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HABITAT CONSERVATION ASSESSMENT AND CONSERVATION STRATEGY THE LEMHI PENSTEMON *Penstemon lemhiensis*

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HABITAT CONSERVATION ASSESSMENT AND CONSERVATION STRATEGY THE LEMHI PENSTEMON *Penstemon lemhiensis*

1. Introduction and Objectives

Introduction and ObjectivesIntroduction and Objectives

This document is a combined Habitat Conservation Assessment (HCA) and Conservation Strategy (CS) for the Lemhi penstemon (*Penstemon lemhiensis*). This species is considered a "species of concern" by the U.S. Fish and Wildlife Service (FWS) based on the recent introduction of a new classification system for candidate species (USDI 1996). Under the previous FWS classification, the Lemhi penstemon was considered a C2 candidate for listing as threatened (USDI 1993).

The HCA provides detailed information on the taxonomy, distribution, ecology, and threats related to *Penstemon lemhiensis*. This information forms the basis for the development of a Conservation Strategy, which outlines specific recommended conservation activities and monitoring.

This range-wide Conservation Strategy is designed to provide recommended management guidelines for the next five years (FY1997-2002), providing for the identification of conservation measures adequate to maintain the species over its range, the release of some population areas to other multiple uses, and the specification of studies and research that are recommended in the intervening period in order to develop a more effective revised strategy in 2002. The strategy covers only populations administered by the U.S. Forest Service (USFS) or Bureau of Land Management (BLM) in Montana and Idaho (approximately 80% of the known populations). National Forests involved in Montana are the Deerlodge, Bitterrroot, and Beaverhead NFs. In Idaho, populations of *P. lemhiensis* are administered by the Salmon and Challis NFs, combined administratively into a single unit, and hereafter referred to as the Salmon NF. Bureau of Land Management lands are administered by the Lemhi Resource Area in Idaho and the Butte District in Montana.

The species is known from a total of 171 populations, 94 found in Idaho and 77 in Montana. Many are represented by 10 or less individuals, and many populations (approximately 70%) occur on road-side sites vulnerable to impacts from road maintenance, weed control, and mining activities. Populations in native habitat are threatened by livestock and native ungulate grazing, knapweed invasion, and successional processes occurring in the absence of fire. Most monitored populations have shown an acute downward trend since 1989, the largest a 95% decline. The small total number of individuals, the threats from a number of

common public and forest land management activities, and the measured decline combine to create significant conservation concern for *P. lemhiensis*.

Because it is distributed widely across the landscape in so many populations and because it occurs so often along roads, *P. lemhiensis* often creates management conflicts with other uses of federal lands. Significant agency resources are spent in ameliorating or eliminating these conflicts, which may involve populations of just a few plants. These resources could be more effectively spent in proactive management of the few large populations of *P. lemhiensis* that occur in native habitat.

Actions outlined under this Conservation Strategy find authority in the Endangered Species Act (ESA), the National Forest Management Act (NFMA), the Federal Land Policy and Management Act (FLPMA) and USFS and BLM policy. Forest Service lands are managed to maintain viable populations of all native plant and animal species. A viable population is one that has the estimated numbers and population structure, including reproductive individuals, to ensure the continued existence of the species throughout its existing range within a given area (Forest Service Manual FSM 2670.5.22). Similarly, BLM lands are managed "in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental...values" (FLPMA 102 (a)).

In addition to those species federally recognized as threatened or endangered under the Endangered Species Act, or by FWS as Species of Concern (formerly Candidate species), the Forest Service and the BLM have recognized the need to implement special management for other rare species on the lands they administer. Such species are designated as "Sensitive" by the Regional Forester (USFS) or the State Director (BLM). The objectives of management for such species are to ensure their continued viability throughout their range on NF and BLM lands, and to ensure that they do not become threatened or endangered because of agency actions (FSM 2670 and BLM Manual 6840). Species designated by FWS as Species of Concern are generally managed as Sensitive species by both agencies. Three management goals are identified in agency manuals and directives: 1) monitor and inventory species to provide information needed for management and to support or reject listing; 2) manage species to ensure continued viability or recovery throughout their range on agency lands; and 3) modify or abandon agency actions that may result in the need to list a candidate species as threatened or endangered (FSM 2670 and BLM 6840).

Objectives for this Conservation Strategy are to:

1) Identify populations that are critical to the maintenance of the species throughout its range.

2) Develop specific recommendations for management objectives, management actions and monitoring for these populations.

3) Stratify remaining populations by importance and recommend management activities and monitoring for each group.
4) Identify populations that are of low conservation value.
5) Specify information gaps and the studies and activities needed to fill them.

2. Taxonomy and morphology

Taxonomy and morphologyTaxonomy and morphology

1. Taxonomy

TaxonomyTaxonomy

***Penstemon lemhiensis* was originally considered a subspecies of the widespread species, *P. speciosus*, based on a few collections from Lemhi County, Idaho (Keck 1940). Based on additional collections in Montana in the late 1940s, *P. speciosus* ssp. *lemhiensis* was elevated to the species level (Keck and Cronquist 1957).**

***Penstemon lemhiensis* is one of about 250 species in the genus, most of which occur in the western United States (Cronquist et al. 1984). Within the genus, *P. lemhiensis* belongs to the subgenus Habroanthus, section Glabri, series Speciosi (Keck 1940 and 1957).**

2. General Non-technical Description

General Non-technical DescriptionGeneral Non-technical Description

***Penstemon lemhiensis* is a robust non-rhizomatous perennial plant. Plants have clusters of one to several rosettes arising from a base branched just below the ground surface. Some rosettes give rise to unbranched flowering stems 15-30" tall. Striking dark sky blue flowers are borne in a single spike up to 12" long. Flowers are tubular, flaring gradually to the mouth, with two lips on top and three on the bottom. Each flower can be up to 1.5" long. Flowers contain five stamens, four of which are fertile, and one of which is sterile (the staminode). In many species of *Penstemon*, the staminode is hairy (bearded), from which comes one of the common names in the genus - "beardtongue." In *Penstemon lemhiensis*, the staminode lacks hairs. Sepals are up to 0.5" long, with about half the length a long narrow tip, occasionally with a few irregular teeth. Stem leaves are untoothed, opposite on the stem, and clasping to sessile at the base. Basal leaves have petioles. Leaves either lack hairs, or have only short inconspicuous ones, most visible along the margins. *Penstemon lemhiensis* is illustrated in Appendix VIII, Figure 1.**

The large size, entire leaves, and large conspicuous blue flowers distinguish this *Penstemon* from many of the other *Penstemon* species found in the region (*P. albertinus, P. globosus, P. aridus, P. attenuatus, P. eriantherus, P. diphyllus, P. montanus, P. fruticosus, P. deustus, rydbergii, P. procerus, P. humilis, P. radicosus, P. pumilus, P. acuminatus,* and *P. palmeri,* which is planted, and

sometimes naturalized in east-central Idaho and adjacent Montana). To separate *Penstemon lemhiensis* from closely related species (*P. payettensis* and *P. cyaneus*, which occur within the range of *P. lemhiensis*, and *P. speciosus* and *P. pennellianus*, which do not), the key distinctive characteristics are the hairless staminode and the long-tipped sepals. These and other differentiations are described in more detail below in Section D.

3. Technical Description

Technical DescriptionTechnical Description

General: perennial herb, 3-7dm tall, with 1-several stout stems from a branched caudex. Leaves: often finely hirtellous-puberulent, but sometimes glabrous or merely cinereous along the margins; margins entire; basal leaves clustered, 3-20cm long and 1-2.5cm wide, petiolate; blade oblanceolate to narrowly elliptic; cauline leaves sessile, opposite, lanceolate, 2-12cm long and 0.5-2cm wide, generally becoming progressively smaller above. Inflorescence: glabrous; verticillasters 3 to many, more or less secund. Flowers: calyx 7-11mm long, segments lanceolate to narrowly ovate, evidently but not strongly scarious-margined below, tapering to a long acuminate or subcaudate tip about as long as the body; corolla bright blue to purplish, 40-55mm long, about 1.5mm wide at the mouth; pollen sacs 1-3mm long, divaricate and sometimes sigmoidally twisted, evidently dentate-ciliolate along the sutures, pubescent near the connective and on side opposite the dehiscence; staminode glabrous. Fruits: capsules 10-15mm long; seeds 2-3mm long. (Description compiled from Keck 1940; Hitchcock et al. 1959; Dorn 1984).

4. Notes on Morphology, Biogeography, Phylogenetic History and Hybridizations

Notes on Morphology, Biogeography, Phylogenetic History and HybridizationsNotes on Morphology, Biogeography, Phylogenetic History and Hybridizations

Cronquist (in Hitchcock et al. 1959) considered *P. lemhiensis* to be part of a geographic replacement series of closely related, but "technically well-marked," species that include *P. speciosus, P. payettensis, P. cyaneus* and *P. pennellianus* (Table 1). These are all members of the *Penstemon* Section Glabri, which as a group includes common perennials found throughout the Intermountain West (Meyer and Kitchen 1994). The four related species are illustrated in Appendix VIII, Figure 2.

***Penstemon lemhiensis* is found in Montana from just south of Darby, east to Butte, and south to Dillon -- in the Bitterroot, Highland, and Pioneer Mountains. In Idaho, it is found along the Continental Divide from Leadore north to Lost Trail Pass, west to Horse Creek Pass in the Bitterroot Mountains and south along the Salmon River Range approximately to Williams Creek. It is absent from the Lemhi Mountains. Map 1 (Appendix VIII) illustrates the distribution of *P. lemhiensis* in Idaho and Montana.**

***Penstemon payettensis* is found in central Idaho, from the Salmon River axis south to the Snake River Plains, and west across central Idaho to the Wallowa Mountains of northeast Oregon. The range of *P. payettensis* overlaps that of *Penstemon lemhiensis* in the Salmon River Range along the southwest border of the range of *P. lemhiensis*. *Penstemon cyaneus* is found in the upper Snake River Plains (Bingham, Butte and Elmore counties, Idaho), east to Park County (Wyoming) and Madison County (Montana) and north into Lemhi and Custer counties (Idaho). It is the large *Penstemon* found in the Lemhi Range, and overlaps into the southernmost portion of the range of *P. lemhiensis* in Idaho. *Penstemon speciosus* is the most widespread, occurring from the east side of the Cascades in Washington, south through eastern Oregon to northern California, and east through Nevada to northeast Utah. In Idaho, it is known only from the west side of the state south of the Snake River Plains, and is not known from Montana (Dorn 1984). *Penstemon pennellianus* is found in the Blue Mountains of Oregon and Washington (Wallowa county, Oregon, and Osotin, Columbia, and Garfield counties, Washington). It does not occur in Montana or Idaho.**

Contrary to Keck and Cronquist's (1957) assertion that all of these species are geographically isolated, the ranges of *P. lemhiensis, P. payettensis* and *P. cyaneus* overlap slightly. At the southwestern edge of the range of *P. lemhiensis*, and in the Lemhi Mountains, some populations combine characters of these three species, suggesting that hybridization may occur. Areas containing populations that seem to combine characters are illustrated in Map 2 (Appendix VIII). The most commonly combined characters are leaf shape, sepal shape, and hairiness or glabrosity of the staminode (Table 1).

***Penstemon lemhiensis* may be fairly recently evolved. One hypothesis is that these closely related species are the product of adaptive radiation from a single more widespread parent (perhaps *P. speciosus*). Alternatively, *Penstemon lemhiensis* may be the product of hybridization. Keck (1940) and Watson (1976) suggested that it arose via hybridization between *P. cyaneus* and *P. speciosus*, followed by segregation and isolation. The highly variable habitat occupied by *P. lemhiensis* suggests a hybrid species; such species are often able to inhabit a wider range of conditions than the parental species. Hybridization is a common speciation mechanism in *Penstemon* generally (Clark 1971).**

5. Collections

CollectionsCollections

***Penstemon lemhiensis* was first collected in 1920 in Lemhi County by E.B. and L.B. Payson (1975, ID). Additional collections were made by R.F. Blair in 1936, 1937, and 1938 (Keck 1940) and in 1946 by Hitchcock and Muhlick (14335, NY). On the basis of the Blair collections, Keck (1940) described *P. speciosus* ssp. *lemhiensis*. The type collection is from Granite Mountain (Blair s.n., Stanford**

University). The first collection in Montana was made in 1947 by F.H. Rose, in Beaverhead County "west of Big Hole Battlefield National Monument" (Rose 3502, MONTU). The first Ravalli County collection was made by T.G. and V.C. McCall in 1950 (McCall 352, MONTU, between Conner and Sula). Field surveys throughout the range of the species in the 1970s through 1990s resulted in further collections from numerous additional stations (see Appendix X and XII for a complete record of all known populations).

Table 1. Technical characteristics of *P. cyaneus, P. lemhiensis, P. payettensis, P. pennellianus* and *P. speciosus* (based on Hitchcock et al. 1959). Leaf and calyx shape and hairiness of the staminode are the characters most commonly combined in potentially hybridizing populations.

Species	Vegetative Characteristics	Calyx	Corolla and Anthers	Staminode
Penstemon cyaneus	Basal leaves up to 16cm long and 2.5cm wide; blade petiolate, oblanceolate to narrowly elliptic; cauline leaves up to 11cm long and 3cm wide; glabrous to glaucous	4-7mm long, segments broad, with erose-scarious margins, inconspicuously or scarcely pointed	Corolla 25-35mm long, 1cm wide at mouth; pollen sacs 1.8-3.0mm long, divaricate, sigmoidally twisted downward, ciliolate along sutures and hispidulous on surface, proximal portion indehiscent	Sparsely to moderately short-bearded
Penstemon lemhiensis	Leaves similar to *P. cyaneus*, averaging a little narrower; often finely hirtellous - puberulent	7-11mm long, segments lanceolate to narrowly ovate, evidently but not strongly scarious-margined below, tapering to a long acuminate or subcaudate tip	Similar to *P. cyaneus*; a single specimen with glabrous anthers	Glabrous
Penstemon payettensis	Basal leaves up to 15cm long and 5cm wide, petiolate, oblanceolate to broadly ovate; cauline leaves sessile, lance-ovate to ovate, clasping, 1.5-4cm wide; glabrous	5-8mm, scarcely to evidently scarious-margined, with a more or less elongate, acuminate to subcaudate tip	Corolla 18-28mm, 1cm wide at the mouth; pollen sacs 1.1-1.9mm long, oppositely divaricate, straight, setulose-dentate along the sutures	Short-bearded
Penstemon pennellianus	Basal leaves up to 27cm long and 4cm wide, petiolate, oblanceolate to narrowly elliptic; cauline leaves sessile, broad and clasping; 6-9cm long and 2.5-4cm wide (2-3x as long as wide), glabrous	6-9mm, scarious-margined, with an acuminate tip	Corolla 26-33mm long, 1cm wide at the mouth; pollen sacs 1.9-2.5mm long, oppositely divaricate, sigmoidally twisted, setose-dentate along sutures and hispidulous on surface toward the indehiscent proximal end	Short-bearded

Penstemon speciosus	Basal leaves to 9cm long and 2cm wide, petiolate, lanceolate to ovate; cauline leaves sessile, lanceolate, subcordate, 3.5-7cm long and 0.3-1.2cm wide; glabrous to puberulent	6-10mm, segments lanceolate to ovate, tips acuminate to acute; margins scarious and erose	Corolla 25-32mm long, 1cm wide at the mouth; pollen sacs 2-3mm long, oppositely divaricate and sigmoidally twisted; setulose-dentate along the sutures, glabrous to sparsely hairy	Glabrous to short-bearded

From these characters, the following short key provides for the separation of the two species similar to and occurring within the range of *P. lemhiensis* (adapted from Hitchcock et al. 1959, Dorn 1984 and Keck and Cronquist 1957).

Key to Similar Plants within the Range of *Penstemon lemhiensis*

1. Pollen sacs 1.1-1.9mm, straight or arcuate, becoming opposite or upwardly divaricate after dehiscence, glabrous except along the sutures, sometimes obscurely short-hairy toward the connective, wholly dehiscent; corolla 18-28mm.....*Penstemon payettensis*

1. Pollen sacs 1.8-3.0mm, sigmoidally twisted, downwardly divaricate (sometimes opposite in *P. cyaneus*); proximal portions remaining indehiscent; corolla 25-38mm

2. Calyx 4-7mm, the segments very broad and with prominently erose-scarious margins, inconspicuously or scarcely pointed; staminode bearded...*Penstemon cyaneus*

2. Calyx 7-11mm, segments long-acuminate or subcaudate, less prominently scarious, staminode glabrous.....*Penstemon lemhiensis*

Note that this key will not perform well on the southwestern edge of the range of Penstemon lemhiensis where apparent hybridization and blurring of characters occurs. Map 2 (Appendix VIII) illustrates areas in Idaho where problematic populations have been observed.

3. Status

StatusStatus

1. Status

StatusStatus

***Penstemon lemhiensis* is currently considered a Species of Concern by the U.S. Fish and Wildlife Service (FWS) under new regulations that reclassify Category 2 Candidates (USDI 1996; Lanier 1995). Through 1995, the species was classified as a Category 2 Candidate (C2) for listing as threatened by the FWS (USDI 1993). Category 2 taxa were those "for which information now in possession of the Service indicates that proposing to list them as threatened or endangered is possibly appropriate, but for which substantial data on biological vulnerability and threat(s) are not currently known," a description which well matches the current knowledge of *P. lemhiensis*.**

The species was originally included in the "notice of consideration" by the FWS in 1975 (USDI 1975), and formally placed in Category 1 in 1980 (USDI 1980). It was placed in Category 2 in 1983 and was retained as a C2 species until 1995 when it was reclassified as a "species of concern" (USDI 1983, 1985, 1990, 1993, 1995).

The U.S. Forest Service currently includes *P. lemhiensis* on its lists of sensitive species for Region 1 and Region 4 (USDA Forest Service 1994; Lanier 1995). The Idaho Bureau of Land Management lists Lemhi Penstemon as a State Sensitive species (Rosentreter personal communication).

The species is listed as "imperiled in Montana," a state rank of S2, by the Montana Natural Heritage Program. It has been given the same listing in Idaho. Henderson (1981) and the Montana Rare Plant Project (Lesica et al 1984) recommended that the species be given federal "threatened" status. *Penstemon lemhiensis* was also unofficially designated as "threatened" by Lesica and Shelly (1991).

2. Distribution, Ownership and Population Size

Distribution, Ownership and Population SizeDistribution, Ownership and Population Size

A total of 94 populations have been recorded in Idaho, and 77 in Montana (Appendix I, Table 1). Populations vary in size from a single individual to several thousand. Table 2 summarizes populations by size class and ownership. (For a list of all known populations sorted by ownership, see Appendix I, Table 2). Populations are evaluated by population size class rather than by actual numbers for two reasons. One is that counts are unreliable, especially for populations of more than 30 individuals or for sparse populations in native habitat. Comparison of measured population numbers (using sample plots to conduct counts) to estimations clearly show that underestimates of population size by ocular estimation are the norm. Using classes buffers these estimation errors such that populations are likely misclassed by at most one class. The second reason is that populations fluctuate dramatically over time, thus counts made in the late 1980s are not really comparable to those made in the mid 1990s. Size classes also help to buffer these changes. Biologically, it can probably be assumed that populations in size classes 1, 2 or 3 (<50 individuals) have high potential for extirpation due to a number of size-related factors, compared to populations in the larger classes. Populations in size class 6 are orders of magnitude larger, and represent true "large" populations that are assumed to be at a lower risk of extirpation.

The number of populations is also approximate. It should be remembered in comparing populations that some clusters that are within a mile or less of each other are recorded as a single "element occurrence" by the Montana Natural Heritage Program (MNHP) and the Idaho Conservation Data Center (ICDC), while

other similarly spaced population areas are identified as several occurrences. Many of the populations currently identified as separate occurrences may be shown with additional survey work to be part of a continuous, but at times sparse, population. Since it is uncertain how far the main pollinator travels, and thus which populations can be considered interbreeding (and thus "populations" in the technical sense), most documented *P. lemhiensis* occurrences should probably be considered "locations" rather than true biological "populations" (although the term "population" will be used interchangeably with "occurrence" throughout this Conservation Strategy).

With these caveats, Table 2 shows that over 50% of the populations are in size class 1 or 2; approximately 69% are in class 3 or less (less than 50 individuals). Only three out of 171 populations have been recorded as consisting of over 300 to "thousands" of individuals.

Table 2 also summarizes the ownership distribution among Forest Service, BLM, National Park Service, state and private entities. Lemhi Penstemon is found on four U.S. National Forests (Salmon NF in Idaho; Beaverhead, Bitterroot and Deerlodge NFs in Montana), two BLM Districts (Salmon District in Idaho and Butte District in Montana) and on National Park lands (Big Hole Battlefield National Monument). Map 1 (Appendix VIII) illustrates the distribution of Lemhi Penstemon. Of known populations, about 8% are found on private lands in Montana and another 10% occur within the boundaries of the Salmon NF, but may occur on small parcels of private land (patented mining claims) within the Forest. (These are termed "Salmon NF and/or private" in the summary tables.) The Salmon NF has the largest percentage of populations on federally owned land (51%), but over 75% of these would be classed as "small" populations (population size class 3 or less).

Populations are distributed throughout the Salmon NF in the Salmon River Mountains between Panther Creek and the Salmon River, and north of the Salmon River downstream from the confluence with the North Fork on the southern flank of the Bitterroot Range. Populations are also known from tributaries of the North Fork, south of Gibbonsville, Idaho. Four populations occur on the Salmon NF in a cluster near Bannock Pass nearly 50 miles from the main distribution on the Salmon NF. The nearest known population to these is on the Salmon BLM, about 15 miles north. No populations are known from Challis NF portion of the lands administered by the Salmon NF.

Table 2. *Penstemon lemhiensis* populations classed by size class and ownership. Size classes are as follows: 1= <10 individuals, 2= 10-29, 3=30-49 4= 50-99, 5=100-300, 6=>300.*

			Size Class					
Ownership/Administration	Total	Percent	1	2	3	4	5	6

Beaverhead NF	22	13.0	4	7	4	5	2	0
Bitterroot NF	23	13.6	5	7	4	5	2	0
Deerlodge NF	1	0.6	0	0	0	0	0	1
Salmon NF	70	41.4	15	27	10	5	12	1
National Park Service	1	0.6	0	0	0	0	0	1
BLM Butte District	15	8.9	5	4	1	3	2	0
BLM Salmon District**	5	3.0	0	1	2	1	1	0
State of Idaho	1	0.6	1	0	0	0	0	0
Salmon NF and/or private	17	10.1	7	7	1	1	1	0
Private (MT)	14	8.3	2	1	1	5	5	0
Total	169	100.0	39	54	23	25	25	3
Percent in each size class			23.1	32	13.6	14.8	14.8	1.78

* occurrences ID009 and the Montana record (MT021) from "west of the Battlefield" (Appendix I) are excluded. ** Includes one population (ID001) shared with the Salmon NF.

In Idaho, the remaining populations are on BLM (Salmon District) and Idaho State lands (one population near Bannock Pass). BLM populations are widely distributed along the southwest flank of the Beaverhead Range (tributaries to the Lemhi River). All records of *P. lemhiensis* populations on the east side of the Lemhi Range appear to be *P. cyaneus* or possibly hybrids (see Appendix I).

The Beaverhead NF administers 22 populations (Table 2), seven of which are classified as "large" (class 4-6). The distributional range of these populations is the periphery of the Pioneer Range on all four sides, the southeast flank of the Anaconda-Pintlar Range, and the east side of the Beaverhead and Bitterroot Ranges (east of the Continental Divide). The wide distribution of populations suggests the need for additional survey work.

The Bitterroot NF has 23 known populations. All of these are found south of Darby, Montana. Several are found at low elevations near the confluence of the West Fork and the East Fork of the Bitterroot. Another population cluster is found in several headwater tributaries of the West Fork. These are within a few miles of populations known from Idaho (Spring Creek drainage).

The population on the Deerlodge NF is from a recently discovered cluster in the Butte Highlands, all within a square mile, and thus considered a single occurrence. This occurrence is unusual in that it occurs in fairly high elevation openings in limber and lodgepole pine on limestone soils. It also represents the eastern extent of the species.

Butte BLM administers 15 populations, most of which are fairly small. Populations are clustered in the Bloody Dick drainage and in the historic mining area north of Bannock, Montana. Two fairly large populations are found on isolated tracts of BLM lands about 15 miles north of Wisdom, Montana, on breaks associated with the Big Hole River.

The National Park Service at the Big Hole Battlefield National Monument administers one of the largest populations of *Penstemon lemhiensis* known. This site is especially

important for conservation management of *Penstemon lemhiensis* because of its size, its protected status, and the good condition of the habitat (Ramstetter 1983). The population is not, however, addressed in this strategy.

3. Adequacy of Inventory

Adequacy of InventoryAdequacy of Inventory

Lemhi penstemon, especially when in flower, is easily spotted from a moving vehicle, and thus more than 86% of the known population locations are along roadsides (Table 3). Plants lacking flowers, however, are easily overlooked. When project-level inventories are conducted in an area known to contain populations, additional population areas are usually found. Crofts (1990) located approximately 16 new populations in an area that had been previously surveyed when he inventoried the area as part of an EIS for the Beartrack Mine above Salmon, Idaho (note that number of populations is always approximate, since some surveyors combine proximal populations together while others label them as separate occurrences). On the Bitterroot NF, surveys in 1993 and 1994 in potential burn units of an ecosystem management project located several new occurrences in native habitat in a drainage where a road-side population was found in 1989 (Pietarinen, personal communication).

Table 3. Summary of populations located, classed by year first observed and visibility from a roadway.

	Visibility					Total	
	Not visible		Visible from road		Unknown		
First Observation Date	Idaho	Montana	Idaho	Montana	Montana	Idaho	Montana
1920-1969	0	0	5	2	1	5	3
1970-1979	0	0	7	4	0	7	4
1980-1989	1	3*	44**	25***	2	46	30
1990-1995	4	10	33	29	1	38	40
total	5	13	89	60	4	96	77

*** all located in 1988 and 1989 ** 36 of these located in 1988 and 1989 ***14 of these located in 1988 and 1989**

By the beginning of 1980, only 19 populations were known from the two states (Table 3). Even as late as 1987, only 40 populations were known. Focused inventory work in the late 1980s and early 1990s resulted in the location of more than 130 new populations. The majority, however, of known populations (approximately 78% in Montana and 94% in Idaho) are found along roads that are accessible by vehicles. Most of these road-side populations are along roads that are fairly well-travelled, accessible by two-wheel drive

vehicle. These data suggest that additional inventory along less accessible roads and in unroaded habitat will likely yield additional locations. The distribution of populations (Map 1, Appendix VIII) also suggests that additional populations occur between known ones.

Some areas are known to be poorly inventoried. The Frank Church River of No Return Wilderness and the Anaconda-Pintlar Wilderness have not yet been inventoried, and have the potential to yield new populations that are protected from many of the common threats to *P. lemhiensis*.

4. Research and Monitoring

Research and MonitoringResearch and Monitoring

This section summaries research and monitoring methodology used in three studes of *P. lemhiensis*. The results from these studies are referenced throughout the remaining sections of the strategy.

1. Ramstetter 1983

Ramstetter 1983Ramstetter 1983

Ramstetter studied *P. lemhiensis* in Montana as a Master's research project at the University of Montana, Missoula. Her primary research site was the Big Hole National Battlefield in Montana, but she also studied populations at Argenta, Lemhi Pass, and Badger Pass in Montana and Colson Creek and Bannock Pass in Idaho. Her research included characterization of the habitat, correlation of *P. lemhiensis* density with vegetation cover, measurement of herbivory, and study of the pollination system and seed germination.

Habitat characterization involved measurement of physical parameters such as slope and aspect, classification and qualitative description of soils, and measure of vegetation in two transects, one with ten $1m^2$ plots and a second with twenty plots. Vegetation was estimated into 5 cover classes. An additional 20 plots were sampled in an area that did not contain *P. lemhiensis*.

Seed germination was studied using 250 seeds divided among five treatments: room temperature, scarified, cold treated, scarified and cold treated, and treatment with gibberellic acid. Pollination studies involved observations of pollinators and five treatments of inflorescences: 1) anthers removed; 2) pollinators excluded by mesh bags and plants cross-pollinated by hand; 3) pollinators excluded and flowers self-pollinated by hand; 4) stigmas removed; and 5) control. Twelve inflorescences were assigned to each treatment, but sample size generally declined by the end of the experiment due to deer browsing.

2. Montana Forest Service and BLM Monitoring

Montana Forest Service and BLM MonitoringMontana Forest Service and BLM Monitoring

Monitoring was initiated at three Forest Service sites in Montana in 1989: French Creek Discovery Mine, French Creek Park Mine and Badger Pass North. On BLM lands, monitoring was initiated at the Badger Pass Microwave site in 1990 and the Horse Prairie Guard Station site in 1991. At the Forest Service sites, methodology generally followed Lesica (1987) in which 1m² plots placed next to each other along a transect are used to map plants by a coordinate system. At the Badger Pass Microwave site, 44 plants were monumented with rebar, and their locations mapped using azimuth and distances. This was supplemented in 1991 with three short transects similar to the Forest Service transects, which included some of the marked plants within the plots. A similar transect was established on the roadcut population at Horse Prairie, but because the population was so small in 1991, the transect was only 5 plots long.

Each plant was mapped as seedling, small rosette or larger rosette (see Achuff 1992 and Shelly 1990b for details). Reproductive output was measured for each reproductive plant by counting the number of inflorescences produced and the number of fruits produced. Aborted flowers and browsed stems were also counted for each individual. A summary of the results is presented in tabular form in Appendix II, and the results are referenced throughout this strategy.

3. Idaho Forest Service and BLM Monitoring

Idaho Forest Service and BLM MonitoringIdaho Forest Service and BLM Monitoring

Monitoring was initiated at two BLM sites in 1989 and continued through 1992. Plants were mapped using a coordinate system created by a permanent baseline and the measure of distance along and from (perpendicular to) the baseline. Plants were noted by reproductive status and number of inflorescences. Fruits were counted on each successful inflorescence, and the number of browsed and aborted inflorescences noted for each plant. Only plants greater than 3cm diameter were included. The methodology was designed to monitor the survivorship of individuals and population density. The size of the populations was small enough that a single baseline captured all of the population. A summary of results is presented in tabular form in Appendix III.

The Salmon Forest initiated monitoring on a ponderosa pine site scheduled for winter harvest to evaluate the effects of the harvest prescription (population ID090). Individual plants were monumented by stakes in the summer of 1993. Harvest occurred in the winter of 1996-97. The harvest prescription called for logging on snow and frozen ground but some of the area was logged during a winter thaw. Some portions of the area containing *P. lemhiensis* had substantial surface disturbance. The site will be remeasured in the summer of 1997 to evaluate survival of *P. lemhiensis*.

5. Autecology

AutecologyAutecology

1. Habitat

HabitatHabitat

1. General

GeneralGeneral

With an elevational range from 3200 to 8100 ft., *P. lemhiensis* can clearly occupy a range of sites. These elevational differences show no microsite pattern (such as drier and warmer aspects at higher elevations) or distributional pattern (higher sites at the southern edge of the range). Extreme elevational distributions are exhibited by populations located within the same drainage or within a few miles of each other. Slopes vary from 60% to nearly level, although most sites range from 10-30%. Aspect is generally south (southeast and southwest), but *P. lemhiensis* occurs on all aspects. Obviously, associated vegetation is also variable, ranging from ponderosa pine savannah along the lower Salmon River in Idaho to limber and lodgepole pine at some sites in Idaho and Montana. The most common habitat is mountain sagebrush/bluebunch wheatgrass openings in sparse Douglas-fir stands, but *P. lemhiensis* also occurs in sagebrush/grassland habitat (mostly mountain sagebrush sites). These types of habitats are widespread throughout the range of *P. lemhiensis*. Such lack of habitat specificity is unusual in a rare species, and makes prediction of habitat and focused range-wide inventory efforts difficult.

2. Soil

SoilSoil

Soils are derived from a number of parent materials including granitics, dolomite, limestone, and volcanics. Soil texture can be generally characterized as clay to sandy loams. A nearly constant feature of soils on all *P. lemhiensis* sites is a high percentage of coarse fragments ranging in size from 1cm to a few decimeters. Many sites have shallow soils, which results in natural slope slippage and low vegetative cover of associated species.

3. Community Types

Community TypesCommunity Types

A list of all associated species recorded during various studies of *P. lemhiensis* is presented in Appendix IV. Because of the variability in habitat, species associates are also variable, but three species are almost constant associates: *Agropyron spicatum, Artemisia tridentata* var. *vaseyana* and *Eriogonum umbellatum* (species nomenclature follows Hitchcock and Cronquist 1973, except for *Artemisia*, which follows Cronquist 1994). Based on field work conducted in 1994, published descriptions, and records in the Idaho Conservation Data Center and Montana Natural Heritage Program databases, seven common habitats or communities were delineated for Lemhi Penstemon. These correspond to types 1-7 listed on tables in Appendix I.

1. Deep-soil Rangeland (Type 1)

Deep-soil Rangeland (Type 1)Deep-soil Rangeland (Type 1)

Sites are sagebrush/grassland dominated by *Artemisia tridentata vaseyana, Agropyron spicatum,* and *Festuca idahoensis*. Soils are deep, usually sandy to clay loams, and often rocky or gravelly. Sites are usually benches or alluvial deposits. Slopes are often steep, creating the bare soil microsite inhabited by *Penstemon lemhiensis* through slope movement and erosion. Common associated species are *Balsamorhiza sagittata, Crepis modocensis, Sedum lanceolatum, Calochortus nuttallii, Eriogonum heracleoides, E. umbellatum, Potentilla glandulosa, Lupinus* spp., *Poa nevadensis, Stipa* spp., *Koeleria nitida, Castilleja pallescens,* and *Viola beckwithii.*

2. Shallow-soil Rangeland (Type 2)

Shallow-soil Rangeland (Type 2)Shallow-soil Rangeland (Type 2)

Sites are near or in rocky outcrops. Vegetative cover is low, but is usually dominated by *A. tridentata* var. *vaseyana* and *A. spicatum*. Soils are shallow with large coarse fragments or outcrops. Soil texture is clay to sandy loam. Slopes are moderate to gentle, the bare soil microsite created by shallow harsh soils rather than the steepness of the slope. Common associates are *Artemisia frigida, Achillea millefolium, Antennaria microphylla, Chrysothamnus viscidiflorus, Sedum lanceolatum, Phacelia linearis, P. heterophylla, Gilia aggregata, Eriogonum ovalifolium, Astragalus miser, Stipa comata,* and *Poa secunda.*

3. Deep-soil Douglas-fir Openings (Type 3)

Deep-soil Douglas-fir Openings (Type 3)Deep-soil Douglas-fir Openings (Type 3)

These sites are similar to Type 1 in vegetative structure but are found small openings in sparse Douglas-fir stands. Douglas-fir regeneration is common and sites may be lost to canopy closure. Often the occurrence of *P. lemhiensis* in these openings appears to be related to human disturbance such as old mining roads, skid trails, and mining pits. Vegetation is similar to Type 1 except for the addition of Douglas-fir and a few additional species such as *Heuchera grossulariifolia, Antennaria racemosa, Physocarpus malvaceus, Spiraea betulifolia,* and *Symphoricarpos* spp. Occasionally these sites may also contain some *Populus tremuloides,* especially if they are near the bottom of a slope.

4. Shallow-soil Douglas-fir Openings (Type 4)

Shallow-soil Douglas-fir Openings (Type 4)Shallow-soil Douglas-fir Openings (Type 4)

These sites are similar in vegetative structure to Type 2 but are found small openings in sparse Douglas-fir stands. Soils appear to be too shallow and hot to support Douglas-fir, and regenerating trees are rare in the openings. These sites occur from the Douglas-fir/sagebrush ecotone, up to the Douglas-fir/lodgepole ecotone, although occupied openings are rarely in pure lodgepole pine stands.

5. High Elevation Lodgepole/Limber Pine Openings (Type 5)

High Elevation Lodgepole/Limber Pine Openings (Type 5)High Elevation Lodgepole/Limber Pine Openings (Type 5)

These openings are usually in mixed forests of Douglas fir and lodgepole or limber pine. The type occurs at higher elevations compared to Type 4. Type 5 sites are found primarily in the Highlands near Butte and at the head of Echo Gulch in the Pioneer Mountains (MT011; 8100' elevation). It is rare on the Salmon NF. Soils are usually fairly shallow, carbonaceous, with a large coarse fragment. Vegetation is dominated by *A. tridentata* var. *vaseyana* and *A. spicatum*. Some unusual associated species on this type include *Pedicularis contorta* and *Townsendia parryi.*

6. Ponderosa Pine Savanna (Type 6)

Ponderosa Pine Savanna (Type 6)Ponderosa Pine Savanna (Type 6)

These sites are found at lower elevations on the Salmon NF along Panther Creek, the Salmon River, and the lower part of the North Fork of the Salmon River in Idaho, and at lower elevation sites in Ravalli County in Montana. Vegetation is open ponderosa pine with *A. spicatum* understory. *Purshia tridentata* is a common associate. Soils are fairly deep, usually sandy to loamy, and often lacking the coarse fragments common in the other site types. Sites along the Salmon River corridor and lower tributaries are currently being invaded by young ponderosa pine and Douglas-fir, possibly as a result of fire suppression (Moseley 1989). Knapweed is also common on these sites in both Idaho and Montana.

7. Alluvial Fans/Ponderosa Pine (Type 7)

Alluvial Fans/Ponderosa Pine (Type 7)Alluvial Fans/Ponderosa Pine (Type 7)

Vegetation and soils in this type are similar to Type 6, and this type may be considered simply a special topographic variant of Type 6. These sites occur on alluvial fans at the mouths of gulches associated with the Salmon River and Panther Creek. Low elevation sites in Ravalli County along the Bitterroot River may also be this type, but due to lack of information they were classified as Type 6. These sites are all heavily infested with knapweed.

4. Natural Disturbances

Natural DisturbancesNatural Disturbances

***Penstemon lemhiensis* appears to be a species dependent on small-scale disturbances in native sites. Native sites usually have shallow soils or fairly steep slopes which allow for natural slope movement due to frost action and erosion. Bare ground at most native sites ranges from 30-70% cover (Elzinga, 1994 observations).**

The apparent requirement of *P. lemhiensis* for some level of surface disturbance in its native habitat pre-adapts it to colonize man-made disturbed habitats such as road cuts and fills, although these habitats are usually occupied by small populations. Of populations found completely in roadcut and fill material (69 of the 171 total), over 70% have less than 30 individuals. Of the 115 populations that occur in the roadc cut or fill and in adjacent native habitat, 63 of these (55%) have less than 30 plants (size classes 1 and 2). These small population sizes, however, may be an artifact of survey methods, since some roadside survey efforts only documented plants that were easily observed along the road and failed to explore adjacent native habitat. Some of these "small" roadside populations may thus prove to be much larger with additional survey work.

It is unlikely that populations that are limited to roadsides are stable over the long term, although re-surveys of known populations in 1994 gives no suggestion that these populations are more prone to extinction than larger ones (Elzinga, personal observations). One interesting observation was that at both monitored Idaho populations, the portion of the population on native habitat disappeared by 1991. Repeated annual observations through 1995 have not located any plants in native habitat (Elzinga, personal observation), although the species likely remains present there in the seedbank. The portion of the population on the roadcut, although reduced in numbers, continues to occupy the site.

2. Reproductive Ecology

Reproductive EcologyReproductive Ecology

1. Phenology

PhenologyPhenology

Plants overwinter as semi-evergreen rosettes, and previous year's seedheads are often visible into the next year. Plants begin producing new leaves in the early spring (March to April, depending on elevation). Flowering stalks begin forming in early May, and bloom from late May to late June. Plants form fruit from June to August, and by late August fruits are mature and begin to dehisce and disseminate seed. These general phenological dates are highly variable depending on aspect, elevation, and annual weather patterns. Flowering period, for example, can vary by as much as four weeks at the same site between years.

2. Allocation to Flowering

Allocation to FloweringAllocation to Flowering

***Penstemon lemhiensis* only reproduces by seed, although individual plants may become quite large, with several rosettes arising from a branched caudex and taproot. Because of the dependence on seed production, allocation to reproduction is quite high. Although no studies of percent allocation have been completed (measurement of the biomass apportioned to reproduction versus that allocated to herbage and roots), a high percentage of plants within a population may be reproductive (Appendices II and III). This varies by location and by year. Observations suggest that a larger percentage of plants in disturbed habitats such as roadcuts are reproductive and produce more inflorescences per plant compared to those in native habitats. Data from 13 populations observed in 1994 showed 70% of the individuals in roadcut populations were reproductive compared to 41% in native habitat (difference significant at the P<.05 level). Of the plants observed along roadcuts, 10% (9 individuals) supported more than four inflorescences (three of which had nine or more inflorescences); no plants in native habitat supported more than four inflorescences. Approximately 71% of the reproductive individuals in native populations only supported one inflorescence, compared to 53% in the roadcut populations (Elzinga, unpublished data.)**

3. Breeding System

Breeding SystemBreeding System

Ramstetter (1983) observed that the flowers of *Penstemon lemhiensis* are protandrous, which means the anthers shed their pollen before the stigma within the same flower becomes sticky and receptive to pollen. She also found that flowers pollinated by hand from pollen from the same plant (which required using different flowers since the pollen matures before the stigma) achieved a seed set rate of only 2.1%, while open-pollinated flowers with the anthers removed had an average of 17.3% (similar to controls). These observations suggest that *Penstemon lemhiensis* is a nearly obligate outcrosser requiring cross-fertilization from different plants. This has important implications for small populations in which only one or two individuals bloom, and may explain the high number of aborted flowers observed at some populations.

4. Pollinators

PollinatorsPollinators

Ramstetter (1983) observed 13 insect species visiting *Penstemon lemhiensis* flowers. Of these, seven were seen actually entering flowers and contacting stigmas or anthers. These include, in order of importance, a vespid wasp (*Pseudomasaris vespoides)* and several bees: *Osmia brevis* (mason bee), *Lasioglossum trizonatus, Osmia bruneri, Osmia bucephala, Bombus centralis* (bumblebee) and *Anthophora ursina* (digger bee). Of these, *P. vespoides* appears to be the most important. At three sites it was the only species observed visiting *Penstemon lemhiensis.* These wasps were not observed visiting flowers of any other species during the period of *Penstemon lemhiensis* blooming. Additional observations by other investigators found that the vespid wasp was the most frequently encountered insect visitor to *Penstemon lemhiensis* (Shelly 1987; Watson 1976). Vespid wasps are apparently faithful to the genus *Penstemon* in general (Shelly personal communication).

The wasps appear to be pollen collectors. After visiting several flowers and accumulating pollen on their backs and heads, the wasps would collect the pollen from their bodies with their forelegs. Emasculated flowers (those with the stamens removed) were never entered completely or for long (Ramstetter 1983).

Another pollinator and nectar collector, *Osmia brevis*, may be of secondary importance. Ramstetter (1983) found this species was less plant-specific compared to the vespid wasp, collecting nectar from other species blooming in the same area, such as *Frasera albicaulis* and *Achillea millefolium* (Ramstetter 1983).

Seed production may be somewhat pollinator-limited. Ramstetter (1983) found that flowers cross-pollinated by hand had a seed initiation rate of 29.6%, significantly higher than the control value of 18.6% ($p<.05$). Watson (1976) observed that pollinators were only found in large populations, and speculated that small populations (less than 30 plants) were not located by pollinators. Most small roadside populations, however, appear to produce fruit successfully at least on some years (Elzinga, personal observations).

5. Seed Set

Seed SetSeed Set

Natural seed set (seed matured) of plants observed by Ramstetter (1983) averaged 17.8% of ovules. Plants cross-pollinated by hand showed slightly higher success (22.5%). These values are slightly lower than the seed initiation rate (18.6% in controls and 29.6% in hand cross-pollinations), suggesting that plants may not have the resources to mature all initiated seeds, or that seed predation or disease reduces seed production before maturity.

Fertilization and fruit formation appears highly variable from year to year (Appendix II). Average number of fruits per inflorescence on monitored plants was mostly less than 20 at the Montana sites, and averaged 7-12 at the Idaho sites (Appendix III). The failed flower rate was generally over 50%, and often over 70%, perhaps partially a result of lack of pollination (Ramstetter [1983] suggests some pollinator limitation), but also possibly due to a lack of resources required to grow fruit to maturity. Observations over the past six years suggest that seed set is especially poor during drought years, a function of either reduced pollinator visits due to suppressed pollinator populations, or reduced moisture resources for the plant to funnel into fruit and seed production. Complete failure to set seed has also been observed on cold, wet summers (Ramstetter 1983).

Seed production per capsule is variable by year and by site (Table 4), ranging from 20-40 seeds per capsule (Ramstetter 1983; Shelly and Heidel 1993). Potential seed production per plant can be 500 or more seeds, although actual average production is usually much lower.

Table 4. Seed production per capsule, Forest Service Monitoring Transects (from Shelly and Heidel 1993). Values are mean number of seeds per fruit (standard deviation). Data were not recorded at the French Creek sites in 1991 because of lack of fruit production.

	YEAR		
	1989	1990	1991
French Creek Park Mine	32.7 (11.2)	33.8 (8.9)	NR
French Creek Discovery Mine	34.0 (10.3)	31.4 (8.4)	NR
Badger Pass North	36.0 (12.1)	35.6 (12.4)	28.2 (12.4)

6. Dispersal

DispersalDispersal

***Penstemon lemhiensis* has no physical structures that may aid in long-distance dispersal. It is likely that most seeds fall from dehisced capsules within a meter from the parent plant (Ramstetter 1983). Some short-distance dispersal may result from ant collecting and caching.**

It is possible that long-distance dispersal vectors include birds and mammals that eat the seed or inflorescences. Inflorescences are routinely browsed by ungulates, although this usually takes place during the flowering period rather than after fruit and seed production. Ramstetter (1983), for example, noted that the browse loss of 90% measured at Argenta (MT001) took place almost

exclusively between 6 July and 27 August, the period of flowering and early fruit set. Crofts (1990) noted complete herbivory by deer of a small population over a nine-day period in mid July, before fruit had matured. These observations suggest that ungulate dispersal is unlikely. No birds or small mammals have been observed collecting or consuming the mature seeds, but it is possible that the relatively large seeds are used by these animals.

Human dispersal appears common. *Penstemon lemhiensis* has been observed in small populations along road cuts and fills. Usually these are near a larger population in undisturbed habitat that has been bisected by road construction. Seeds are moved by heavy equipment during construction and maintenance activities. Isolated road-side populations may be explained by transportation of seeds retained in caked-on mud on the construction equipment which are then released during operation in a distant area.

7. Seed Viability

Seed ViabilitySeed Viability

No viability studies have been published on *P. lemhiensis*. A study of two closely related species, *P. speciosus* and *P. cyaneus*, found 90% or higher viability (Meyer and Kitchen 1994).

8. Germination, Seedling Dynamics and Seedbank

Germination, Seedling Dynamics and SeedbankGermination, Seedling Dynamics and Seedbank

According to monitoring data collected in Montana, germination conditions appear to have been best in 1993, the year with the lowest mean maximum temperature (Darby and Wisdom station) and highest precipitation in June and July (Butte, Wisdom and Jackson stations) compared to other years in the 1987-1994 monitoring series (Figures 3 and 4, Appendix VIII). At all sites, more seedlings were counted in 1993 than in any other year, and 1993 and 1995 were the only years in which seedlings were counted at the Badger Pass Microwave site (Figure 5, Appendix VIII and Appendix II). Survival of the flush at the Badger Pass North site (66 seedlings) was only 3% (Figure 6, Appendix VIII). At the French Creek Discovery Mine and Park Mine sites, however, survival was 50% or more (of 16 and 14 seedlings respectively).

Interpretation of seedling dynamics must be tempered, however, by consideration of the "new plants" that appear each year as individuals with one (sometimes 2-3) rosettes. At Park Mine, 12 new plants of this type were counted in 1994 (Appendix II). These were likely the result of seedlings that germinated late in the summer or early fall of the previous year, or possibly early in the summer they were measured. A few more field visits could help determine when seedlings appear, and thus perhaps suggest which environmental factors serve as germination cues. The combined recruitment (seedlings and "new plants") was fairly steady over the five-year monitoring period at the French Creek Discovery Mine site in spite of fluctuating precipitation and temperature. Observations suggest that this site might be slightly more moist than other monitored sites, which may account for the steady recruitment (Shelly, personal communication).

***Penstemon lemhiensis* seed requires dormancy-breaking conditions, which in the wild are provided during winter by moist chilling. In the lab, *P. lemhiensis* will only germinate after treatment with moist chilling or gibberellic acid (Ramstetter 1983; Meyer, personal communication), but even after treatment, some portion of the viable seed will remain dormant and not germinate, suggesting the formation of a seedbank.**

In a study of thirty-eight species of *Penstemon*, Meyer et al. (1994) found that most exhibited laboratory germination patterns that suggested retention of a dormant fraction in a seedbank under natural conditions. Germination patterns

from mid-elevation species (similar habitats as *P. lemhiensis*) exhibited an average chill-responsive fraction of less than 75% of the viable seeds. This fraction responded to chilling as a germination cue, providing for spring germination. The other fraction, however, was non-responsive to any length of chilling. This fraction, ranging up to 70% of the viable seeds for some species, potentially provides for carryover of a persistent seedbank.

Two species closely related to *P. lemhiensis* were tested by Meyer et al. (1994). Germination of viable seeds of *P. cyaneus* after 24 weeks of chilling was only 35%, suggesting the remainder is banked in the soil, while that of *P. speciosus* was 90% (Meyer and Kitchen 1994). A small lot (a few hundred seeds collected in 1990) of *P. lemhiensis* showed only 23% germination of viable seeds after 24 weeks of chilling, suggesting that the formation of a seedbank is likely (Meyer, personal communication). Ramstetter succeeded in germinating only 4% of the seed after pre-treatment. Longer chilling may have resulted in more germination (Meyer et al. 1994).

Additional evidence for the formation of a seedbank comes from the five years of monitoring data collected in Montana. At the French Creek Park Mine site, there was no reproduction in 1991 and 1992, yet seedlings appeared in 1993 (Appendix II). This suggests that seeds may be viable for up to two years under natural conditions.

3. Population Ecology

Population EcologyPopulation Ecology

The general life cycle of *P. lemhiensis* is summarized in Figure 7 (Appendix VIII). Populations are comprised of seedlings, non-reproductive, reproductive, and senescent individuals. At the Montana monitoring transects, the percent of reproductive plants ranged from 0-74% (Figure 8, Appendix VIII). At FS transects and the Horse Prairie Guard Station site, reproduction was lowest in 1991 and 1992 (<15%), the two driest years. The percent of the population that was reproductive remained fairly consistent at the Badger Pass Microwave site, ranging from 25-55% throughout the monitoring period (43-71% for the subset of larger marked plants). At the Idaho monitoring sites, the reproductive fraction was 70% (1989) and 82% (1990) at one site, and 31% and 44% at the other (Appendix III).

Larger plants (as measured by the number of rosettes) are more likely to be reproductive, with the percentage of reproductive individuals in the 7+ rosette size class mostly over 50% and often over 80% (Appendix II). Since only a single inflorescence is produced per rosette (each rosette is unbranched), multiple inflorescences are only produced by multiple rosette plants. The average number of inflorescences per plant for all years and all sites was mostly under 2.5, with a few exceptions.

Mortality was highest at all populations monitored in Montana in 1991 and 1992 (Figure 9, Appendix VIII; Appendix II). In both years, summer temperatures were relatively high (Wisdom station) and precipitation low compared to other years in the monitoring period. Overall, mortality was usually highest in the smaller size classes (1-3 rosette plants). Some mortality, however, also occurred in larger size classes. Because of the lack of 1-3 rosette plants to grow into the larger size classes, and recruitment over time of new individuals into the 1-3 rosette size classes, the populations became dominated by smaller plants over time. The percentage of the population found as 1-3 rosette plants increased at French Creek Park Mine from 32% to 72%, at French Creek Discovery Mine from 23 to 78%, and at Badger Pass North, from 15 to 50% overthe monitoring period. Most sites exhibited a steady increase in the percent of the population comprised by one-rosette plants up to 1993, with some decrease at French Creek Discovery Mine and Badger Pass North in 1994 as populations began to recover (Figure 10, Appendix VIII). At Badger Pass Microwave, however, the size class distribution remained fairly constant, indicative of the relatively stable population found there.

Plants can survive at least six years, and in some populations many of the original plants measured when the monitoring transects were established remained alive throughout the monitoring period. Of the 38 plants marked at Badger Pass Microwave in 1991, 35 were still alive in 1995. Of the plants monitored along the transect (which contained many of these marked individuals), 27 of 31 plants survived between 1991 and 1995. Of those that didn't survive, four were one-rosette individuals and one was a two-rosette individual. Survival and longevity was very low at the Forest Service transects. At French Creek Discovery Mine only 7 of 35 individuals survived, at Badger Pass North only 1 out of 105 and at French Creek Park Mine only 8 of 84 plants survived between 1989 and 1994.

6. Community Relationships

Community RelationshipsCommunity Relationships

1. Herbivory

HerbivoryHerbivory

Browsing of flowering stems by domestic livestock can be extremely high in areas managed for grazing. Ramstetter (1983) found that outside the Big Hole Battlefield, combined use by deer and cattle was 90%. Use inside, where cattle are excluded, was 23%. Grazing and trampling by cattle may eliminate plants. At the Big Hole Battlefield, Ramstetter (1983) found that in one area, plants grew up to the boundary fence, but were not found in similar habitat just on the other side, an area that is grazed by cattle.

Use by native ungulates, likely deer, may be more common and more severe at some sites than livestock herbivory. Crofts (1990) observed a population in mid-July with 31 large flowering plants. Nine days later only four plants were still in

flower; the remainder had been grazed down to the basal leaves by deer (livestock are rare in this area). Ramstetter (1983) found that at Argenta (MT-001), browsing was 90%. Shelly (1987) observed that cattle use in this area is rare, and that high levels of browsing are probably due to deer. At Bannock Pass, 39% of the stalks were browsed, and at Colson Creek, 67% were browsed (Ramstetter 1983). Livestock use is probably heaviest at the Bannock Pass site.

Monitoring data from Montana and Idaho shows that browsing is highly variable, and may be due to either domestic or native ungulates. In Montana browse loss of inflorescences was generally highest among the monitored transects in the exclosed Badger Pass microwave site, ranging from 40-72% between 1991 and 1994. Browse loss of the 34 inflorescences was zero, however, in 1995. At the three Forest Service transects, the low production of inflorescences in 1991-1994 limited the availability for browse, but during the first two years of monitoring (tracking 26-107 inflorescences), browse loss was 1.5-22% (Appendix II). In Idaho, browse loss at one site grazed by cattle averaged 20-24%, while browse loss at a second site only lightly used by cattle was less than 10% (Appendix III).

Observations suggest that deer use of *P. lemhiensis* is preferential. Areas were vegetation appears to be very lightly or not at all used will still exhibit fairly heavy use of *P. lemhiensis* inflorescences, most often during the flowering period (Elzinga, personal observation). Ramstetter (1983) noted 23% of the *P. lemhiensis* inflorescences along a roadcut were browsed, compared to 28% of the *Tragopogon dubius* inflorescences, 9% of *Potentilla gracilis,* and 3% of *Gilia aggregata*.

Most domestic and native ungulate utilization of *P. lemhiensis* inflorescences has been observed to occur during flowering, rather than after seed has matured. Thus utilization represents a negative impact through the reduction of reproductive output, an impact that is not offset or ameliorated by dispersal of mature seeds, as might be the case if utilization occurred later in the season. The overall affect on population viability resulting from levels of utilization that have been observed are unknown.

Inflorescences are also damaged by insects. Ramstetter (1983) noted that complete caterpillar damage of buds and flowers occurred in 41% of the inflorescences at Bannock Pass and partial damage in 11%.

2. Disease and Predation

Disease and PredationDisease and Predation

Predation of ovules and capsules has been noted by Ramstetter (1983). At the Forest Service monitoring transects in Montana, larval borings into seed capsules affected up to 36% of the produced fruits (Appendix II).

3. Competition

CompetitionCompetition

Although no specific experiments have been done to evaluate the effects of competition on *Penstemon lemhiensis,* some anecdotal and compositional evidence suggests that *P. lemhiensis* may have poor competitive ability. Ramstetter (1983) compared vegetative cover in areas with *P. lemhiensis* and found that the density of *P. lemhiensis* was 2.7 individuals/m² in plots with 25-50% cover of associated species compared to 0.3 individuals/m² in plots with 75-100% cover. She also observed that plants growing in an area with dense bunchgrass cover were smaller and had a lower seed set compared to plants in an area with less vegetation (13.1% seed set compared to 19.1%). The ability of *P. lemhiensis* to colonize disturbed areas such as road cuts and fills is additional evidence of the low competitive ability of the plant.

Alternatively, it may not be the low competitive ability of adult plants that limits the plant to less competitive situations, but the need for frequent, open microsites conducive to germination. Observations suggest that *P. lemhiensis* occurs most often on slopes with natural slippage and small microsites of disturbed or exposed soil. Although *P. lemhiensis* is a perennial, it is unknown if it is a relatively long- or short-lived one. Most of the individuals measured at the Montana monitoring sites died over the 5-6 year monitoring period and the short-lived nature of other *Penstemon* species has been documented (Meyer, personal communication). The level of mortality measured at monitored sites, however, may be unusually high, a result of the drought that coincided with the monitoring period. Yet, even if *P. lemhiensis* is relatively long-lived under more favorable conditions, the fact that it has been observed to decline so precipitously at many populations across the range (see Population Trends, below), suggests that periodic germination is important, and that open germination microsites with conditions of low competition may also be important for the maintenance of populations.

7. Population Trends

Population TrendsPopulation Trends

At most of the populations monitored in Montana, numbers of individuals declined (Figure 11, Appendix VIII; Appendix II). Populations declined most dramatically at the French Creek Park Mine and Badger Pass North sites (84 to 35 plants; 106 to 6 plants, respectively), slightly less so at the Horse Prairie site (37 to 10 plants). The other two sites, however, exhibited increases over the

monitoring period. French Creek Discovery Mine increased from 35 plants in 1989 to 43 plants in 1994. At the Badger Pass Microwave site, the population increased from 31 individuals in 1991 to 39 individuals in 1995.

In Idaho, populations declined between 1989 and 1990 by a few plants, then dramatically between 1990 and 1991 (Appendix III). Only the portions of the two populations occurring on road cuts survived between 1990 and 1991, and native habitat has not been recolonized to date (Elzinga, 1995 observations). At the Silver Pine site (ID090), the population declined from over 100 individuals to 50 between 1993 and 1996 (Schuldt, personal communication).

Observations and counts also suggest declines at many other populations (Appendix V). This may be partially due to a decline in the percent of blooming individuals, since counts of rosettes are inaccurate, but at some populations the decline is so dramatic that it is unambiguous.

These trends are alarming, but may be a natural pattern of decline and resurgence. Most *Penstemon* species are short-lived (Meyer and Kitchen 1994; Meyer et al. 1994) and populations have typically been observed to fluctuate dramatically (Meyer, personal communication). If seedling establishment conditions are not met for several years, populations may appear to "crash," but it is likely that during favorable years, or perhaps after disturbances (see Sections VIII. F and G on fire), populations may re-establish. Based on germination patterns and comparisons with closely related species, *Penstemon lemhiensis* likely forms a seedbank which buffers declines.

One piece of evidence suggesting that populations exhibit large fluctuations naturally is the series of observations at the Badger Pass Microwave site. Watson (1976) noted only five plants at the site. In 1986, 190 plants were counted, 75 of which were in the exclosure. The record for 1989 reads: "very few plants observed and none found inside the exclosure." In 1990, 44 plants were marked with rebar in the exclosure, and in 1991, additional plants were included in transects (Appendix II).

8. Anthropogenic Threats

Anthropogenic ThreatsAnthropogenic Threats

1. Grazing

GrazingGrazing

Impacts of livestock grazing on *P. lemhiensis* are uncertain. The key mechanisms of impact are browsing of inflorescences and associated reduction in reproductive output, trampling damage, and indirect impacts through effects on community structure. It is unlikely that herbivory of leaves is common, since the low growth of the basal rosettes is mostly out of reach of the grazing animal.

Browsing of inflorescences by livestock can be heavy (see section VI.A.), but in most populations exposed to grazing in which observations have been made, use is low to moderate. Unlike deer, cattle do not seem to exhibit a preference for *Penstemon lemhiensis* inflorescences. In some populations, however, use levels may compromise reproductive output so severely that the seed crop is inadequate to maintain the stand. *Penstemon lemhiensis* requires periodic reproduction by seed, since it does not reproduce vegetatively and is likely relatively short-lived. And unlike some perennial species, once grazed, *P. lemhiensis* does not produce another inflorescence or branch from the inflorescence stub (Ramstetter 1983).

Both native and domestic ungulates utilize *P. lemhiensis* during the flowering season. Apparently, once seed has matured and the stalks dried, they are no longer palatable, although some occasional use may occur. Because most use takes place before seeds are mature, there is little, if any, benefit from grazing in terms of seed dispersal.

The effects of trampling on *P. lemhiensis* are similarly uncertain. Ramstetter speculated that trampling and grazing, combined with the reduced reproductive output, may be responsible for the lack of *P. lemhiensis* outside the fenced Big Hole Battlefield Monument boundary compared to the large numbers of plants on similar habitat just inside the fence.

Indirect effects on *P. lemhiensis* through alteration of associated community structure is difficult to evaluate. Moderate livestock use may actually be beneficial to *P. lemhiensis* through the reduction of competition and opening of "safe sites" for seedling establishment. Alternatively, grazing may also provide "safe sites" for weed establishment, and livestock can act as dispersal agents for weeds.

In general, low levels of livestock grazing do not appear to significantly compromise or negatively impact *P. lemhiensis*. Moderate to heavy levels, especially when occurring during the flowering season, may be damaging due to dramatic reduction in seed production. Use levels on *P. lemhiensis* sites can sometimes be very heavy, especially on small openings in timbered sites. This was observed at the Butte Highlands populations in 1994, when the small meadow openings were heavily used by cattle (Elzinga, personal observations).

Use by native ungulates, especially deer, is much more difficult to control than livestock grazing, but browse damage to flowering stalks can be very high (see Section VI.A.). Use appears to be highly variable from year to year, probably dependent on availability of other forage. Because of that variability, use by native ungulates is unlikely a major threat at this time. Changes by state

agencies in deer management that result in larger herds, however, may be a problem.

The combined use by native and domestic grazers creates a difficult situation for federal managers since it is extremely difficult to differentiate between native and domestic grazing use in areas where both classes of grazing animals occur. Because options for controlling native grazers are limited, conservation strategies should focus on those applicable to domestic grazers.

2. Mining

MiningMining

***Penstemon lemhiensis* is often found in historic mining districts that may become reactivated as new technology allows the extraction of remaining mineralization. All of the known populations occur in areas that are under claim for mining or along access roads that may be affected by increased mining operations. Under the Mining Law of 1872, there are few options for the management agency in the event of a conflict between *P. lemhiensis*, which has no protection under the ESA, and mining activity. Exploration and claim maintenance, although often limited in areal extent, can have devastating consequences on a localized *P. lemhiensis* population. In the BLM, exploration and surface disturbance of under 5 acres can proceed with a 15-day notice, and often do without botanical surveys. No decision record is issued by the agency, and it has been argued that the approval is not discretionary (Babits, personal communication). The Forest Service is required to complete a NEPA analysis for all proposed exploration activities, and issue a decision for the project (Henderson, personal communication). Botanical surveys are completed as part of the NEPA analysis. For both agencies, denial of exploration activities is rare, but altering exploration plans to avoid sensitive resources at the request of the agency is common.**

The impacts of large-scale mineral development are often easier to evaluate and mitigate than small exploration activities. Projects are generally assessed for both agencies under an Environmental Impact Statement, or at minimum, an Environmental Assessment, through which impacts can be evaluated and reduced. The larger companies that are usually responsible for mineral development are also likely to be amenable to expensive mitigation efforts as a demonstration of their environmental sensitivity, compared to the small miners often responsible for exploration.

3. Road Maintenance and Reconstruction

Road Maintenance and ReconstructionRoad Maintenance and Reconstruction

Roadside populations (approximately 70% of the total) are vulnerable to impacts or even extirpation from standard road maintenance activities of grading, fill slope recontouring, and widening. These activities often take place on federally owned land with little internal discussion or review by botanical specialists. Populations along roads maintained by the state or county receive no protection.

4. Timber Harvest

Timber HarvestTimber Harvest

Timber harvest activities may directly impact *P. lemhiensis* populations through mortality caused by substrate alteration during the construction of roads and skid trails and from heavy equipment travel in the sale area. Plants may be damaged or killed by being dug up or driven over. The overall impact of these activities on a population depends on several factors, including intensity of activity, soil moisture, and slope. It is likely that even minimal traffic and substrate disturbance will result in plant mortality because of the shallow root system of *P. lemhiensis*.

In most cases, populations are not found within timber stands, but rather at the edges of stands and in forest openings. These populations should be avoidable during harvest activities if populations are located during project planning. There is potential for impact in populations that are not located, either because surveyors overlook inconspicuous plants (non-blooming populations) or because the population is at a low point in population density cycles, and residing primarily below ground in the seedbank.

Designing timber sale activities to avoid *P. lemhiensis* in ponderosa pine stands may be more difficult, since the plant grows as an understory species in the stand. One population in Idaho is in an area proposed for harvest in winter 1996-1997; the effects will be monitored in the summer of 1997 (Population #ID090; Schuldt, personal communication). The primary anticipated improvement from winter harvest is reduced substrate surface disturbance and plant mortality. Whether winter harvest provides adequate protection from harvest activities remains to be seen.

Effects of timber harvest activities are largely unknown, but may be a complex mix of negative and positive. Although poorly planned activities could eliminate a localized population through surface disturbance caused by road construction, skidding, and yarding activities, harvest with minimal surface impact may actually improve *P. lemhiensis* habitat in the short term by providing minor surface disturbance and opening of the canopy. This has not been demonstrated, but is a possibility given the propensity of *P. lemhiensis* for disturbed road cut and fill material and fairly open sites. Over the long-term, however, the dense canopy of

a regenerating stand probably would result in the subsequent loss of *P. lemhiensis* from the understory, unless the open canopy created by harvest is maintained by periodic fire or other means.

5. Weeds: Infestation and Control

Weeds: Infestation and ControlWeeds: Infestation and Control

Application of herbicide to control roadside weed infestations has been noted as a threat in past conservation evaluations (Shelly 1987; Moseley 1989). Roadside weed spraying is commonly done on all county-administered roads in Idaho and Montana. Cooperative programs with counties may also give the counties responsibilities for roadside weed spraying along FS and BLM roads. Roadside spraying under these agreements is particularly difficult for agency specialists to manage. Communication of areas to avoid often passes through several layers of bureaucracy, and is often misinterpreted or ignored at the county field crew level. In the absence of cooperative agreements with the county, agency crews may be responsible for herbicide application along agency roadways, but since these crews are usually a part of a different administrative division than the resource specialist, communication remains difficult. At least one roadside population is thought to have been eradicated by roadside herbicide spraying by BLM crews in Montana (Heinze, personal communication) and another on the Salmon NF (Henderson 1981). Approximately 70% of the known populations are at risk from this activity due to their roadside location.

Conversely, infestation by noxious weeds is a more serious threat to overall species viability than the occasional roadside population threatened or eradicated by roadside herbicide application. Spotted knapweed (*Centaurea maculosa*) is the most important threat. None of the populations visited in 1994 lacked spotted knapweed, and at some, most notably the populations along Panther Creek and the Salmon River, knapweed was abundant and *P. lemhiensis* absent or declined from earlier population counts (Elzinga, personal observations). A biologist with the Salmon NF noted that at sites along Panther Creek, knapweed had dramatically increased over amounts observed 2-3 years previous (Schuldt, personal communication). Knapweed infestation is also severe at some of the lower elevation sites in Ravalli County.

Spotted knapweed is a direct threat to *P. lemhiensis* populations. Observations suggest that *P. lemhiensis* and spotted knapweed occupy the same bare soil microsites (Moseley 1989; Elzinga, personal observations). A strongly competitive species, knapweed can possibly displace adult *P. lemhiensis*, perhaps through allelopathic mechanisms (Locken and Kelsay 1987). It likely also competes for germination openings with *P. lemhiensis*. Spotted knapweed is a prolific seed producer, up to 30,000 seeds/m² (Schirmann 1981). These can germinate in the fall, given suitable conditions (Eddleman and Romo 1988), and thus usurp potential germination sites from *P. lemhiensis*, which germinates in

the spring. The observation of loss or severe declines of *P. lemhiensis* in communities where knapweed infestations have increased, and the observation of the apparent robustness and high fecundity of roadside *P. lemhiensis* (which are often not subject to competition), provide strong anecdotal evidence of the current and potential severity of the problem.

6. Community Closure/Lack of Fire

Community Closure/Lack of FireCommunity Closure/Lack of Fire

Moseley (1989) suggested that canopy closure and advanced succession caused by fire suppression may be a threat to *P. lemhiensis*. This phenomenon is likely most important in the ponderosa pine habitat occupied by *P. lemhiensis* along the Salmon River and Panther Creek in Idaho, where surface fires were frequent prior to 1935 (Barrett 1988; Barrett and Kilgore 1985). It may also be important in the Butte Highlands populations, which occupy meadows within a forest matrix. These meadows appear to be shrinking due to encroachment by conifers from adjacent forests (Joy, personal communication). Succession due to lack of fire may also be important in the sagebrush grassland habitats of eastern Idaho and western Montana, but many of these sites have low sagebrush cover due to natural slope disturbances or shallow soils.

There is anecdotal evidence that *P. lemhiensis* responds favorably to fire. At the Big Hole Battlefield, burns resulted in a flush of *P. lemhiensis* plants (Shelly, personal communication). Moseley (1989) noted that the largest and most vigorous population in the Salmon River area was in a 1985 burn (#ID039), although this population had declined by 1995 (Wenger, personal communication).

Two fire ecology studies currently underway may provide information on the response of *P. lemhiensis*. The Bitterroot NF, with technical assistance from the Intermountain Research Station in Missoula, will monitor the response of *P. lemhiensis* in an ecosystem management project which includes a number of burn units. The Montana Natural Heritage Program is coordinating another study which will measure the response of *P. lemhiensis* to prescribed burns at three sites (Badger Pass North, Badger Pass Microwave, and the Canyon Creek site (MT038) (Shelly and Heidel 1995). The Canyon Creek site was burned in the fall of 1995 (includes a burn and control plot). The other two sites will be completely burned in the fall of 1996. Response of seedling recruitment and mortality of adult plants will be the focus of the study.

7. Interaction of Weed Infestation and Fire

Interaction of Weed Infestation and FireInteraction of Weed Infestation and Fire

While *P. lemhiensis* may respond favorably to fire, and may be negatively impacted by canopy closure resulting from fire suppression, the historic fire situation has changed with the introduction of spotted knapweed, creating an

extremely complicated management situation. Knapweed, similar to *P. lemhiensis*, responds favorably to microsite openings and also to fire (Roche, personal communication). On the Bitterroot NF, prescribed fire in shelterwood cuts on dry Douglas-fir and ponderosa pine communities (typical *P. lemhiensis* habitat) resulted in a doubling of spotted knapweed cover (Carey 1995). Similarly on another western Montana prescribed fire, spotted knapweed volume increased from 238 ft^3/acre before the burn to 476 ft^3/acre by the second growing season after the fire (Noste 1982). This knapweed response, and the negative effect it may have on *P. lemhiensis,* may outweigh any benefits of prescribed fire for *P. lemhiensis* in areas vulnerable to knapweed.

8. Demographic Threats

Demographic ThreatsDemographic Threats

Approximately 50% of the known populations are smaller than 30 individuals. The small size of these *P. lemhiensis* populations places them at risk of localized extinction due to demographic fluctuations. Successful pollination of *P. lemhiensis* is dramatically increased by cross-pollination occurring between two different plants (while some selfing may occur, it is limited; Ramstetter 1983). Small populations with only a single blooming individual may thus fail to produce seed for several years. In addition, small population may be less likely to be located by pollinators, although successful pollination in small populations has been observed. Small populations may also lack any blooming individuals, simply due to chance fluctuations in demography. A larger population is buffered from these chance occurrences.

Small populations are also at higher risk of the negative effects of small scale disturbances caused by both natural and anthropogenic factors. A single deer can consume all inflorescences in a year, or a small-scale surface disturbance (such as a mining drill pad or an isolated road maintenance or weed control action) can eliminate all individuals of a population. These types of disturbances are more damaging for a small population because it is unlikely that adjacent individuals remain to provide recolonization of the disturbed sites. Such disturbances may, however, be buffered by a seed bank.

The impact of inbreeding depression in small populations of *P. lemhiensis* is unknown. There is no evidence that plants found in small populations exhibit any signs of inbreeding such as reduced reproductive output or dwarfism. In fact, many small populations found along roadcut habitats appear to be especially vigorous, although this may be a function of reduced competition.

One benefit of the distribution of *P. lemhiensis* in many small populations scattered across the landscape is a reduction in risk of extinction from a single catastrophic event. If the species were distributed in a few large adjacent populations, the species as a whole would be at greater risk of extinction due to a

single event such as a severe fire or landslide. Although smaller populations may individually be at relatively greater risk of extinction compared to larger ones, for the species as a whole this distribution pattern makes the species fairly resistant to rapid range-wide extinction.

9. Conservation Strategy - Overview

Conservation Strategy - OverviewConservation Strategy - Overview

1. Issues and Goals

Issues and GoalsIssues and Goals

The general goals of this conservation strategy are to provide for long-term conservation of *P. lemhiensis*, maintain future conservation management options, and minimize conflict with other resource values and land management activities. These goals will be further refined in later sections into measurable management and resource objectives.

Several issues have been identified in the description of the species, its ecology, and its threats. These must be addressed in designing an effective conservation approach. They are summarized as follows:

<u>Species Distribution and Inventory</u>: While inventory work has been done in both states (in some areas extensively), four facts suggest that new populations would be located by additional inventory work: 1) the high percentage of populations known from the cut and fill slopes of easily accessible (two-wheel drive) roads; 2) the fact that nearly 50% of the known populations have been found in the past five years; 3) the distributional gaps between known populations; 4) the abundance of apparently suitable habitat. There has also been a problem with recording known populations and archiving those locations in the Idaho Conservation Data Center or Heritage Program databases. In Idaho alone, 11 new populations were added to the database based on searches of files at the Salmon NF in preparation for this habitat assessment. A third problem is that documented road cut and fill populations have not been completely inventoried for total areal extent. In some cases where this has been done, it has been found that the roadside population was only a small portion of the total population, which actually extended into native habitat adjacent to the road. The Conservation Strategy (CS) must facilitate inventory and recording of populations.

<u>Implications of Additional Populations</u>: If additional inventory work does identify new populations, this has important implications. The first is that some of these populations may be of higher conservation value than the ones identified as critical in this strategy. The second issue is that if a large number of unknown populations exist, protective management of known *P. lemhiensis* populations may be unnecessarily restrictive on other management activities and resource uses. The CS must 1) include a protocol for protecting newly located populations and 2) balance the needs of *P. lemhiensis* conservation with allowing for alternate uses of population sites as new information becomes available.

Road Cut/Fill Populations: These populations present a special conservation challenge because they occur in areas of high human activity and thus are vulnerable to a number of threats: road maintenance, accidental herbicide application, weed infestation, and increased collection and herbivory due to easy access. Protecting populations from these threats requires a significant amount of management effort. Approximately 55% of these road cut and fill populations contain fewer than 30 individuals clustered in a relatively small area; thus, in addition to the anthropogenic threats listed above, they are susceptible to demographic fluctuations and localized extirpation, may suffer from a lack of pollinators, and are vulnerable to natural localized disasters. And, because of their small size, it is possible that these populations suffer from inbreeding depression and low genetic variability. Conversely, larger populations, especially those in native habitat, are more likely to have the higher genetic variability necessary for long-term survival. These populations also provide a larger return for conservation expenditure, in terms of the number of individuals protected. The CS must develop approaches that directs most agency conservation resources toward protecting and managing large populations in native habitat.

Population Dynamics: The declines monitored since 1989 at the Montana and Idaho sites, and observational evidence at other populations, suggests that populations of *P. lemhiensis* have declined range-wide in the past 6 years. It is uncertain, however, if this is a natural level of population fluctuation in response to drought (or other unknown natural factors), a response to successional advancement due to fire suppression, caused by management activities such as grazing and timber harvest, or some combination of these or other factors. If populations form a substantial and long-lived seedbank, the loss of above ground individuals may not be critical. The CS must outline strategies for seedbank research and for continued monitoring of population dynamics.

Mitigation of other Activities: The effects of livestock grazing and timber harvest are unknown and may be positive or negative depending on local circumstances and the nature of the activity. The CS must develop the best guidelines possible, given the lack of information, and specify monitoring that will assess the impacts of these activities.

Coordination: Because *P. lemhiensis* occurs on 10 or more administrative units (if Ranger Districts and Resource Areas are considered), there is considerable opportunity for overlap of activities and duplication of effort. The CS must identify actions to facilitate coordination and cooperation among federal agencies and their administrative units.

2. Overview of Strategy

Overview of StrategyOverview of Strategy

1. Conservation of Known Populations

Conservation of Known PopulationsConservation of Known Populations

Populations vary in their value for conservation purposes based on such criteria as size, location, and habitat quality. In some circumstances, the effort in terms of time, energy and money to remove or reduce threats to a given population may not be warranted. This CS employs an approach that ranks known populations on BLM and FS lands, prioritizing the order in which populations receive management actions and protection.

All known populations were evaluated and placed into one of four conservation classes. Methods of classification are described in detail in Section X.A.

Class A populations are those which are considered key components of maintaining range-wide viability. These populations were chosen based on size, habitat diversity, habitat quality, geographic distribution, management options, and ownership. Only populations over 100 individuals were considered potential Class A populations. No roadcut populations were included.

Class B populations are those that should be managed for conservation of the species, but are of lower priority for proactive management activity. These populations should be protected, but will likely not be as closely monitored and will receive less investment in expensive vegetative treatments such as weed control or prescribed burning compared to Class A populations.

Class C populations include very small (generally less than 30 individuals) isolated populations in native habitat, a few larger native populations that are heavily infested with knapweed, and moderately sized roadcut populations. Management actions are designed primarily to reduce road-associated threats.

Class D populations are those that are very small, possibly ephemeral, and generally found on road cuts and fills. A few very small, weedy native populations are included here as well. The roadside populations are subject to a number of threats, such as road maintenance and weed spraying, that require large amounts of management effort to reduce. These populations would receive minimal management effort.

2. Inventory

InventoryInventory

Two types of inventory work are recommended in this strategy. General project-related inventory work is required for all federal projects with potential to impact *P. lemhiensis*. Project surveys should be completed during the blooming period by trained personnel, preferably professional botanists.

Equally important is inventory of potential habitat of *P. lemhiensis* that is not project-driven. These inventories are designed to locate new populations of *P. lemhiensis* and extend the known range within and at the periphery of its distribution.

3. Research

ResearchResearch

Three research projects are recommended by this strategy: determination of knapweed control measures compatible with *P. lemhiensis*; evaluation of the inter-related effects of fire, canopy closure, and knapweed invasion in burn areas; and germination and seedbank studies.

4. Coordination

CoordinationCoordination

Coordination and information exchange is facilitated by two recommended actions. First, each agency should annually report on the implementation of management actions, and inventory, research and monitoring results. These reports should be disseminated to all parties administering *P. lemhiensis* populations. The second action is to schedule meetings to discuss *P. lemhiensis* management and share information.

10. Conservation Management Actions for populations

Conservation Management Actions for populationsConservation Management Actions for populations

1. Classification of Populations

Classification of PopulationsClassification of Populations

Classification of populations began with an evaluation of population size and general habitat (roadcut vs. native; see Appendix I). Based on these two factors, populations were grouped into 5 categories: Category 1 populations are those that are very large and occur on native habitat; Category 2 populations are moderately large native populations or extremely large roadcut populations; Category 3 are medium-sized native populations, large roadcut populations and mixed roadcut and native populations; Category 4 are small native and medium-sized roadcut; and Category 5 populations are very small isolated native populations or small roadside populations. Judgement was exercised in classification of some borderline cases and populations where personal knowledge suggested that population size was significantly underestimated. Populations in these five classes were then grouped into the four protection classes: A, B, C or D (Table 5). Due to the small number of large populations of *P. lemhiensis* in native habitat, nearly all Category 1 populations automatically were classified as Protection Class A populations. The single exception (Red Butte; MT012) was classified as Protection Class B because of its proximity to an even

larger A population (French Creek). Similarly, all Category 5 populations were automatically classified into Protection Class D.

The remaining three size/habitat groups (Categories 2, 3, and 4) were classified based on distribution, habitat, and ownership. All populations were located on Forest Plan or similar maps and compared for distribution. Based on gaps in the distribution of protected sites, some Category 2 populations were classified as Protection Class A or B, and Category 3 populations were classed as Protection Class B or C. The number of Class A and B populations in each habitat class was then evaluated (Table 6). Some movement of populations to different protection classes occurred in order to balance gaps in the protection of habitat types. Most Category 4 populations were classified into the Protection Class D, but a few were placed in the C class, based on good habitat, distribution, or the expectation that the population would be found to be larger with further survey work. A complete listing of populations arranged by ownership and protection classification is given in Appendix I, Table 2, and a listing arranged by protection classification in Table 4.

The conversion of five size/general habitat categories to four protection classes was found to be advantageous because it allowed for flexibility within the middle range, where comparisons are most difficult. The semi-objective method described here was found more useful than a test of a more objective method that used weightings for each category (size class, general habitat, habitat type, knapweed infestation, distribution). The latter was not flexible enough to deal with information gaps, nor did it allow the integration of information such as predicted larger population size.

The drawback to this approach is that it is difficult to add new populations without comparing them to all the others. This comparative approach, in which all populations are considered and classed relative to other populations, is recommended for revisions to this CS, but for the life of the CS new populations should be classified based on the following criteria. Populations should be given the most protective class based on the criteria, but may be given a higher class if judged appropriate by the Forest or District Botanist or Rare Plant Coordinator.

1. Native habitat with minimal knapweed
   - Class A. Populations over 100 individuals
   - Class B. Populations of 50-100 individuals
   - Class C. Populations of 30-50 individuals
   - Class D. Populations of less than 30 individuals
2. Native habitat with dense knapweed infestations
   - Class A. Populations of over 300 individuals (population size makes knapweed control cost-effective)
   - Class B. Populations of over 200 individuals

Class C. Populations of 100-200 individuals
Class D. Populations of <100 individuals

3. Roadcut habitat
Class B. Populations of over 300 individuals
Class C. Populations of 200-300 individuals
Class D. Populations of <200 individuals

Table 5. Number of populations classed by protection class (A, B, C or D) for each landowner.

Ownership	Class A	Class B	Class C	Class D	Total
Beaverhead NF*	4	4	6	8	22
Bitterroot NF*	2	5	8	8	23
Deerlodge NF*	1	0	0	0	1
Salmon NF*	4	9	9	49	71
BLM Butte*	2	4	1	8	15
BLM Salmon*	1	2	1	2	6
NPS	1	0	0	0	1
State of Idaho	0	0	0	1	1
Private (MT)	2	3	5	4	14
Private &/or Salmon NF**	0	1	3	13	17
Total for Participants in CS	14	24	25	75	145
Total***	17	28	33	93	171

* denotes CS participants **populations may either be on private or Salmon NF lands ***excludes 2 populations for which ownership is uncertain (MT021 and ID009)

Table 6. Summary of Protection Class A and B by habitat distribution. Habitat types are those described in section V.A.3. The last column presents the percentage of all known populations in a particular habitat type that are placed in Protection Class A or B (*e.g.* for habitat Type 1, 33.3% of the known populations are in Protection Class A or B, 66.7% are in Protection Class C or D).

Habitat	Class A		Class B		Total Protected	Total Known Populations		%
	ID	MT	ID	MT	Number Protected in class A or B	ID	MT	
Deep-soil Rangeland (Type 1)	0	3	2	3	8	8	16	33.3
Shallow-soil Rangeland (Type 2)	1	2	0	2	5	2	24	19.2
Deep-soil Douglas-fir Openings (Type 3)	1	2	5	2	10	30	11	24.4
Shallow-soil Douglas-fir Openings	0	2	2	2	6	5	10	40.0

(Type 4)								
High Elevation Lodgepole/Limber Pine Openings (Type 5)	**0**	**2**	**0**	**0**	**2**	**0**	**3**	**66.7**
Ponderosa Pine Savannah (Type 6)	**3**	**1**	**1**	**2**	**7**	**12**	**8**	**35.0**
Alluvial Fans/ Ponderosa Pine (Type 7)	**0**	**0**	**1**	**0**	**1**	**10**	**0**	**10.0**
Habitat unknown					**0**	**29**	**5**	**0.0**

***Excluded from this assessment are five populations, all in Montana, which have been classified as A or B but are on private land, thus are not part of the strategy and are not considered protected: MT003, MT022, MT025. MT047, MT059. See Appendix I.**

2. Protection Class A Populations

Protection Class A PopulationsProtection Class A Populations

These populations are considered the most critical for maintaining the viability of *P. lemhiensis* throughout its range over the long term. Management activities should be prioritized so that these populations are given the conservation efforts needed. Table 7 summarizes the characteristics of the populations. Table 8 identifies management actions. Table 9 lists population objectives for *P. lemhiensis*. Location of these populations is illustrated on Map 3, Appendix VIII.

Table 7. *Penstemon lemhiensis* populations classed into the highest protection class (A). Site names and numbers are those given in the Idaho Conservation Data Center Database (ID) or the Montana Natural Heritage Program database (MT). Those marked with an asterisk have been monitored for several years..

Site Name and Number	Description
	Beaverhead NF
*French Creek (MT009)	One of the largest populations known, in fairly good native habitat; monitored. Disturbance associated with historic mining. Current threats: some knapweed invasion, reopening of the nearby Yellow Band Mine. This population experienced significant declines in the early 1990s, but has apparently begun to recover (see Appendix II).
*Badger Pass North (MT019)	This fairly large population has been monitored since 1989. Grazing is moderate and habitat is in fairly good condition. Current threats: some knapweed; moderate livestock grazing may be a threat; the population has declined the most dramatically of any of those monitored, but it is also one of the driest sites, and may have been impacted by the drought of the early to mid 1990s. Lack of fire and sagebrush encroachment may be a problem at this site.
*Echo Gulch (MT011)	Large native population in two population areas, one of which was monitored in 1994. Grazing is light and knapweed minimal. Mining may be a threat (test pits in area).
*Canyon Creek (MT038)	One of the largest Montana populations in native habitat, with a small adjacent sub-population area along a road cut and fill and the slope above. Site is included in the Montana Natural Heritage/FS experimental burn project for *P. lemhiensis*.
	Bitterroot NF
French Basin (MT076)	A recent location, this is a moderate to large population in good condition habitat which represents the low elevation sites in Ravalli County. It is the only such population in this habitat that is not heavily infested with knapweed.
*Beaver Creek (MT073)	Large population in good condition grassland openings in an "Ecosystem Management" project area. Population monitored in 1994 and 1995. Represents the cluster of populations found in the upper elevations of the West Fork of the Bitterroot River.
	Deerlodge NF
*Fish Creek (MT046)	Large population, distributed in a cluster of moderate to large sub-populations. Population at the eastern edge of *P. lemhiensis* range. Portion of population monitored in 1994. Threatened by mining, livestock grazing, and possibly forest encroachment into meadow habitat.
	Salmon NF
*Silver	Population is near the southwestern limit known for the species in a ponderosa pine

Site Name and Number	Description
Pine (ID0090)	stand. Stand is proposed for winter harvest (1996-1997). Population has been monitored with a stake row since 1993.
Spring Crk Swtchbks (ID013)	Initial observations suggested another roadcut population, but additional survey work identified a fairly large population in native habitat between switchbacks. Population represents those found along tributaries on the north side of the Salmon River from North Fork to Shoup.
Wheat Creek Ridge (ID038)	While not a large population, it is the most western known along the Salmon River corridor, and is in fairly good condition native habitat within the Frank Church River of No Return Wilderness.
Upper Colson Crk (ID039)	This is the largest population known in Idaho, several thousand plants. Population area extends across several tributaries to the Salmon River (Owl Creek, Ebenezer, and Colson). Habitat is in fairly good condition, much of it burned in 1986. Many subpopulations occurred throughout the drainage on the road toward Long Tom in 1988. Moseley found high densities on the ridge between Colson Creek and Ebeneezer Creek (see Appendix XI). Current population levels are much lower, and many areas no longer support visible signs of *P. lemhiensis*.
	Butte BLM
*Badger Pass Microwave (MT005)	Population is of moderate to large size, found on native habitat adjacent to a microwave tower. Much of the site has been exclosed from livestock -- one of few populations protected from livestock grazing. It has been monitored since 1990.
*Big Hole River (MT049)	Large population on native habitat near the highway with many multi-rosette reproductive plants in 1993. Although the population experienced high mortality in 1994, the low elevation location, unusual habitat (range breaklands) and its isolated location (distant from any population clusters) make this a high value site. Monitored in 1994.
	Salmon BLM
Ramsey Mountain (ID101)	High elevation site in good condition sagebrush grassland; large population adjacent to repeater. No known knapweed problem.

Table 8. Recommended management actions for Protection Class A populations. Table is continued on the following page.

Action	Rationale	Implementation and Monitoring	Management Response
1. Limit grazing use of inflorescences to no more than 30% of available, unless grazing occurs after seed dissemination.	1. Since no data are available to show the effect of reduction in reproductive success caused by any level of grazing, 30% was selected as a reasonable standard. This level is rarely observed except under heavy livestock use. Use levels this high are occasionally caused by deer.	1. Begin application of standard in the 1997 grazing season. Monitor with standard method described in Appendix VII.	1. Since grazing damage may also be attributable to deer, inflorescence loss must exceed this limit for two years before alternatives will be considered to restrict livestock access to the population during the blooming period. It is unlikely that such heavy use by native ungulates will occur consistently. If after two years of observations, utilization does not appear to be a factor, monitoring may be discontinued until domestic grazing use changes.
2. Maintain existing exclosure at the Badger Pass Microwave Site (MT005) and continue to eliminate livestock access to this population.	2. This exclosure is the only one in existence restricting livestock from *P. lemhiensis*.	2. Check fence annually. Check area for cattle sign in the fall to determine if exclosure has been violated.	2. Repair as needed.
3. Design mineral exploration activities to avoid areas occupied by *P. lemhiensis*.	3. Many resource specialists have had good success working with miners to avoid sensitive resources.	3. Track conflicts and resolutions and describe in annual report.	3. If adverse impacts cannot be avoided, seed will be collected from the population and adults salvaged and another similar population from the B protection class will be designated as an A population to replace the impacted one. These actions are considered strictly salvage operations, and should not be considered mitigation. They are only appropriate in mining

Action	Rationale	Implementation and Monitoring	Management Response
			situations where agency discretion is limited and no other options exist.

Table 8. Continued. Recommended management actions for Protection Class A populations Table is continued from previous page.

Action	Rationale	Implementation and Monitoring	Monitoring Response
4. Negative impacts from Timber harvest and associated activities (roads, landings, skid trails, etc.) in Protection Class A populations will be eliminated through use of one or more of the following: 1) avoidance of areas of *P. lemhiensis* occurrence through sale layout and design; 2) helicopter logging; and 3) winter logging on ground frozen to a depth of 10cm or more with 25cm or more snow cover. Sales in Class A populations will be closely administered to ensure that that restrictions are not violated.	4. Careful design and administration should eliminate threats to *P. lemhiensis* in Class A populations.	4. Monitoring should be designed to measure the effects of the treatment, and at minimum include treated units and controls. Specific design depends on situation.	4. Effects will be assessed and mitigating actions implemented on a case-by-case basis.
5. Proposed road maintenance and reconstruction activities planned in the vicinity of a designated population should be evaluated. If there is potential for impact, the population should be flagged, reviewed on-site with road crews, and avoided.	5. An annual review of road maintenance plans can identify early potential conflicts and develop effective mitigation.	5. Track conflicts and resolutions and describe in annual report.	5. Mitigate unavoidable impacts from road maintenance required for safety on a case-by-case basis.
6. Review proposed weed control activities annually. If actions are to occur in the vicinity of a designated population, the population should be flagged, reviewed on-site with spray crews, and avoided. Timing of treatment may be restricted to the blooming period of *P. lemhiensis* to facilitate detection of plants.	6. The short stretches of road cut and/or fill occupied by *P. lemhiensis* can be avoided during herbicide application.	6. Track conflicts and resolutions and describe in annual report.	6. Weeds may be hand pulled or grubbed within population areas. Chemical control may be initiated at the discretion of the agency rare plant specialist (see Resource Objective #4, Table 9).

Table 9. Resource objectives for Protection Class A populations of *Penstemon lemhiensis*.

Action	Rationale	Monitoring	Management Response
1. Management actions at Class A populations will be triggered by a decline in the size or density of a population of 50% or more over the five year period of the CS as measured against the 1997 size.	1. Declines of this magnitude have been measured at some of the monitoring sites. It is chosen as the threshold, which when reached will trigger additional activities, because losing half of any of those populations designated as "A" is considered a conservation concern. Note that this level does not apply to two populations (MT005 and MT049) which are addressed below.	1. Implement monitoring in FY1997. Standard Monitoring Method (Appendix VII).	1. If a population shows unacceptable declines, initiate more intensive monitoring or research to determine cause of decline, or implement management actions (if indicated by available data or information). Monitoring and management may remain unchanged, however, if the Coordinating Committee (see Section XIII) determines that consistent declines at all monitored sites are attributable to weather-related fluctuations or some other factor not controllable through management.
2. Management actions will be triggered by a decline in population size or density of more than 30% from the existing size of the population at the Badger Pass Microwave Site (MT005) over the five year period of the CS.	2. This threshold decrease level was chosen because this population appears to be more stable than any of the others monitored. A decline of 30% would exceed the declines measured at this site, and would be a conservation concern.	2. Monitor using the existing marked plants (monitored since 1990) and transects (monitored since 1991).	2. If unacceptable declines are measured, more intensive monitoring or management actions will be implemented.
3. Management actions will be triggered by a decrease in population size or density at the Big Hole River site (MT049) of more than 20% from the 1994 size over the five year period of the CS.	3. Because of the high mortality experienced by this population in 1993 (dead stems still visible in 1994), any further decreases are a conservation concern.	3. Monitor using the transects established in 1994.	3. If unacceptable declines are measured, more intensive monitoring or management actions will be implemented.
4. Management response will be triggered by an increase in knapweed frequency of more than 20% over the five year period of the CS, compared to that measured during the first year of monitoring. Treatment may be implemented	4. Knapweed represents the biggest threat to most of the "A" populations, but some populations appear to be coexisting with knapweed. For these populations, chemical treatment may be a more serious threat than the knapweed. This level of increase in knapweed was chosen as the threshold above	4. Implement monitoring in FY1997. Standard Monitoring Method (Appendix VII).	4. If unacceptable increases occur, control activities will be initiated. Treatment of knapweed without monitoring data may be initated at the discretion of the specialist. Choice of control measure will be determined on a site-specific basis by the specialist. An increase in monitoring

immediately if infestations are small and controllable with prompt treatment, or are aggressive and clearly threatening *P. lemhiensis*.	which control activities will be initiated. Treatment may be initiated immediately, however, for populations that are clearly threatened, or for small infestations that could be quickly controlled with minimal effects on *P. lemhiensis*.		intensity to measure the response of *P. lemhiensis* in treatment areas is recommended.

3. Class B Populations

Class B PopulationsClass B Populations

Conservation actions are similar, but less stringent than those recommended for Class A populations. Monitoring requirements are also reduced, but all Class B populations should be monitored. Class B populations are listed in Appendix I, Table 2 and are summarized here: Table 10 summarizes management actions for Protection Class B populations and Table 11 summarizes resource objectives. Location of these populations is illustrated on Map 3, Appendix VIII.

Beaverhead NF — **Quartz Hill Gulch (MT010), Red Butte (MT012), Kearns Creek (MT018)**

Bitterroot NF — **Upper WF Bitterroot (MT045), Castner (MT061), Beaver Creek (MT073), Robbins Gulch (MT075)**

Butte BLM — **Ermont Gulch (MT014), Roberts Gulch (MT015), Bloody Dick 1 (MT028), Hwy 43/Big Hole (MT058)**

Salmon NF — **Williams Creek Summit (ID003), Cliff Creek (ID004), Napoleon Ridge (ID022), Trapper Flat (ID026), Fitzer Flat (ID027), Ridge Road (ID069), Deep Creek (ID088), Ransack (ID092), Birch Creek Trail (ID093)**

Salmon BLM — **Wimpy Creek (ID010), Warm Springs (ID012)**

Table 10. Management Actions and resource objectives recommended for Protection Class B populations. Table continued on following page.

Action	Rationale	Implementation and Monitoring	Management Response
Standard Management Actions			
1. Limit grazing use of inflorescences to no more than 50% of available, unless grazing occurs after seed dissemination.	1. This level is higher than that allowed in Class A populations, a reflection of the lower	1. Begin application of standard in the 1997 grazing season. Monitor with standard	1. Since grazing damage may also be attributable to deer, inflorescence loss must exceed this limit for two years before alternatives will be considered to restrict livestock access to the

Action	Rationale	Implementation and Monitoring	Management Response
seed dissemination.	conservation value of B populations.	method, Appendix VII.	population during the blooming period. It is unlikely that such heavy use by native ungulates will occur consistently. If after two years of observations, utilization does not appear to be a factor, monitoring may be discontinued until domestic grazing use changes.
2. Design mineral exploration activities to avoid areas occupied by *P. lemhiensis*.	2. Many resource specialists have had good success working with miners to avoid sensitive resources.	2. Track conflicts and resolutions and describe in annual report.	2. If conflict cannot be avoided, another similar population (from the "C" list) will be designated as a "B" population to replace the impacted one. Selection from the C category should consider geographic distribution as well as population size and quality.

Table 10. Management actions for Protection Class B populations. Table continued from previous page.

Action	Rationale	Monitoring	Management Response
3. Proposed road maintenance and reconstruction activities planned in the vicinity of a designated population should be evaluated. If there is potential for impact, the population should be flagged, reviewed on-site with road crews, and avoided.	3. About 70% of the "B" populations are at least partially along road cut or fill slopes, but potential impacts can be easily avoided because populations are localized.	3. Track conflicts and resolutions and describe in annual report.	3. Unavoidable impacts resulting from maintenance required for safety will be mitigated on a case-by-case basis.
4. Review proposed weed control activities annually. If actions are to occur in the vicinity of a designated population, the population should be flagged, reviewed on-site with spray crews, and avoided. Timing of treatment may be restricted to the blooming period of *P. lemhiensis* to facilitate detection of plants.	4. Impacts from herbicide application can be avoided in the small portion of roadcuts occupied by *P. lemhiensis.* Where knapweed or other weeds may be a problem, control activities can be implemented on an experimental basis.	4. Track conflicts and resolutions and describe in annual report.	4. Weed control activities in populations are allowed if conducted for experimental purposes and to benefit *P. lemhiensis.*
5. Negative effects from Timber harvest and associated activities (landings, roads, etc.) on Protection Class B populations will be minimized through use of one or more of the following: 1) avoidance of areas of *P. lemhiensis* occurrence through sale layout and design; 2) helicopter logging; and 3) winter logging on ground frozen to a depth of 10cm or more with 25cm or more snow cover. Sales in *P. lemhiensis* class B populations will be closely administered to ensure that that restrictions are not violated. Experimental prescriptions designed to remove understory trees and enhance the savannah structure of old growth stands and *P. lemhiensis* habitat are encouraged.	5. Such design should reduce threats to *P. lemhiensis* to a reasonable level, while allowing for timber production and stand and habitat enhancement under ecosystem management strategies.	5. Monitoring should be designed to measure the effects of the treatment, and at minimum include both treatment and control units. Specific design depends on situation.	5. Effects will be assessed and mitigating actions implemented on a case-by-case basis.
6. Timber harvest and associated activities should not occur in population areas occupying small	6. Such restrictions should have minimal	6. Inventory proposed harvest areas; monitor	6. If populations are inadvertently damaged, the

openings.. Harvest may occur in adjacent areas if the population is completely avoided. Buffers may be included where needed.	**effects on timber harvest, but will eliminate direct impacts from associated activities such as road building.**	**harvest activities to ensure populations are not affected.**	**damaged area will be monitored to measure recovery and recolonization.**

Table 11. Objectives for *P. lemhiensis* populations and habitat at Protection Class B populations.

Resource Objectives	Rationale	Monitoring	Management Response
1. Management actions at a Class B population will be triggered by a decline in the size or density of the population of more than 50% over the five year period of the CS as measured against the 1996 size.	1. This level is the same as that established for "A" populations.	1. Standard Monitoring Method (Appendix VII).	1. If the population shows unacceptable declines, compare to other monitored populations. If the downward trend seems to be limited to a particular population, more intensive monitoring, or management actions (if indicated by available data or information) may be implemented.
2. Management response will be triggered by an increase in knapweed frequency of more than 20% over the five year period of the CS, compared to that measured during the first year of monitoring. Treatment may be implemented immediately if infestations are small and controllable with prompt treatment, or are aggressive and clearly threatening *P. lemhiensis*.	2. Knapweed represents the biggest threat to most of the "B" populations, but some populations appear to be coexisting with knapweed. For these populations, chemical treatment may be a more serious threat than the knapweed. This level of increase in knapweed was chosen as the threshold above which control activities will be initiated. Treatment may be initiated immediately, however, for populations that are clearly threatened, or for small infestations that could be quickly controlled with minimal effects on *P. lemhiensis*.	2. Implement monitoring in FY1997. Standard Monitoring Method (Appendix VII).	2. If unacceptable increases occur, control activities will be initiated. Treatment of knapweed without monitoring data may be initated at the discretion of the specialist. Choice of control measure will be determined on a site-specific basis by the specialist. An increase in monitoring intensity to measure the response of *P. lemhiensis* in treatment areas is recommended.

4. Class C and D Populations

Class C and D PopulationsClass C and D Populations

Conservation actions for Class C populations focus on minimizing impacts from roadside activities (Table 12). Class D populations may not receive any special management, although they may be protected from activities such as road maintenance and weed control at the discretion of the resource specialist. In the summer field season before this CS terminates, all Class D populations will be revisited to determine how many of them were lost with this approach.

Populations classified as C and D populations are listed in Appendix I. Location of these populations is illustrated on Map 3, Appendix VIII.

Table 12. Management actions for Class C populations.

Action	Implementation	Monitoring	Management Response
Standard Management Actions			
1. Proposed road maintenance and reconstruction activities planned in the vicinity of a designated population should be evaluated. If there is potential for impact, the population should be flagged and reviewed on-site with road crews.	**1. About 65% of the "C" populations may be affected by this activity.**	**1. Track conflicts and resolutions and describe in annual report.**	**1. Unavoidable maintenance impacts will be evaluated on a case-by-case basis.**
2. Review proposed weed control activities annually. If actions are to occur in the vicinity of a designated population, the population should be flagged and reviewed on-site with spray crews Timing of treatment may be restricted to the blooming period of *P. lemhiensis* to facilitate detection of plants.	**2. About 65% of the "C" populations may be affected by this activity.**	**2. Track conflicts and resolutions and describe in annual report.**	**2. Weed control activities may be allowed in populations that appear to be impacted by knapweed. The response of *P. lemhiensis* and reduction of knapweed should be monitored.**

11. Research

ResearchResearch

The following research is proposed for all parties managing *P. lemhiensis* populations. Interagency funding and cooperation should be considered where appropriate. Information on germination and seedbank dynamics, fire ecology and options in weed control will allow for the development of more specific management actions in the revision of this CS, which is recommended in approximately five years.

1. Germination and Seedbank

Germination and SeedbankGermination and Seedbank

Seed viability and germination requirements for *P. lemhiensis* should be determined. Bitterroot Native Growers has completed some trials for *P. lemhiensis*. Personnel at the USDA-FS shrub lab in Provo have also conducted limited trials for *P. lemhiensis;* extensive trials contracted by the Montana Natural Heritage Program are nearly completed (Meyer, personal communication; Heidel, personal communication).

The germination ecology of other *P.* species and observations in monitored populations strongly suggest that *P. lemhiensis* forms a seedbank. The longevity of the seedbank is, however, unknown, but has important implications for management of this species. Burial trials, complemented with seed storage and periodic germination trails, may be initiated by the Montana Natural Heritage Program, depending on the results of the germination studies (Heidel, personal communication).

2. Fire Ecology

Fire EcologyFire Ecology

The fire ecology of *P. lemhiensis* is interrelated with its competitive interactions with other species and its potential interaction with spotted knapweed. Effects of fire are direct (mortality of existing individuals) and indirect (effect on community dynamics) and will vary by season of burning and fire intensity. Such complication forms a difficult research situation. Initially, trials could be done in which populations are burned and the response monitored. Such trials are currently underway at two Beaverhead NF sites (Canyon Creek, MT038; and Badger Pass North, MT019), and one Butte BLM site (Badger Pass Microwave, MT005), coordinated by the Montana Natural Heritage Program (Heidel, personal communication). The study focuses on mortality of existing plants and the effects of burning on recruitment of seedlings. Additional fire response studies are planned by the Bitterroot NF in conjunction with the Intermountain Research Station in Missoula.

In Idaho, one site (Trapper Flat, ID026) was treated with a combined burn and weed treatment, and used for a helicopter landing during a timber sale in 1996. Adult plants of *P. lemhiensis* were transplanted to a portion of the site that was not treated. It is hoped that *P. lemhiensis* will respond favorably from the seedbank. The response of this treatment on *P. lemhiensis* is being monitored.

Information from these initial studies will be limited by the lack of controls, although one site (Canyon Creek) will have a burned and unburned treatment. At a minimum continued monitoring at unburned nearby sites should remain a priority. These can aid in the interpretation of the response to burning and effects due to weather. Care should be used in applying results from these prescribed fire studies to other populations for two reasons. First, the lack of controls means that interpretation will be limited, because although the response measured may be due to the fire, it may also be caused by some other factor such as high spring moisture.. The second reason is that none of the current fire ecology studies measures the response of knapweed. Even if there are favorable responses measured at the burned sites, using prescribed fire at other sites, especially those with heavy knapweed infestation, may be inappropriate, resulting in increases in knapweed rather than *P. lemhiensis* (Roche, personal communication).

3. Weed Control

Weed ControlWeed Control

Biological control agents have not yet been shown effective for spotted knapweed control (Roche, personal communication), so control efforts in the near future will likely rely primarily on chemical methods. The use of the most commonly applied chemical, 2-4-D, is known to result in high mortality of *P. lemhiensis*, as well as associated forbs. Two other chemical control agents may have potential for *P. lemhiensis* sites: picloram and clopyralid. These chemicals have been shown to control knapweed without resulting in complete eradication of all associated forbs (Roche, personal communication), but their affect on *P. lemhiensis* is unknown. Dosage response trials should be completed to determine the highest application levels possible to control knapweed without killing *P. lemhiensis*. These trials could be completed under natural conditions using protection class C or D populations.

12. Inventory

InventoryInventory

Two types of inventory work are recommended for agencies administering lands with potential habitat for *P. lemhiensis.* The first type, often called clearance inventories or project inventories, are surveys undertaken in areas where management actions that could impact *P. lemhiensis* and other sensitive species are proposed. These surveys, especially when the project area is large, should be conducted during flowering when the plant is easily located. This recommended action should impose no undue burden, since it is current policy of all concerned federal agencies to conduct project surveys as part of NEPA analysis and Threatenend, Endangered and Sensitive Species assessments. Acreage surveyed annually will vary with projects proposed.

The second type of inventory work consists of specific surveys to locate new populations of *P. lemhiensis*. Such work is made difficult by the nonspecificity of *P. lemhiensis* habitat. Nearly every aspect, elevation, slope, and soil type have potential for occupation. An effective way, however, to locate new *P. lemhiensis* populations in native (non-roadcut) habitat is to survey along roads and trails within the geographic range of the species. In most cases, a road or trail-side population is an indicator of a nearby native population that served as a seed source (Croft 1990).

The recommended strategy is for each agency to survey a certain amount of road or trail miles per year for five years (1997-2001), or to conduct the entire amount of survey miles within a single fiscal year, perhaps to take advantage of a good flowering year (Table 13). These surveys should focus on 4-wheel drive roads and jeep trails as well as trails accessible by motorcycle or horseback. Roads may be surveyed that have been surveyed in the past in order to better document location and size, and possibly locate new populations. Any located roadside populations should be used as the center of an inventory rectangle of native habitat, 0.25 mile wide and 1 mile long, with the long axis running parallel to the road. Surveys should be completed by botanists or biologists with training in plant identification. Recommended for the Salmon NF and Beaverhead NF are 70 road miles per year, for a total of 350 over the five year period. Recommended for the Bitterroot NF, Butte BLM (primarily Dillon Resource Area) and Salmon BLM (Lemhi Resource Area) are 50 miles per year (250 miles total) and for the Deerlodge NF, 30 miles (150 total). Areas with high potential are identified in Table 13 as focus areas, but other areas may be surveyed instead if the agency specialist deems appropriate.

In addition, all field-going personnel should be trained to recognize *P. lemhiensis* and be asked to document occurrences. Documentation should include collection of a flowering spike (from a fairly large population), or of a few flowers, complete with sepals, from a small population (< 20 reproductive individuals), so

that the identification can be verified by the agency botanist or sensitive plant coordinator.

Finally, survey work is recommended in some areas in the Frank Church River of No Return Wilderness (Salmon NF), the Selway-Bitterroot Wilderness and the Anaconda-Pintlar Wilderness. Only the first wilderness area is recommended as a specific inventory action because of the proximity of populations to the boundary and the known occurrence of suitable habitat. Survey work in the Selway-Bitterroot and Anaconda-Pintlar wilderness areas should be done as feasible, primarily using personnel with other responsibilities in these areas.

Documentation of located sites should be included in the annual report and also reported to the Idaho Conservation Data Center or the Montana Natural Heritage Program. Populations may be documented using standard agency forms, or the form presented in Appendix VII.

Table 13. Proposed *P. lemhiensis* inventory responsibilities for 1997 through 2000.

Responsible Party	Action	Proposed Completion Date
Salmon NF	Inventory 70 miles of road or trail annually. Focus on the west slope of the Beaverhead Mountains from Bannock Pass to Lost Trail Pass, the Salmon River Range north of Williams Creek Summit, and the area between the Salmon River and the Montana boundary. Survey work is also proposed for the Frank Church River of No Return Wilderness: 15 person days.	Road inventories done annually from 1997 to 2001, or the entire 350 miles completed by the end of FY2000. Frank Church survey work completed by end of FY 2000.
Beaverhead NF	Inventory 70 miles of road or trail annually. Focus on the lower elevations of the Pioneers, the east side of the Beaverhead Mountains, and the SE side of the Anaconda Range.	Road inventories done annually from 1997 to 2001, or the entire 350 miles completed by the end of FY2000.
Deerlodge NF	Inventory 30 miles of road or trail annually. Focus on the area between the Anaconda-Pintlar Wilderness and the Mt. Haggin area, the area north of Wise River and the Highland Mountain region.	Road inventories done annually from 1997 to 2001, or the entire 150 miles completed by the end of FY2000.
Bitterroot NF	Inventory 50 miles of road or trail annually. Focus on the East and West Forks of the Bitterroot and low elevation sites along the Bitterroot River.	Road inventories done annually from 1997 to 2001, or the entire 250 miles completed by the end of FY2000.
Butte BLM	Inventory 50 miles of road or trail annually. Focus on Big Hole Valley and Horse Prairie area.	Road inventories done annually from 1997 to 2001, or the entire 250 miles completed by the end of FY2000.
Salmon BLM	Inventory 50 miles of road or trail annually. Focus on west flank of the Beaverhead/ Bitterroot Range.	Road inventories done annually from 1997 to 2001, or

Responsible Party	Action	Proposed Completion Date
		the entire 250 miles completed by the end of FY2000.
All	Hold one training session each year for new personnel on the recognition of *P. lemhiensis* and data recording procedures for use by non-specialists and field crews.	Annually, if new personnel have been added since the last session.

13. Coordination

CoordinationCoordination

Annual reports should be prepared by each agency, summarizing the implementation of management actions in *P. lemhiensis* populations and the results of inventory, research, and monitoring. These reports should be disseminated to all parties administering or having and interest in *P. lemhiensis* populations (e.g., all participating NF and BLM offices, USFWS, the Idaho Conservation Data Center, the Montana Natural Heritage Program, the Big Hole Battlefield National Monument). These reports should be due by the end of February of each year. They are not meant to be onerous or formal, but simply a brief written summary of actions and information to facilitate communication. Coordination should also be facilitated by annual winter meetings to discuss *P. lemhiensis* management and share information. Suggested scheduling is either annually or every two years. Meetings may be held in conjunction with annual rare plant conferences. Representatives from the Bitterroot NF, Beaverhead NF, Deerlodge NF, Salmon NF, Salmon BLM, and Butte BLM should attend. These agents form a "Coordinating Committee" that will collectively make changes in the strategy as they become necessary and determine priorities. A recorder should be designated for each meeting and the notes forwarded to Regional FS representatives, the BLM state botanists, the Idaho CDC and the MNHP.

14. Reviewers

ReviewersReviewers

Cindy Haggas, Ecologist, Salmon NF, North Fork District, North Fork, Idaho
Brian Hockett, Ecologist, Dillon Resource Area, Butte District BLM, Dillon, Montana
Pat Hurt, Wildlife Biologist, Salmon NF, Salmon, Idaho
John Joy, Ecologist, Deerlodge NF, Butte, Montana
Linda Pietarinen, Ecologist, Bitterroot NF, Hamilton, Montana
Diane Schuldt, Wildlife Biologist, Salmon NF, Salmon, Idaho
Steve Shelly, Regional Botanist, Forest Service, Region 1, Missoula, Montana
Helen Ulmschnieder, Ecologist, Lemhi Resource Area, Salmon District BLM, Salmon, Idaho

Dick Wenger, Wildlife Biologist/Sensitive Plant Coordinator, Salmon NF, Salmon, Idaho

15. References

ReferencesReferences

Achuff, P.L. 1992. Demographic monitoring of *Penstemon lemhiensis*, Dillon Resource Area. Helena, MT: Montana Natural Heritage Program.

Achuff, P.L.; Shelly, J.S. 1991. Demographic monitoring of *Penstemon lemhiensis*, Beaverhead National Forest, 1990 Progress Report. Helena, MT: Montana Natural Heritage Program.

Babits, G. 1994. Personal communication. Geologist. Salmon, ID: USDI-Bureau of Land Management, Lemhi Resource Area.

Barrett, S.W. 1988. Fire suppression's effects on forest succession within a central Idaho Wilderness. Western Journal of Applied Forestry 3:76-80.

Barrett, S.W.; Kilgore, B.M. 1985. Wilderness fire history studies in the Northern Rockies. Page 315 *in* Lotan, J.E. et al., Technical Coordinators. Proceedings -- Symposium and Workshop on Wilderness Fire. General Technical Report INT-182. Ogden, UT: USDA-FS, Intermountain Research Station.

Carry, J.H. 1995; Winkler, G. 1987. *Centaurea maculosa*. *In* Fischer, W.C., compiler. The Fire Effects Information System (*database*). Missoula, MT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Intermountain Fire Sciences Laboratory.

Clark, D.V. 1971. Speciation in *Penstemon* (Scrophulariaceae). Ph.D. Dissertation. Missoula, MT: University of Montana.

Crofts, K. 1990. Draft Beartrack Project Vegetation Technical Report. Steamboat Springs, CO: ACZ INC. Engineering and Environmental Services; 1475 Pine Grove Road, Suite 205. On file at Boise, ID: Conservation Data Center and at Salmon Idaho: Salmon National Forest Supervisor's Office.

Cronquist, A. 1994. Intermountain Flora. Volume 4, Asterales. Bronx, NY: New York Botanical Gardens.

Cronquist, A.; Holmgren, A.H.; Holmgren, N.H.; Reveal, J.L.; Holmgren, P.K. 1984. Intermountain Flora. Volume Four. Bronx, NY: New York Botanical Garden.

Dorn, R.D. 1984. Vascular Plants of Montana. Cheyenne, WY: Mountain West Publishing.

Eddleman, L.E.; Romo, J.T. 1988. Spotted knapweed germination response to stratification, temperature, and water stress. Canadian Journal of Botany 66: 653-657.

Heidel, B.L. 1995, 1996. Personal communication. Botanist. Helena, MT: Montana Natural Heritage Program.

Heidel, B.L.; Shelly, J.S. 1993. Demographic monitoring of *Penstemon lemhiensis*, Dillon Resource Area, Bureau of Land Management, 1992 progress report. Helena, MT: Montana Natural Heritage Program.

Henderson, D.M. 1981. *Penstemon lemhiensis*. Page 32 *in*: Rare and Endangered Plants Technical Committee, Idaho Natural Areas Council. Vascular Plant Species of Concern in Idaho. Moscow, ID: University of Idaho Forest, Wildlife and Range Experiment Station, Bulletin No 34.

Henderson, R. 1996. Personal communication. Minerals Specialist. Salmon, ID: Salmon and Challis National Forest, Supervisor's Office.

Heinze, D. 1995. Personal communication. State Botanist (retired). Helena, MT: USDI-Bureau of Land Management, Montana State Office.

Hitchcock, C.L.; Cronquist, A.; Ownbey, M; Thompson, J.W. 1959. Vascular Plants of the Pacific Northwest, Part Four. Seattle, WA: University of Washington Press.

Hitchcock, C.L.; Cronquist, A. 1973. Flora of the Pacific Northwest. Seattle, WA: University of Washington Press.

Joy, J. 1995. Personal communication. Ecologist. Butte, MT: USDA-Forest Service, Deerlodge National Forest.

Keck, D.D. 1940. Studies in *Penstemon*. VII. The subsections *Gairdneriani, Deusti* and *Arenarii* of the *Graciles*, and miscellaneous new species. American Midland Naturalist 23:594-616.

Keck, D.D.; Cronquist, A. 1957. Studies in *Penstemon*. IX. Notes on northwestern American species. Brittonia 8:247-250.

Lanier, T. 1995. Intermountain Region Proposed, Endangered, Threatened and Sensitive Species List. Odgen, UT: USDA-Forest Service, Region 4, Regional Office.

Lesica, P. 1987. A technique for monitoring nonrhizomatous, perennial plant species in permanent belt transects. Natural Areas Journal 7:65-68.

Lesica, P.; Moore, G.; Peterson, K.M.; Rumely, J.H. 1984. Vascular Plants of Limited Distribution in Montana. Monograph No. 2, Montana Academy of Sciences, Supplement to the Proceedings, Vol. 43.

Lesica, P.; Shelly, J.S. 1991. Sensitive, Threatened and Endangered Vascular Plants of Montana. Helena, MT: Montana Natural Heritage Program, Occasional Publication No. 1.

Locken, L.J.; Kelsey, R.G. 1987. Cnicin concentrations in *Centaurea maculosa*, spotted knapweed. Biochemical Systematics and Ecology 15(3): 313-320.

Meyer, S.E. 1995. Personal communication. Research Ecologist. Provo, UT: USDA-FS, Shrub Lab, Intermountain Research Station.

Meyer, S.E.; Kitchen, S.G. 1994. Habitat-correlated variation in seed germination response to chilling in *Penstemon* Section Glabri (Scrophulariaceae). American Midland Naturalist 132:349-365.

Meyer, S. E.; Kitchen, S.G.; Carlson, S.L. 1994. Seed germination timing patterns in Intermountain *Penstemon* (Scrophulariaceae). American Journal of Botany 82(3):377-389.

Noste, Nonan V. 1982. Vegetation response to spring and fall burning for wildlife habitat improvement. *In*: Baumgartner, David M., compiler & editor. Site preparation and fuels management on steep terrain: Proceedings of a symposium; 1982 February 15-17; Spokane, WA. Pullman, WA: Washington State University, Cooperative Extension: 125-132.

Ramstetter, J. 1983. An ecological study of the regional endemic *Penstemon lemhiensis* (Keck) Keck and Cronq. (Scrophulariaceae). M.S. thesis. Missoula, MT: University of Montana.

Reel, S.; Schassberger, L.; Ruediger, W. 1989. Caring for our Natural Community: Region 1 Threatened, Endangered and Sensitive Species Program. Missoula, MT: USDA-Forest Service, Wildlife and Fisheries.

Roche, C. 1995. Personal communication. Weed Specialist. Moscow, ID: University of Idaho.

Rosentreter, R. 1995. Personal communication. State Botanist. Boise, ID: USDI-Bureau of Land Management, Idaho State Office.

Schirman, R. 1981. Seed production and spring seedling establishment of diffuse and spotted knapweed. Journal of Range Management 34(1): 45-47.

Schuldt, D. 1994. Personal communication. Wildlife Biologist. Salmon, ID: USDA-Forest Service, Salmon and Challis National Forests, Cobalt Resource Area.

Shelly, J.S. 1987. Status review of *Penstemon lemhiensis*. Unpublished Report to USDA Forest Service, Region 1, Beaverhead and Bitterroot National Forests. Helena, MT: Montana Natural Heritage Program.

Shelly, J.S. 1990a. Report on the conservation status of *Penstemon lemhiensis*, a candidate threatened species: Montana. Unpublished Report to the U.S. Fish and Wildlife Service. Helena, MT: Montana Natural Heritage Program.

Shelly, J.S. 1990b. Status review update and establishment of demographic monitoring studies: *Penstemon lemhiensis*. Unpublished Report to USDA Forest Service, Region 1, Beaverhead and Bitterroot National Forests. Helena, MT: Montana Natural Heritage Program.

Shelly, J.S. 1995. Personal Communication. Regional Botanist. Missoula, MT: USDA-FS, Regional Office, Region 1.

Shelly, J.S.; Achuff, P.L. 1992. Demographic monitoring of *Penstemon lemhiensis*, Beaverhead National Forest, 1991 progress report. Helena, MT: Montana Natural Heritage Program.

Shelly, J.S.; Heidel, B.L. 1993. Demographic monitoring of *Penstemon lemhiensis*, Beaverhead National Forest, 1992 progress report. Helena, MT: Montana Natural Heritage Program.

USDA Forest Service. 1994. Update of Northern Region (Region 1) Sensitive Species List. Missoula, MT: USDA Forest Service, Region 1, Regional Office. Reference Number 2670.

USDI. 1975. Threatened or endangered fauna or flora; Review of status of vascular plants and determination of "critical habitat." Federal Register 40(127): 27824-27924.

USDI. 1980. Endangered and threatened wildlife and plants; Review of plant taxa for listing as endangered or threatened species. Federal Register 45(252): 82480-82569.

USDI. 1983. Endangered and threatened wildlife and plants; Supplement to review of plant taxa for listing; Proposed rule. Federal Register 48(229): 53640-53670.

USDI. 1985. Endangered and threatened wildlife and plants; Review of plant taxa for listing as endangered or threatened species. Federal Register 50(188): 39525-39584.

USDI. 1990. Endangered and threatened wildlife and plants; Review of plant taxa for listing as endangered or threatened species. Federal Register 55(35): 6183-6229.

USDI. 1993. Endangered and threatened wildlife and plants; Review of plant taxa for listing as endangered or threatened species. Federal Register 58(188): 51144-51190.

USDI. 1996. Endangered and Threatened Wildlife and Plants; Review of Plant and Animal Taxa That Are Candidates for Listing as Endangered or Threatened Species. Federal Register Notice 61(40): 7596-8613.

Watson, T.J. 1976. An evaluation of putatively threatened or endangered species from the Montana Flora. Missoula, MT: Department of Botany, University of Montana.

Wenger, D. 1995. Personal Communication. Wildlife Biologist. Salmon, ID: Supervisor's Office, Salmon and Challis National Forests.

Penstemon lemhiensis occurrences in Montana.

Information derived from Lemhi Penstemon Conservation Strategy Appendix 1 Table 2 (1997) and Montana Heritage Program records as of May 24, 2005.

CS ID (EO_NUM)	Ownership	Protection Class	# Individ.	Last Observed	2005 surveyor	Comments
1 (1)	B-DNF (Private)	B	101-1000	1988	Wooley/Gibson	
2 (2)	Private	C	60-70	1989	B Hockett	roadside
3 (3)	Private	C	164 in 1983	1993	B Hockett	knapweed
4 (4)	Private (BNF)	C	83	1989	?Bitterroot NF	weeds
5 (5)	BLM	A	? 60 in 2004	1989	B Hockett	
6 (6)	NPS – Big Hole	A	447	1999	S Rinehart?	
7 (7)	Private (BNF)	C	10	1989	?Bitterroot NF	knapweed
8 (8)	BLM	A	1 in 1984	1990	B Hockett	*Positive ID needed.*
9 (9)	B-DNF	D	40-47	1997	Wooley/Gibson	
10 (10)	B-DNF	B	203	1986	Wooley/Gibson	
11 (11)	B-DNF	B	252 in 1986	1989	Wooley/Gibson	
12 (12)	B-DNF	B	12	1989	Wooley/Gibson	
13 (13)	B-DNF	C	100-125	1986	Wooley/Gibson	
14 (14)	BLM	D	2	1990	Wooley/Gibson	
15 (15)	BLM	B	9	1994	B Hockett	
16 (16)	B-DNF	D	8-10	1995	Wooley/Gibson	
17(17)	B-DNF	D	4	1993	Wooley/Gibson	
18 (18)	B-DNF (Private)	B	50	1989	Wooley/Gibson	
19 (19)	B-DNF	A	?	1989	Wooley/Gibson	
20 (20)	B-DNF	C	6	1987	B Hockett	
21 (none)	Private	unknown	unknown	1947	S Rinehart	W of Big Hole Battlefield. Historic record.
None (22)	Private (BLM)	unknown	unknown	1987	B Hockett	*Positive ID needed.*
23 (23)	B-DNF	A	17 in 1989	1994	S Rinehart	uncommon
24 (24)	BLM	C	17 in 1990	1990	B Hockett	
25 (25)	Private	A	110	1989	S Rinehart	
26 (26)	Private	C	117	1991	S Rinehart	Relocated in 1991 by Quinn Carver
27/28 (27)	BLM	B	3	1994	B Hockett	
29 (29)	BLM (Private)	D	33	1993	B Hockett	
30 (30)	BNF	D	4	1989	?Bitterroot NF	knapweed
31 (31)	BNF (Private)	D	14	1989	?Bitterroot NF	knapweed

U = unknown; EO = Montana Heritage occurrence; CS = Lemhi Penstemon Conservation Strategy

May 31, 2005

***Penstemon lemhiensis* occurrences in Montana.**

Information derived from Lemhi Penstemon Conservation Strategy Appendix 1 Table 2 (1997) and Montana Heritage Program records as of May 24, 2005.

CS ID (EO_NUM)	Ownership	Protection Class	# Individ.	Last Observed	2005 surveyor	Comments
32 (32)	Private	D	50+	1989	Wooley/Gibson	
33 (33)	Private	D	2	1989	Wooley/Gibson	
34 (34)	Private	C	74	1989	B Hockett	
35 (35)	BLM/B-DNF	D	68	1993	B Hockett	
36 (36)	Private	C	73	1992	S Rinehart	Potentially extirpated by road construction
37 (37)	BNF	C	57	1992	?Bitterroot NF	knapweed
38 (38)	B-DNF	B	65	1993	Wooley/Gibson	knapweed
39 (NA)	B-DNF (Private)	D	U	1992	B Hockett	MT Heritage reflects different location/EO#24?
NA (39)	Private	U	5	1992	S Rinehart	CS reflects different location.
40 (none)	Private	C	U	1992	Wooley/Gibson	
41 (NA)	BLM	D	U	1990	B Hockett	MT Heritage reflect different location/EO#35?
42 (42)	Private	D	12	1990	S Rinehart	
43 (43)	BNF	D	40	1994	?Bitterroot NF	
44 (44)	B-DNF	D	21	1990	Wooley/Gibson	degraded by livestock
45 (45)	BNF	B	comments	1992	?Bitterroot NF	12 subpop'ns with 12 – 50 individ each
46 (46)	B-DNF	A	200+	1993	S Mincemoyer	
47 (47)	Private	A	100 - 200	1992	S Mincemoyer	
48 (48)	B-DNF	C	3-17	1993	S Rinehart	Ecodata plot #2PL115
49 (49)	BLM/B-DNF	A	comments	1996	S Rinehart	~37 subpop'ns/530 rosettes, Section 18 not included
50 (50)	BNF	D	14	1992	?Bitterroot NF	
51 (none)	BNF	C	U	1992	?Bitterroot NF	
52 (52)	B-DNF	A	26	1992	S Rinehart	
53 (53)	B-DNF	C	4	1994	S Rinehart	
54 (54)	B-DNF	D	14	1992	S Rinehart	
55 (55)	B-DNF	D	52	1993	S Rinehart	
56 (56)	BNF	B	30	1997	?Bitterroot NF	
57 (57)	BLM (Private)	C	1	1993	S Rinehart	
58 (none)	B-DNF	C	U	1994	S Rinehart	
59 (59)	Private	B	80-90	1993	S Rinehart	
60 (60)	BNF	C	47	1995	?Bitterroot NF	

U = unknown; EO = Montana Heritage occurrence; CS = Lemhi Penstemon Conservation Strategy

May 31, 2005

Penstemon lemhiensis occurrences in Montana.

Information derived from Lemhi Penstemon Conservation Strategy Appendix 1 Table 2 (1997) and Montana Heritage Program records as of May 24, 2005.

CS ID (EO_NUM)	Ownership	Protection Class	# Individ.	Last Observed	2005 surveyor	Comments
61 (61)	BNF	D	59	1993	?Bitterroot NF	
62 (62)	BNF	D	14	1994	?Bitterroot NF	
63 (63)	B-DNF	A	61	1993	S Rinehart	
64 (64)	BNF	C	16	1993	?Bitterroot NF	
65 (65)	B-DNF	D	6+	1993	S Rinehart	
66 (66)	B-DNF	D	26	1994	S Rinehart	
67 (none)	BNF	C	U	1992	?Bitterroot NF	
68 (68)	BNF	C	12	1994	?Bitterroot NF	
69 (none)	BNF	D	U	1984	?Bitterroot NF	
70 (70)	BNF	D	2	1994	?Bitterroot NF	
71 (71)	BNF	D	8	1994	?Bitterroot NF	livestock trails w/lots of knapweed
72 (72)	BNF	D	5-7	1994	?Bitterroot NF	
73 (73)	BNF	B	50-80	1994	?Bitterroot NF	
74 (74)	BNF	B	24	1994	?Bitterroot NF	
75 (75)	BNF	B	95-100	1994	?Bitterroot NF	dense knapweed
76 (76)	BNF	D	97	1995	?Bitterroot NF	4 subpop'ns
77 (77)	BNF	B	54	1998	?Bitterroot NF	4 subpop'ns

Additional Montana Heritage Records

2005 Surveyor	EO_NUM
Bitterroot NF	80, 86, 87, 88, 90
B Hockett	85 *positive ID needed*
S Rinehart	89
Wooley/Gibson	79, 82, 83, 84, 91

U = unknown; EO = Montana Heritage occurrence; CS = Lemhi Penstemon Conservation Strategy

May 31, 2005