

BRADSHAW'S  
LOMATIUM  
*(Lomatium bradshawii)*



U.S. Department of the Interior  
Fish and Wildlife Service  
Region One, Portland, Oregon  
August, 1993



# **BRADSHAW'S LOMATIUM**

## **RECOVERY PLAN**

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

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Date: August 13, 1993

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## **EXECUTIVE SUMMARY OF THE RECOVERY PLAN FOR BRADSHAW'S LOMATIUM**

**Current Status:** This species is federally listed as endangered. Extant populations, for the most part, are remnant small populations within a 10 mile radius of Eugene, Oregon.

**Habitat Requirements and Limiting Factors:** Bradshaw's lomatium occurs in two very distinct habitats. The rarest are the shallow, stream covered basalt areas found in Marion and Linn Counties, near the Santiam River. However, the majority of Bradshaw's lomatium populations occur on seasonally flooded prairies which are common by creeks and small rivers in the southern Willamette Valley. They occur in areas with deep, pluvial clays, usually in a matrix with alluvial silts.

The populations are subject to alteration or destruction through agricultural, industrial, or residential development, and competition with encroaching woody vegetation.

**Recovery Objectives:** Downlisting to threatened.

**Recovery Criteria:** Bradshaw's lomatium can be downlisted when 10 population are protected and managed as necessary to assure their continued existence. The 10 populations will be distributed in the 4 recovery areas as follows: North Central 2, Central 2, Southwest 4, and Southeast 2. For purposes of this plan, a viable population includes at least 2000 flowering plants occupying at least 20 acres of secure habitat, with the population structure indicating stable or increasing plant numbers.

**Actions Needed:**

1. Set up seed bank.
2. Establish management areas.
3. Enhance populations.
4. Monitor populations.

**Recovery Costs (\$1,000):**

<b><u>Year</u></b>	<b><u>Need 1</u></b>	<b><u>Need 2</u></b>	<b><u>Need 3</u></b>	<b><u>Need 4</u></b>	<b><u>TOTAL</u></b>
1994	12.0	18.5	77.5	16.5	124.5
1995	12.0	17.5	77.5	16.5	123.5
1996	3.0	50.0	77.5	16.5	147.0
1997	3.0	56.5	41.0	12.0	112.5
1998	3.0	25.0	41.0	12.0	81.0
1999	3.0	31.5	9.5	12.0	56.0
2000	3.0	20.0	9.5	12.0	44.5
2001	0.0	0.0	0.5	12.0	12.5
2002	0.0	0.0	9.5	12.0	21.5
2003	0.0	0.0	9.5	12.0	21.5
2004	0.0	0.0	0.5	9.0	9.5
2005	0.0	0.0	0.5	9.0	9.5
<b>TOTAL</b>	<b>39.0</b>	<b>219.0</b>	<b>354.0</b>	<b>151.5</b>	<b>763.5</b>

**Date of Recovery:** Downlisting should be initiated in 2005, if recovery criteria are met.

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# Recovery Plan

## Bradshaw's Lomatium (Lomatium bradshawii)

### I. INTRODUCTION

#### Overview

Lomatium bradshawii was first recognized for consideration as endangered or threatened in the report to Congress by the Smithsonian Institution (Ayensu and DeFillips 1975). On September 30, 1988, L. bradshawii was listed as endangered in a final rule published by the U.S. Fish and Wildlife Service (FWS).

Bradshaw's desert parsley (Lomatium bradshawii) is a member of the Apiaceae (Umbelliferae) or the umbel or parsley family. The genus is a North American group with its center of distribution in the western United States. The genus is composed of taprooted or tuberous perennial herbs with large, winged fruits.

Lomatium bradshawii is endemic to the central and southern portions of the Willamette River Valley, in western Oregon. It was first collected by J.C. Nelson near Salem, Oregon in 1916. The type specimen was collected in 1921, outside of Eugene, by R.V. Bradshaw, for whom the species was named by Mildred Mathias in 1934. It was originally described as Leptotaenea bradshawii Mathias, and was renamed Lomatium bradshawii (Rose ex. Math.) Math. & Constance in their 1942 revision of the genus.

The species was never widely collected, and there were no known collections between 1941 and 1969, leading to the assumption that the taxon might be extinct. By 1980, following a study of the species, eight populations of the species had been located, including one large population. Since 1980, five new sites have been discovered, including three large populations.

In addition to the large habitat areas containing many plants, Lomatium bradshawii occurs as isolated individuals in a number of areas: occasionally along roadside ditches, or sometimes along bare-soil areas by dikes with remnant habitats. In all of these cases, the individuals apparently are part of a large, historic population which was divided by farming, flooding or urban development. The location of all known sites is outlined in Table 1. The major threat to the species is habitat loss. Today, approximately 0.1 percent of the Willamette Valley prairie remains (Alverson, pers. comm. 1993).

#### Description:

Lomatium bradshawii is a low, erect perennial forb with leaves ranging from 1 to 3 dm long (Kaye, pers. comm. 1993). The petioles are usually as long as the leaves, which are highly dissected (ternately and then pinnately) into small linear segments. The ultimate segments are generally 2-12 mm long. The entire plant is rarely greater than 4 dm tall, with mature plants having only 2-6 leaves. It is taprooted, with the caudex usually located about 3-5 cm below the surface of the ground.

The yellow flowers of Lomatium bradshawii are small and compact, even for a Lomatium. The petals when expanded are about 1 mm long, and about 0.5 mm across. Umbellets are rarely larger than 1 cm. The umbels are asymmetrical, tending to elongate away from the center of the plant. Inflorescences have from 5 to 14 umbellets, although the rays and pedicels become poorly defined in the middle of the umbel. The species is most easily

identified by the involucels, which are 3 cleft to the middle, with the lobes often cleft again.

The fruit is oblong, 8-11 mm long, with thickened lateral wings. It is born on 1 to 4 fertile rays that are unequal in length, up to 1 dm long. Figure 1 is a line drawing of Lomatium bradshawii, drawn by Daphne Stone.

Lomatium bradshawii is most closely related to L. cookii Kagan of the Rogue River and Illinois River Valleys in southwestern Oregon. It is in a small group of Lomatiums that occur in wetlands or vernal pool habitats known from valleys in Oregon and northern California.

**Distribution:**

As was mentioned in the introduction, Lomatium bradshawii is endemic to the central and southern portions of the Willamette Valley in western Oregon. It is known from Marion, Linn, Benton and Lane Counties. The majority of the sites, and plants occur in and adjacent to the Eugene metropolitan area, with the greatest concentrations found in west Eugene. The historical distribution is currently unknown, since this species has never been widely collected, so it must be assumed that the known distribution is somewhat equivalent to the

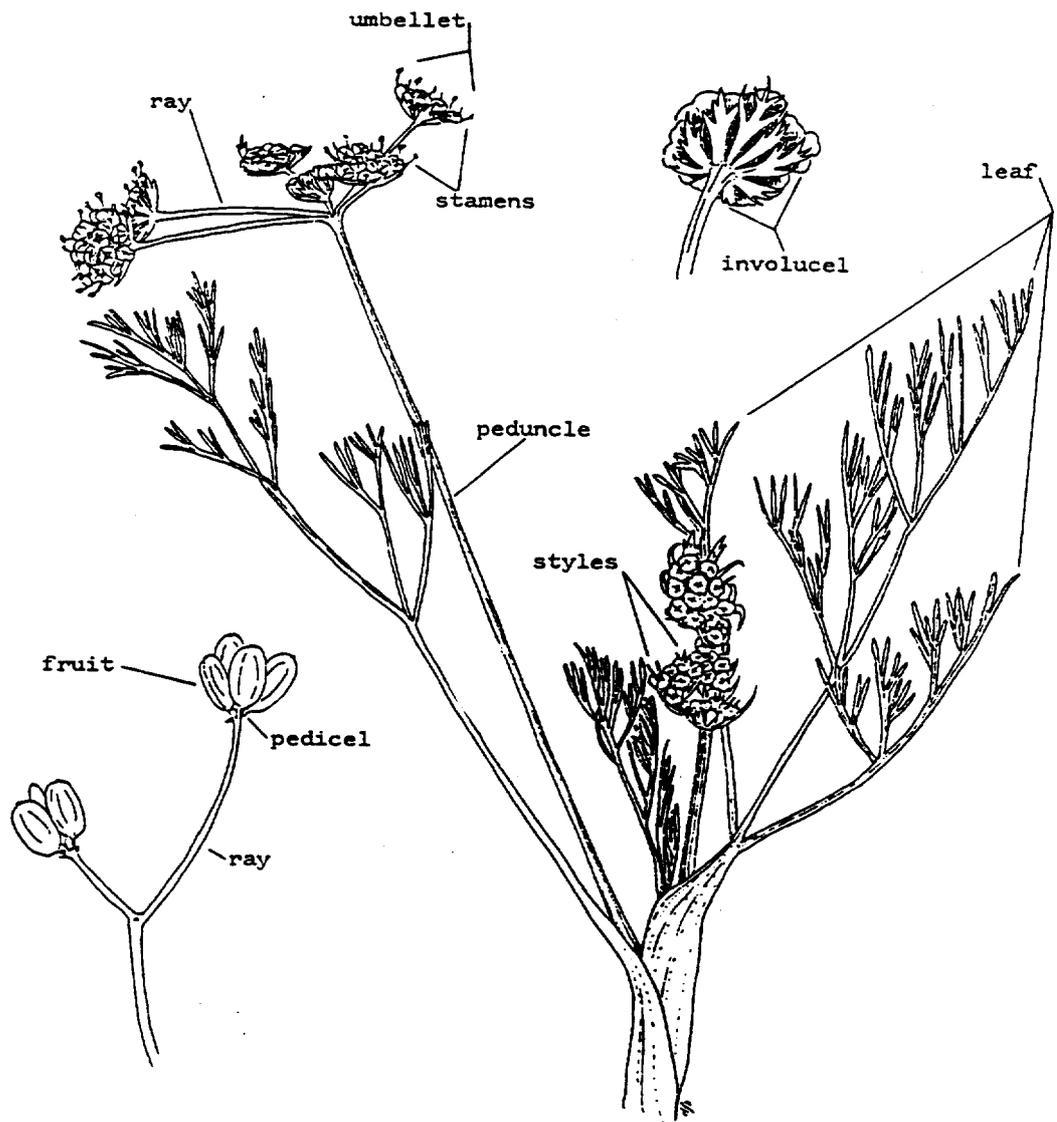


Figure 1. Illustration of *Lomatium bradshawii* Labeled are the parts of the plant referred to in the text.

historical one - in spite of the fact that most areas of habitat have been converted to agriculture or developed for housing.

In addition to the currently known extant sites (Table 1), the original 1916 collection site near Salem by Nelson, has not been relocated, and is assumed to be extirpated. The extant sites occur in four major areas. These four areas are outlined below:

1) The north central Willamette Valley, which is the northern edge of the range of Lomatium bradshawii. The area is located near the North Santiam River between Linn and Marion County, and includes one site in each county. An additional unverified report also has the plant seen near Salem, also in Marion County;

2) The central Valley, which includes the three sites in Benton County, one in north Corvallis, one at Muddy Creek, and one at the William Finley National Wildlife Refuge;

3) The west Eugene area consists of six sites, which includes the area from the Type Location in downtown Eugene west to Lorane and north to the Long Tom BLM site, all in Lane County; and

4) The southeastern populations, which includes three small populations, one newly discovered at Springfield Drive Inn, one at Buford Park, and the third at Short Mountain-Camas Swale, all within Lane County. Figure 2 is a map of all known, extant occurrences of Lomatium bradshawii.

**Table 1: List of Known Bradshaw lomatium locations**

<i>Site Name</i> <sup>1</sup>	<i>Ownership</i>	<i>Acreage of Habitat</i>	<i># Plants Known</i>
<i>North Central</i>			
1. Kingston Meadows	pvt	~ 5+	est 5,000
2. Sublimity	pvt	2	est 250
		7	5,250
<i>Central</i>			
3. Jackson-Frazier	Benton Co. Corvallis	15	350
4. William Finley NWR	USFWS	20+	2,500
5. Muddy Creek (new)	pvt	~5	> 50
		40	2,900
<i>Southwest</i>			
6. Long Tom ACEC	BLM	2	300
	pvt	15	est 1,000
7. Fern Ridge Lake	ACOE	~100	est 10,000
8. W. Eugene Wetlands (including Willow Creek)	TNC, pvt, BLM	~40	est 25,000
9. Veneta	City of Veneta	~5	~ 500
10. Amazon Park	City of Eugene	~7	~ 750
11. Coyote Cr. (upstream) Spencer Creek	pvt	<5	200
		174	37,750
<i>Southeast</i>			
12. Springfield Drive Inn	pvt	5	~ 100
13. Buford Park	Lane Co.	5	est 5,000
14. Short Mtn. - Camas Swale	Lane Co./pvt ODOT	100	1,250
		110	6,350
		Total: 331	Total: 52,250

<sup>1</sup>The numbered locations in the table are displayed in Figure 2.

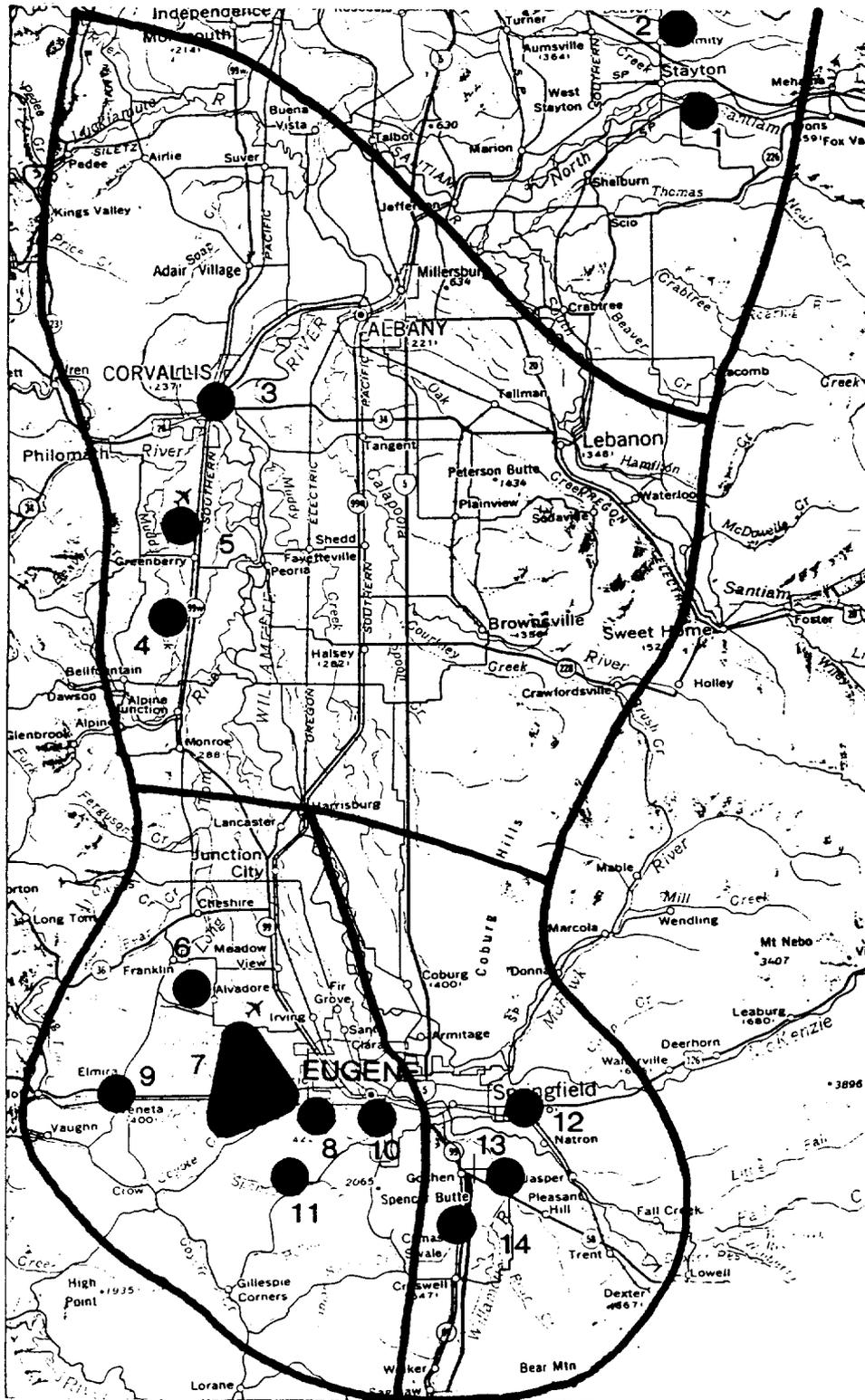


Figure 2. Distribution of Bradshaw's lomatium.

### Habitat/Ecosystem:

The habitat of Lomatium bradshawii has been well studied. It occurs in two very distinct habitats. The rarest are the shallow, stream covered basalt areas found in Marion and Linn County near the Santiam River. These sites were found by Ed Alverson (1990) using soil maps. The soil type is characterized by the SCS (Williams 1972) as the Stayton Silt Loam. It is described as well drained, in alluvium underlain by basalt. The shallow depth to bedrock, 20 inches or less, results in sites which are poorly suited to agriculture.

According to Alverson (1990), the Stayton Silt Loam sites occur as scattered locations in deeper soiled areas belonging to the Nekia-Jory association, which were originally vegetated by grassland and oak savanna. The Bradshaw's lomatium (Lomatium bradshawii) plants at these sites occur in areas with almost no soil, usually in vernal wetlands or along stream channels. Both sites have remnant habitats, that are characterized as mounded prairie or mima-mounds. Although the mounds are marginal, L. bradshawii occurs in areas that are adjacent to the mounded prairie areas.

The majority of Lomatium bradshawii populations occur on seasonally saturated or flooded prairies, which are common by creeks and small rivers in the southern Willamette Valley. They occur in areas with deep, pluvial clays, usually in a matrix with alluvial silts. The soils at these sites are dense, heavy clays, with a slowly permeable clay layer located between 15 and 30 cm below the surface. They are characterized as Dayton silt loams, Nantoy or Bashaw Clays by the SCS. This slowly permeable clay layer is critical to the seasonal wetland character of the grasslands. The slowly permeable clay layer results in a perched water table in winter and spring so soils are generally saturated to the surface or slightly inundated during the wet season. Moist sites are jurisdictional wetlands under the Federal criteria.

This relic wetland prairie has been described as the tufted-hairgrass (Deschampsia cespitosa) valley prairie and has been studied extensively (Moir

and Mika 1976, Kagan 1980, Alverson 1989, Connely 1991).

The tufted-hairgrass prairie ranges from fairly wet areas with high sedge (Carex) and rush (Juncus) cover, to drier bunchgrass prairie. In the wet areas, Lomatium bradshawii occurs on the edges of tufted-hairgrass or sedge bunches in patches of bare or open soil. In the drier areas, it is found in the low areas, such as small depressions, trails or seasonal channels, also with open, exposed soils.

Danthonia californica, Festuca rubra and Luzula campestris are also constant native associates in the drier areas. Panicum occidentale occurs in both wet and dry areas. The wetter areas tended to have greater cover of Juncus and Carex species including Juncus patens, J. tenuis, J. bufonius, Carex unilateralis, C. aurea, and C. obnupta, and Hordeum brachyantherum. In all of the sites, introduced pasture grasses including Anthoxanthum odoratum, Holcus lanatus, Poa pratensis, Agrostis tenius, A. alba, Dactylus glomerata, and Festuca arundinacea were present in varied amounts.

Complete or partial species lists for Lomatium bradshawii habitats are available from the managing agency, for the following sites: Willow Creek (The Nature Conservancy), the Long Tom ACEC (Area of Critical Environmental Concern)(The Eugene District of the BLM), the Fern Ridge RNA (Research Natural Area)(The Fern Ridge Lake Project of the Portland District of the Army Corps of Engineers), and Willamette Prairie RNA (Finley Wildlife Refuge, U.S. Fish and Wildlife Service).

#### **Life History/Ecology:**

Lomatium bradshawii has a life history that is better known than most rare species (Kaye 1992, Kagan 1980). It reproduces entirely by seeds, which are produced on umbels. Like many species in the genus, the early umbels are

largely male with most flowers not producing styles or stigmas. Flowers are visited by numerous pollinators, and require insects for pollination. (Kaye, Pers. comm.) Currently, it is not known if the species is self-compatible. In addition, the second umbel has exposed stigmas immediately after it is out of its sheath, but before it has elongated (see Figure 1). The first umbels produced are primarily male flowers and then second umbels produced have more flowers with both male and female organs.

Lomatium bradshawii blooms fairly early in the spring, usually in April and early May. In the Willamette Valley, these are often wet, rainy weeks, when flying insects such as large bees and butterflies are largely absent. Pollinators observed included a number of beetles, ants, and some small native bees in the Andradeae. The very general nature of the insect pollinators probably buffers the species from population swings of any one pollinator (Kaye 1992).

Lomatium bradshawii produces large fruits, which have corky thickened-wings. These fruits are fairly heavy, and usually fall to the ground fairly close to the parent. Fruits appear to float somewhat, and may be distributed by water. The population patterns do appear to follow seasonal, microchannels in the tufted-hairgrass prairies, but whether this is due to dispersal or habitat preference is not clear.

Preliminary demographic models suggest that 2000 flowering plants with a normal complement of vegetative individuals have a 90 percent probability of surviving for 100 years. This is based on field calculated data (Kaye and Connelly 1993, in prep.). A typical population is composed of many more vegetative plants than reproductive plants. In general, populations that have experienced prescribed fire have a higher probability of survival.

### Sensitive Species

Lomatium bradshawii occurs with many native forbs at all of the sites,

including some rare and endangered endemics. Erigeron decumbens ssp. decumbens (which is listed by the Oregon Department of Agriculture as Endangered), Lupinus sulphureus var. kincaidii and Aster curtus are C2 taxa that occur at many of the sites of Lomatium bradshawii. Delphinium pavaenocium and Sidalcea nelsoniana are two local endemics, that occur with Lomatium bradshawii at the William Finley National Wildlife Refuge. Sidalcea nelsoniana is currently listed as Threatened. At the Long Tom ACEC, the federal candidate Montia howellii occurs adjacent to a population of Lomatium bradshawii. Horkelia congesta ssp. congesta occurs at some of the Lane County Lomatium bradshawii sites. Aster hallii, Sidalcea campestris, S. cusickii, and Cardamine penduliflora are other Willamette Valley endemic taxa that occur in upland habitat near Lomatium bradshawii.

In addition to the rare plants listed above, Lomatium bradshawii occurs in the same areas as the rare butterfly, Icaricia icarioides fenderi (Fender's blue butterfly). This butterfly was thought to be extinct until 1988, and is a high priority for federal listing. Its southernmost occurrence is at Willow Creek, where it oviposits on the C2 candidate Lupinus sulphureus var. kincaidii that occurs in uplands adjacent to Lomatium bradshawii.

Aside from the plants and animals which are known to occur in adjacent habitats of Lomatium bradshawii, two rare animals, the Oregon chub (Hybopsis crameri, proposed endangered by the USFWS) and the western pond turtle (Clemmys marmorata, C2 Federal Candidate), both are known from stream backwaters, oxbows and channels which occur adjacent to known Lomatium bradshawii habitats. Protection of habitat for Lomatium bradshawii therefore, has the additional benefits of potentially providing habitat for these very important animals.

**Reasons for Listing:**

1. The habitat of Lomatium bradshawii is presently being destroyed and modified by a number of factors including:
  - a. Invasion of prairie vegetation by trees and shrubs that is altering most of the known sites from wet prairies to woodlands, eliminating L. bradshawii habitat.
  - b. Changes in flooding patterns and water movement, which may be critical to the seedling establishment of Lomatium bradshawii plants, is occurring at all of the known sites due to adjacent agricultural and urban development.
  - b. Much of the habitat occurs in and near Eugene and Corvallis, and is threatened by urban development.
  - c. Other remaining sites occur on private lands that are threatened by agricultural or rural development.
2. Disease, from a fungal parasite, as well as insect predation of the plants and fruit, may be threatening the long term existence of the smaller populations of Lomatium bradshawii.
3. Other Natural factors such as inbreeding depression or limited pollinator availability may reduce the fecundity of Lomatium bradshawii, leading to low seed set and limited reproductive capacity.

**Conservation Measures:**

Lomatium bradshawii is endangered as a result of habitat modification and destruction, both from natural and human-caused factors. The species has

been the focus of intense research since 1979, and extensive data on its demography, reproduction, and response to fire has been obtained. The Nature Conservancy (TNC), The Army Corps of Engineers (ACE), The U.S. Fish and Wildlife Service and The Bureau of Land Management (BLM) all own land with populations of Lomatium bradshawii, and are managing the sites in order to promote the species' long term survival. All of these agencies are in the process of developing plans for the protection of Lomatium bradshawii on their lands, and these plans have been incorporated into this recovery plan.

**Strategy of Recovery:**

There are two critical aspects to the recovery of Lomatium bradshawii. The first task is to ensure the protection of sites by acquisition, conservation easement, or management agreement to prevent their destruction from rural, urban or industrial development. The second task is management of protected sites to assure long-term survival of the lomatium populations.

## II. RECOVERY

### Objective

Lomatium bradshawii can be downlisted to threatened status when 10 populations are protected and managed as necessary to assure their continued existence. The 10 populations will be distributed in the 4 recovery areas as follows: *North Central 2*, *Central 2*, *Southwest 4*, and *Southeast 2*. Within each recovery area, additional occupied sites between designated recovery populations need to be secured and managed so as to provide corridors for gene flow between populations. For the purposes of this plan, a viable population includes at least 2000 flowering plants<sup>1</sup> occupying at least 20 acres of secure habitat, with a population structure indicating stable or increasing plant numbers. The 20 acres of secure habitat should be contiguous (i.e., a single site). However, if more than one site is necessary to meet either the population or habitat size, the individual sites must have the potential of supporting at least 20 flowering plants and the potential for genetic exchange exists. Protected, secure habitat is habitat that is being actively managed and protected in perpetuity for Lomatium bradshawii maintenance and enhancement as the primary goal. Furthermore, the threat from woody invasion is eliminated by active management.

No delisting objective is being proposed at this time, but upon completion of Task 273 the plan will be revised and a delisting objective set.

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<sup>1</sup> See Life history for recovery rational

## Narrative

### 1. Establish seed bank.

The Berry Botanic Garden has an established seed bank, and is actively participating in the Lomatium bradshawii recovery effort.

#### 11. Select source populations.

While some seeds should be collected from all sites, certain populations are better choices for seed collection. Those with diverse habitats and immediate and high threats are the best choice. In addition, those with good rates of seed production, and moderately high plant densities, are better than those where seeds are critical for population maintenance.

##### 111. Determine genetic variability.

Genetic variability will indicate the degree of collection necessary at each of the sites. It may be quite difficult to determine this. No electrophoretic work has been done on Lomatium bradshawii, but this may be a suitable method of looking for variability in populations.

##### 112. Determine impacts of seed collection.

Seed collection should be limited at the very small populations, as well as in populations that are actively expanding.

#### 12. Collect seeds, and store them at established seed bank facility.

The Berry Botanic Garden has seeds collected from many of the sites, including the Kingston site, Amazon Park, Finley Refuge, and Willow Creek. Collection from Jackson-Frazier and Bufford Park should be a priority. The garden should continue their collection and research efforts.

### 2. Secure and manage habitat to support 10 viable populations in the 4 recovery areas.

Until the sites are selected, protection should be done for as many of the sites as is possible. At least ten viable populations must be protected by perpetual administrative agreements with the landowners on whose land Lomatium bradshawii is found.

21. Locate additional sites.

Lomatium bradshawii habitat has been well searched, but two population centers, the northeast area by the North Santiam River and the southeast area by the Coast Fork of the Willamette River both have the potential for additional sites.

211. Identify potential habitats.

Using soil maps and aerial photographs, identify areas that are suitable for Lomatium bradshawii, based on information from the closest known populations.

2111. Identify potential habitats North Central Willamette Valley

The original 1916 collection near Salem, which has not been relocated, is assumed to be extirpated. Soils maps and aerial photographs should be used extensively to identify some sites near Salem that have a good potential.

2112. Identify potential habitats Central Valley

Soils maps and aerial photographs in the Brownsville area should be used to identify other sites in addition to the newly reported Brownsville site.

2113. Identify potential habitats Southeastern

212. Search potential habitats for additional populations needed for recovery.

Within the north central Willamette Valley, the central Valley, and the south east recovery areas additional sites are needed to meet the recovery objectives.

2121. North Central Willamette Valley Recovery Area

Currently there are only two known sites and both are in private ownership. For locations of the Sublimity and Kingston Meadows sites see Figure 2. More sites may be needed if the owner of the Sublimity site is not willing to

cooperate in the recovery efforts.

2122. Central Valley Recovery Area

Currently there are only three known sites; two in public ownership, one in private ownership. A reported fourth site, Brownsville, needs to be verified and inventoried. The Jackson-Frazier site is owned by Benton County and the other site is on the William Finley National Wildlife Refuge. See Figure 2 for general location of these sites.

2123. Southeast Recovery Area.

Currently there are only three known sites with two of these in private ownership and the third in public ownership. The Springfield site is inadequate in size to be a viable population.

22. Determine ownership of extant sites

The initial stage in securing sites and later developing management plans to enhance the population is to determine the ownership. The ownership of 10 sites are known and included below, from north to south:

*North Central*

The Sublimity grassland site is owned by a private landowner.

Kingston Meadows is owned by a private landowner.

*Central*

The Jackson-Frazier area is owned and managed by both Benton County, Oregon and the City of Corvallis.

Muddy Creek site is in private ownership.

The William Finley population occurs at two areas on the William Finley National Wildlife Refuge which is managed by the U.S. Fish and Wildlife Service.

*West Eugene*

The Long Tom ACEC is owned and managed by the Bureau of Land Management. The greatest part of the population occurs on

adjacent private land.

The Fern Ridge Lake population occurs in at least six localities managed by the Army Corps of Engineers and isolated individual plants in the southern area which is leased to the Oregon Department of Fish and Wildlife as a Wildlife Management Area.

The Lomatium bradshawii habitat at Willow Creek is largely owned by The Nature Conservancy. A small portion of the habitat is privately owned by the Bailey Hill Land Company, but is leased and managed by The Oregon Field Office of The Nature Conservancy. The City of Eugene owns another small parcel which is also managed by The Nature Conservancy.

#### *South Eastern*

The ownership for the new Springfield Drive Inn site needs to be determined.

The Buford Park area is owned by Lane County.

Short Mountain-Camas Swale is partially privately owned, as part of three tax lots, as well as being included in an Oregon Highway Department right-of-way. The Short Mountain Landfill is owned by Lane County.

#### 23. Ascertain willingness of landowners to participate.

The landowners of all known sites are aware of the existence of Lomatium bradshawii on their property. They should be informed of the recovery effort. Federal agencies should be contacted and asked to assist with the recovery plan. Private landowners should be contacted, and if they are interested in participating and protecting their populations, should be included in the recovery effort. Some preliminary information concerning willingness of land owners to participate in recovery efforts is discussed below as background to the selection process, which is the next task:

The owner's of the Sublimity Grassland site have been contacted by The Nature Conservancy, and have not been interested in granting a conservation easement. The USFWS or other private or public agency could pursue some type of cooperative agreement, or could attempt to purchase the Lomatium bradshawii habitat at the site.

The Kingston Meadows property is for sale, and The Nature Conservancy is attempting to acquire it. TNC has apparently committed to raising the money to acquire and manage the site.

The Benton County Commission has not determined what the long term plan is for the management of their portion of the Jackson-Frazier site, but they have Registered the area under the Oregon Natural Heritage Program, indicating a voluntary commitment to protect the site and the rare plant population. The City of Corvallis owns and manages the rest of the site.

Current management of the two sites on the William Finley National Wildlife Refuge have involved annual inventory by refuge staff. The management of these two sites should be incorporated into the overall management plan for the Refuge.

At the Fern Ridge Lake sites, The Army Corps has been exceptional in protecting their rare plant habitats.

The Long Tom ACEC occurs on Federal Land and is currently being managed by Bureau of Land Management for Lomatium bradshawii. The willingness of the private landowner adjacent to the BLM lands needs to be determined.

At the Willow Creek site, The Nature Conservancy has prepared a Site Stewardship Summary for Lomatium bradshawii and preserve design plan.

24. Select 10 management areas.

Using the information gathered from tasks numbers 21, 22 and 23 the U.S. Fish and Wildlife service in consultation with the Army Corps of Engineers, Bureau of Land Management, and the other land owners should choose at least four management areas in the west Eugene recovery area and two in the other three recovery areas. Currently, sites being recommended for downlisting include Kingston Meadows, Jackson-Frazier Wetlands, William Finley National Wildlife Refuge, Fern Ridge Lake Project, Willow Creek, and Buford Park. Four additional management areas are essential for downlisting, one in the northeastern Willamette Valley area, one in the southeastern area, and two in West Eugene. There is currently only one additional population in the northeastern Valley area known today, the Sublimity site. The population size is too small to be considered viable, but sufficient habitat is probably present to allow for expansion of the population. Until a better site is found, this should be considered for inclusion as essential for downlisting to threatened. There are two additional sites known in the southeastern area besides the recommend Buford Park. One was newly discovered in 1991, in Springfield with about 100 plants in 5 acres of habitat. The second includes about 1250 at the Short Mountain-Camas Swale site. The Short Mountain-Camas Swale population has much

larger habitat area (mostly unoccupied), and should be considered for inclusion in the recovery strategy as the second site necessary for the southeast recovery area. For the third site in west Eugene recovery area, the Long Tom ACEC site owned by the Bureau of Land Management and adjacent private land is recommended. This site is significant because some of the population occurs on Federal Land and is currently being managed for Lomatium bradshawii.

25. Establish 10 management areas .

Once the sites have been selected (Task #23), management areas need to be established. Establishing management areas will include delineating the boundaries of each area and securing the habitat within the boundaries.

251. Delineate boundaries of the management areas.

Figure 2 shows the general location of the known extant populations. The population and subpopulation boundaries for Lomatium bradshawii plants should be mapped at all selected populations. The boundaries of each management unit should be drawn on maps that have a scale not greater than 1:6,000. At many of the sites, population numbers are below viable levels. Often, this is a result of limited habitat. In these cases, additional habitat should be included within the boundary of the management area to allow for expansion of Lomatium bradshawii populations.

252. Secure the habitat supporting each population.

Once the boundaries of the selected populations have been delineated, a mechanism needs to be in place to protect the habitat from alterations and to allow for the development of management plans to enhance the populations. Once the landowners have been identified and contacted, an analysis must be made of the various protective alternatives available. The public landowners managing known sites all have indicated a willingness to assist in the recovery effort. If private owners are not interested in protecting these populations; than attempts should be made to acquire (fee or easements on) their sites, either by a Federal Agency, a State Agency, or a Conservation Group who would protect the populations.

26. Enhance populations within each of the 10 management areas

The management of the known sites to enhance populations of Lomatium bradshawii is as difficult or perhaps more difficult than protecting the sites. The management plans must address secondary succession occurring at all sites, fire, hydrology, competition from exotics, and adjacent development occurring at most areas. Before management plans can be developed, some understanding into which factors may be limiting plant numbers at the site, and which may be leading to declines in populations.

261. Evaluate threats to the species.

In order to delist, threats preventing the populations from becoming stable need to be eliminated. Thus the following threats will be evaluated as to their impacts on population survival.

2611. Examine secondary succession or potential habitat modification.

Secondary succession is occurring at most Lomatium bradshawii sites. The result of this secondary succession is that the native grassland habitats are replaced by Oregon ash, hawthorn, crabapple, escaped pears and apples, or possibly eventually conifer forests. Lomatium bradshawii can not survive in these forested habitats. Controlling secondary succession is critical. Many of the sites are in fairly late stages of ash invasion, while others are still open grasslands with few seedling trees. All of the sites, with the exception of the two in the northern valley, show some type of secondary succession occurring. At the sites with secondary succession occurring, there is a need for some secondary succession control, and woody plant invasion should be the primary factor in evaluating the need for prescribed fire. Certain sites, such as Willow Creek, are located in areas with adjacent development. Fires may have to be use in conjunction with other activities. Attempts are being made to work with air pollution authorities, local fire prevention officials, and others to obtain permits, and to

develop the ability to use prescribed fire to maintain and enhance Lomatium bradshawii habitat. Important factors include the timing (seasonality and frequency of burns), the intensity, the cost, and safety. Secondary factors include: 1) fire effects on other native and potential threatened species in the habitat (Erigeron decumbens and Aster curtus), 2) alien or exotic species and potential fire effects on these and the natives, and 3) the political considerations of burning in the Willamette Valley.

2612. Examine effects of competition.

Competition from native and introduced species may be limiting reproduction and survival of Lomatium bradshawii individuals. At sites where reproduction is limited, studies should be done to determine if inter-specific competition is a factor. It may be that prescribed fire along with seasonal flooding is needed to maintain open microsites suitable for germination.

2613. Examine affects of tree roots on hardpan maintenance.

Sites with some Oregon ash invasion should be tested to determine the depth and nature of the clay hardpan. It may be essential to remove invading trees quickly (and manually), if the hardpan may be destroyed by the trees before the trees can be removed through a series of prescribed burns.

2614. Determine impact of fungal diseases.

A fungal (Ascomycete) parasite has been observed on Lomatium bradshawii plants. There was minor mortality in some patches during some years. However, major damage to populations has not been observed. This fungus has only been seen at Willow Creek, Long Tom, and Fern Ridge to date. This fungus has been identified as Physoderma in the Chytridiales.

2615. Determine insects impacts on plants.

Spittle bugs have been observed on a number of plants at all of the sites. The bugs apparently do not cause mortality, but do significantly reduce (or eliminate) the number of seeds produced. The number of plants attacked are fairly limited at most populations, although in patches, most of the plants can have spittle bugs present. The only other insect observed was a seed weevil, which damaged significant numbers of the fruit at some of the sites.

2616. Determine human impact.

At Willow Creek, trails created by bikes, horses, and vehicles have caused significant damage to Lomatium bradshawii individuals and patches.

2617. Determine herbicide impacts.

Adjacent use of herbicides on lawns, gardens and farms, and roadside spraying of herbicides may damage or destroy populations of Lomatium bradshawii. Sites in which this may be a problem should be identified, and spraying or use of herbicides should be controlled.

2618. Determine grazing impacts (Geese, Sheep, and Cattle).

Grazing of cattle has reduced or eliminated Lomatium bradshawii populations at some sites (Buford Park). At Sublimity, domestic geese grazing has all but eliminated reproduction of the small population present.

2619. Determine impacts of exotic plants.

The existence of dense sods created by Festuca arundinaceae and Anthoxanthum odoratum inhibit the growth and germination of Lomatium bradshawii. At some of the sites, shading or past disturbance has caused some major areas to be dominated by these species. At other sites, Phalaris arundinaceae also forms dense stands. If these exotic grasses expand into the native wet

grasslands, some type of control will have to be established. Initially, the boundaries of areas with dominance of these species should be established, and lines drawn beyond which control actions will be started.

262. Identify autecological needs.

2621. Determine hydrologic requirements.

Since the current hydrologic regimes are so critical to the existence of Lomatium bradshawii, these must be maintained at the sites. Adjacent development can alter both overland water flows and subsurface water flows. Baseline data on both of these factors should be determined at all sites and adjacent development should be planned to limit any impact on water flow patterns. Initial studies have been done at Willow Creek, Fern Ridge Lake, and Long Tom.

2622. Examine fecundity and reproductive health.

If seed production or population appears to be declining the following should be analyzed:

26221. Inbreeding depression.

Inbreeding depression was considered a potential factor in the limited fecundity observed in Lomatium bradshawii populations. This could be examined by experimentally crossing some individuals from different populations. This must be done carefully, since many of the populations have been isolated for years, and may have genetic site specificity. Electrophoresis could also be used to determine outcrossing rate.

26222. Pollinator availability.

Native flies, ground nesting bees, and other native insects were observed to visit Lomatium bradshawii flowers (Kaye pers. comm. 1992). It is possible that lack of pollinators could limit fruit set.

2623. Examine presence of seedling survival.

If seeds are being produced but seedlings are not present the following should be analyzed:

26231. Seed viability

Work at the Berry Botanic Garden Seed Bank with Lomatium bradshawii indicates good germination success, and fairly high viability. The rate varied between 80 and 90 percent for some treatments of each accession tested (although some other treatments had much lower rates).

26232. Seed predators or parasites

Seed predators were observed by Kagan (1980) to be a major factor at some sites. The primary culprit was a seed weevil. Since then, few seed predators or parasites have been observed.

26233. Determine optimal microhabitat for germination and seedling establishment.

A study needs to be done which identifies the condition and microhabitats that are optimal for seedling establishment and survival. The role of fire removing thatch and increasing nutrient availability needs to be evaluated further. Preliminary studies by Kaye and Connelly (1993 in prep.) indicate that prescribed burning is beneficial to growth and development of seedlings.

263. Write site specific management plan for each management area.

After management areas have been established (task 242), threats evaluated, and autecological research completed, site specific management plans need to be developed. For those sites that are recommended for establishing recovery management areas, a discussion of those things that need to be considered when preparing the site specific management plan follows:

Sublimity Grassland has some serious management problems that must be addressed to provide for long term security for the species. Scots broom, blackberry, spiraea, and Oregon ash are all invading the site. Succession is in a very early stage here, and can be fairly easily controlled either mechanically, or by a prescribed fire. However, if action is delayed, the cost and time involved in controlling invading species will greatly increase. The secondary succession at this site is occurring primarily outside of the Lomatium bradshawii habitat areas. Much of the population is grazed heavily by domestic geese living in the adjacent pond. The geese remove most of the leaves and cause the Lomatium bradshawii plants present to produce limited seeds. In addition, the area is occasionally grazed by domestic sheep and cattle, both of which eat Lomatium bradshawii. The plants occur in a low meadow adjacent to a small stream. With no changes in upstream uses, the habitat for Lomatium bradshawii will probably remain secure. However, upstream water flows should be measured and monitored, and logging and agricultural activities along the stream should not be increased. The current habitat for Lomatium bradshawii at this site is limited to between 2 and 3 acres, of which only one has any plants present. An additional two acres on the north side of the stream have suitable habitat, and perhaps the plants could be reestablished there. In addition, the removal of the pond could both decrease herbivory and increase the habitat areas. Additional habitat is necessary to assure the population remains large enough to be viable over time.

Kingston Meadows has some serious management problems that must be addressed to provide for long-term security of the species. Scots broom, blackberry, spiraea, and Oregon ash are all invading the site.

Succession is in a very early stage here, and can be controlled either mechanically, or by prescribed fire. However, if action is delayed, the cost and time involved in controlling invading species will greatly increase. The secondary succession at this site is occurring primarily outside of the Lomatium bradshawii habitat areas.

Jackson-Frazier has some serious management problems that must be addressed to provide for long-term security for the species. Dr. Bob Frenkel has prepared a draft management plan for the site. This site, with the adjacent development and the upstream development, has had major changes in hydrology. Oregon ash, willow, and hawthorn are all invading the site. Succession was controlled throughout much of the population area by mechanical removal by a tractor. This resulted in a series of parallel rows of debris which occur throughout the population area. If these can be removed without disturbing the existing population, fire may be the appropriate method for reducing succession. The site is located near a Junior High School, and adjacent to housing developments in Corvallis. Some plan to restrict use within high Lomatium bradshawii density areas should be included in the overall protection plan. Much of the former habitat for Lomatium bradshawii at this site has been buried by fill dirt, or covered by housing. Some restoration of the southern areas may be required to provide enough habitat area to allow for the population to be considered secure (given the management constraints present at the site).

The William Finley National Wildlife Refuge site has had some management by the refuge staff. Oregon ash, rose, and spiraea are all invading the site. Succession has been controlled throughout the site with prescribed fires. The overall fire plan for the area should reduce succession in the population area, provided the fire plans include these areas. Potential conflicts exists between geese and management needs for Lomatium bradshawii.

The Fern Ridge Lake area contains one of the largest habitat areas and has the second largest overall population of Lomatium bradshawii. The Corps has studied management techniques, including prescribed burning, and has annually monitored its

subpopulations. At this time, only one of the subpopulations on the project appears stable. The overall management of the species at the site has been exceptional, but a Lomatium bradshawii protection plan would assist in assuring long term viability, especially regarding maintaining gene-flow throughout the subpopulations present. If possible, address the populations of Erigeron decumbens which are present in the management plan. Oregon ash, rose, and spiraea are all invading the site. Succession has been controlled in part of the site with prescribed fires, but long term burning will be difficult in Lane County (due to smoke management conflicts and problems with field burning). The overall fire plan for the area should reduce succession in the population area, provided the Lomatium bradshawii habitat areas are burned. Some subpopulations are near the lake edge, and hydrologic fluctuations may lead to invasion of Phalaris arundinaceae (reed canary grass). Other subpopulations are adjacent to ponds, ditches and other hydrologic structures (including two abandoned ditches). Modifications of these structures (naturally or for wildlife or water management) could effect the Lomatium bradshawii populations. The continued uses of the project area have the potential to modify rare plant habitats. The subpopulations at Fern Ridge are located primarily along the eastern edge of the Fern Ridge Lake. The populations are spaced so that with proper planning and management they should allow for the maintenance of long term gene-flow throughout these populations, and the adjacent populations at the Long Tom ACEC to the north, and the West Eugene populations to the east.

The Nature Conservancy is developing a management plan that should address the serious management problems present at the Willow Creek site. The plan should be completed by the end of November 1993, and should address the needs of Lomatium bradshawii and the other Federal Candidate plants present. This site, with the adjacent development and the upstream development, will likely see major changes in hydrology. The Nature Conservancy is working to develop a plan that assures that hydrologic regime remains stable. Oregon ash, introduced fruit trees (pear and apple), and hawthorn are all invading the site. The Nature Conservancy has attempted mechanical removal, cutting and girdling trees by

hand, and fire, and still has not succeeded in slowing down the secondary succession. Additional work in this area is critical. The site is located near a High School, and adjacent to housing and industrial developments in west Eugene. The city is working on a cooperative plan (the West Eugene Wetlands study), to attempt to deal with this. Some plan to restrict use within high Lomatium bradshawii density areas and this should be included in the overall protection plan. Willow Creek and Fern Ridge Lake project contain over 95 percent of the known plants of Lomatium bradshawii. A number (3 are currently known) of small sites are located between the two large populations. Provide protection for these sites, or include them within a habitat corridor, to allow for some gene flow to occur between the populations.

Buford Park has management problems that must be addressed to provide for long term security for the species. Oregon ash, hawthorn, blackberry and other weeds are invading the site. Succession has been slowed by cattle grazing, but the grazing has damaged the Lomatium bradshawii population. The County has recently limited livestock grazing to the west side of the Park. Other means of controlling succession at this site need to be identified. The site is located near Eugene, in an area receiving heavy recreational use. The use may not be a serious threat, but management of people here is essential to maintain a viable Lomatium bradshawii population. The habitat area is currently, or has in the past been grazed by cattle, although the majority of the plants are now included in a fence. Much of the former habitat for Lomatium bradshawii at this site appears not to be occupied by the plant. However, meeting this objective should be possible here.

Short Mountain-Camas Swale also has some serious management problems that must be addressed to provide from long term security for the species. Hawthorn, Oregon ash, fruit trees, scots broom, blackberry, spiraea and introduced weeds are all invading the Camas Swale site. Succession is far enough along that if control is not started soon, it will become very difficult and expensive. In addition, the site's proximity to I-5 makes the use of prescribed fire extremely difficult. Much of the habitat is apparently changing from tufted-hairgrass prairie to wetlands

dominated by Carex and Mentha, possibly as a result of hydrologic changes from the fact that the site is bounded by the Railroad on the west, I-5 on the east, and is bisected by State Highway 99. The additional water does not seem to influence Lomatium bradshawii in the more northerly populations, but the southern ones may not be able to survive in these habitats. An examination of the hydrology of the site is essential. At the Camas Swale portion of the site, Lomatium bradshawii currently occupies only a few acres of habitat, mostly along the roadside, in spite of the fact that there are 10-20 acres of adjacent habitat which appear suitable. To assure long term viability, the population must be expanded into a larger habitat area. This may require some type of habitat restoration. This site has potential habitat on both sides of Highway 99. More available habitat is present on the west side of the highway, but no plants occur in this area except along the road right-of-way. There are a few plants in the area between Highway 99 and I-5, but this area appears to have less than 5 acres of suitable habitat. The other part of this site is the Short Mountain Landfill, and is east of I-5. This part of the site contains approximately 1250 plants.

The Long Tom ACEC population is currently threatened by secondary succession, and largely occurs on adjacent private lands. The BLM is attempting to acquire the private lands, and to control trees by prescribed burns. Oregon ash, hawthorn, oak and spiraea are all invading the site. Control of tree and shrub invasion has been attempted through prescribed fires. The overall fire plan may not be enough, since succession has progressed far enough that some manual removal of woody material may be essential. The BLM should work with The Nature Conservancy (which has similar problems at Willow Creek), to attempt to restore much of the habitat. The majority of the population, and the best quality habitat occurs on private lands just north of the existing ACEC. The BLM is attempting, through The Nature Conservancy and The Trust for Public Lands, to acquire this property. Potential boundaries should be included in this plan.

264. Implement site specific management plans.

After the management plan is developed, coordination between FWS and all other parties involved is essential during implementation of these plans. These sites should be managed as specified in the appropriate management plan to increase plant numbers to viable levels. At many of the sites, population numbers are below viable levels due to poor quality habitat, exotic species or invasion of shrubs and trees. At these sites, burning, manual tree and shrub control, or other measures may be essential.

27. Determine population trends.

At all of the sites, obtain plant numbers via counting or sampling, and determine population trends. At the larger sites, baseline information on plant locations and numbers need to be established.

271. Establish permanent plots, photopoints & monitoring techniques.

Monitoring schemes need to be developed for all of the sites. About half of the populations can be censused by counting all individual plants. The remainder have large enough plant numbers to require some sampling. Sampling methods have been tested at Willow Creek Preserve, Long Tom ACEC, and at Fern Ridge Reservoir. Monitoring techniques are critical because prescribed fire is apparently essential to control secondary succession, and perhaps to maintain openings to allow germination. Since there are many factors to be evaluated regarding prescribed burns (periodicity, frequency, intensity), sampling is critical to determine the best management methods at each site.

272. Conduct periodic monitoring.

Periodic monitoring is essential. Annual sampling should be done for at least 3 years, and if plant numbers are stable, sites should then be resampled every third year. The majority of the sites have active threats, including secondary succession and adjacent hydrological disturbances. At these sites, annual sampling will be required, both to examine effects of management and the threats.

**273. Conduct demographic studies to verify downlisting and determine delisting objective.**

Gather necessary demographic data for determining transition values and variance to be used in modeling population persistence for at least one population in each of the four areas.

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### III. IMPLEMENTATION SCHEDULE

The table that follows is a summary of scheduled actions and costs for this recovery program. It is a guide to meet the objectives of the Bradshaw's Lomatium Recovery Plan. This table indicates the priority in scheduling tasks to meet the objectives, which agencies are responsible to perform these tasks, a time-table for accomplishing these tasks, and the estimated costs to perform them. Implementing Part III is the action of this plan, that when accomplished, will satisfy the recovery objective. Initiation of these actions is subject to the availability of funds.

Priorities in Column 1 of the following implementation schedule are assigned as follows:

Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.

Priority 2 - An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to provide for full recovery of the species.

Recovery Plan Implementation Schedule for Bradshaw's Lomatium

PRIORITY	TASK	TASK DESCRIPTION	TASK DURATION YEARS	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES (\$1,000)				
						FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
Needs 1: Conserve genetic material										
1	111	Determine genetic variability	2	FWS-ES*	6	3	3			
				BLM	6	3	3			
				CORPS	6	3	3			
1	112	Determine impact of seed collections	3	FWS-ES*	3	1	1	1		
				BLM	3	1	1	1		
				CORPS	3	1	1	1		
1	12	Collect seeds and store them at established seed bank facility	4	FWS-ES*	4				1	1
				BLM	4				1	1
				CORPS	4				1	1
Subtotal needs 1:					39	12	12	3	3	3
Needs 2: Establish management Areas										
1	2111	Identify Potential habitat in North Central Willamette Valley	3	FWS-ES*	1.5	0.5	0.5	0.5		
				BLM	1.5	0.5	0.5	0.5		
				CORPS	1.5	0.5	0.5	0.5		
				ODA	1.5	0.5	0.5	0.5		
1	2112	Identify Potential habitat in Central Valley	3	FWS-ES*	1.5	0.5	0.5	0.5		
				BLM	1.5	0.5	0.5	0.5		
				CORPS	1.5	0.5	0.5	0.5		
				ODA	1.5	0.5	0.5	0.5		
1	2113	Identify Potential habitat in Southeastern recovery area	3	FWS-ES*	1.5	0.5	0.5	0.5		
				BLM	1.5	0.5	0.5	0.5		
				CORPS	1.5	0.5	0.5	0.5		
				ODA	1.5	0.5	0.5	0.5		

Recovery Plan Implementation Schedule for Bradshaw's Lomatium

PRIORITY	TASK	TASK DESCRIPTION	TASK DURATION YEARS	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES (\$1,000)				
						FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
1	2121	Search Potential Habitat in North Central Willamette Valley	3	FWS-ES*	6			2	2	2
				BLM	6			2	2	2
				CORPS	6			2	2	2
				ODA	6			2	2	2
1	2122	Search Potential Habitat in Central Valley	3	FWS-ES*	6			2	2	2
				BLM	6			2	2	2
				CORPS	6			2	2	2
				ODA	6			2	2	2
1	2123	Search Potential Habitat in Southeastern recovery area	3	FWS-ES*	6			2	2	2
				BLM	6			2	2	2
				CORPS	6			2	2	2
				ODA	6			2	2	2
1	22	Determine ownership of extant sites	5	FWS-ES	3	1			1	1
1	23	Ascertain willingness of land owners to participate	6	FWS-ES	6	1.5	1.5		1.5	
1	24	Select 12 management areas (3 in each recovery area)	3	FWS-ES*	8	2	2		2	
				BLM	8	2	2		2	
				CORPS	8	2	2		2	
				ODA	8	2	2		2	
				TNC	8	2	2		2	
1	251	Delineate boundaries of the management areas	5	FWS-ES*	16			4	4	
				BLM	16			4	4	
				CORPS	16			4	4	
				ODA	16			4	4	
				TNC	16			4	4	

Recovery Plan Implementation Schedule for Bradshaw's Lomatium

PRIORITY	TASK	TASK DESCRIPTION	TASK DURATION YEARS	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES (\$1,000)				
						FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
1	252	Secure the habitat supporting each population	5	FWS-ES*	0				TBD	TBD
				BLM	0				TBD	TBD
				CORPS	0				TBD	TBD
				ODA	0				TBD	TBD
				TNC	0				TBD	TBD
		Subtotal needs 2:			219	18.5	17.5	50	56.5	25
		Need 3: Enhance populations								
2	2611	Examine secondary succession or potential habitat modification	5	FWS-ES	10	2	2	2	2	2
				BLM	10	2	2	2	2	2
				CORPS	10	2	2	2	2	2
				ODA	10	2	2	2	2	2
				TNC	10	2	2	2	2	2
2	2612	Examine effects of competition	5	FWS-ES	10	2	2	2	2	2
				BLM	10	2	2	2	2	2
				CORPS	10	2	2	2	2	2
				ODA	10	2	2	2	2	2
				TNC	10	2	2	2	2	2
2	2613	Examine affects of tree roots on hardpan maintenance	3	FWS-ES	6	2	2	2		
				CORPS	6	2	2	2		
				TNC	6	2	2	2		
2	2614	Determine impact of fungal diseases	5	FWS-ES	7.5	1.5	1.5	1.5	1.5	1.5
				CORPS	7.5	1.5	1.5	1.5	1.5	1.5
				TNC	7.5	1.5	1.5	1.5	1.5	1.5

Recovery Plan Implementation Schedule for Bradshaw's Lomatium

PRIORITY	TASK	TASK DESCRIPTION	TASK DURATION YEARS	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES (\$1,000)				
						FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
2	2615	Determine insects impacts on plants	5	FWS-ES	5	1	1	1	1	1
				FWS-REF	5	1	1	1	1	1
				BLM	5	1	1	1	1	1
				CORPS	5	1	1	1	1	1
				ODA	5	1	1	1	1	1
				TNC	5	1	1	1	1	1
2	2616	Determine human impact	3	FWS-ES	3	1	1	1		
				FWS-REF	3	1	1	1		
				BLM	3	1	1	1		
				CORPS	3	1	1	1		
				ODA	3	1	1	1		
				TNC	3	1	1	1		
				BENTONCO	3	1	1	1		
2	2617	Determine herbicide impacts	3	FWS-ES	1.5	0.5	0.5	0.5		
				FWS-REF	1.5	0.5	0.5	0.5		
				BLM	1.5	0.5	0.5	0.5		
				CORPS	1.5	0.5	0.5	0.5		
				ODA	1.5	0.5	0.5	0.5		
				TNC	1.5	0.5	0.5	0.5		
				ODOT	1.5	0.5	0.5	0.5		
2	2618	Determine grazing impacts (geese, sheep, & cattle)	5	FWS-ES	2.5	0.5	0.5	0.5	0.5	0.5
				FWS-REF	2.5	0.5	0.5	0.5	0.5	0.5
				BLM	2.5	0.5	0.5	0.5	0.5	0.5
				CORPS	2.5	0.5	0.5	0.5	0.5	0.5
				ODA	2.5	0.5	0.5	0.5	0.5	0.5
				LANECO	2.5	0.5	0.5	0.5	0.5	0.5

Recovery Plan Implementation Schedule for Bradshaw's Lomatium

PRIORITY	TASK	TASK DESCRIPTION	TASK DURATION YEARS	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES (\$1,000)				
						FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
2	2619	Determine impacts of exotic plants	5	FWS-ES	2.5	0.5	0.5	0.5	0.5	0.5
				FWS-REF	2.5	0.5	0.5	0.5	0.5	
				BLM	2.5	0.5	0.5	0.5	0.5	
				CORPS	2.5	0.5	0.5	0.5	0.5	
				ODA	2.5	0.5	0.5	0.5	0.5	
TNC	2.5	0.5	0.5	0.5	0.5					
2	2621	Determine hydrologic requirements	3	FWS-ES	3	1	1	1		
				BLM	3	1	1	1		
				CORPS	3	1	1	1		
				TNC	3	1	1	1		
2	26221	Examine inbreeding depression	3	FWS-ES	3	1	1	1		
				BLM	3	1	1	1		
				CORPS	3	1	1	1		
				ODA	3	1	1	1		
2	26222	Examine pollinator availability	3	FWS-ES	3	1	1	1		
				BLM	3	1	1	1		
				CORPS	3	1	1	1		
				ODA	3	1	1	1		
2	26231	Examine seed viability	Cont.	FWS-ES	6	0.5	0.5	0.5	0.5	0.5
2	26232	Examine seed predators or parasites	3	FWS-ES	3	1	1	1		
				BLM	3	1	1	1		
				CORPS	3	1	1	1		
				ODA	3	1	1	1		

Recovery Plan Implementation Schedule for Bradshaw's Lomatium

PRIORITY	TASK	TASK DESCRIPTION	TASK DURATION YEARS	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES (\$1,000)				
						FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
2	26233	Determine microhabitat for germination & seedling establishment	3	FWS-ES	8	2	2	2	1	1
				BLM	8	2	2	2	1	1
				CORPS	8	2	2	2	1	1
				ODA	8	2	2	2	1	1
2	263	Write site specific management plan for each management area	2	FWS-ES	4					
				FWS-REF	4					
				BLM	4					
				CORPS	4					
				ODA	4					
				LANECO	4					
				BENTONCO	4					
				TNC	4					
				ODOT	4					
2	264	Implement site specific management plans	Cont.	FWS-ES	0					
				FWS-REF	0					
				BLM	0					
				CORPS	0					
				ODA	0					
				LANECO	0					
				BENTONCO	0					
				TNC	0					
				ODOT	0					
		Subtotal needs 3:			354	77.5	77.5	77.5	41	41

Recovery Plan Implementation Schedule for Bradshaw's Lomatium

PRIORITY	TASK	TASK DESCRIPTION	TASK DURATION YEARS	RESPONSIBLE PARTY	TOTAL COST	COST ESTIMATES (\$1,000)				
						FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
Need 4: Monitor populations										
2	271	Establish permanent monitoring plots, photopoints, and sampling techniques	3	FWS-ES	1.5	0.5	0.5	0.5		
				FWS-REF	1.5	0.5	0.5	0.5		
				BLM	1.5	0.5	0.5	0.5		
				CORPS	1.5	0.5	0.5	0.5		
				ODA	1.5	0.5	0.5	0.5		
				LANECO	1.5	0.5	0.5	0.5		
				BENTONCO	1.5	0.5	0.5	0.5		
				TNC	1.5	0.5	0.5	0.5		
ODOT	1.5	0.5	0.5	0.5						
2	272	Conduct periodic monitoring	Cont.	FWS-ES	12	1	1	1	1	1
				FWS-REF	12	1	1	1	1	1
				BLM	12	1	1	1	1	1
				CORPS	12	1	1	1	1	1
				ODA	12	1	1	1	1	1
				LANECO	12	1	1	1	1	1
				BENTONCO	12	1	1	1	1	1
				TNC	12	1	1	1	1	1
ODOT	12	1	1	1	1	1				
2	273	Conduct demographic studies	10	FWS-ES	10	1	1	1	1	1
				BLM	10	1	1	1	1	1
				ODA	10	1	1	1	1	1
Subtotal needs 4:					151.5	16.5	16.5	16.5	12	12
Total Costs					763.5	124.5	123.5	147	112.5	81

**Codes used in implementation schedule**

Continual = Task will be implemented on an annual basis once it is begun.

Ongoing = Task is currently being implemented and will continue until action is no longer necessary for recovery.

\* = Lead Agency

Total Cost = projected cost of task from task start to task completion.

Responsible Parties:

BENTONCO = Benton County, Oregon

BLM = Bureau of Land Management

CORPS = Army Corps of Engineers

FWS-ES = Fish and Wildlife Service Division of Ecological Services

FWS-REF = Fish and Wildlife Service Division of Refuges

LANECO = Lane County, Oregon

ODA = Oregon Department of Agriculture

ODOT = Oregon Department of Transportation

TNC = The Nature Conservancy Oregon Chapter

**Appendix Table 1: Agencies/Individuals contacted during review for Bradshaw's Lomatium Recovery Plan.**

**AGENCIES**

**Chief of Engineers, U.S. Army Corps of Engineers, Attn: CECS,  
Washington, D.C. 20314-1000**

**\*Fern Ridge Lake, Army Corps of Engineers, 26275 Clearlake Road,  
Junction City, Oregon 97448**

**Corps of Engineers, Dexter Dam, Lowell, Oregon 97452**

**Bureau of Land Management, 1849 C Street, MS. Room 5600,  
Washington, D.C. 20240**

**\*State Office, Bureau of Land Management, 1300 NE 44th Avenue, P.O.  
Box 2965, Portland, Oregon 97208**

**\*District Manager, Bureau of Land Management, P.O. Box 10226,  
Eugene, Oregon 97440**

**Salem District Manager, Bureau of Land Management, 1717 Fabry Road  
SE, Salem, Oregon 97306**

**U.S. Fish and Wildlife Service, Division of Endangered Species, (M.S. 452  
ARLSQ), 1849 C Street, NW, Washington, D.C. 20240**

**U.S. Fish and Wildlife Service, Office of Research Support, (RD-  
8/ORS, M.S. 725 ARLSQ), 1849 C Street, NW, Washington,  
D.C. 20240**

**U.S. Fish and Wildlife Service, Office of Public Affairs, (PA 3447 MIB),  
1849 C Street, NW, Washington, D.C. 20240**

**U.S. Fish and Wildlife Service, Division of Refuges, (M.S. 670 ARLSQ),  
1849 C Street, NW, Washington, D.C. 20240**

**\*U.S. Fish and Wildlife Service, Ecological Services, 911 NE 11th Avenue,  
Portland, Oregon 97232-4181**

**U.S. Fish and Wildlife Service, Division of Refuges, 911 NE 11th Avenue,  
Portland, Oregon 97232-4181**

**\*U.S. Fish and Wildlife Service, Oregon State Office, 2600 SE 98th  
Avenue, Portland, Oregon 97266**

**U.S. Fish and Wildlife Service, Finley National Wildlife Refuge, 26208  
Finley Refuge Road, Corvallis, Oregon 97333**

**Environmental Protection Agency, Hazard Evaluation Division - EEB  
(TS769C), 401 M Street, SW, Washington, D.C. 20460**

**\*Oregon Department of Agriculture, 635 Capital Street NE, Salem,  
Oregon 97310-0110**

**\*Oregon Department of Transportation, 135 Transportation Building,  
Salem, Oregon 97301**

**Benton County Board of Commissioners, 180 SW 5th Street, Corvallis,  
Oregon 97330**

**Lane County department of Health and Environment, 125 E. 8th Avenue,  
Eugene, Oregon 97401**

**\*Lane County Parks, 3040 N. Delta Highway, Eugene, Oregon 97401**

**Linn County Board of Commissioners, P.O. Box 100, Albany, Oregon  
97321**

**Marion County Board of Commissioners, 100 High St., NE, Salem,  
Oregon 97301**

**Arnold Arboretum, 123 Arborway, Jamaica Plain, Massachusetts 02130**

**\*Berry Botanic Garden, 11505 SW Summerville Avenue, Portland, Oregon  
97219**

**President, Oregon Native Plant Society, 699 W. 2nd Street, Primville,  
Oregon 97734**

**Oregon Natural Resources Council , 1161 Lincoln, Eugene, Oregon 97401**

**\*Oregon Natural Heritage Program, The Nature Conservancy, 1234 NW  
25th Avenue, Portland, Oregon 97210**

## **INDIVIDUALS**

**\*Ed Alvorson, Eugene Public Works, 858 Pearl, Eugene, Oregon 97401**

**Kathy Connelly, Rangeland Resources, Oregon State University, 4699  
Satter Dr., NE, Salem, Oregon 97305**

**\*Jenny Dimling, 1575 Washington, Eugene, Oregon 97402**

**Kate Dwire, 33787 SE White Oak Road, Corvallis, Oregon 97330**

**Dr. Robert Frenkel, Department of Geography, Oregon State University,  
Corvallis, Oregon 97331**

**Christie Galen, 434 NW Sixth, Portland, Oregon 97209**

**Dr. Boone Kauffman, Department of Range Land Resources, Oregon  
State University, Corvallis, Oregon 97331**

**John Koenig, JK Consulting, P.O. Box 10774, Eugene, Oregon**

**\*Rhoda Love, 393 Fulvue, Eugene, Oregon 97405**

**Bruce Newhouse, 2525 Potter, Eugene, Oregon 97403**

**Ethan Perkins, 2586 Potter, Eugene, Oregon 97405**

**\*Dr. Thomas Pringle, P.O. Box 3429, Eugene, Oregon 97403**

**Peggy Robinson, 2090 Harbor Dr., Spring, Oregon 97477**

**Charlene Simpson, 1992 Lake Isle, Eugene, Oregon 97401**

**Pete Sorenson, Sorenson and Atkins, 474 Willamette #303, Eugene,  
Oregon 97401**

**Dan Stotter, Stotter & Lee, 2408 Harris, Eugene, Oregon 97405**

**Dave Wagner, University of Oregon Herbarium, Eugene, Oregon 97403**

**Dr. Mark Wilson, Department of Botany, Oregon State University,  
Corvallis, Oregon 97331**

**Peter Zika, 4230 NW Clubhouse Pl. #1, Corvallis, Oregon**

**\* = Comments Received**