).

Abundance and Population Trends

Population sizes are probably similar to those of *H. bracteosa* var. *bracteosa*, though two population estimates were quite large (i.e., the bracketed categories of 52,325-121,400 and 77,100-155,450 were recorded by Frost and Sweeney near Woodcock Mountain). Amsberry and Brown (2016) observed apparent increases in two subpopulations in Woodcock Bog RNA (Central West Illinois Valley Essential Wetland), but did not relocate any plants in a third occurrence in the central west Illinois Valley, which had 10,000 plants in 1995, but only 10 plants in 2012. Brown (2017) observed 1,131 plants at Mendenhall Creek Essential Wetland.

Western Bog Violet – *Viola primulifolia* ssp. *occidentalis*

Life History

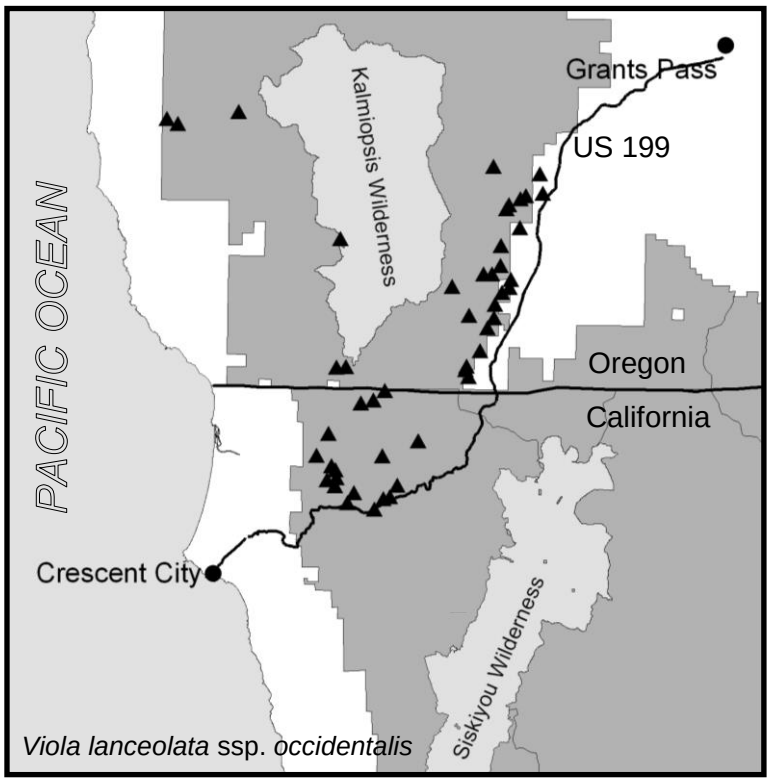
Viola primulifolia ssp. *occidentalis* is a perennial rhizomatous forb that grows 8-19 cm tall. The glabrous leaves are basal, crenate, broad-lanceolate in shape, and borne on hairless petioles that are longer than the leaf blades (30-110 mm). Flowers are entirely white except for three purple veins on the front of the lower petal. It blooms from April to early June, and capsulate fruits are generally mature by July.

Range and Distribution

The distribution of *V. primulifolia* ssp. *occidentalis* is similar to that of *G. setigera*. It is restricted to serpentine wetlands in the Siskiyou Mountain area of southwest Oregon and extreme northwest California (Figure 10). The taxon is currently known only from Curry and Josephine Counties in Oregon, and Del Norte County in California. Most populations are along the western edge of the Illinois Valley from Eight Dollar Mountain south to Oregon Mountain, south in the North Fork Smith River drainage to Gasquet Mountain, and west to Vulcan Peak in the Kalmiopsis Wilderness Area.

There are a total of 49 records for *V. primulifolia* ssp. *occidentalis*, including 31 in Oregon and 18 in California. There is one collection from 1942 by D. Overlander in Douglas County, Oregon that was most likely mislabeled. (The site is well outside the range of the species and the population is no longer extant.) One population included in the CNDDB database was south of the Highway 199, near the Siskiyou Wilderness; however, this site does not harbor *V. primulifolia* ssp. *occidentalis* (L. Hoover, pers. comm.). For all known occurrences, elevations range from 600 feet to 3,925 feet (mean 1803 feet). Of the 49 occurrences of *V. primulifolia* ssp. *occidentalis*, 24 are on lands administered by the Rogue River-Siskiyou National Forest, 18 on Six Rivers National Forest, six on Medford District BLM, and one on private property (The Nature Conservancy, Eight Dollar Mountain Preserve).

Figure 10: Known occurrences of *Viola primulifolia* ssp. *occidentalis*. Data were acquired from the California Natural Diversity Database (CNDDB) on September 19, 2006 and from the Oregon Biodiversity Information Center (ORBIC) on May 17, 2006. Gray areas are National Forests and their boundaries.



Abundance and Population Trends

Viola primulifolia spp. *occidentalis*, due to its highly rhizomatous nature, can prove challenging when attempting to obtain accurate and repeatable population estimates. Population estimates range greatly, from the bracketed categories of 15-50 to 100,000-500,000 plants. In a detailed study of 36 wetlands, Frost et al. (2004) found on average 3,850 *V. primulifolia* ssp. *occidentalis* per wetland. In 2015-2017, nearly 650,000 ramets were observed in seven Essential Wetlands in Oregon (Amsberry and Brown 2016, Brown 2017). Very little is known about population trends in *V. primulifolia* ssp. *occidentalis*, though no extirpations have been noted. Since previous visits, Amsberry and Brown (2016) observed apparent increases in eight subpopulations in Oregon, but could not relocate one small population.

IV. CONSERVATION

Threats

Threats to species associated with *Darlingtonia* wetlands are outlined in the context of four criteria, listed in priority order.

Criteria 1: The present or threatened destruction, modification, or curtailment of the taxa's habitat or range

Hydrological Impacts

Any alteration of the hydrology of a serpentine wetland has the potential to drain water away from the wetland and its associated plant community. Several studies and general field observation indicates that the hydrological regime of the wetland environment is probably the most critical component of serpentine wetland communities and their associated rare plant habitat (Becking 1982, Borgias 1993, Borgias and Biegel 1996, Frost et al. 2004). All of the rare target species discussed in this Conservation Strategy are associated with high soil moisture or flowing water. Mining and its related activities, Off Highway Vehicle (OHV) use, road construction and maintenance, fire suppression activities, and domestic water diversions all have the potential to adversely affect hydrologic processes by accelerating or diverting water flows. These activities represent significant threats to serpentine wetland biodiversity because many species are sensitive to small changes in hydrology and water chemistry.

Mining and its related activities: There are numerous mining claims in and around many of the *Darlingtonia* wetlands that provide habitat for these five species. Mining activities, including soil removal, water diversion, road development, excavation of test pits, and dumping of overburden rock have led to a decline in the quantity and quality of serpentine wetland habitat. Most direct losses of serpentine wetland habitat associated with mine development occurred historically, but current mining operations and associated road maintenance continue to affect some areas.

- In 2016 the USFS and BLM completed an Environmental Assessment (EA) (USDA & USDI 2016) for mineral withdrawal on certain lands in southwest Oregon. Based on the findings in the EA a decision was rendered to withdrawal 5,216 acres of BLM-managed public domain and revested Oregon California Railroad lands (O&C), and 95,806 acres of National Forest System (NFS) lands from mining. These lands cover a portion of the populations focused on in this Conservation Strategy. The purpose of the withdrawal was to maintain the current environmental baseline, relative to mining, mineral exploration and development, and geothermal energy development, while Congress considers legislation enacting a permanent withdrawal from mineral entry. The Southwestern Oregon Mineral Withdrawal removes the lands from settlement, sale, location and entry under the public lands laws, location and entry under the U.S. mining laws, and operation of the mineral and geothermal leasing laws for the following 20 years. The mineral withdrawal does not prohibit ongoing or future mining exploration or extraction operations on valid pre-existing mining claims.

- As of 2001 there were 1,190 active mining claims on the Rogue River-Siskiyou National Forest (Conservation Biology Institute 2001). An Environmental Impact Statement for suction dredge mining published by the Siskiyou National Forest showed 577 mining claims along stream courses, which are often associated with wetland locations (USDA 2001).

- As of 2013, 28 occurrences of the five special status plant taxa were located at least partly within the same quarter section as one or more active mining claims on the Medford District BLM (ORBIC 2013, USDI 2014). At last observation, nine of these occurrences had good or excellent viability ranks. In addition, 47 of 50 plant occurrences on Medford District BLM are located within the same 7th-level watershed as one or more active mining claims, including 20 plant occurrences with good or excellent viability, at last observation.

- Of 35 serpentine wetlands sampled by Frost et al. (2004) across southwest Oregon and northwest California, mining-related impacts were noted in 11 sites (31%).

- Commercial mining at Nickel Mountain was likely responsible for the loss of the Douglas County population of *Epilobium oreganum* and *Viola primulifolia* ssp. *occidentalis* (USDA and USDI 2006).

- Suction dredging in active stream channels is a common mining activity which probably does not affect habitat for the five taxa to any large extent. Larger scale mining of serpentine-associated minerals (nickel, chromium, copper, and gold) has been proposed numerous times in the Siskiyou Mountain region but is not actively occurring at this time. This kind of mining would clearly pose a significant threat to these taxa if undertaken in areas where the species are known to occur. It is possible that mining activities would increase if the price of these metals rises to the point where commercial extraction becomes economically attractive.

- Withdrawal of wetland habitats from mining activity may not be sufficient in itself to protect these species, as the effects of altered hydrology may occur downstream or down slope from the point of disturbance. For example, Becking (1982) describes a wetland that dried out due to upslope logging and road building, coupled with excavation of an adjacent slope. In an extensive survey of *Darlingtonia* wetlands, Frost et al. (2004) observed several similar cases where wetlands had been significantly degraded or destroyed by road-related alteration of upslope water flows (see also *Road Construction and Maintenance* section below).

- Numerous mines are found in areas with high concentrations of serpentine wetlands and their associated rare plant species. As an illustration of this potential conflict, numerous populations of all five taxa are found in Josephine Creek, Oregon, on the Wild Rivers Ranger District, Rogue River-Siskiyou National Forest (Figure 10). In total, this watershed contains 49 known occurrences comprised of 192 spatially separated sub-populations. Moreover, the upper portion of this watershed is likely to contain more populations of each taxa than have been previously recorded, because several major tributaries have not been systematically surveyed (e.g., Canyon Creek and Fiddler Gulch; E. Frost, pers. comm.). According to the Mineral Availability System /Mineral Industry Location System (USEPA 1998), in 1998, Josephine Creek had a total of 43 active and inactive claims. This total included 6 placer mines, 18 surface mines, 11 underground mines, and eight unknown types. These data demonstrate that the area with the highest concentration of special-status plants in wetlands has historically been an active area for mining.

- In 2003 a claimant submitted a plan to sample gravel deposits along Josephine Creek (Wild Rivers Ranger District) to verify the value of gold in the area (K. Johnson, pers. comm.). The claimant did not find sufficient gold to warrant further exploration; however, this testing of deposits highlights the potential for future mining operations in the vicinity of serpentine wetlands.

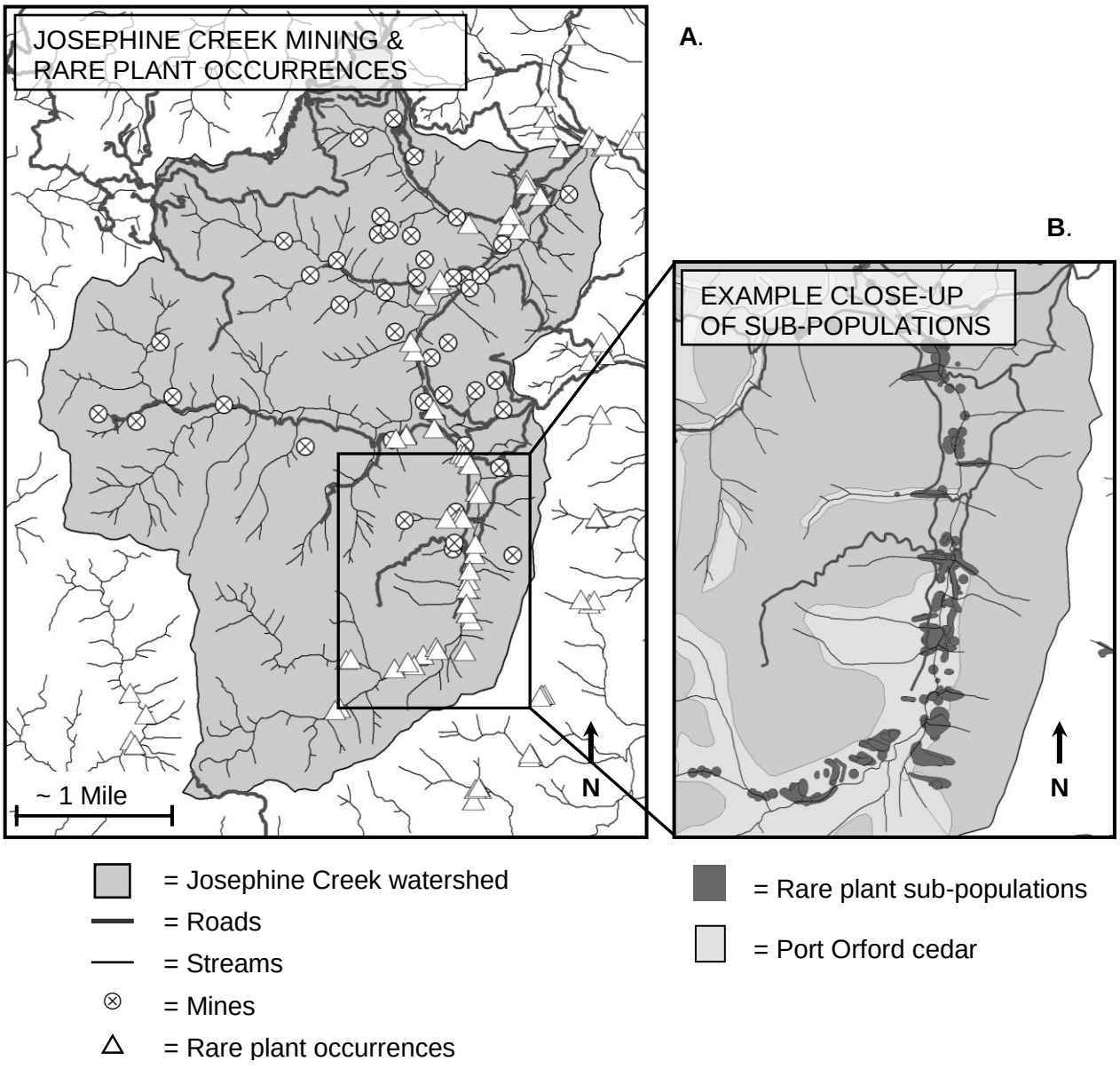


Figure 11. (A) Josephine Creek watershed, showing the proximity of mining claims and rare plant occurrences. Triangles indicate plant occurrences and crossed circles (⊗) indicate mines. (B) Dense concentration of known sub-populations along the main stem of Josephine Creek. Port Orford cedar is the dominant tree in serpentine wetlands and is threatened by an invasive root rot.

Lack of management options relative to mining activities also increases the risk to serpentine wetlands and the rare species they support. At present, none of the five target species are federally listed as threatened or endangered; therefore, none receive protection under the federal Endangered Species Act. In addition, neither USFS nor BLM guiding policies, plans, or land allocations afford much protection from proposed mineral entry. USFS mining regulations require miners to submit a Notice of Intent, then a Plan of Operations before mining activities can take place. BLM surface management policy, as detailed in Manual 3809 (USDI Bureau of Land Management 2012a) and Handbook 3809-1 (USDI Bureau of Land Management 2012b), requires a Notice of Intent for all mineral exploration greater than casual use that disturbs $\leq$ 5 acres of public land. A Plan of Operations is required for activity that would disturb > 5 acres, or that occurs within an Area of Critical Environmental Concern (ACEC), including Research Natural Areas (RNA). All of the Essential Wetlands managed by BLM are within ACECs.

As is the case with any activity occurring on Federal land, environmental documentation would be required which would include an analysis of effects to Sensitive or Special Status species. Mitigations may be proposed to reduce effects during mining, yet most of the mitigation focuses on what happens after mining. Essentially, standards and guidelines concerning minerals management do not focus on protecting rare species, wetlands, or riparian areas prior to disturbance; rather, they focus on reclamation plans, disposal of toxic wastes, recontouring slopes, etc., after mining. Because protections may not exist or can be discretionary when mineral entry is proposed, mining is clearly one of the most significant threats to the five rare plant species and their wetland habitats. High levels of disturbance associated with mining, the potential for additional claims to become active in the future, and insufficiency of existing regulatory mechanisms necessitates further actions (i.e. mineral withdrawal) to protect serpentine wetlands from this activity.

Road Construction and Maintenance: Road construction, primarily associated with mining, has occurred extensively on Eight Dollar Mountain, along Josephine Creek, and throughout the North Fork of the Smith River drainage in California, particularly around Gasquet Mountain. The majority of these roads are compacted bulldozer tracks. Where roads go through or occur near serpentine wetlands and/or stream channels, they can alter the hydrologic patterns by intercepting water and diverting it down slope along the roadbed, thereby removing water from the system. Many wetlands are located in close proximity to roads that were not designed to avoid impacts to these wetlands. For example, Frost et al. (2004) found that of 27 sampled wetlands, 66% were subject to some level of road-related disturbance. Becking (1982) describes a *Darlingtonia* wetland on private property where upslope logging and road building coupled with the excavation of the adjacent slope caused a wetland to dry out. Pulling ditches along roads can also destroy roadside wetland plants. Examples of this impact exist on roads near Game Lake, Snow Camp, and Iron Mountain on the Rogue River-Siskiyou National Forest (USDA and USDI 2006). Similarly, the lack of routine road maintenance may also pose problems for serpentine wetlands if drainage and erosion problems develop and are not remedied. During habitat assessments conducted in 2015-2017, road maintenance was noted as a threat for five of nine Essential Wetlands in Oregon (Amsberry and Brown 216, Brown 2017).

Off-highway Vehicle Use: Serpentine wetlands near roads and trails are at risk from OHV activity and there have been repeated occurrences of OHV damage in some wetlands (Frost et al. 2004, USDA and USDI 2006, C. Shohet, pers. comm.). The Forest Service has identified some wetlands that have suffered previous damage and taken measures to close access; however, OHV use continues to be a significant threat to other wetlands (USFWS 1996). In other cases, as with 8 of 9 Essential Wetlands in Oregon assessed in 2015-2017, OHVs do not appear to be a threat (Amsberry and Brown 2016, Brown 2017). OHVs can also threaten Port Orford cedar populations in *Darlingtonia* wetlands, as increases in the movement of mud and organic material greatly increases risk of infection from POC root disease (see *Disease and Predation* section below). This is especially true where roads provide access to high concentrations of *Darlingtonia* wetlands or where roads occur upslope and adjacent to the wetlands.

Fire Suppression Activities: Fire suppression activities, including constructing hand line, dozer line, safety zones, parking areas, logistics areas, and helispots, pose threats to the hydrologic integrity of *Darlingtonia* wetlands. Fire line construction can divert water flow away from the wetland plant community, resulting in disruption of the wetland and potential loss of associated rare plants. Several wetlands were significantly degraded in this way on the Rogue River-Siskiyou National Forest as a part of fire suppression activities on the 2002 Biscuit Fire (Mazzu and Shohet 2002, Rolle and Shohet 2003).

Water Diversion/Domestic Water Use: Expanding agricultural and rural residential water usage in Josephine and Del Norte counties has led to increased domestic pressure on the seeps and springs feeding the wetlands, resulting in less water delivery to the wetlands. Some recent diversions have adversely affected *Darlingtonia* wetlands and their associated habitat (USDA and USDI 2006). Of the wetlands sampled by Frost et al. (2004), approximately 35% were subject to some level of water diversion. During habitat assessments conducted in 2015-2017, water diversion was observed in eight of nine Essential Wetlands in Oregon (Amsberry and Brown 216, Brown 2017).

Altered Fire Cycles

Fire has been a significant and important part of the environment in southwest Oregon and northwest California for millennia, shaping plant communities and forest structure (e.g., Atzet and Wheeler 1982, Skinner 1995, Frost and Sweeney 2000). The frequent presence of fire-scarred trees in *Darlingtonia* wetlands and adjacent vegetation indicates that fire occurred in these habitats with some frequency in the past (Frost et al. 2004). The Jeffery pine plant association, where a large proportion of wetlands occur, is historically less likely to suffer high severity fire due to low fuel loading and widely spaced canopies (Atzet and Wheeler 1982). However, fire exclusion during the last century may have affected fuel loads to the point where recent fire events may be of uncharacteristic intensity (see Skinner et al. 2006 for a discussion).

Fire and successional changes due to fire exclusion may adversely impact wetlands and their associated species. Observations made during field sampling indicate that lack of fire may lead to increased shrub and tree encroachment, particularly around wetland margins (E. Frost, personal observation). During habitat assessments conducted in 2015-2017, woody vegetation succession was noted as a potential threat for seven of nine Essential Wetlands in Oregon (Amsberry and Brown 216, Brown 2017). Nonetheless, the effect of fire and fire exclusion on serpentine wetlands and their associated flora is largely unknown. Disturbance that alters vegetative cover characteristics may impact rare plant habitat. Species like *Epilobium oreganum* that favor habitat with relatively high cover may benefit from fire exclusion. In contrast, *Gentiana setigera*, *Viola primulifolia* ssp. *Occidentalis*, and *Hastingsia bracteosa* var. *bracteosa* appear to prefer more open wetland habitats (Frost et al. 2004). The loss of hill slope vegetation following severe wildfire also has the potential to impact wetlands by accelerating erosion and altering water flows.

High intensity burns that occurred as part of the 2002 Biscuit fire in *Darlingtonia* wetlands did not appear to have immediate adverse effects to the five rare species on the Six Rivers National Forest (Frost et al. 2004, Cramer et al. 2005). Although research is limited, prescribed fire has the potential to maintain open wetland habitats and thereby benefit target species (Borgias and Biegel 1996). Pending better research and monitoring on fire effects in serpentine wetland communities, prescribed fire is a management tool that may have more widespread application (see *Conservation Requirements* section).

Criteria 2: Disease and predation

No major threats from disease or herbivory have been noted for any of the five rare taxa for which this Conservation Strategy is intended to protect. Limited herbivory, most likely by deer and insects, has been noted for *Epilobium oreganum* and *Gentiana setigera* (Kagan 1990a and 1990b). For *Hastingsia* taxa,

grazing by deer has also been noted and can be conspicuous at some locations. Nonetheless, grazing was not considered a major threat to *Hastingsia* in a previous Draft Conservation Strategy (Lang and MacDonald 1987). Neither herbivory or disease has been noted previously for *Viola primulifolia* ssp. *occidentalis*.

While there are no known diseases that directly threaten the five target plant taxa, an invasive root disease that is infecting Port Orford cedar may pose an indirect threat. Port Orford cedar is a large conifer endemic to northern California and southwest Oregon. Across its range, Port Orford cedar inhabits a wide range of habitats, including riparian areas, serpentine soils, sand dunes, and coastal plains (Zobel et al. 1985). Because of its high tolerance of serpentine substrates and water-saturated soils, Port Orford cedar is the most important tree associated with serpentine wetlands. For instance, in a survey of 36 wetlands, Frost et al. (2004) found Port Orford cedar to have the highest constancy (91.7%) and highest mean cover (5.4%) of any tree species.

The invasive root fungus, *Phytophthora lateralis*, has been spreading throughout the range of Port Orford cedar since 1952 (Zobel et al. 1985) and increasingly poses a risk to the species. This fungus infects the roots of Port Orford cedar and almost always results in mortality of infected individuals; areas infested with *P. lateralis* exhibit high levels of cedar mortality (Jules et al. 2002). Movement of the fungal spores from infected areas to uninfested areas occurs in several ways. A primary vector is the incidental deposition of spore-infested mud and organic material attached to the under-carriage or tires of vehicles and equipment traveling along roads dissecting infected drainage. Other vectors are animals moving from infected to uninfected drainages, and hikers, equestrian riders, and forest workers (USDA and USDI 2004) picking up mud along a trail dissecting an infected drainage and transporting the spores elsewhere. Once any Port Orford tree is infected in a given area, spore dispersal occurs downstream and down slope in water. Thus, all areas downstream and down slope of an infested site are at high risk of infection (Jules et al. 2002).

A number of serpentine wetlands are currently infected with this disease, or are in close proximity to areas of known infection (E. Frost, pers. comm., E. Jules, pers. comm.). Of 35 serpentine wetlands sampled by Frost et al. (2004) across southwest Oregon and northwest California, four (11%) exhibited symptoms suggesting active infection by Port Orford cedar root disease; a number of other sites were located in watersheds where infections are likely to spread in the future. Port Orford cedar root disease was observed at Oregon Mountain Essential Wetlands, but not at eight other Essential Wetlands assessed in 2015-2017 (Amsberry and Brown 2016, Brown 2017). The effect of the loss or decline of Port Orford cedar in serpentinewetlands is unknown. However, because Port Orford cedar is the most common tree species in wetland habitats, the potential loss of this species, may alter, at some level, ecological relationships in the *Darlingtonia* plant community. Port Orford cedar provides the dominant form of vertical structure and shade in wetlands, and is likely to alter nutrient dynamics by dropping litter into serpentine wetland habitats (Zobel et al. 1985). While the disease does not directly infect the five target plant species, a loss of this common associate may adversely affect these plants indirectly. Lastly, mortality (or removal) of the trees along roads adjacent to these wetlands could indirectly impact the habitat that supports Sensitive plant populations by changing road-related run-off potential that would flow downhill and potentially alter wetland hydrology.

Criteria 3: Overutilization for commercial, recreational, scientific, or educational purposes

Agencies require the completion of a biological evaluation and associated environmental review before issuing a permit for collection of Sensitive species for scientific or educational purposes. For rare species, including *Darlingtonia californica*, agencies may require a permit for the scientific or educational collections but include terms in the permit to regulate and discourage collections.

Nonetheless, the five target Sensitive plant species covered by this strategy and associated rare species are known to have been collected without a permit in the past and used for commercial, sporting, scientific, and/or educational purposes. Veva Stansell (1980) reports that in the 1940s an individual from Gold Beach collected 10,000 *D. californica* plants from a wetland 7 miles north of Gold Beach, then sold them to a nursery in Portland. Upon returning to this site in the 1980's, not one individual was found. She believes this could also have been due to Highway 101 altering the hydrology. In the past, *D. californica* was commonly sold (Veva Stansel, pers. comm.), and is still available from specialty nurseries. Both *Gentiana setigera* and *Viola primulifolia* ssp. *occidentalis* can be found for sale on the internet from native plant nurseries; whether any of these plants are taken from native habitats is unknown.

Criteria 4: Other natural or man-made factors affecting their continued existence

The five target species all face an elevated risk of extinction due to their small geographic range, high degree of habitat specificity, and relatively small population sizes (Rabinowitz 1981). Additionally, a number of populations are extremely small in area (Frost et al. 2004), which increases the chances of extirpating a population by a single stochastic event. The rate at which new populations would be generated by natural dispersal is likely to be low, especially for the four species with poor dispersal mechanisms.

Permitted livestock grazing is no longer considered a significant threat to any of the Essential Wetlands or any other known serpentine wetlands on federal lands within the area covered by this Conservation Strategy. At least several serpentine wetlands in the vicinity of Eight Dollar Mountain in Josephine County, OR, were regularly grazed by livestock until fairly recently (L. Mazzu, pers. comm.). Because of the prolonged recovery time required following disturbance on serpentine soils, the effects of such activities where they have occurred may persist long after they have been terminated.

Currently there are several invasive species within the region that have some potential to invade serpentine wetlands and potentially cause shifts in species composition and/or plant community dynamics (e.g., purple loosestrife, Japanese knotweed, poison hemlock, Himalayan blackberries, meadow knapweed, common velvetgrass). Except for the blackberry and common velvetgrass, these species are not yet known to be established in serpentine wetlands, and it is unknown how easily they may invade these sites. Amsberry and Brown (2016) also observed false brome adjacent to the Star Flat wetland, but the potential impact of this species on wetlands is unknown. Meadow knapweed is also known from the edge of Star Flat wetland (S. Osbrack, pers. comm.). When considering invasive plant treatments, managers should weigh the benefits of treatment against the risk of non-target impacts from herbicide and trampling.

Timber harvesting in close proximity to serpentine wetlands also has the potential to damage associated rare plant populations. Harvesting upslope or adjacent to wetlands has the potential to alter hydrologic regimes on which wetland communities and rare plants depend. Roads associated with timber harvesting can increase this effect on hydrology (see section on roads above). Direct physical disturbances, such as skidding trees through or adjacent to wetlands, also has the potential to harm rare plant populations. While conventional timber harvest is generally not planned on federal lands with serpentine soils, post-fire logging does occur and can result in the same impacts as green tree harvest (e.g. Biscuit Fire Recovery Project FEIS 2004, Beschta et al. 2004).

Conservation under Existing Policies and Plans

Establishing a network of Essential Wetlands will guide their management and facilitate the implementation of specific conservation objectives. Overarching guidance in agency policies, existing plans and land allocation direction further contributes to the conservation objectives as well.
The five target species are on the agencies' Sensitive or Special Status species lists, which provide a measure of protection from potential detrimental effects of actions occurring on lands administered by the Forest Service and BLM (Forest Service manual 2670; BLM manual 6840). These policies and plans include respective National Forest Land and Resource Management Plan Forest-wide standards and guidelines as amended by the Northwest Forest Plan (NWFP; USDA and USDI 1994) and management objectives and direction of the BLM's Resource Management Plans (USDI 2016a and 2016b).

Forest Service manual 2670.22, for example, outlines the following actions for Sensitive species (http://www.fs.fed.us/r6/sfpnw/issssp/agency-policy):

1. Develop and implement management practices to ensure that species do not become threatened or endangered because of Forest Service actions.
2. Maintain viable populations of all native and desired nonnative wildlife, fish, and plant species in habitats distributed throughout their geographic range on National Forest System lands.
3. Develop and implement management objectives for populations and/or habitat of sensitive species.

An example of Sensitive plant conservation guidance from the Siskiyou National Forest Land and Resource Management Plan (1989) states, "[h]abitat is managed to ensure that the species do not become threatened or endangered because of management activities. Protection of known or potential populations of sensitive plants is accomplished through Forest-wide Standards and Guidelines and land allocation (section IV-12)." The Forest-wide standards and guidelines state, "[a]t the Forest level, fish and wildlife habitat shall be managed to maintain viable populations of all existing native and desired non-native plant and animal species. Distribution of habitat shall provide for species viability and maintenance of populations throughout their existing range on the Forest (section IV-26)."

The Six Rivers National Forest Land and Resource Conservation Plan (USDA 1995) designated the North Fork Smith River as a Special Interest Area, specifically a Botanical Area. Three of the 7 Essential Wetland identified on the Forest are located within the Botanical Area. Botanical areas are "classified under 36 CFR 294.1 and managed to protect areas of the Forest with important botanical resources. These areas include some of the best examples of indigenous and sensitive plant concentrations, sensitive plant habitat, conifer diversity and unique plant communities on the Forest" (Six Rivers LRMP IV-51). One Essential Wetland is located in a Research Natural Area (RNA). From the LRMP (IV-30), "RNAs may serve as education and research sites on plant and animal communities, and may also help to implement provisions of special acts, such as the Endangered Species Act and the monitoring provisions of the National Forest Management Act" (USDA 1995).

The BLM's Southwestern Oregon Record of Decision and Resource Management Plan (ROD/RMP) (USDI 2016a), which includes the Medford District, and the Northwestern and Coastal ROD/RMP (USDI 2016b), which includes the Coos Bay District, each provide the following direction for rare plants:

1. Manage ESA candidate and Bureau Sensitive species consistent with any conservation agreements or strategies including the protection and restoration of habitat, alteration of the type, timing, and intensity of actions, and other strategies designed to conserve populations of the species.

2. Prior to implementing actions (other than fire management operations in response to unplanned ignitions or escaped prescribed fires) that could result in habitat modification or species disturbance in the suitable habitat of any ESA-listed, proposed, or candidate plant species, or Bureau Sensitive plant species, conduct surveys to determine species presence.
3. Maintain or restore natural processes, native species composition, and vegetation structure in natural communities through actions such as applying prescribed fire, thinning, removing encroaching vegetation, treating non-native invasive species, retaining legacy components (e.g., large trees, snags, and down logs), maintaining water flow to wetlands, and planting or seeding native species.
4. Create new and augment existing populations of ESA-listed, proposed, and candidate plant species and Bureau Sensitive plant and fungi species to meet recovery plan or conservation strategy objectives.

Furthermore, all of the Essential Wetlands managed by BLM are located within ACECs and identified as relevant and important values in need of special management. The RMPs direct managers to implement activities as necessary to maintain, enhance, or restore these relevant and important values. Special management includes limiting or excluding public motorized access, managing vegetation for fire resiliency, maintaining natural communities and rare plant habitat, and recommending a withdrawal from locatable mineral entry.

Protection of the five Sensitive taxa may also be afforded by standards and guidelines associated with Riparian Reserves covered in the NWFP. All wetlands, whether they are mapped or unmapped, are designated Riparian Reserve. Wetlands ≥1 acre are buffered by 150 feet slope distance, while wetlands <1 acre are buffered by 100 feet slope distance (or one site-potential tree). The NWFP also states that management activities within Riparian Reserves must show how the actions are maintaining or improving Aquatic Conservation Objectives: "As a general rule, standards and guidelines prohibit or regulate activities in Riparian Reserves that retard or prevent attainment of the Aquatic Conservation Strategy objectives" (C-31). Roads must be managed to minimize "disruption of natural hydrologic flow paths, including diversion of stream flow and interception of surface and subsurface flow" (C-32). Fire and fuels management should be designed "to meet Aquatic Conservation Strategy objectives, and to minimize disturbance of riparian ground cover and vegetation. Strategies should recognize the role of fire in ecosystem function and identify those instances where fire suppression or fuels management activities could be damaging to long-term ecosystem function" (C-35). Lastly, the NWFP states that General Riparian Area Management be done in such a way as to "[i]dentify and attempt to secure in-stream flows needed to maintain riparian resources, channel conditions, and aquatic habitat" (C-37).

Similarly, the BLM's RMPs/RODs (USDI 2016a and 2016b) provide Riparian Reserve management direction intended to achieve the following objectives: (1) provide for conservation of Bureau Special Status riparian-associated species, (2) maintain and restore natural channel dynamics, processes, and the proper functioning condition of riparian areas, stream channels, and wetlands, and (3) maintain water quality and streamflows within the range of natural variability.

Essential Wetland Selection

Essential Wetlands were previously defined in the Conservation Agreement (USDA and USDI 2006) and were selected to capture a wide range of population-level and habitat diversity (see below for details on criteria). In total, there are 19 Essential Wetlands outlined in the Conservation Agreement. Each of the named wetlands is comprised of one or more discrete *Darlingtonia* wetlands; often they consist of clusters of serpentine wetlands defined by their proximity or by a shared hydrologic system.

The Essential Wetlands in the Conservation Agreement were intended to represent the full range of genetic and ecosystem diversity of these sensitive species and their habitat, and include the largest populations. Sites were selected based upon the presence of the target plant species, geographic distribution, and population size. For example, populations occurring at elevational extremes were selected if this varied for a species (as it does for *Gentiana setigera* and *Viola primulifolia* ssp. *occidentalis*). Plant populations occurring across the full array of wetland and ecosystem types were also included, so that hill-slope, streamside, and terrace wetlands at elevational extremes were selected for each taxon. Whenever possible, wetlands in previously designated protected areas (e.g. Research Natural Areas, Botanical Areas, Areas of Critical Environmental Concern,) were selected, as were wetlands with populations of multiple species.

Addition of Essential Wetlands

The Conservation Agreement states that additional Essential Wetlands can be designated in the future, where appropriate (Section VI C). Under this Conservation Strategy, three Essential Wetlands are being added, bringing the total to 22 (Table 3, Figure 12). Designation of these new additions is based upon the following criteria: (1) wetlands that contain three or more of the five target taxa; (2) serpentine wetlands on the periphery of a target taxon's geographic range; (3) distinct areas in which all five taxa overlap; and (4) large populations of a single species as related to the size of the other wetland sites.

Table 3. Essential Wetlands listed in Appendix C of the Conservation Agreement and those added as a part of this Conservation Strategy.

In Oregon:	In California:
Cedar Log RNA (Wild Rivers RD)	Gasquet Mountain North
Central West Illinois Valley (Wild Rivers RD, Medford BLM)	Gasquet Mountain South
East Eight Dollar Mountain (Medford BLM)	L.E. Horton Research Natural Area
Elder Creek (Wild Rivers RD)*	Major Moores
Hunter Creek Coastal area (Gold Beach RD, Coos Bay BLM)	Peridotite Creek
Josephine Creek wetlands (Wild Rivers RD)*	Pioneer Village
Josephine Creek-Days Gulch (Wild Rivers RD)	Upper Wimer Road
Lemmingsworth Gulch RNA (Gold Beach RD)	
Mendenhall Creek wetlands (Wild Rivers RD)*	
Northwest Illinois Valley (Wild Rivers RD, Medford BLM)	
Oregon Mountain Wetlands (Wild Rivers RD, Medford BLM)	
Snow Camp (Gold Beach RD)	
Vulcan Lake-Vulcan trailhead (Gold Beach RD)	
West Eight Dollar Mountain-Illinois River-Star Flat (Wild Rivers RD)	
Wimer Road wetlands (Wild Rivers RD)	

* Not included in the Conservation Agreement, but added for the Conservation Strategy.

Mendenhall Creek Wetland Complex: A serpentine wetland that contains three or more target taxa

No single wetland site is known to support populations of all five target taxa. However, there are at least three wetlands that contain four taxa, and at least 13 serpentine wetlands that contain three taxa (Frost et al. 2002, 2004). Of the 16 wetlands with three or four target taxa, all but five are already included in the list of Essential Wetlands. The remaining five wetlands are all found along or adjacent to Mendenhall Creek, a small tributary of Rough & Ready Creek along the west side of the Illinois Valley (Rogue River-Siskiyou National Forest). Importantly, these wetlands all harbor populations of *Hastingsia bracteosa* var. *atropurpurea*, the taxa which is least represented by the Essential Wetlands. Based on these criteria, the five Mendenhall Creek wetlands are also being added as Essential Wetlands. These sites are all relatively small, undisturbed streamside and hill slope wetlands discovered as part of systematic wetland survey efforts conducted in 2001 (Frost 2002).

Elder Creek Wetland: A serpentine wetland on the periphery of a taxa's range

The original list of Essential Wetlands captures much of the variation in habitat and geographic range of the five taxa in southwest Oregon and northwest California; however, considering overall distributional coverage, the Elder Creek powerline wetland is also being added to the list. This wetland contains one of the eastern-most population of *Epilobium oreganum* and represents the only Essential Wetland on the east side of the Illinois Valley, where there are several known wetlands.

Josephine Creek Wetland Complex: A distinct area in which all five taxa overlap and containing large populations relative to other wetlands

The Josephine Creek watershed, a low-elevation tributary of the Illinois River in Josephine County, OR, includes the greatest abundance of all five target taxa. All five taxa are found here, most especially *Hastingsia bracteosa* var. *atropurpurea*, the taxa which is least represented by the Essential Wetlands. At present, the watershed is known to contain 49 occurrences comprised of 192 sub-populations. For *Hastingsia bracteosa* var. *atropurpurea*, 48% (10 of 21) of the known occurrences and 88% (54 of 61) of existing sub-populations are within this watershed. These *H. bracteosa* var. *atropurpurea* populations are quite large; three were recorded with the following bracketed population estimates (1,750-4,100; 2,850-6,750; and 77,100-155,450 individuals). Moreover, populations of other target taxa are often quite large and robust (Frost 2002). For instance, the following population estimates were recorded in Josephine Creek watershed for *E. oreganum* (1,750-4,000 individuals), *Gentiana setigera* (1,126-2,850 individuals), *H. bracteosa* var. *bracteosa* (14,500 individuals), and *Viola primulifolia* ssp. *occidentalis* (115,600-260,350 individuals). Because of the regional conservation importance of Josephine Creek wetlands and their close proximity to each other, all *Darlingtonia* wetlands in this watershed are being included as Essential Wetlands.

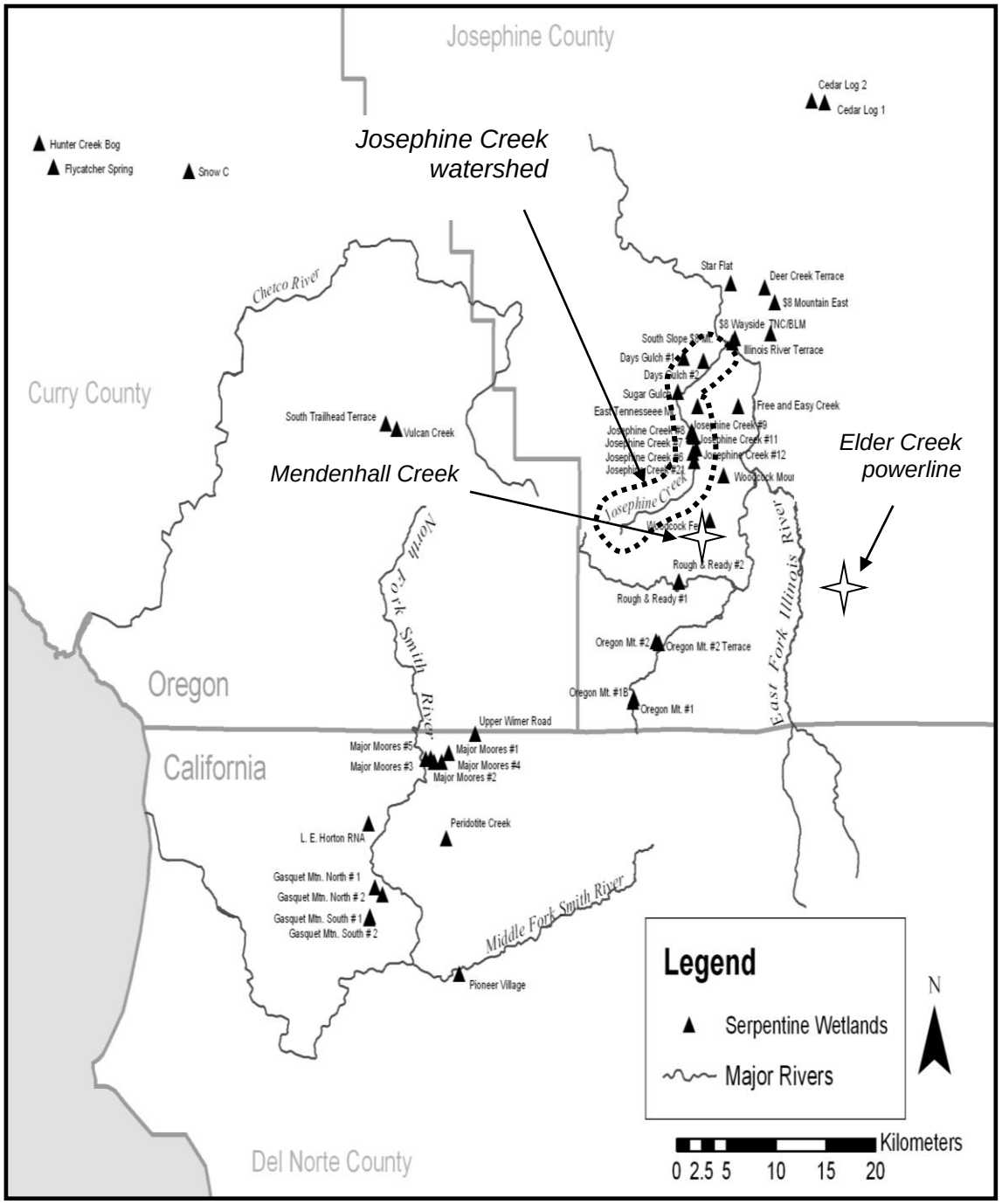


Figure 12. Map of all Essential Wetlands. Triangles are wetlands previously designated in the Conservation Agreement. Stars are additional wetlands designated in this Conservation Strategy. The Josephine Creek watershed (dotted line) is a region rather than a single location and thus is not indicated with a star.

Conservation Needs for Essential Wetlands

Increase protections of Essential Wetlands from mineral entry

Increase protections of *Darlingtonia* wetlands from the detrimental effects of mineral entry via proposing mineral withdrawals. This is supported in Forest Service Manual policy 2761.03 which states "Forest officers should consider withdrawals…in which the management direction is not compatible with …use under the mining laws; for example, research natural areas…and botanical areas." Similarly, when designating ACECs or RNAs through a Resource Management Plan, the BLM may propose mineral withdrawal if a site's important values could be adversely affected by locatable mineral development. In the BLM's 2016 RMPs/RODs that cover the Coos Bay and Medford Districts, all ACECs and RNAs that contain Essential Wetlands are recommended for withdrawal.

Because current regulations do not formally protect *Darlingtonia* wetlands from the potential detrimental effects of mineral entry (see *Threats* section and *Assumptions* section above), increased protections should be enacted. There are two broad types of strategies to employ:

1. Administrative withdrawal of Essential Wetlands from future mineral entry.
2. For any Essential Wetlands that are not withdrawn and for all other Darlingtonia wetlands, develop mitigation and reclamation design features that address short- and long-term habitat and plant community health, changes in hydrologic condition, prevention of *Phytophthora lateralis* introduction, and restoration for all Essential Wetlands

Administrative withdrawal of Essential Wetlands from future mineral entry:

Essential Wetlands includes some wetlands that are protected from future mineral entry, such as those in Botanical Areas and Research Natural Areas where valid existing rights no longer exist (i.e. Smith River National Recreation Area). However, a significant proportion of sites on the Essential Wetlands list currently do not have any formal protective designation. In order to ensure that Essential Wetlands continue to act as a conservation stronghold for target species, land management agencies should provide funding to apply for Administrative Withdrawal for each wetland that currently lacks this designation. The area that should be withdrawn should include the serpentine wetland and additionally the area that maintains the wetlands direct hydrologic regime (e.g., seeps, overland flow). The boundaries of the wetland and area of hydrological influence should be determined by a professional botanist and hydrologist.

The mineral withdrawal process is detailed in the Forest Service Manual, Chapter 2760, and the Federal Land Policy and Management Act of 1976, Section 204 [43 U.S.C. 1714] (Appendix C).

Develop mitigation efforts and reclamation plans for all Essential Wetlands not withdrawn and for Other Darlingtonia *Wetlands when mineral entry is proposed:*

For Essential Wetlands that are not withdrawn:

- Develop mitigations that include (1) buffering of the wetland from any mining-related disturbance, (2) ensuring hydrologic flow is not compromised by excluding mining-related disturbance, (3) minimizing disturbances related to ground-disturbing activities in areas surrounding the wetland, and (4) retaining all canopy trees in and around wetlands, (5) Port Orford cedar disease prevention measures

- Develop reclamation measures that (1) aim to repair any mining related impacts that affect the hydrology, (2) restore the Darlingtonia wetland plant community and the rare plants therein, and (3) provides for post-reclamation monitoring.

For other Darlingtonia wetlands within the range of the five rare taxa, land management agencies should adopt the following guidelines.

- A professional botanist shall visit all proposed mining sites to map and assess all *Darlingtonia* wetlands and associated rare plants.

- A professional hydrologist shall visit all proposed mining sites and develop recommendations to prevent or minimize disturbance to *Darlingtonia* wetlands and, importantly, the hydrological regime that supports it.

- If any of the five target wetland species are found in the area of proposed mineral entry, mitigation and reclamation measures shall be developed to protect and restore the populations.

Reduce significant threats and encourage population recovery

Some Essential Wetlands are currently impacted by one or more of those activities outlined in the *Threats* section above, such that rare species populations may be at risk. For example, where illegal chronic off-highway-vehicle use in wetlands is occurring, these activities may pose threats to the five target taxa and/or wetland hydrology. The methodology for assessing these threats is outlined in the *Monitoring* section below. Where significant impacts are occurring, specific mitigation measures shall be developed by appropriate resource management personnel. Agencies shall address these mitigation measures within three years of the assessment. Furthermore, non-system motorized roads or trails that either dissect or are located immediately upslope of Essential Wetlands shall not be added to the system where it is determined that use of these routes by off-highway-vehicles may further impair or alter hydrological conditions associated with the wetlands.

Reduce the risk of Port Orford root rot disease

Because of the common association of Port Orford cedar in *Darlingtonia* wetlands, protecting the cedar from *Phytophthora lateralis* is a key part of protecting the five rare plant taxa in wetlands. Any activity or proposed activity in or near wetlands should be assessed for the risk it poses to the cedar within the wetland. Factors that should be given consideration include potential sources of *P. lateralis*, such as vehicular traffic (especially during the wet season) and movement of soils and other moist organic material.

Specifically, the following activities require mitigation to protect wetlands:

- Any activity occurring in or near water sources uphill and/or upstream of a *Darlingtonia* wetland.
- Any activity in which mud or organic material is moved into areas in or adjacent to wetlands.
- Any road construction, road maintenance, or road decommissioning near, upstream, or upslope of wetlands.

The following should also be consulted for mitigation guidelines and risk assessments:

> *USDA Forest Service and USDI Bureau of Land Management. 2004. USDA-FS; Final Supplemental Environmental Impact Statement on Management of Port Orford cedar in Southwest Oregon. Portland, OR. 464 p.*

Educate the public about the rarity and importance of Darlingtonia wetlands

Educational programs aimed at the public should be further developed to increase awareness about *Darlingtonia* wetlands and the rare taxa they support. Several recent and on-going educational programs serve as useful examples and should be expanded upon as resources become available. For instance, Six Rivers National Forest has developed an interpretive trail to a *Darlingtonia* wetland along Highway 199 in the Smith River Recreation Area. Likewise, the Medford District BLM has completed a boardwalk into a *Darlingtonia* wetland along Eight Dollar Mountain Road in the Illinois Valley. The Wild Rivers Ranger District of the Rogue River-Siskiyou National Forest has installed interpretive signs within the Eight Dollar Mountain Botanical Area. They have also developed a botanical drive. Both have information on rare serpentine plants.

As resources become available, expand existing educational programs that focus not only on the general public, but also specific groups and organizations such as horticulturalists, recreationists, and OHV users. Programs should include the following:

- Informational signs about rare and interesting plants (i.e., not just *Darlingtonia*) at those wetlands with interpretive trails.
- Materials, such as pamphlets, audio-visual and interpretive programs and posters for distribution in schools, with non-profit organizations, and at agency offices.
- Public presentations and educational programs about serpentine wetlands. As an example of such a program, the Siskiyou Field Institute of the Illinois Valley annually offers a one-day public field course on *Darlingtonia* wetlands to educate the public about the, ecology and conservation value of these communities.
- Interpretive signage and trails at one or more additional serpentine wetlands, especially in areas where none currently exist (e.g., Gold Beach RD, Rogue River-Siskiyou National Forest).

Conservation Needs for other *Darlingtonia* Wetlands

In addition to the Essential Wetlands, other *Darlingtonia* wetlands occur within the range of the Conservation Strategy. This includes *Darlingtonia* wetlands found on Coos Bay District BLM, Medford District BLM, Rogue River-Siskiyou National Forest, and Six Rivers National Forest. Although the Strategy prioritizes efforts within Essential Wetlands, these other wetlands are also in need of protection, monitoring, and management. Specifically, these other wetlands would benefit from the following actions:

1. Educate the public about the rarity and importance of *Darlingtonia* wetlands and their significant contribution to maintaining biodiversity in the Klamath-Siskiyou region.
2. Identify and pursue funding sources to support research to answer fundamental questions about *Darlingtonia* wetlands and their associated rare plants
3. Continue inventory and survey work for all five rare taxa, especially in under-surveyed areas. This work should be used for, among other things, future revision of the Essential Wetland list.
4. Encourage other federal land units that support one of more the five rare taxa to be included in future versions of the Conservation Strategy.

V. RESEARCH, INVENTORY, AND MONITORING OPPORTUNITIES

Monitoring History

Various monitoring and studies focusing on serpentine wetland vegetation and associated rare species have been conducted over the last 20 years, but they have generally occurred in a piecemeal, uncoordinated fashion and at inadequate temporal and/or spatial scales to provide much useful data. Bennett (1987) established a series of permanent macro-plots designed for long-term monitoring of *Hastingsia bracteosa* var. *bracteosa* at four wetland sites located on Eight Dollar Mountain, Josephine County, OR; however, the macro-plots were never resurveyed. The Nature Conservancy of Oregon monitored the short-term response (three years) of *Epilobium oreganum* to a prescribed burn at a single wetland site (Cedar Log Flat RNA) in southwest Oregon (Borgias and Biegel 1998, Borgias et al. 2004). Similarly, Borgias and Biegel (1996) reported on post-fire vegetation monitoring at several wetlands affected by the 1994 Mendenhall Fire in the Josephine Creek watershed. The objective of this effort was limited to establishing a series of photopoints (that have since not been retaken) and qualitatively describing fire effects in burned sites.

An additional wave of research and monitoring in serpentine wetlands began in 2001 with initiation of a study designed to characterize the environmental / habitat relations of the five target plant species, at both coarse (wetland) and fine (plot) scales (Frost et al. 2002). Immediately following the completion of this study, the ~500,000-acre Biscuit Fire affected a number of wetland and rare plant sites in southwest Oregon and northwest California. In an attempt to take advantage of available pre-fire data, a monitoring project was initiated in 2003 to investigate fire effects on target plant species in burned vs. unburned wetlands (Cramer et al. 2005). In 2005, a second year of fire effects monitoring was completed on the Six Rivers National Forest, and a long-term monitoring protocol was initiated for evaluating multi-year population fluctuations in *Viola primulifolia* ssp. *occidentalis* and *Gentiana setigera*. (Carothers and Frost 2006). Since 2005, no additional monitoring work has been conducted for this project.

In 2009, at Woodcock Bog RNA (Central West Illinois Valley wetland), the Medford District BLM installed three permanent 80-m transects to monitor long-term trends of a *Darlingtonia* wetland plant community (Schuller et al. 2010). Both physical attributes and vegetation were documented using a monitoring protocol standardized for RNAs across the Pacific Northwest. Transects were monitored again in 2015 and are scheduled for repeated monitoring every 5-10 years. The monitoring protocol and data are available from the Medford District office.

From 2015 to 2017, the Oregon Department of Agriculture (ODA), Native Plant Conservation Program, developed and tested a long-term monitoring protocol intended to address Tasks 1 and 2. The goal of this monitoring effort is to document the status of these five rare species, identify sites in which populations of one or more taxa may be declining, monitor habitat threats, and prioritize sites needing habitat improvement or other management actions.

To test the protocol, ODA visited 9 Essential Wetlands occurring in the Illinois Valley, Oregon. Three wetlands are located on land managed by Medford District BLM, and six are located on USFS Wild Rivers Ranger District. ODA staff monitored and mapped populations of the five target taxa, documented and scored threats at each site, developed management recommendations, and photographed habitat from permanent photopoints. The monitoring protocol proved to be rapid, efficient, repeatable, and easy to

teach. Data for BLM wetlands have been entered in GeoBOB. Tabular data (Amsberry and Brown 2016, Brown 2017) and the monitoring form are located in Appendix D.

Long-term Monitoring Strategy

One of the Conservation Strategy's objectives is to provide a mechanism for tracking the loss and conservation of serpentine wetland habitat and associated special-status plant species in the assessment area over time. This will primarily entail the monitoring of habitat conditions, plant population sizes, and threats to the populations within Essential Wetlands. The long-term monitoring strategy includes four primary components:

Complete threat assessments in Essential Wetlands

All Essential Wetlands, including the new additional Essential Wetlands added in this Conservation Strategy, will be visited by a botanist to assess existing and potential threats (e.g., water diversion, OHVs, new roads, fire lines, invasive species) as soon as reasonably possible, and periodically thereafter. Threat assessments should use simple visual methods and focus on tangible threats that might trigger management action. A simple database should be created to track threats and management recommendations.

Once the threat assessments have been completed, priority action plans will be developed and implemented for all wetlands where current threats appear to endanger one or more of the five rare taxa or are likely to result in a change to wetland hydrology.

Resurvey rare plant populations in Essential Wetlands every five years

A long-term monitoring program for all five rare plant taxa will be initiated. This program will begin in tandem with the threats assessment outlined above. For each taxa, a minimum of twelve occurrences from the list of Essential Wetlands will be selected for long-term monitoring. These populations should represent a broad geographic range for each species, and include previously surveyed populations whenever possible. All parties agree to finalize the list of occurrences selected for long-term monitoring in the first year following signature of this strategy.

Gathering the type of detailed demographic data that are needed to detect a statistically significant change in a single population size is a labor-intensive endeavor, one that requires carefully estimating large numbers of individual plants (see Cramer et al. 2005). Using these techniques would be impractical for assessing enough populations to make meaningful conclusions about species' status. Instead, methods should be selected that allow for detection of gross changes in population size or extirpations of populations. If gross changes are observed, then additional fine-scale monitoring may be triggered to validate (or dismiss) or further characterize those observations.

Population sizes at each monitoring site should be estimated using standardized size classes: 1: 1-10, 2:11-50, 3: 51-100, 4: 101-250, 5: 251-500, 6: 501-1,000, 7: 1,001-2,500, 8: 2,501-5,000, 9: 5,001-10,000, 10: 10,001-25,000, 11: 25,000+. Where populations are smaller than 250 plants (or stems in the case of rhizomatous *Viola primulifolia* spp. *occidentalis*), all individuals (or *Viola* stems) should be counted directly.

The same occurrences will be re-surveyed every five years. A report will be generated after each survey in which population size and cover values for each taxa are presented and compared with previous surveys. Graphical and tabular forms of all data, including past surveys, should be shown in the report. Significant declines in any population should be noted and priority action plans developed where

management is necessary. If any population declines more than 50%, more intensive monitoring should be implemented at that site, to include permanent plots and counts of individual plants. If for any one of the rare taxa more than 15% of the monitored populations are extirpated, more aggressive conservation actions or reintroduction programs should be initiated.

Produce reports of monitoring, inventory, and conservation actions every five years

Summary reports will be provided to the ISSSSP coordinators, USFWS, and other interested stakeholders every five years for the duration of the Conservation Strategy. The report should include (1) a review of monitoring or other research efforts, (2) a list of all new occurrences found of the five rare taxa, (3) a review of any new mining claims or mineral withdrawals that could affect any of the wetlands considered important for these species, (4) a review of any impacts from mining, OHV, invasive species, succession, or other threats to the Essential Wetlands, (5) a description of management actions implemented, and (6) recommendations for future management, and (7) recommended revisions to the list of Essential Wetlands .

Annually update agency corporate databases and supplemental records for Essential Wetlands

Currently, there is no single database or consolidated record cataloguing the Essential Wetlands and associated taxa. Although construction of a single consolidated multi-agency database is not practical, existing agency corporate databases will be updated annually and subsequently shared with ORBIC and CNDD. Each year, all new data from threat assessments, population monitoring, and inventories will be entered into the appropriate special status species corporate database for USFS (NRIS/NRM TES Plants) and OR/WA BLM (GeoBOB). (The annual data entry due date for USFS R6 and OR/WA BLM is March 1st.) However, not all data products from monitoring and research projects can be included in these corporate databases. Thus, all parties are encouraged to work together to develop data management standards for supplemental data and records.

Additional Research and Inventory Needs

Beyond the general monitoring strategy outlined above, there are seven additional research and inventory needs:

1. *Inventory potential habitat*: Areas with potential habitat that have not been inventoried for wetlands and associated rare plants should be inventoried. In particular, priority areas to inventory are canyon bottoms along North Fork Smith River (Six Rivers National Forest), tributaries of Josephine Creek (Canyon and Fiddler Creek drainages), Kalmiopsis Wilderness (serpentine only), upper East Fork Illinois River (serpentine), and Whiskey Creek (Rogue River-Siskiyou National Forest).

2. *Revisit populations lacking current data*: Populations that have not been revisited in over ten years should be resurveyed. Results should be documented in agency and state heritage databases.

3. *Prescribed fire study:* Because of the great potential for fire and fire suppression to influence serpentine wetlands, the effects of prescribed fire as a management tool in wetland communities should be more rigorously assessed. Using prescribed fire, information should be gathered on soil/peat loss, wetland expansion or contraction, nutrient cycling, changes in woody plant encroachment, and plant community response. If possible, prescribed fires should be carried out in a few select wetlands such that precise pre- and post-burn data can be collected on populations

of the five rare taxa. This will be the most direct way to determine how fire can be appropriately used to manage populations of these taxa

4. *Clarify the status and taxonomy of Epilobium oreganum in California:* Although more than half of the known total occurrences for *E. oreganum* are reported in California, very little associated information is available. For example, some records are based on 40 year-old collections (e.g., those on the Klamath and Mendocino National Forest; Hoover 2006) and/or are ostensibly located on soil types other than ultramafics, which is inconsistent with occurrence data from Oregon (Marla Knight, pers. comm.). Given these problems, all suspected California occurrences of this species should be reviewed to determine if they are accurate and up to date. Herbarium records, agency sighting reports, expert observations and, if necessary, field visits should be utilized as part of this status review.

5. *Study the hydrologic regime of serpentine wetlands:* A study should be designed and conducted to better understand the hydrological dynamics in serpentine wetlands, including seasonal and annual variation in water flows, point of origin, and degree of connectivity between wetlands (sensu Borgias 1993). Ideally, this study should include the different kinds of serpentine wetlands.

6. *Study cultivation and introduction techniques:* Augmentation, introductions, and reintroductions may become important management strategies in the future if extinctions of existing populations are observed. Suitable wetlands for introduction trials may be selected using the habitat variables described in Frost et al. (2002). Use of seeds, whole plants, and/or below-ground parts should be considered in conducting introductions. Any introduction program should begin with seed collection, then greenhouse and field studies, in which seed germination requirements can be determined and various means of propagation can be compared (e.g., asexual vs. sexual reproduction). Monitoring should be conducted to assess the success over time.

7. *Study population demographics*: Given poor understanding of demographic characteristics and life history dynamics for the five focal species, a long-term autecological monitoring effort would clarify when plants initially become reproductive, how long they live, and what environmental conditions (e.g., climatic variation) influence their populations. Though this information is relatively expensive to collect, it would prove useful in conservation management by helping to predict future reproductive effort and evaluating the significance of population fluctuations that occur in Essential Wetlands.

VI. IMPLEMENTATION

This Conservation Strategy identifies a need for numerous conservation actions and inventory, monitoring, and research projects. Table 4 summarizes those tasks, the responsible agencies, frequency of implementation, and desired completion dates. Some tasks, such as threat assessments and population monitoring in Essential Wetlands, were already underway prior to completion of the Strategy. The results of that work (see Appendix D for tabular data summary) will be used to inform action plans that address priority management needs. Many tasks will involve cooperation between agencies, including sharing data, coordinating research, and implementing a standardized monitoring protocol. Other tasks, such as inventorying suitable habitat for wetlands and rare taxa, can be completed independently by each administrative unit. Although not explicitly identified as a task, periodic meetings are encouraged to facilitate cooperation, review progress, and consider the need for Conservation Strategy updates.

Table 4. Summary and timeline for implementing primary conservation and monitoring tasks identified in this Conservation Strategy.

Task	Responsible Agency	Frequency	Start Date	Desired Completion
Assess threats at all Essential Wetlands				
Rogue River – Siskiyou National Forest wetlands	RRSNF	Every 5 years[1]	2015	Ongoing
Six Rivers National Forest wetlands	SRNF	Every 5 years[1]		Ongoing
Coos Bay BLM wetlands	CBLM	Every 5 years[1]		Ongoing
Medford BLM wetlands	MBLM	Every 5 years[1]	2015	Ongoing
Finalize list of occurrences selected for long-term monitoring in Essential Wetlands (12 occurrences per taxon).	All	Once	2018	2018
Monitor population trends and habitat conditions for selected occurrences (12 occurrences per taxon)				
Rogue River-Siskiyou National Forest wetlands	RRSNF	Every 5 years	2015	Ongoing
Six Rivers National Forest wetlands	SRNF	Every 5 years		Ongoing
Coos Bay BLM wetlands	CBLM	Every 5 years		Ongoing
Medford BLM wetlands	MBLM	Every 5 years	2015	Ongoing
Produce inventory and monitoring reports	All	Every 5 years		Ongoing
Create priority action plans to address Essential Wetland threats and management needs				
Rogue River-Siskiyou National Forest wetlands	RRSNF	Every 10 years		Ongoing
Six Rivers National Forest wetlands	SRNF	Every 10 years		Ongoing
Coos Bay BLM wetlands	CBLM	Every 10 years		Ongoing
Medford BLM wetlands	MBLM	Every 10 years	2018	Ongoing
Inventory suitable habitat for serpentine wetlands and associated rare taxa				
North Fork Smith River	SRNF	Once		2025
Canyon and Fiddler Creek (Josephine Creek watershed)	RRSNF	Once		2025
Kalmiopsis Wilderness	RRSNF	Once		2025
Upper East Fork Illinois River	RRSNF	Once		2025
Whiskey Creek	RRSNF	Once		2025
Evaluate need to designate new Essential Wetlands	All	Every 5 years		Ongoing

Task	Responsible Agency	Frequency	Start Date	Desired Completion
Continue long-term community monitoring at Woodcock Bog RNA	MBLM	Every 5-10 years	2009	Ongoing
Revisit populations that have not been monitored in over 10 years (outside of Essential Wetlands)	All	Once		2025
Conduct study on effects of prescribed fire	Any	Once		2025
Conduct taxonomic review of California *Epilobium* specimens.	SRNF	Once		2025
Conduct study on hydrology of major serpentine wetland types	Any	Once		2025
Study techniques for cultivating and outplanting the five rare taxa	Any	Once		2025

[1] For two monitoring cycles, then reevaluate assessment timeframe.

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APPENDIX A. Vascular Plant Species Associated with Conservation Strategy Wetlands

Constancy and mean cover values for the most common vascular plants in Darlingtonia wetlands occupied by one or more of the five focal species (from Frost et al. 2004).

Species	Common Name	Constancy (% occurrence)	Mean Cover (%)
Trees			
Chamaecyparis lawsoniana	Port Orford cedar	91.7	5.4
Pseudotsuga menziesii	Douglas-fir	86.1	2.5
Pinus monticola	Western white pine	80.6	3.1
Shrubs			
Rhododendron occidentalis	Western azalea	100	16.7
Rhamnus californica	California coffeeberry	97.2	3.5
Ledum glandulosum	Labrador tea	55.6	5.3
Herbs			
Darlingtonia californica	California pitcher plant	100	39.6
Helenium bigelovii	Bigelow's sneezeweed	100	2.8
Rudbeckia californica	California cone-flower	97.2	3.4
Cypripedium californicum	California lady-slipper	91.7	<1
Tofieldia glutinosa	Sticky Tofieldia	88.9	1
Narthecium californica	Bog asphodel	88.9	11.6
Castilleja miniata ssp. *elata*	Siskiyou Indian paintbrush	88.9	<1
Platanthera sparsiflora	Short-flowered bog orchid	86.1	<1
Parnassia californica	Grass-of-Parnassus	83.3	<1
Sanguisorba officinalis	Great burnet	80.6	5
Graminoids			
Eriophorum crinigerum	Cotton-grass	100	13.3
Carex echinata	Star sedge	94.4	7.2
Carex aurea	Golden sedge	86.1	3

APPENDIX B. Species Classification and Descriptions

Epilobium oreganum Greene

Synonyms: *Epilobium exaltatum* Drew (in part); *Epilobium brevistylum* Barbey var. *exaltatum* (Drew) Jepson; *Epilobium glaucum* Howell; and *Epilobium subcaesium* Greene.

Common Names: Oregon willow-herb, Grants Pass willow-herb, Oregon fireweed

Citations:

Greene, S. 1888. *Epilobium oreganum*. Pittonia 1:255.

Hoch, P. 1993. The Jepson Manual. Higher plants of California: *Epilobium oreganum*. University of California Press, Berkeley, CA. Pg. 797.

Howell, T. 1888. New *Epilobium* species from Oregon. Bull. Torrey Bot. Club 15:24.

Taxonomy:

The original description of *Epilobium oreganum* was written by Greene (1888), based on a specimen collected by Thomas Howell " in spring runs, Grants Pass"July 1887, Curry County, Oregon. The taxonomy became confused when it was described again from California by Drew in 1889 as *Epilobium exaltatum*, which represented the typical California material of *Epilobium oreganum*. Taxonomic confusion increased when Jepson (1925) expanded the concept of the species to include characters of the more widespread *Epilobium* ciliatum, with which *E. oreganum* will occasionally hybridize (Kagan 1990). Jepson called this taxon *E. californicum* var. *exaltatum*. Munz (1951) carried this confusion on, with the inclusion of *Epilobium exaltatum* as a species in the California Flora.

Based on the most recent revisions of the genus (Hoch 1977, 1993), *Epilobium exaltatum* is no longer considered to be a valid taxon. Some collections labelled as *E. exaltatum* from California are *E. oreganum*, while others have been categorized as *E. ciliatum*. The reason for the confusion about the California status of *Epilobium oreganum* is that some botanists have incorrectly assumed that all plants which key to *E. exaltatum* in California are actually *E. oreganum*. In addition to the confusion with *Epilobium exaltatum*, *E. glaucum* (Howell 1888) and *E. subcaesium* (Greene 1892) are also synonyms of *E. oreganum*.

Description:

Non-Technical

Epilobium oreganum is a tall (4-10 dm), slender glabrous to glaucous perennial in the evening-primrose family (Onagraceae). Its herbage is glabrous or nearly so, and the lance-shaped leaves are sessile, slightly toothed, from one to three inches long. The flowers are erect, with four pink to purplish colored petals that are slightly less than one-half inch long. The seed pods may be from one and one-half to two inches long, and have short pedicels. The species blooms from late July to September and probably continues flowering and fruiting until frosts kill it back. The long narrow capsules (25-45 mm) mature and split within two weeks of the first flowering, and continue for the remainder of the season (Kagan 1990b). The species is distinguished from other members of the genus by its glabrous herbage and white, divided (or four-parted) stigma which extends beyond the pink to purplish corolla (Hickman 1993). Other similar-appearing species of *Epilobium* have a club-shaped stigma. The only confusion which is likely to occur would be the result of hybridization, which can occur in this group.

Technical

Adapted from Meinke (1982) and Hoch (1993): Herbaceous perennial with running rootstocks bearing pink scales; stems 4.5-7.5 dm high, subglabrous. Leaves (30-90 mm) are narrowly lanceolate to narrowly ovate, 3-8 cm long and 0.5-1.8 cm wide, serrulate, with conspicuous reddish veins and petiole 1-3 mm. Inflorescence is sparsely strigose; flowers pink to rose-purple, comprised of hypanthium (2-3 mm), sepals (4-10 mm), and notched petals (7-15 mm). Stamens shorter than pistil and stigma conspicuously four-lobed. Fruit capsule (25-45 mm) hairy and glandular, pedicel 3-6 mm. Seeds (0.9-1.3 mm) are papillate-ridged.

Gentiana setigera A. Gray

Synonyms: *Gentiana bisetaea* T.J. Howell

Common Names: Mendocino gentian, Waldo gentian, elegant gentian

Citations:

Chambers, K.L. and J. Greenleaf. 1989. *Gentiana setigera* is the correct name for *Gentiana bisetaea* (Gentianaceae). Madroño 36(1): 49-50.

Gray, A. 1876. Miscellaneous botanical contributions (Latin description of *Gentiana setigera*). Proc. Amer. Acad. Arts 11:71-104 (84).

Howell, T. 1901. Flora of Northwest America. Fasc. IV: 445.

Pringle, J.S. 1993. The Jepson Manual. Higher plants of California: Gentiana setigera. University of California Press, Berkeley, CA. Pg. 669.

Taxonomy:

Gentiana setigera was first discovered by Bolander on Red Mountain in Mendocino County, California, and was described as *Gentiana setigera* by A. Gray in 1876 (Gray 1876). It was later discovered and described by Thomas Howell from the western edge of the Illinois Valley in Josephine County, Oregon, and given the name *Gentiana bisetaea* (Howell 1901). Because Howell discovered the main area of habitat, and the taxon was often observed in southwest Oregon, the name *G. bisetaea* was most widely used (Kagan 1990).

In California, the name *Gentiana setigera* was confused with a similar taxon occurring in the same region, *G. plurisetosa* C. Mason. *Gentiana plurisetosa* has quite similar flowers to *G. setigera*, but differs in having strictly erect or ascending stems, a poorly developed basal rosette of leaves, broad cauline leaves nearly alike (except the lowest 2-3 pairs) at equally spaced nodes up the stem, often several flowers at the apex, and corolla sinuses often with more numerous capillary appendages (Chambers and Greenleaf 1989). In addition, it appears that *Gentiana setigera* occurs only on ultramafic soils, while *Gentiana plurisetosa* occurs only on granitic or dioritic substrates. A more detailed taxonomic description for these taxa is given by Chambers and Greenleaf (1989).

Description:

Non-Technical

Gentiana setigera is a perennial forb in the family Gentianaceae, growing to 14 inches in height with a characteristic basal tuft of closely spaced leaves and numerous cauline leaf pairs. Flowering stems arise laterally below the basal rosette of leaves, each supporting 1-4 flowers. The flowers are one and one-half inches long and deep blue inside, with a white center, sprinkled with green dots and greenish on the outer surface. The funnelform flowers are erect and usually solitary at the top of the stem or axillary to leaf-like subtending bracts on the upper stem. The five petal lobes are separated by several long, thread-like pointed appendages. Based on its size and appearance, this species probably does not flower and fruit until its second year. Flowering occurs from late July to September and probably continues until frosts kill it back (Chambers and Greenleaf 1989).

Technical

Adapted from Peck (1961) and Pringle (1993): Decumbent, herbaceous perennial with 1 – few, 20 – 45 cm stems arising laterally on a short caudex from below basal rosette. Basal leaves are 25 – 85 mm long and 5-15 mm wide, spoon-shaped to obovate, obtuse-tipped; cauline leaves are many, opposite, 10 – 40 mm long, elliptic, with a sheathing base. Lower leaves are crowded, wider than the upper, thickish; upper leaves less than internodes. Peduncle bears compact cyme of 1 – 4 radial, 5-parted flowers: corolla (25)35 – 55 mm, blue; calyx lobes about equaling the tube, deeply blue within and green-tinged outside, finely mottled with greenish dots, lobes 10 – 18 mm, elliptic-obovate, acuminate, minutely erose; sinus appendages deeply divided into 2 – 3 threadlike parts. Seeds are 2-valved, winged. Blooms August – September.

Hastingsia bracteosa var. *bracteosa* Watson

Synonyms: *Schoenlirion bracteosum* Frye & Rigg

Common Names: Large-flowered rush-lily

Citations:

Sherman, H. and R. Becking. 1991. The generic distinctiveness of *Schoenlirion* and *Hastingsia*. Madroño 38: 130-138.

Watson, S. 1885. Descriptions of some new species of plants, chiefly from our western territories. Proc. Amer. Acad. Arts. 20: 377.

Taxonomy:

Hastingsia bracteosa var. *bracteosa* was originally described by Sereno Watson in 1885, based on specimen collected by Thomas Howell in May 1884 from "Eight Dollar Mountain" in Josephine County, OR (Watson 1885). The genus *Hastingsia* was separated from *Schoenolirion* by Watson in 1879 for *Hastingsia album*, a species from the western United States described by Durand (1855). Watson felt that the morphology and disjunct distribution of the western *Schoenolirion* species sufficiently separated them from those in the eastern U.S. to warrant a new genus. The genus *Hastingsia* was not recognized by most western botanists (Abrams 1923, Frye and Riggs 1912, Jepson 1925, Munz 1973, Peck 1961) until Sherman's doctoral research (1969) reconfirmed Watson's decision to segregate the western taxa. Following Sherman's treatment, *Hastingsia* has become generally accepted as the appropriate generic name for all of the western taxa (Becking 1986, Biosystems 1981, Kartesz and Kartesz 1980, Webb 1985)

Description:

Non-Technical

Hastingsia bracteosa var. *bracteosa* is a robust, long-lived, herbaceous perennial in the Lily family (Liliaceae). The leaves, one to three, are 10 to 20 inches long and approximately one quarter inch wide. The short-pediceled flowers are white to cream-colored and borne on a terminal raceme, 4-15 inches long, with 10-30 flowers per inch of raceme. Tepals are one-half inch long, and stamens about two-thirds the length of the tepals. The bracts are narrow, tapering to a point, and are three-eighths of an inch long. It blooms primarily in May and June, and fruit capsules mature in July and August. *Hastingsia bracteosa* var. *bracteosa* can be distinguished in the field from the more common *H. alba* by its larger perianth segments (8-12 mm long versus 3-6 mm long) and by its included stamens. Non-flowering individuals are indistinguishable from *Hastingsia alba* and *H. bracteosa* var. *atropurpurea*, both of which may occur in the same habitats (Lang and MacDonald 1987).

Technical

From Peck (1961) (as *Schoenolirion*): Bulb narrowly ovoid, 26–43 × 15–27 mm, sometimes with blackish tunic; stem 4-7 dm high, bearing 1-3 reduced grayish green leaves. Leaves: 2.5-5 dm long, 3-7 mm wide. Inflorescence: terminal raceme 1-3 dm long, rarely branched, 2-4 mm at base; flowers (10–) 25–30(–40) per 10 cm of raceme. Flowers: bracts narrowly attenuate, 7-10 mm long, the stout pedicels 2-3 mm long; tepals lanceolate, long acuminate, dull white to yellowish white with pale yellowish or purplish central vein, oblong-lanceolate, 8–12 mm long × 2 mm wide; stamens half to two-thirds as long as the perianth at anthesis; filaments 5–7 mm; anthers pale yellowish, style nearly as long as the ovary. Capsules ellipsoid to obovoid-ellipsoid, barely stipitate, 8–11 × 6–8 mm. Seeds dark grayish green, sometimes yellowish brown to black, 4–5 mm.

Hastingsia bracteosa Watson var. *atropurpurea* (Becking) F. Lang & P. Zika

Synonyms: *Hastingsia atropurpurea* Becking

Common Names: Purple-flowered rush-lily

Citations:

Becking, R.W. 1986. *Hastingsia atropurpurea* (Liliaceae: Asphodeleae). A new species from southwest Oregon. Madroño 33: 175-181.

Lang, F. 1994. Hastingsia bracteosa / atropurpurea: A taxonomic status report. Prepared for the USDA Forest Service, Siskiyou National Forest. Unpublished report.

Lang, F.A. and P.F. Zika. 1997. A nomenclatural note on *Hastingsia bracteosa* and *Hastingsia atropurpurea* (Liliaceae). Madroño 44(2):189-192.

Taxonomy:

Although a purple-flowered form of *Hastingsia* was acknowledged in previous floristic treatments (Peck 1961), the variants were considered conspecific and not given special taxonomic consideration. Becking (1986) first described the purple-flowered, more robust form of *Hastingsia* from Josephine County, Oregon as a new species, *Hastingsia atropurpurea*. He distinguished the new species from *H. bracteosa* on the basis of a distinct, dark purple perianth, larger bulb size, larger and more robust scape, longer and wider, more glaucous leaves, shorter and more branched racemes, larger number of veins in the leaves, shorter floral and inflorescence bracts and greater density of flowers in the raceme.

Subsequent to its recognition as a new species, Lang and Zika (1997) examined a wide array of morphological characters in both *H. bracteosa* and *H. atropurpurea* and were unable to detect significant differences between the two. All morphological criteria used by Becking (1986) yielded widely overlapping measurements (Lang 1994). In addition, where both taxa were found in the same habitat, they appeared to hybridize, as evidenced by flowers with a range of intermediate colors (Lang and Zika 1997). Based on these findings, Lang and Zika (1997) proposed that the purple-flowered form be reduced in rank to a variety, *Hastingsia bracteosa* var. *atropurpurea* Becking. In accordance with these findings, the two taxa were treated as varieties of *H. bracteosa* in the most recent taxonomic revisions (Kartesz 1999), and this is the nomenclature followed here.

Description:

Non-Technical

H. bracteosa var. atropurpurea is very similar to the white-flowered rush lily *var. bracteosa* described above except for the deep purple color on the outer surfaces of its flower segments. Plant and flower size are about the same, tepals are one-half inch long, and stamens about two-thirds the length of the tepals. The bracts are narrow, tapering to a point, and are three-eighths of an inch long. The leaves, one to three, are 10 to 20 inches long and approximately one quarter inch wide. It blooms primarily in May and June and fruit capsules mature in July and August.

Technical

From Becking (1986) (as *H. atropurpurea*): Robust perennial herb, scape single, arising from the top of the bulb, 71-99 cm tall. Bulb oblong or infrequently more oblong-ovate; 28-54 mm long and 18-30 mm wide; bulb scales light brownish, fleshy, densely packed forming the bulb, with a blackish exterior tunica consisting of hardened dried vein remnants. Leaves distinctly grass-like, deeply to distinctly keeled or V-shaped, bluish-green, glabrous, 25-55 cm long and 6-12 mm wide. Mature plants often have abundant dead, blackish and shriveled foliage persisting at the base of the scape at the soil level. Terminal raceme 20-70 flowered, erect, solitary; often the scape is branched below the terminal raceme with 1 to 3 shorter lateral ascending racemes. Sepals and petals lanceolate, 9-12 mm

long, 2 mm wide, erect and forming a closed perianth, tri-nerved, purple-black with a pale green central vein; discoloring often in herbarium specimens to dark purple; each perianth segment narrowing into a flattened and triangular tip, whitish in color with minute dense stiff hairs along the tip margins. Capsule oblong to oblong-ovate, broadly 3-lobed and slightly constricted one-third below its top, 2 seeds per locus. Seed fusiform, elongate with two laterally flattened sides, shiny, black with irregular reticulation on the rounded surface.

Viola primulifolia L. ssp. *occidentalis* (A. Gray) L.E. McKinney & R.J. Little

Synonyms: *Viola occidentalis* (Gray) T.J. Howell, *V. lanceolata* L. ssp. *occidentalis* (A.Gray) N.H. Russell

Common Names: Western bog violet, white bog violet

Citations:

Fernald, M.L. 1949. Contributions from the Gray Herbarium of Harvard University – No. CLXIX. Part II. 2. Rhizome characters in and minor forms of Viola. Rhodora 51: 51-57.

Howell, T.1897. *Viola lanceolata* ssp. *occidentalis* (Gray). Botanical Gazette 11(10):255.

Little R.J. and McKinney L.E. 1992. A nomenclatural change in *Viola lanceolata* ssp. *occidentalis* Phytologia 72(2): 79

Kartesz, J.T. 1994. Synonymized checklist of the vascular flora of the United States, Canada and Greenland. Timber Press, Portland, OR.

Kartesz, J.T. 1999. A synonymized checklist and atlas with biological attributes for the vascular flora of the United States, Canada, and Greenland. First edition. In: Kartesz, J.T., and C.A. Meacham. Synthesis of the North American Flora, Version 1.0. North Carolina Botanical Garden, Chapel Hill, N.C.

Russell, N.H. 1955. *Viola lanceolata* ssp. *occidentalis* (Gray) Amer. Midland Naturalist 54(2): 485.

Taxonomy:

Western bog violet has had a dynamic taxonomic history, with numerous changes in nomenclature that reflect some disagreement about the species' phylogenetics. The taxa was originally described as *Viola lanceolata* ssp. *occidentalis occidentalis* by Thomas Howell in 1896, then later renamed by Fernald (1949) as *V. primulifolia* var. *occidentalis*. Little and McKinney (1992) promoted this taxa to a subspecific rank in his treatment of the genus *Viola lanceolata* ssp. *occidentalis* for the Jepson Manual. Up until recently, a minority of botanists have argued that this violet is more closely related to *Viola lanceolata* ssp. *occidentalis*, a species widely distributed in the eastern United States. In his taxonomic review of North American acaulescent white violets, Russell (1955) states that "The majority of taxonomists have considered this violet most closely related to *V. primulifolia* due to the very similar leaf shapes of the two taxa...However, in almost every character except leaf shape it more closely resembles *V. lanceolata*." Based on these arguments, Kartesz (1999) transferred material from northwest California and southwest Oregon that had formerly been called *Viola primulifolia* ssp. *occidentalis* back to *Viola lanceolata* ssp. *occidentalis*. He transferred the remainder of the former (1994) *V. primulifolia* material to *Viola* x *primulifolia*, which occurs in the eastern US and Canada (west to Texas).

Description:

Non-Technical

V. primulifolia var. *occidentalis* is a perennial forb that grows 8-19 cm tall. The glabrous leaves are basal, crenate, broad-lanceolate in shape, and borne on hairless petioles that are longer than the leaf blades (30-110 mm).

Rootstocks produce abundant runners (stolons). Flowers, between 10 – 15 mm in length, are entirely white except for three purple veins on the front of the lower petal. The lateral petals are bearded, and the spur is short and sac-shaped. It blooms from April to early June, and capsulate fruits are generally mature by July.

Technical

From Little (1993): Rhizomatous, glabrous perennial growing to 8-25 cm tall, producing runners (stolons) late in the season. Leaves arising directly from a short rootstock are basal, simple, blade is 15-70 mm, elliptic to widely ovate, crenate, base tapered, tip acute or rounded; long slender petiole is 30-110 mm. Inflorescence peduncle 40-165 mm, flowers white, lowest petals (including spur) 10-14 mm, the lower 3 purple-veined, lateral 2 heavily bearded. Fruit 5-8 mm, glabrous. Cleistogamous flowers 0 (Little 1993). Blooms April – June.

APPENDIX C. The Federal Land Policy and Management Act of 1976, as Amended, Section 204, Withdrawals

WITHDRAWALS
Sec. 204. [43 U.S.C. 1714] (a) On and after the effective date of this Act the Secretary is authorized to make, modify, extend, or revoke withdrawals but only in accordance with the provisions and limitations of this section. The Secretary may delegate this withdrawal authority only to individuals in the Office of the Secretary who have been appointed by the President, by and with the advice and con-sent of the Senate.

(b) (1) Within thirty days of receipt of an application for withdrawal, and whenever he proposes a withdrawal on his own motion, the Secretary shall publish a notice in the Federal Register stating that the application has been submitted for filing or the proposal has been made and the extent to which the land is to be segregated while the application is being considered by the Secretary. Upon publication of such notice the land shall be segregated from the operation of the public land laws to the extent specified in the notice. The segregative effect of the application shall terminate upon (a) rejection of the application by the Secretary, (b) withdrawal of lands by the Secretary, or (c) the expiration of two years from the date of the notice.

(2) The publication provisions of this subsection are not applicable to withdrawals under subsection (e) hereof.

(c) (1) On and after the dates of approval of this Act a withdrawal aggregating five thousand acres or more may be made (or such a withdrawal or any other withdrawal involving in the aggregate five thousand acres or more which terminates after such date of approval may be extended) only for a period of not more than twenty years by the Secretary on his own motion or upon request by a department or agency head. The Secretary shall notify both Houses of Congress of such a withdrawal no later than its effective date and the withdrawal shall terminate and become ineffective at the end of ninety days (not counting days on which the Senate or the House of Representatives has adjourned for more than three consecutive days) beginning on the day notice of such withdrawal has been submitted to the Senate and the House of Representatives, if the Congress has adopted a concurrent resolution stating that such House does not approve the withdrawal. If the committee to which a resolution has been referred during the said ninety day period, has not reported it at the end of thirty calendar days after its referral, it shall be in order to either discharge the committee from further consideration of such resolution or to discharge the committee from consideration of any other resolution with respect to the Presidential recommendation. A motion to discharge may be made only by an individual favoring the resolution, shall be highly privileged (except that it may not be made after the commit-tee has reported such a resolution), and debate thereon shall be limited to not more than one hour, to be divided equally between those favoring and those opposing the resolution. An amendment to the motion shall not be in order, and it shall not be in order to move to reconsider the vote by which the motion was agreed to or disagreed to. If the motion to discharge is agreed to or disagreed to, the motion may not be made with respect to any other resolution with respect to the same Presidential recommendation. When the committee has reprinted, or has been discharged from further consideration of a resolution, it shall at any time thereafter be in order (even though a previous motion to the same effect has been disagreed to) to move to proceed to the consideration of the

resolution. The motion shall be highly privileged and shall not be debatable. An amendment to the motion shall not be in order, and it shall not be in order to move to reconsider the vote by which the motion was agreed to or disagreed to.

(2) With the notices required by subsection (c) (1) of this section and within three months after filing the notice under subsection (e) of this section, the Secretary shall furnish to the committees–

(1) a clear explanation of the proposed use of the land involved which led to the withdrawal;

(2) an inventory and evaluation of the current natural resource uses and values of the site and adjacent public and nonpublic land and how it appears they will be affected by the proposed use, including particularly aspects of use that might cause degradation of the environment, and also the economic impact of the change in use on individuals, local communities, and the Nation;

(3) an identification of present users of the land involved, and how they will be affected by the proposed use;

(4) an analysis of the manner in which existing and potential resource uses are incompatible with or in conflict with the proposed use, together with a statement of the provisions to be made for continuation or termination of existing uses, including an economic analysis of such continuation or termination;

(5) an analysis of the manner in which such lands will be used in relation to the specific requirements for the proposed use;

(6) a statement as to whether any suitable alter-native sites are available (including cost estimates) for the proposed use or for uses such a withdrawal would displace;

(7) a statement of the consultation which has been or will be had with other Federal departments and agencies, with regional, State, and local government bodies, and with other appropriate individuals and groups;

(8) a statement indicating the effect of the pro-posed uses, if any, on State and local government interests and the regional economy;

(9) a statement of the expected length of time needed for the withdrawal;

(10) the time and place of hearings and of other public involvement concerning such withdrawal;

(11) the place where the records on the withdrawal can be examined by interested parties; and

(12) a report prepared by a qualified mining engineer, engineering geologist, or geologist which shall include but not be limited to information on: general geology, known mineral deposits, past and present mineral production, mining claims, mineral leases, evaluation of future mineral potential, present and potential market demands.

(d) A withdrawal aggregating less than five thou-sand acres may be made under this subsection by the Secretary on his own motion or upon request by a department or an agency head–

(1) for such period of time as he deems desirable for a resource use; or

(2) for a period of not more than twenty years for any other use, including but not limited to use for administrative sites, location of facilities, and other proprietary purposes; or

(3) for a period of not more than five years to preserve such tract for a specific use then under consideration by the Congress.

(e) When the Secretary determines, or when the Committee on Natural Resources of the House of Representatives or the Committee on Energy and Natural Resources of the Senate [P.L. 103-437, 1994] notifies the Secretary, that an emergency situation exists and that extraordinary measures must be taken to preserve values that would otherwise be lost, the Secretary notwithstanding the provisions of subsections (c) (1) and (d) of this section, shall immediately make a withdrawal and file notice of such emergency withdrawal with both of those Committees [P.L. 103-437, 1994]. Such emergency withdrawal shall be effective when made but shall last only for a period not to exceed three years and may not be extended except under the provisions of subsection (c) (1) or (d), whichever is applicable, and (b) (1) of this section. The information required in subsection (c) (2) of this subsection shall be furnished the committees within three months after filing such notice.

(f) All withdrawals and extensions thereof, whether made prior to or after approval of this Act, having a specific period shall be reviewed by the Secretary toward the end of the withdrawal period and may be extended or further extended only upon compliance with the provisions of sub-section (c) (1) or (d), whichever is applicable, and only if the Secretary determines that the purpose for which the withdrawal was first made requires the extension, and then only for a period no longer than the length of the original withdrawal period. The Secretary shall report on such review and extensions to the Committee on Natural Resources of the House of Representatives and the Committee on Energy and Natural Resources of the Senate. [P.L. 103-437, 1994]

(g) All applications for withdrawal pending on the date of approval of this Act shall be processed and adjudicated to conclusion within fifteen years of the date of approval of this Act, in accordance with the provisions of this section. The segregative effect of any application not so processed shall terminate on that date.

(h) All new withdrawals made by the Secretary under this section (except an emergency withdrawal made under subsection (e) of this section) shall be promulgated after an opportunity for a public hearing.

(i) In the case of lands under the administration of any department or agency other than the Department of the Interior, the Secretary shall make, modify, and revoke withdrawals only with the consent of the head of the department or agency concerned, except when the provisions of subsection (e) of this section apply.

(j) The Secretary shall not make, modify, or revoke any withdrawal created by Act of Congress; make a withdrawal which can be made only by Act of Congress; modify or revoke any withdrawal creating national monuments under the Act of June 8, 1906 (34 Stat. 225; 16 U.S.C. 431–433); or modify, or revoke any withdrawal which added lands to the National Wildlife Refuge System prior to the date of approval of this Act or which thereafter adds lands to that System under the terms of this Act. Nothing in this Act is intended to modify or change any provision of the Act of February 27, 1976 (90 Stat. 199; 16 U.S.C. 668dd (a)).

(k) There is hereby authorized to be appropriated the sum of $10,000,000 for the purpose of processing withdrawal applications pending on the effective date of this Act, to be available until expended.

(l) (1) The Secretary shall, within fifteen years of the date of enactment of this Act, review withdrawals existing on the date of approval of this Act, in the States of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming of (1) all Federal lands other than withdrawals of the public lands administered by the Bureau of Land Management and of lands which, on the date of approval of this Act, were part of Indian reservations and other Indian holdings, the National Forest System, the National Park System, the National Wildlife Refuge System, other lands administered by the Fish and Wildlife Service or the Secretary through the Fish and Wildlife Service, the National Wild and Scenic Rivers System, and the National System of Trails; and (2) all public lands administered by the Bureau of Land Management and of lands in the National Forest System (except those in wilderness areas, and those areas formally identified as primitive or natural areas or designated as national recreation areas) which closed the lands to appropriation under the Mining Law of 1872 (17 Stat. 91, as amended; 30 U.S.C. 22 et seq.) or to leasing under the Mineral Leasing Act of 1920 (41 Stat. 437, as amended; 30 U.S.C. 181 et seq.).

(2) In the review required by paragraph (1) of this subsection, the Secretary shall determine whether, and for how long, the continuation of the existing withdrawal of the lands would be, in his judgment, consistent with the statutory objectives of the programs for which the lands were dedicated and of the other relevant programs. The Secretary shall report his recommendations to the President, together with statements of concurrence or nonconcurrence submitted by the heads of the departments or agencies which administer the lands. The President shall transmit this report to the President of the Senate and the Speaker of the House of Representatives, together with his recommendations for action by the Secretary, or for legislation. The Secretary may act to terminate withdrawals other than those made by Act of the Congress in accordance with the recommendations of the President unless before the end of ninety days (not counting days on which the Senate and the House of Representatives has adjourned for more than three consecutive days) beginning on the day the report of the President has been submitted to the Senate and the House of Representatives the Congress has adopted a concurrent resolution indicating otherwise. If the committee to which a resolution has been referred during the said ninety day period, has not reported it at the end of thirty calendar days after its referral, it shall be in order to either discharge the committee from further consideration of such resolution or to discharge the committee from consideration of any other resolution with respect to the Presidential recommendation. A motion to discharge may be made only by an individual favoring the resolution, shall be highly privileged (except that it may not be made after the committee has reported such a resolution), and debate thereon shall be limited to not more than one hour, to be divided equally between those favoring and those opposing the resolution. An amendment to the motion shall not be in order, and it shall not be in order to move to reconsider the vote by which the motion was agreed to or disagreed to. If the motion to discharge is agreed to or disagreed to, the motion may not be made with respect to any other resolution with respect to the same Presidential recommendation. When the committee has reprinted, or has been discharged from further consideration of a resolution, it shall at any time thereafter be in order (even though a previous motion to the same effect has been disagreed to) to move to proceed to the consideration of the resolution. The motion shall be highly privileged and shall not be debatable. An amendment to the motion shall not be in order, and it shall not be in order to move to reconsider the vote by which the motion was agreed to or disagreed to.

(3) There are hereby authorized to be appropriated not more than $10,000,000 for the purpose of paragraph (1) of this subsection to be available until expended to the Secretary and to the heads of other departments and agencies which will be involved.

APPENDIX D. ODA's Fen Assessment Methodology, Data Summary, and Field Form

Sources:

Amsberry and Brown (2016). Complete dataset, including spatial data, available from BLM, Medford District.

Brown (2017). Complete dataset, including spatial data, available from USFS, Rogue River-Siskiyou National Forest, Wild Rivers Ranger District.

Note: Not all 2017 data have been included in the Appendix as of 1/18/2018.

Methodology

Following the selection of priority monitoring sites, target areas for revisit were identified based on the previously documented occurrences of the target plants; surveying outside of historic occurrence areas was not the focus of this effort. The 2015-2016 site assessments were informed by Oregon Biodiversity Information Center (ORBIC) and BLM occurrence records and spatial data of the target plants predating February 2015 (BLM 2015, ORBIC 2015). The 2017 site assessments were informed by the 2015 ORBIC data in additional to USFS occurrence records and spatial data of the target plants predating May 2017 (USFS 2017). These target plant occurrence data sets were also the sources for historic population and site information compiled for each site.

Site Names and Occurrence Identification Numbers

Site names were assigned following the conventions set forth in the Conservation Agreement. Without specific location information for previously designated sites, established site names may have been misapplied. Some Essential Wetlands encompass fen complexes that contain several distinct wetland areas that contain discrete occurrence clusters of target plants. In most cases, distinct fens were treated as individual sites here, but in some cases, discreet wetland areas were grouped together into one site.

Occurrence records of the target plants have been assigned unique identification numbers by ORBIC, BLM, and USFS. ORBIC assigns an element occurrence identifier number to each occurrence record while BLM and USFS assign a flora site identification number. Historic target plant occurrences are referred to using the unique ORBIC, BLM, or USFS identification numbers (site number [#]) sourced from the attribute tables associated with occurrence spatial data provided to us for this project (BLM 2015, ORBIC 2015, USFS 2017). The ORBIC site numbers were sourced from the EO_ID attribute field, BLM site numbers were sourced from the FLSITE_ID attribute field, and USFS site numbers were sourced from the SITE_ID_FS attribute field. In some cases, multiple discrete occurrences are grouped under the same identification number.

Previously established occurrence identification numbers were assigned to updated occurrence data collected during this project based on spatial proximity. When the distribution of target plants mapped during this project overlapped with, or were in the immediate vicinity of a historic mapped distribution, they were considered the same occurrence. In cases where the target plant occurrence spatial data was inaccurate (e.g. a large circle that encompasses the general location of the occurrence), or multiple target plant patches were combined in the same occurrence, the previously established occurrence identification number may have been misapplied to the data collected during this project.

Extent of Sites and Monitoring Areas

While general target areas for monitoring were based on the locations of previous occurrences, the actual extent of monitoring areas was determined on-site. Monitoring areas included the current and historic spatial extent of the target plants, along with the surrounding serpentine fen habitat, to ensure that any threats to the fen habitat and general site conditions would be encountered. Monitoring encompassed the broader serpentine wetland communities that include areas with perennial surface-flow of water as well as drier-seeming portions of habitat that contain wetland plant associates (possibly supported by sub-surface water flow). For example, while *Darlingtonia californica* (California pitcher plant, cobra lily) and *Viola primulifolia* ssp. *occidentalis* tended to be closely tied to areas of standing or flowing surface water, monitoring was extended beyond the obviously wet areas to capture the *Hastingsia bracteosa* var. *bracteosa* and *H. b.* var. *atropurpurea* that was prevalent on the edges and drier-looking portions of the wetland. A buffer of unsuitable habitat surrounding each serpentine fen was monitored to confirm the spatial limits of target plant populations and fen habitat, and to allow for the inspection of any adjacent threats that could potentially impact a site.

Monitoring was generally intended to be confined to the publically owned portions of each serpentine fen site, but along poorly marked property boundaries, portions of private property were included. In such cases, the reported number of target plants in the population may include plants that occur on private land adjacent to BLM or USFS property. At the Deer Creek and TNC sites, fens extend beyond public ownership boundaries onto private lands protected by conservation easements; portions of these private land sites were monitored with permission from the landowners.

Threat Assessments

The rapid fen assessment monitoring protocol developed by ODA involves identifying and evaluating threats facing the serpentine fens (if any) in addition to monitoring populations of the target plants when they were encountered. Documenting threats was an ongoing process throughout the monitoring of each serpentine fen and included documentation of site-wide threats as well as taxon-specific threats. The Conservation Agreement lists alterations to hydrology and altered fire regimes as primary threats to fen habitat and the target species. Several categories of common hydrology-related alterations were explicitly identified as threats: mining and related activities, road construction and maintenance, off highway vehicle (OHV) use, fire suppression activities, and water diversion. The encroachment of trees and shrubs is identified as a threat resulting from reduced frequency of fires. Port Orford cedar root disease (*Phytophthora lateralis*) is also considered a potential threat because of its tendency to lead to the death of Port Orford cedar (*Chamaecyparis lawsoniana*) trees, which is a significant component of many

serpentine fen plant communities. Invasive plant species with the potential to invade and alter the fen plant community are also threats.

Threat evaluations were based on informed observations of problems currently impacting the fen, minor issues that might develop into significant problems, and potential threats associated with expected future activities. Threats and potential problems were scored on standard scales to simplify comparison between sites and help prioritize management needs. Informed observations strike a balance between simplicity and functionality, with the goal providing basic information that can guide management priorities across the range serpentine fens while avoiding overly complicated data collection protocols that may be unattainable and/or avoided by staff with limited time and resources. Taking descriptive notes and photos during site assessments provides crucial supplemental site information. While this report focuses on substantial threats that are priorities to track and potentially treat, all baseline threat assessment results were presented to the BLM and USFS, including details not be covered here.

The severity and extent of each threat identified in the serpentine fens was documented. The severity of most threats was scored on a scale from zero to ten, with zero being no impact, and ten being an extirpation-level impact (e.g. the entire wetland was paved over with asphalt, or it was completely drained due to water diversion). The maximum severity score for tree encroachment was seven, assuming that tree encroachment alone does not pose an extirpation level threat. The extent of each threat was documented as the proportion of the monitoring area that appears to be impacted. The severity score (between zero and ten) and extent of a threat (recorded as a proportion) were multiplied to yield the threat category score for the site. Given the simplified scoring of threat severity and extent, it is critical that each threat be clearly described and photo documented as a default. When pertinent, GPS was used to document the locations of specific threats and points of interest to aid in their relocation.

In some cases, threats at a single site were evaluated and quantified more than once during multiple visits, and threats assessed at different times yielded different threat score values. As target plants are not equally distributed in a given site, threats may affect them differently. Assessing threats multiple times, taking into account the distribution of each target plant present, will help provide a more complete and balanced threat assessment. For example, during *V. p.* ssp. *occidentalis* monitoring at the Deer Creek site, about 35% of the fen was documented as being impacted by low severity tree encroachment and about 10% being impacted by low severity shrub encroachment. During *H. b.* var. *bracteosa* monitoring, about 25% of the fen was documented as being impacted by moderate severity tree encroachment and about 15-20% being impacted by moderate severity shrub encroachment. These different threat assessments from the same year could mistakenly be attributed to differences in estimating the severity and extent of threats. Monitoring notes reveal that these two target taxa occupy different areas (with *H. b.* var. *bracteosa* occurrences resulting in broader fen boundaries) that are impacted by tree and shrub encroachment differently. This should not be surprising considering they generally occupy different portions of the fen: *V. p.* ssp. *occidentalis* can often be found in wetter area where sparse small trees are often present (but few shrubs) and *H. b.* var. *bracteosa* can often be found on the drier margins of the fen where trees and shrubs seem to occasionally pose a competitive threat.

Water Diversion

Interfering with and altering water flow patterns in a fen can have results ranging from nearly no effect to a complete loss of fen habitat. Sites may be threatened by currently active water diversions as well as

potential water diversions expected as a result of anticipated activities. The severity of a water diversion was determined based on the amount of water being diverted (or expected to be diverted) and the efficacy of the diversion (or expected diversion). When relatively large amounts of water are diverted, the threat is more severe, and when the water diversion is highly effective, the threat is also more severe. The extent of a water diversion threat and the estimated proportion of the fen impacted are based on where in the fen the water is being taken from. If water is being diverted "upstream" of the fen, then the whole fen is subject to the water loss, but when water is diverted near the outflow of a fen, less of the fen is impacted.

In numerous cases, the threat of potential water diversion is coupled with other potential threats associated with anticipated or planned activities. For example, road and utility infrastructure are present at several sites, and routine maintenance of such infrastructure is expected in the future. Maintenance activities have the potential to alter site topography, maybe only slightly, which could potentially alter the flow of water through a site. Although it is difficult to assess potential threats such as these, it is important to identify them so they can be addressed and avoided through proper planning.

Road Construction and Maintenance

New road construction would result in the destruction of target plants and fen habitat in the roadbed footprint. The severity of a road construction threat would be extreme where habitat is destroyed and more subtle in portions of the fen affected by residual impacts. The administrative protection of wetlands and serpentine fens decrease the chances of sanctioned new road construction through a fen. Unsanctioned road building may be more likely at remote sites.

Road maintenance not only has the potential to destroy fen habitat and target plants within the project area, but could also result in water diversion with further reaching impacts across the fen. The severity of a road maintenance threat was based on the density and abundance of fen habitat and target plants in the areas immediately surrounding the road, with higher abundance and density associated with greater severity. The extent of a road maintenance threat include the portions of fen habitat that appear likely to be destroyed or damaged as well as portions of the fen that may be impacted by resulting water diversion.

Trail maintenance, powerline corridor maintenance, and other maintenance (or construction) of human infrastructure are treated similarly.

Tree Encroachment

Trees, in varying abundance, are a natural component of serpentine fen habitat. Fire suppression has generally reduced fire frequency on the landscape and may be responsible for more trees establishing in open habitat that was once maintained by periodic fires. It is not known what level of tree density is problematic in serpentine fens, but increased tree encroachment can increase transpiration rates, canopy cover, and shading of low-growing forbs (USDA & USDI 2006). Resultant drying of a site could threaten the overall fen habitat and shading might negatively impact several of the target plants that appear to prefer open habitat.

Although trees were present at every site, not all trees pose a threat, and a process was developed to take that into account when determining the severity of tree encroachment. Trees in a fen were assigned to three height size classes: small trees are less than one meter tall, medium trees were between one and

three meters tall, and large trees were greater than three meters tall. Small trees were deemed the greatest threat based on the assumption that a fen fully stocked with small trees would be most susceptible to excessive drying (as a result of increased transpiration rates) and shading as the trees develop. Large trees were deemed the least threat based on the assumption that mature trees are generally well spaced (especially in depauperate serpentine habitats) and haven't been solely responsible for excessive drying or shading of fens. Medium trees were assigned an intermediate threat level.

Each height size class of trees was assigned a weighted threat severity: small trees were assigned seven, medium trees were assigned three, and large trees were assigned one. Within a fen, the proportion of trees in each height size class was estimated. The threat severity score of each height size class is calculated by multiplying the proportion of trees in that class by the weighted threat severity of that class. The sum of the height size class threat severity scores is the cumulative weighted threat severity of tree encroachment for the site. The cumulative weighted threat severity is multiplied by the proportion of the fen area with trees present to yield the final tree encroachment threat score.

Tree encroachment data was collected at every site, regardless of whether or not it appeared to be a threat. This information will help track changes in the structure of the tree community over time.

Shrub Encroachment

Shrubs are also a natural component of serpentine fen habitat. With fire suppression management, the abundance of woody shrubs may have increased where they otherwise would have naturally burned. It is not known at what level shrub density begins to threaten fen habitat, but increased shrub encroachment can increase transpiration rates, site drying, and the shading of low-growing forbs, potentially posing a threat the fen habitat and target plants.

The severity of shrub encroachment was determined by the relative density of shrubs at a site, and whether the shrubs are growing above other herbaceous fen vegetation and target plants. Higher densities of shrubs and the abundance of herbaceous fen vegetation under shrub canopy cover were both associated with greater threat severity and potential for shading and competition. The extent of shrub encroachment was determined as the estimated proportion of the fen area with shrubs present

Shrub encroachment data was collected at every site, regardless of whether or not it appeared to be a threat. This information will help track changes in the structure of the shrub community over time.

Off Highway Vehicle Use

Damage from motorized vehicle traffic has previously been documented as a threat to serpentine fen habitat. Sites in close proximity to established roads and trails may be more susceptible to motorized vehicle traffic. The severity of an OHV threat was based on the degree of damage, ranging from minor crushed vegetation to the complete destruction of habitat and removal of vegetation cover (severe). The extent of the threat was based on the proportion of the fen that was impacted.

Invasive Weeds

Infestations of invasive weeds have the potential to fundamentally alter site conditions and vegetation community composition. The severity of an invasive weed threat was loosely based on the percent cover

of the weed within the infested area and the extent of the threat was based on the proportion of the fen that was impacted.

Rare Plant Taxa Assessments

Population monitoring of the target plants focused on determining the number and spatial distribution of plants at a site. Due to inconsistencies in the ORBIC, BLM, and USFS target plant occurrence data sets, each site was checked for each taxon regardless of whether or not it had been previously reported there. Target plant populations were either censused, which involved counting all qualifying individuals, or estimated using stratified sampling methods. Plant counts were recorded periodically during monitoring and the edges of occurrences were usually marked using pin-flags or flagging tape. General soil moisture conditions within the occupied areas were documented as a percent of substrate in the occupied area that is dry, moist, saturated, holding standing water, or containing flowing water. The perimeter of target plant occurrences was recorded by walking the flag-marked edge while collecting a GPS track (set to collect points at short intervals). Occasionally, GPS points were manually collected along the target plant occurrence edges (at short intervals) which circumvented the need for flagging boundaries. The tracks or points were digitized and served as the basis for the mapped spatial distributions of target plant occurrences documented here; occupied area was derived from the digitized distributions.

In cases where conducting a census of a target plant populations was not feasible, the number of qualifying individuals in a population were estimated. A complete population census could be extremely time consuming in some cases and potentially more damaging to the vegetation community if it required more foot traffic through a fen. The stratified sampling approach to estimating population size involved counting the number of qualifying individuals within a sub-sample area that would then serve as a unit to help estimate plant counts in larger areas with similar target plant density. As presented in the Draft Conservation Strategy (2014), population size can be estimated using the following standard size class ranges (listed in numbers of qualifying individuals): 1-10, 11-50, 51-100, 101-250, 251-500, 501-1,000, 1,001-2,500, 2,501-5,000, 5,001-10,000, 10,001-25,000, and 25,000+.

Permanent photopoints were established to help track structural changes within a site. Photopoint locations were selected to provide maximum visual coverage of the monitoring area. Including areas with high concentrations of target plants was a priority in order to be able to track changes that may affect target plants. Photopoint locations were marked using numbered aluminum tags that were affixed to living trees, and occasionally substantial dead wood (i.e. a stump or large snag), using aluminum nails. The locations of each photopoint were recorded using GPS.

Several monitoring visits were scheduled in order to monitor each of the target plant populations when they are most visible during their peak flowering period. In 2015, the *V. p.* ssp. *occidentalis* monitoring was conducted between May 5th – 7th, the *H. b.* var. *bracteosa* and *H. b.* var. *atropurpurea* monitoring took place during June 16th – 18th (with additional *V. p.* var. *occidentalis* monitoring as well), and monitoring of the late-season blooming *G. setigera* and *E. oreganum* took place between August 4th – 6th. Several assessment trips had to be rescheduled for 2016 because of site closures due to safety concerns associated with the 2015 Buckskin Wildfire. These monitoring visits were completed in 2016 along with others that were not completed in 2015 due to time constraints during early season monitoring visits.

During 2015 monitoring, the relatively sparse and diminutive flowering of *V. p.* ssp. *occidentalis* didn't increase the plants' visibility and expedite monitoring. However, the taxon's distinctive and persistent leaves make monitoring after peak flowering possible, so its monitoring was later coupled with monitoring for *H. b.* var. *bracteosa* and *H. b.* var. *atropurpurea*. The 2016 monitoring for *V. p.* ssp. *occidentalis*, *H. b.* var. *bracteosa*, and *H. b.* var. *atropurpurea* was conducted during June 14th – 16th.

In 2017, target plant monitoring was condensed into two visits. Monitoring for *H. b.* var. *atropurpurea*, *H. b.* var. *bracteosa*, and *V. p.* ssp. *occidentalis* was conducted during June 19th – 22nd and monitoring for *E. oreganum* and *G. setigera* took place during August 7th – 10th.

Epilobium oreganum Monitoring

Monitoring for *E. oreganum* was conducted during the first week of August, in conjunction with *G. setigera* monitoring. This plant's relatively low visibility (due to sparse vegetation and diffuse inflorescences of small flowers) coupled with its general scarcity (compared to the other target plants) make it a difficult plant to monitor. The sporadic nature of this taxon's occurrences reinforced the need to carefully inspect all fen habitat.

Epilobium oreganum can reportedly tolerate the most vegetation cover and may be least susceptible to the threat of encroachment by woody vegetation. Plants were found in the open, but they were also regularly found growing in and amongst shrubs, where the stems and inflorescences would often extend above the shrub foliage. Some plants had stems that branched near the base, and often the base of a plant wasn't visible through the surrounding vegetation. In some patches, individual *E. oreganum* stems were clustered so close to one another it was difficult to tell if they arose from the same plant, or were distinct individuals. Without manually sifting through the dense herbaceous vegetation, it is not possible to make a definitive determination. Since it was not feasible to spend time finding the base of all the plants in a patch of clustered stems, an *E. oreganum* stem not visibly connected to another stem was counted as an individual unit. Counting stems would likely lead to a slight overestimate in the number of individuals counted.

Gentiana setigera Monitoring

Monitoring for *G. setigera* was conducted during the first week of August, in conjunction with *E. oreganum* monitoring. The distinctive morphology of this plant, especially its broad spoon-shaped leaves and large showy flowers, helped make it readily visible during monitoring. Vegetative plants and flowering plants may produce multiple rosettes on stems arising from below the central rosette. All rosettes that were not visibly connected to one another were counted as individuals, including seedlings with one or two pairs of leaves, branched and unbranched rosettes, and flowering plants. This may have led to a slight overestimate in the number of individuals present by mistakenly counting connected rosettes as individuals if their connecting stem was not visible. Based on the size of seedlings, it is plausible that many went undetected if they were hidden amongst the dense herbaceous fen vegetation, possibly resulting in an underestimate of number of individuals.

Hastingsia bracteosa var. atropurpurea and H. b. var. bracteosa Monitoring

Monitoring for *H. b.* var. *atropurpurea* and *H. b.* var. *bracteosa* was conducted during the middle of June, occasionally in conjunction with *V. p.* ssp. *occidentalis* monitoring. Compared to the other target plants,

both varieties of *Hastingsia* seemed to be relatively tolerant of dry conditions. Plants were often found beyond the visibly wet portions of the fen, occasionally in areas where *D. californica* and other common fen associates were not present.

Flowering individuals tended to be easy to spot during monitoring as their racemose inflorescence often extend above surrounding vegetation. Because non-flowering individuals of each variety are indistinguishable one another, and from the co-occurring *Hastingsia alba* (Lang and McDonald 1987), only flowering individuals were counted during monitoring. Flowering *H. b.* var. *atropurpurea* and *H. b.* var. *bracteosa* are easily distinguished from *H. alba* because their stamens are shorter than the tepals (petals and sepals) as opposed to being longer. Flowering *H. b.* var. *atropurpurea* are distinguished from *H. b.* var. *bracteosa* by their dull purple tepals as opposed to white tepals. While the ease of detecting flowering plants encouraged accurate monitoring counts (of flowering plants), the inability to account for vegetative individuals results in an underestimate of the total number of individuals of both taxa.

Viola primulifolia ssp. occidentalis Monitoring

Monitoring for *V. p.* ssp. *occidentalis* was conducted during peak flowering in the first week of May, and also in conjunction with *H. b.* var. *atropurpurea* and *H. b.* var. *bracteosa* monitoring in the middle of June. Although the low stature and sparse flowering of this plant make it difficult to detect from afar, its affinity for water and wet areas allowed for efficient and effective targeted monitoring. Individual plants tend to spread vegetatively from their rhizomes and stolons (prostrate rooting stems), resulting in networks of clonal plants. It is difficult to tell which plants are genetically distinct individuals (ramets) and which are genetically identical clonal plants (genets) because the rhizomes and stolons that connect clonal plants are often not readily visible. Following methods established by Carothers and Frost (2006), who counted the number of "stems", rooted nodes with basal leaves (including both genets and ramets) were counted as the individual unit for this project.

Carex klamathensis Observations

Carex klamathensis is a globally rare sedge associated with serpentine fens of southern Oregon and northern California. This taxon had not been formally described prior to the publication of the Conservation Agreement (2006) and was not included in this project. The status of *C. klamathensis* is similar to that of the target plants, which makes it a good candidate for inclusion in future planning and conservation efforts. Rogue River-Siskiyou National Forest Wild Rivers Ranger District staff recently surveyed for *C. klamathensis* and monitored previously reported occurrences (Osbrack 2017, personal communication). Sites assessed during this project that also contain *C. klamathensis*, as determined by USFS efforts, are listed in the results section for planning purposes.

Assessment of serpentine wetlands and five associated rare vascular plants in the Illinois Valley: Population Monitoring Data							
				Epilobium oreganum			
Site name	**Essential wetland**	**Sub-wetland name**	**Ownership**	**ORBIC EO_ID**	**BLM FLSITE_ID**	**Previous plant count**	**2015 plant count**
Days Gulch 029 & 820 Jct.	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	24497	N/A	~20	100
Days Gulch East	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	32456	N/A	~110-275	**0**
Days Gulch Middle	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	32456	N/A	~110-275	**0**
Days Gulch Sec. 35 East Edge	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	N/A	N/A	None	0
Days Gulch West	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	N/A	N/A	None	0
Deer Creek	East Eight Dollar Mountain	Deer Creek wetland	BLM/private	18813	8331, 1061	175	495
Illinois R. Terrace	West Eight Dollar Mountain-Illinois River-Star Flat	Illinois River/Wild and Scenic River terrace fen	USFS	17306	N/A	66	42
Illinois R. Terrace Roadside	West Eight Dollar Mountain-Illinois River-Star Flat	Illinois River/Wild and Scenic River terrace fen	USFS	N/A	N/A	None	0
Section 9 North	Oregon Mountain Wetlands	Sec. 9 wetland	BLM	N/A	N/A	None	0
Section 9 South	Oregon Mountain Wetlands	Sec. 9 wetland	BLM	N/A	N/A	None	0
Section 19	Central West Illinois Valley	SE Section 19 wetland	BLM	10891	82	110	**0**

Assessment of serpentine wetlands and five associated rare vascular plants in the Illinois Valley: Population Monitoring Data							
Site name	**Essential wetland**	**Sub-wetland name**	**Ownership**	***Epilobium oreganum***			
Star Flat	West Eight Dollar Mountain-Illinois River-Star Flat	Star Flat DACA wetland	USFS	1759	N/A	~750	350
TNC	East Eight Dollar Mountain	The Nature Conservancy-Medford BLM ACEC wetland	BLM/TNC	N/A	N/A	None	**72**
Whiskey Creek	Oregon Mountain Wetlands	Whiskey Creek wetland	BLM	N/A	N/A	None	0
Woodcock Bog North	Central West Illinois Valley	Woodcock Bog RNA	BLM/private	2565	102	11-50	**0**
Woodcock Bog South	Central West Illinois Valley	Woodcock Bog RNA	BLM	11827	N/A	40	295

Assessment of serpentine wetlands and five associated rare vascular plants in the Illinois Valley: Population Monitoring Data							
				Gentiana setigera			
Site name	**Essential wetland**	**Sub-wetland name**	**Ownership**	**ORBIC EO_ID**	**BLM FLSITE_ID**	**Previous plant count**	**2015 plant count**
Days Gulch 029 & 820 Jct.	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	7384	N/A	~750-1,500	316
Days Gulch East	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	7384	N/A	~750-1,500	1,030
Days Gulch Middle	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	7384	N/A	~750-1,500	308
Days Gulch Sec. 35 East Edge	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	14034	N/A	~600-1,250	507
Days Gulch West	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	7384	N/A	~750-1,500	553
Deer Creek	East Eight Dollar Mountain	Deer Creek wetland	BLM/private	15921	1073, 151	~20	1,111
Illinois R. Terrace	West Eight Dollar Mountain-Illinois River-Star Flat	Illinois River/Wild and Scenic River terrace fen	USFS	8033	N/A	200	137
Illinois R. Terrace Roadside	West Eight Dollar Mountain-Illinois River-Star Flat	Illinois River/Wild and Scenic River terrace fen	USFS	N/A	N/A	None	200
Section 9 North	Oregon Mountain Wetlands	Sec. 9 wetland	BLM	N/A	N/A	None	0
Section 9 South	Oregon Mountain Wetlands	Sec. 9 wetland	BLM	N/A	N/A	None	0
Section 19	Central West Illinois Valley	SE Section 19 wetland	BLM	5917	419, 66	250	0

Assessment of serpentine wetlands and five associated rare vascular plants in the Illinois Valley: Population Monitoring Data							
Site name	**Essential wetland**	**Sub-wetland name**	**Ownership**	***Gentiana setigera***			
Star Flat	West Eight Dollar Mountain-Illinois River-Star Flat	Star Flat DACA wetland	USFS	20520	N/A	400	1381
TNC	East Eight Dollar Mountain	The Nature Conservancy-Medford BLM ACEC wetland	BLM/TNC	24040	14517, 465	2	497
Whiskey Creek	Oregon Mountain Wetlands	Whiskey Creek wetland	BLM	10800	N/A	small pop.	0
Woodcock Bog North	Central West Illinois Valley	Woodcock Bog RNA	BLM/private	12740	100, 130	51-100	475
Woodcock Bog South	Central West Illinois Valley	Woodcock Bog RNA	BLM	327	1429	5,000	284

Assessment of serpentine wetlands and five associated rare vascular plants in the Illinois Valley: Population Monitoring Data								
Site name	**Essential wetland**	**Sub-wetland name**	**Ownership**	***Hastingsia bracteosa* var. *atropurpurea***				
				ORBIC EO_ID	**BLM FLSITE_ID**	**Previous plant count**	**2015 plant count**	**2016 plant count**
Days Gulch 029 & 820 Jct.	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	N/A	N/A	None	0	N/A
Days Gulch East	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	N/A	N/A	None	0	N/A
Days Gulch Middle	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	N/A	N/A	None	0	N/A
Days Gulch Sec. 35 East Edge	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	N/A	N/A	None	0	N/A
Days Gulch West	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	N/A	N/A	None	0	N/A
Deer Creek	East Eight Dollar Mountain	Deer Creek wetland	BLM/private	N/A	N/A	None	0	N/A
Illinois R. Terrace	West Eight Dollar Mountain-Illinois River-Star Flat	Illinois River/Wild and Scenic River terrace fen	USFS	N/A	N/A	None	N/A	0
Illinois R. Terrace Roadside	West Eight Dollar Mountain-Illinois River-Star Flat	Illinois River/Wild and Scenic River terrace fen	USFS	N/A	N/A	None	N/A	0
Section 9 North	Oregon Mountain Wetlands	Sec. 9 wetland	BLM	N/A	N/A	None	N/A	0
Section 9 South	Oregon Mountain Wetlands	Sec. 9 wetland	BLM	N/A	N/A	None	N/A	0
Section 19	Central West Illinois Valley	SE Section 19 wetland	BLM	3639	1087	10	**0**	N/A

Assessment of serpentine wetlands and five associated rare vascular plants in the Illinois Valley: Population Monitoring Data								
Site name	**Essential wetland**	**Sub-wetland name**	**Ownership**	***Hastingsia bracteosa* var. *atropurpurea***				
Star Flat	West Eight Dollar Mountain-Illinois River-Star Flat	Star Flat DACA wetland	USFS	N/A	N/A	None	0	N/A
TNC	East Eight Dollar Mountain	The Nature Conservancy-Medford BLM ACEC wetland	BLM/TNC	N/A	N/A	None	0	N/A
Whiskey Creek	Oregon Mountain Wetlands	Whiskey Creek wetland	BLM	N/A	N/A	None	N/A	0
Woodcock Bog North	Central West Illinois Valley	Woodcock Bog RNA	BLM/private	6776	N/A	51-100	2,500	N/A
Woodcock Bog South	Central West Illinois Valley	Woodcock Bog RNA	BLM	13837	N/A	5,000	5,000-10,000	N/A

Assessment of serpentine wetlands and five associated rare vascular plants in the Illinois Valley: Population Monitoring Data								
Site name	**Essential wetland**	**Sub-wetland name**	**Ownership**	***Hastingsia bracteosa* var. *bracteosa***				
				ORBIC EO_ID	**BLM FLSITE_ID**	**Previous plant count**	**2015 plant count**	**2016 plant count**
Days Gulch 029 & 820 Jct.	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	6283	N/A	14,500	8,135	N/A
Days Gulch East	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	5781	N/A	15,000-35,000	8,000	N/A
Days Gulch Middle	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	5781	N/A	15,000-35,000	13,200	N/A
Days Gulch Sec. 35 East Edge	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	6961	N/A	~300-800	3,000	N/A
Days Gulch West	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	5781	N/A	15,000-35,000	5,027	N/A
Deer Creek	East Eight Dollar Mountain	Deer Creek wetland	BLM/private	22900	148, 1089	7,950	5,000-10,000	N/A
Illinois R. Terrace	West Eight Dollar Mountain-Illinois River-Star Flat	Illinois River/Wild and Scenic River terrace fen	USFS	12704	N/A	1,600	N/A	13,207
Illinois R. Terrace Roadside	West Eight Dollar Mountain-Illinois River-Star Flat	Illinois River/Wild and Scenic River terrace fen	USFS	N/A	N/A	None	N/A	1,486
Section 9 North	Oregon Mountain Wetlands	Sec. 9 wetland	BLM	N/A	N/A	None	N/A	0
Section 9 South	Oregon Mountain Wetlands	Sec. 9 wetland	BLM	N/A	N/A	None	N/A	0
Section 19	Central West Illinois Valley	SE Section 19 wetland	BLM	N/A	165	10	0	N/A

Assessment of serpentine wetlands and five associated rare vascular plants in the Illinois Valley: Population Monitoring Data								
Site name	**Essential wetland**	**Sub-wetland name**	**Ownership**	***Hastingsia bracteosa* var. *bracteosa***				
Star Flat	West Eight Dollar Mountain-Illinois River-Star Flat	Star Flat DACA wetland	USFS	366	N/A	~1,000	500	N/A
TNC	East Eight Dollar Mountain	The Nature Conservancy-Medford BLM ACEC wetland	BLM/TNC	14422	14518	10,000	10,000 - 25,000	N/A
Whiskey Creek	Oregon Mountain Wetlands	Whiskey Creek wetland	BLM	N/A	N/A	None	N/A	0
Woodcock Bog North	Central West Illinois Valley	Woodcock Bog RNA	BLM/private	N/A	99	75	0	N/A
Woodcock Bog South	Central West Illinois Valley	Woodcock Bog RNA	BLM	N/A	124	5,000	0	N/A

Assessment of serpentine wetlands and five associated rare vascular plants in the Illinois Valley: Population Monitoring Data								
Site name	**Essential wetland**	**Sub-wetland name**	**Ownership**	***Viola primulifolia* var. *occidentalis***				
				ORBIC EO_ID	**BLM FLSITE_ID**	**Previous plant count**	**2015 plant count**	**2016 plant count**
Days Gulch 029 & 820 Jct.	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	19408	N/A	Few	N/A	0
Days Gulch East	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	N/A	N/A	None	N/A	0
Days Gulch Middle	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	N/A	N/A	None	N/A	0
Days Gulch Sec. 35 East Edge	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	N/A	N/A	None	N/A	0
Days Gulch West	Josephine Creek-Days Gulch	Days Gulch Botanical Area?	USFS	N/A	N/A	None	N/A	0
Deer Creek	East Eight Dollar Mountain	Deer Creek wetland	BLM/private	16473	2233, 1199	500	100,000-500,000	N/A
Illinois R. Terrace	West Eight Dollar Mountain-Illinois River-Star Flat	Illinois River/Wild and Scenic River terrace fen	USFS	12309	N/A	Some	1,780	N/A
Illinois R. Terrace Roadside	West Eight Dollar Mountain-Illinois River-Star Flat	Illinois River/Wild and Scenic River terrace fen	USFS	12309	N/A	Some	501-1,000	N/A
Section 9 North	Oregon Mountain Wetlands	Sec. 9 wetland	BLM	8561	7680	300	10,000-25,000	N/A
Section 9 South	Oregon Mountain Wetlands	Sec. 9 wetland	BLM	8561	7678	2,000	25,000+	N/A
Section 19	Central West Illinois Valley	SE Section 19 wetland	BLM	N/A	N/A	None	0	N/A

Assessment of serpentine wetlands and five associated rare vascular plants in the Illinois Valley: Population Monitoring Data								
Site name	**Essential wetland**	**Sub-wetland name**	**Ownership**	***Viola primulifolia* var. *occidentalis***				
Star Flat	West Eight Dollar Mountain-Illinois River-Star Flat	Star Flat DACA wetland	USFS	27802	N/A	N/A	0	N/A
TNC	East Eight Dollar Mountain	The Nature Conservancy-Medford BLM ACEC wetland	BLM/TNC	N/A	N/A	None	0	N/A
Whiskey Creek	Oregon Mountain Wetlands	Whiskey Creek wetland	BLM	24182	N/A	Some	3,425	N/A
Woodcock Bog North	Central West Illinois Valley	Woodcock Bog RNA	BLM/private	2474	N/A	15-50	390	N/A
Woodcock Bog South	Central West Illinois Valley	Woodcock Bog RNA	BLM	17353	2067	Some	10,000-25,000	N/A

Assessment of serpentine wetlands and five associated rare vascular plants in the Illinois Valley: Descriptions of substantial threats and management recommendations by site (sites are listed in order of decreasing site threat score; this does not necessarily reflect the priority order of management actions)					
Site name	**Owner**	**Site threat score**	**Threat type**	**Threat description**	**Management recommendations**
Section 19	BLM	9.64	Water diversion	A large PVC pipe at the top of the dry drainage is currently diverting water; previously documented fen habitat was not found	Search for any additional water diversions and fen habitat in the area; discontinue any unsanctioned water diversion
			Tree encroachment	The shaded drainage has a mostly closed canopy	No action is currently needed; if hydrology is restored, but isn't followed by sufficient tree mortality, then removing trees may help restore fen habitat
Days Gulch Middle	USFS	8.5	Water diversion	The old road that runs through the fen is both impeding the natural flow of water and providing supplemental water to the site by diverting it from the Days Gulch West site; currently water flows over and along the road	Evaluate the need to alter the process by which water passes across the road
			Water diversion	An old cross-slope ditch is limiting the lower extent of the fen by diverting and impounding water	Evaluate the potential to breach or remove the ditch that is acting as a barrier
			Tree encroachment	Trees of all three height classes are prevalent throughout more than half of the fen	Remove trees of the small and middle height classes to reduce canopy density
			Road maintenance	Maintenance of the old road that runs through the fen could detrimentally divert water away from established fen habitat	Consult with a hydrologist prior to initiating any road maintenance; evaluate the need to alter the process by which water passes across the road
Woodcock Bog North	BLM and private	6.05	Tree encroachment	Small and middle height class trees are prevalent throughout most of the site	Remove trees of the small and middle height classes to maintain a low-density tree canopy
			Water diversion	An approximately 10-15 cm diameter PVC pipe is diverting water in the lower reaches of the fen	Discontinue the water diversion if it is not sanctioned
			Water diversion	Two created terraces that are likely old roads are diverting the natural flow of water to lower areas	Evaluate the need to remove or reduce the terrace formations to help restore the natural water flow

Assessment of serpentine wetlands and five associated rare vascular plants in the Illinois Valley: Descriptions of substantial threats and management recommendations by site (sites are listed in order of decreasing site threat score; this does not necessarily reflect the priority order of management actions)					
Site name	**Owner**	**Site threat score**	**Threat type**	**Threat description**	**Management recommendations**
			Shrub encroachment	Dense shrub cover across approximately half of the fen	Thin out the shrubs to reduce the density of their canopy cover
			Port Orford cedar root disease	The disease is present, but in unknown levels	Actively manage the recruitment of Port Orford cedar, and other trees, to maintain the structural components that trees provide for the site
Days Gulch East	USFS	5.35	Tree encroachment	Trees of all three height classes are prevalent throughout most of the fen	Remove trees of the small and middle height classes to maintain a low-density tree canopy
			Water diversion	An old cross-slope ditch carries running water away from the fen and has created additional fen habitat	Evaluate the potential to breach or remove the ditch that is acting as a barrier
			Road maintenance	Maintenance of the old road that runs through a small portion of the fen could detrimentally divert water away from established fen habitat	Consult with a hydrologist prior to initiating any road maintenance; evaluate the need to alter the process by which water passes across the road
			Port Orford cedar root disease	Over half of the fen appears to be infected	Actively manage the recruitment of Port Orford cedar, and other trees, to maintain the structural components that trees provide for the site
TNC	BLM and TNC	3.45	Water diversion	Several pipes and hoses are actively diverting water	Discontinue any unsanctioned water diversions
			Shrub encroachment	Dense shrub cover across approximately a quarter of the fen	Thin out the shrubs to reduce the density of their canopy cover
Days Gulch Sec. 35 East Edge	USFS	2.8	Water diversion	An old cross-slope ditch runs through the center of the fen and impounds water; another ditch at the lower reaches of the fen has likely limited the extent of habitat (which ends there) by diverting water away	Evaluate the potential to breach or remove the ditches that are acting as barriers

Assessment of serpentine wetlands and five associated rare vascular plants in the Illinois Valley: Descriptions of substantial threats and management recommendations by site (sites are listed in order of decreasing site threat score; this does not necessarily reflect the priority order of management actions)					
Site name	**Owner**	**Site threat score**	**Threat type**	**Threat description**	**Management recommendations**
			Water diversion	The old road that runs through the fen impedes the natural flow of water to the lower areas; two semi-functional culverts are installed here; currently, water partially flows over the road	Evaluate the need to alter the process by which water passes across the road
			Road maintenance	Maintenance of the old road that runs through the fen could detrimentally divert water away from established fen habitat	Consult with a hydrologist prior to initiating any road maintenance; evaluate the need to alter the process by which water passes across the road
Days Gulch West	USFS	2.42	Water diversion	The old road that runs through the fen is impeding the natural flow of water and diverting water to the Days Gulch Middle site; currently, water flows over the road	Evaluate the need to alter the process by which water passes across the road
			Road maintenance	Maintenance of the old road that runs through the fen could detrimentally divert water away from established fen habitat	Consult with a hydrologist prior to initiating any road maintenance; evaluate the need to alter the process by which water passes across the road
Section 9 North	BLM	2.38	Tree encroachment	Numerous young trees are establishing within the small fen clearing and relatively dense forest surrounds the fen	Remove the majority of young tree recruits within the occupied area and remove some surrounding trees to reduce shading of the site
			Shrub encroachment	Sparse shrub cover across approximately half of the fen and denser shrubs surrounding the fen	Remove some surrounding shrubs to reduce shading of the site
Whiskey Creek	BLM	2.1	Tree encroachment	Numerous young trees are crowded into approximately one third of the fen	Remove some of the young crowded trees to reduce canopy density
			Water diversion	The old road that runs through the fen may be diverting water from an area of potential fen habitat	Evaluate the need to alter the process by which water passes across the road

Assessment of serpentine wetlands and five associated rare vascular plants in the Illinois Valley: Descriptions of substantial threats and management recommendations by site (sites are listed in order of decreasing site threat score; this does not necessarily reflect the priority order of management actions)					
Site name	**Owner**	**Site threat score**	**Threat type**	**Threat description**	**Management recommendations**
			Port Orford cedar root disease	About 90% of the Port Orford cedar appear to be showing signs of infection and die-back	Actively manage the recruitment of Port Orford cedar, and other trees, to maintain the structural components that trees provide for the site
Star Flat	USFS	1.52	Invasive weeds	Himalayan blackberry and common velvetgrass occur in the fen; higher levels of non-native vegetation occur around old tire ruts through the fen; surrounding habitat is inundated with non-native grasses and forbs, including false brome	Remove and treat weeds that occur in and immediately adjacent to the fen, then re-seed with native plants; treat a buffer surrounding the fen to help discourage the establishment of non-native plants in the fen
Illinois R. Terrace Roadside	USFS	1.44	Water diversion	An old ditch impounds water along the upslope edge of the fen	Evaluate the potential to breach or remove the ditch that is acting as a barrier
			Water diversion	The adjacent road partially impounds water along the lower edge of the fen habitat while a culvert carries water under the road, partially draining the lower portion of fen habitat	Evaluate the need to alter the process by which water passes across the road
			Road maintenance	Maintenance of the adjacent old road could detrimentally divert water flow	Consult with a hydrologist prior to initiating any road maintenance; evaluate the need to alter the process by which water passes across the road
			Debris dumped	wood chips were dumped into the site	Currently not a threat, but dumping in the site should be avoided in the future
Illinois R. Terrace	USFS	1.4	Invasive weeds	Approximately 20 Scotch broom plants are growing along the edge of the fen, near the river bank	Remove the plants and continue to monitor the site for any new recruitment and infestations
			Shrub encroachment	Dense shrubs occur in scattered concentrations across the fen	Thin out the shrubs to reduce the density of their canopy cover
Deer Creek	BLM and	1.38	N/A	N/A	N/A

Assessment of serpentine wetlands and five associated rare vascular plants in the Illinois Valley: Descriptions of substantial threats and management recommendations by site (sites are listed in order of decreasing site threat score; this does not necessarily reflect the priority order of management actions)					
Site name	**Owner**	**Site threat score**	**Threat type**	**Threat description**	**Management recommendations**
	private				
Days Gulch 029 & 820 Jct.	USFS	1.32	Water diversion	The old road that runs along the bottom edge of the fen is impeding natural water flow to the below-road portion of the fen; currently, water is impounded above the road, and it pools in and flows across the road	Evaluate the need to alter the process by which water passes across the road
			Road maintenance	Maintenance of the adjacent old road could detrimentally divert water flow	Consult with a hydrologist prior to initiating any road maintenance; evaluate the need to alter the process by which water passes across the road
			OHV activity	One set of truck tire tracks veer into the fen, alongside the road, damaging vegetation and compacting soil	No action is currently needed; if this becomes a regular problem, then roadside barriers and signs could be employed to discourage OHV use within the site
Section 9 South	BLM	1.12	Tree encroachment	Dense recruitment occurring in a small portion of the fen	Monitor and remove some of the young trees if they continue to mature and shade the fen
Woodcock Bog South	BLM	0.45	N/A	N/A	N/A

Data Form: Rapid Serpentine Wetland Habitat Quality Assessment

Wetland:	ORBIC EO:	Date:
Subwetland:	Taxon:	Collectors:

Threat	***Severity (0-10)***	***% of wetland impacted***	***Description of threat or other comments***
Mining and related activities			
Road construction and maintenance			
OHV use			
Fire suppression activities			
Water diversion			
Invasive weeds			
Encroachment of trees and/or shrubs			
Other (*Phytophthora* etc.)			

Data Form: Rare Taxon Assessment

Wetland:	ORBIC EO:	Date:
Subwetland:	Taxon:	Collectors:

Number of plants	***Method***	***Occupied area***	***Method***
total		***total***	

Population size class: 1-10, 11-50,51-100, 101-250, 251-500,501-1,000, 1,001-2,500, 2,501-5,000, 5,001-10,000, 10,000-25,000, 25,000+ populations less than 250 should be counted.

Photopoints		
Point ID	*GPS*	*specifics*

Hydrology of occupied area
Soil Moisture Conditions: %dry_____%moist_____%saturated_____%standing H20_____%flowing_____

Photo Credits

Cover: Clockwise from left: serpentine wetland, Evan Frost; *Hastingsia* ©2004 Mark Turner; *Viola primulifolia* ssp. *occidentalis* ©2004 Dan Tenaglia; and *Gentiana* ©2003 Norman Jensen.

Figure 2: Wetland types, Evan Frost.

Figure 3: *Epilobium oreganum* habitat, Evan Frost.

Figure 4: *Gentiana setigera* habitat, Evan Frost.

Figure 5: *Viola primulifolia* ssp. *occidentalis* habitat, Evan Frost.

Figure 6: *Hastingsia bracteosa* var. *bracteosa* and *Hastingsia bracteosa* var. *atropurpurea* habitat, Evan Frost.