REPORT ON THE CONSERVATION STATUS OF *Primula alcalina*, A PROPOSED CANDIDATE SPECIES

by

Robert K. Moseley
Natural Heritage Section
Nongame Wildlife/Endangered Species Program
Bureau of Wildlife

February 1989

Idaho Department of Fish and Game
600 South Walnut, P.O. Box 25
Boise, Idaho 83707
Jerry M. Conley, Director

Status Survey Report prepared for
Idaho Department of Parks and Recreation
through Section 6 funding from
U.S. Fish and Wildlife Service, Region 1

REPORT ON THE CONSERVATION STATUS OF
PRIMULA ALCALINA, A PROPOSED CANDIDATE SPECIES

Taxon Name:	Primula alcalina A. Cholewa & D. Henderson
Common Name:	Alkali Primrose
Family:	Primulaceae
States Where Taxon Occurs:	U.S.A., Idaho, Montana (extirpated)
Current Federal Status:	Proposed Category 2
Recommended Federal Status:	List as Threatened
Author of Report:	Robert K. Moseley
Original Date of Report:	February 25, 1989
Date of Most recent Revision:	N/A

Individual to Whom Further Information and Comments Should be Sent:

Robert K. Moseley
Idaho Natural Heritage Program
Idaho Department of Fish and Game
P.O. Box 25
Boise, ID 83707

ABSTRACT

Primula alcalina (alkali primrose), until recently thought to be conspecific with P. incana, is a narrow endemic, remaining only in east-central Idaho. It is considered extinct in Montana. Alkali primrose is proposed for federal status as a Category 2 Candidate. It is presently known from six Idaho populations in meadows at the headwaters of three spring-fed creeks. An estimated 11,000 alkali primrose individuals occupy habitat within a total area of approximately 440 acres. It occupies very specific, relatively stable microsites within the meadows, a habitat that is highly susceptible to disturbance. Genetic evidence also indicates that alkali primrose may be vulnerable. It is a diploid with high habitat specificity, indicating possible low genotypic variability. Recent biogeographic studies suggest that alkali primrose is a Pleistocene relict.

The chance of finding more populations is low. Extant populations appear to be stable and vigorous, however, past and ongoing destruction and modification of habitat has been documented. Many of these threats are expected to continue. Three-quarters of alkali primrose habitat is on private land, followed by BLM (19%), Forest Service (4%), and Idaho Fish and Game (2%).

On the basis of information summarized in this report, it is recommended that alkali primrose be listed as Threatened, with a priority for listing of 5 (threats of high magnitude, non-imminent immediacy). It is considered extinct in Montana. While the extant populations in Idaho appear stable, low numbers of individuals, small areal extent, wetland habitat highly susceptible to disturbance, past destruction of habitat, possible low genetic variability, and numerous and varied current and potential threats to its habitat make alkali primrose likely to become endangered within the foreseeable future throughout all of its range. Most of its range occurs on private land, with virtually no protection mechanisms available to ensure viability of populations.

It is recommended that the BLM, Forest Service, and Idaho Fish and Game, in cooperation with the Fish and Wildlife Service, establish a long-term monitoring program to measure the effects of ongoing disturbances on population viability.

TABLE OF CONTENTS

I. Species Information.

1. Classification and nomenclature.

A. Species.

1. Scientific name.

a. Binomial: Primula alcalina A. Cholewa & D. Henderson

b. Full bibliographic citation: A.F. Cholewa and D. M. Henderson. 1984. Primula alcalina (Primulaceae): A new species from Idaho. Brittonia 36(1):59-62.

c. Type specimen: United States, Idaho, Lemhi County: 10 miles (16 km) north of Blue Dome, along Birch Creek, 6600 ft (2012 m), moist alkaline meadow with Phlox kelseyi Britton, Valeriana edulis Nutt., Dodecatheon pulchellum (Raf.) Merr., and Potentilla fruticosa L., 15 June 1974, D.M. Henderson, and R. Cates 1372 (Holotype: ID; Isotype: NY).

2. Pertinent synonym(s): None

3. Common name(s): Alkali primrose

4. Taxon codes: PDPRI080Q0 (Idaho and Montana Natural Heritage Programs)

5. Size of genus: Perhaps 500 species, chiefly boreal to alpine in the north Temperate Zone, especially abundant in south-central Asia (Hitchcock 1959; Kelso 1987). Alkali primrose is in Primula section Aleuritia (Duby) Wendelbo (formerly section Farinosae).

B. Family classification.

1. Family name: Primulaceae

2. Pertinent family synonym: N/A

3. Common name for family: Primrose

C. Major plant group: Dicotyledonea

D. History of knowledge of taxon: Primula incana M.E. Jones is a widespread species within the Rocky Mountains and collections were known from as far west as Lemhi County, Idaho. Davis (1952) and Hitchcock (1959a) acknowledged the presence of this taxon in Idaho and later Hitchcock (1973) pointed out that, within this lilac-flowered species, the Idaho plants are white-flowered. He felt that these white-flowered primroses were distinct taxonomically from other populations of P. incana, and suggested more intensive study of the Idaho plants. After intensive floristic work in the region, three relatively small populations of the white-flowered form were discovered and used as the basis for the description of Primula alcalina (Cholewa and Henderson 1984).

E. Comments on current alternative taxonomic treatment(s): As mentioned above, the white-flowered primroses of east-central Idaho (Primula alcalina) were considered conspecific with the lilac-

flowered Primula incana until 1984 (Davis 1952; Hitchcock 1959a; 1973; Henderson 1981a; Cholewa and Henderson 1984).

2. Present legal or other formal status.

A. International: None

B. National (United States).

1. Present designated or proposed legal protection or regulation: Currently, alkali primrose is proposed for federal status as a category 2 candidate.

2. Other current formal status recommendation: Alkali primrose is currently listed as "critically imperiled throughout range" (global rank = G1) by The Nature Conservancy.

3. Review of past status: N/A

C. State.

1. Idaho.

a. Present designated or proposed legal protection or regulation: None

b. Other current formal status recommendation: Alkali primrose is currently listed as "critically imperiled in Idaho" (state rank = S1) by the Idaho Natural Heritage Program.

c. Review of past status: Henderson (1981a) recommended that Primula incana be a State Threatened species because of threats posed by livestock and recreational trampling and campground construction. He recommended only a State Threatened status at the time because, he considered the east-central Idaho populations conspecific with the widespread Primula incana. This obviously changed over the next couple of years when the east-central Idaho populations were described as a new species, Primula alcalina, in 1984 (Cholewa and Henderson 1984).

2. Montana.

a. Present designated or proposed legal protection or regulation: None

b. Other current formal status recommendation: Alkali primrose is currently listed as "of historical occurrence" in Montana (state rank = SH) by the Montana Natural Heritage Program (Shelly 1988). A state historical rank means that it was formerly known to be part of the native biota, with the implied expectation that it may be rediscovered.

c. Review of past status: The Montana Rare Plant Project (Lesica et al. 1984) did not review alkali primrose in its list of vascular plants of limited distribution in Montana. The historical Montana site was not confirmed until 1985 (Lesica 1986a).

3. Description.

A. General nontechnical description: Alkali primrose has a naked scape (flowering stem) 2.5 to 10 inches long, subtended by a rosette of numerous, crinkled leaves that are light green. Leaves are about one inch long, with a generally elliptical blade that gradually narrows to a winged petiole. The umbellate inflorescence has 3 to 10 mostly erect flowers, with farinose calices and white corollas.

B. Technical description: Plants farinose only when young, efarinose in age. Scapose perennials with fibrous roots; leaves 1-4 cm long, elliptic-oblanceolate and narrowed gradually to the winged petiole, efarinose to farinose on the abaxial surface when young, the blade margins crenulate or denticulate, sometimes entire; scape 6.5-24 cm high, medium green proximally and darkened distally; inflorescence an umbel, farinose; involucral bracts 4-7 mm long, lanceolate, plane at base, the apex obtuse or acute; flowers distylous, 3-10 on nearly erect, farinose, purplish-green pedicels; calyx campanulate, 4-6.5 mm long, puberulent and somewhat farinose, sometimes with purplish blotches or striations, lobed 1/3 to 1/2 of its length, apex of the lobes generally acute, gland-tipped; corolla tube 4-7 mm long, lobes 3-5 mm long and deeply cordate, white with yellow fornices; stamen ca 1.5 mm long, anthers located towards the middle of the corolla tube; stigma capitate, in pin plants located in upper third of corolla tube, positions reciprocal in thrum plants; pollen ca 10 microns in diameter in pin plants, ca 12 microns in diameter in thrum plants, exine microreticulate, 3 syncolpate; fruit a capsule; chromosome number: n=9 (Cholewa and Henderson 1984; Kelso 1987).

C. Local field characters: Aside from habitat (see sections I.B.5 and I.C.1), alkali primrose is best characterized by white corollas, generally (at least when mature) efarinose leaves, and small, distylous flowers (Cholewa and Henderson 1984).

Albino flowers can be found in any species of Primula (Kelso 1987). Kelso (1987) found that beyond these exceptional specimens, however, flower color can be a very useful taxonomic character at both the sectional and species level.

Corolla color fading with age can also cause identification problems. Flower color is deepest in buds and young flowers and gradually fades as the flower matures. This is particularly noticeable in the violet-flowered species of section Aleuritia (e.g. Primula incana), where older flowers on herbarium specimens can look almost white (Kelso 1987).

D. Identifying characteristics of material which is in interstate or internation commerce or trade: No interstate or international commerce or trade is known.

E. Photographs and/or line drawings: Line drawings of alkali primrose can be found in Cholewa and Henderson (1984) and Kelso (1987), which have been reproduced in Appendix 2. A color photograph of alkali primrose habitat at the Texas Creek population can been seen in Brunsfeld and Johnson (1985; photo 68). Numerous photographs (35 mm color slides) of alkali primrose and its habitat are in the slide collection of the Idaho Natural Heritage Program. Several of the slides are included in Appendix 3.

4. Significance.

A. Natural: Alkali primrose, being a narrow endemic, distylous, diploid taxon, fits in well with theories on the effect of breeding systems on speciation and is useful in the reconstruction of biogeographic patterns and processes in north temperate regions (Kelso 1987).

B. Human: Many members of the Primulaceae, including many species and cultivars of Primula, are highly prized horticultural specimens. Other than as a rarity, it is doubtful that alkali primrose will become sought after in this respect. It is a small, rather inconspicuous plant, with relatively small white flowers. Many other native primroses surpass this one in beauty. No other agricultural, economic, or other human uses are known.

5. Geographical distribution.

A. Geographical range: Alkali primrose is currently known from meadows at the headwaters of three spring creeks in east-central Idaho: Summit Creek in Custer County; Texas Creek in Lemhi County; and Birch Creek in Lemhi and Clark County. An historical collection is known from meadows near Monida, Montana. The population from which this 1936 collection is made is considered to be extirpated. See Appendix 4 for maps of the three extant and one extinct populations.

B. Precise occurrences.

1. Populations currently or recently known extant.

a. Idaho: The following six extant populations encompass the entire known extent of alkali primrose (see Appendix 4 for maps of the populations and Appendix 5 for occurrence records):

Population	Meadow System
(001) Upper Birch Creek	Birch Creek
(002) Lower Birch Creek	Birch Creek
(003) Upper Summit Creek	Summit Creek
(004) Texas Creek	Texas Creek
(005) Mud Flats	Summit Creek
(006) Moffett Creek	Summit Creek

2. Populations known or assumed extirpated.

a. Montana: In 1936, Frank Rose collected a primrose from "Monida" (collection number 471; MONTU). In 1985, this specimen was identified as alkali primrose by Dr. Douglass Henderson, University of Idaho Herbarium, coauthor of the new species. This location was reported as a new record for Montana's flora (Lesica et al. 1986). Identification of the Rose specimen as alkali primrose was confirmed by Dr. Tass Kelso, Colorado College, in 1989. She noted that both thrum and pin floral morphs occur on the specimen (1989, personal communication).

Thorough searches of over 20 alkaline meadows in southwest Montana, including meadows at Monida, by Peter Lesica in 1985 and 1986, yielded only negative results. He did, however, find two populations of the more common Primula incana in the area, one of

these was at Monida (Lesica 1986b).

I searched the Monida area in August 1988, and found no alkali primrose population. It also appeared that no suitable-appearing habitat presently exists there. As described under the description of habitat in section II.6., alkali primrose appears restricted to microhabitats in alkaline meadows that are subirrigated throughout the year by water from adjacent spring-fed creeks. Soils are saturated to the soil surface throughout the growing season in these microhabitats. These conditions no do not (or no longer) exist at Monida; all meadows checked were dry in August, and no perennial spring creeks were seen.

It is my conclusion, then, that the Monida, Montana, population has been extirpated sometime during the last 53 years by unknown causes.

3. Historically known populations where current status not known: None.

4. Locations not yet investigated believed likely to support additional natural populations: Over the last 15 years, a thorough search of likely habitat in east-central Idaho and adjacent Montana by botanists associated with the University of Idaho Herbarium, University of Montana Herbarium, Idaho Field Office of The Nature Conservancy, Idaho Natural Heritage Program, Montana Natural Heritage Program, and Idaho State Office and Salmon District Office of the Bureau of Land Management have found only the six populations listed above. In Idaho, at least, almost all of the suitable habitat has been checked within the east-central portion of the state. One possibility for further searching in east-central Idaho is on private land along Big Springs Creek in the Little Lost River Valley, approximately 20 miles north of Howe.

Much of the suitable-appearing habitat in southwestern Montana, has also been searched by Peter Lesica, Klaus Lackschewitz, and myself (Peter Lesica, Division of Biological Sciences, University of Montana, 1989, personal communication).

5. Reports having ambiguous or incomplete locality information: None.

6. Locations known or suspected to be erroneous reports: None.

C. Biogeographical and phylogenetic history: Primula sect. Aleuritia is known for polyploidy. In North America it is represented by three narrowly endemic distylous diploids (P. alcalina, P. anvilensis, and P. specuicola) in addition to a widespread distylous diploid, P. mistassinica, and three homostylous polyploids: P. incana (6x), P. laurentiana (8x), and P. stricta (14x) (Kelso 1988).

Kelso (1987, 1988) believes that the diversification of section Aleuritia in North America can be explained by classical models of allopatric speciation in combination with extensive hybridization and polyploidy. She suggests that the restricted diploids represent remnants of the Pleistocene distribution of P. mistassinica and the higher polyploids were created by migration and secondary contact of isolated populations during glacial episodes. Hybrid genomes, self-fertility via homostyly and the presence of newly available habitats

from retreating ice sheets contributed to the survival of the polyploids. In Europe, there is a parallel situation with the diploid P. farinosa, the hexaploid P. scotica, and the octoploid P. scandinavica.

6. General environment and habitat description.

A. Concise statement of general environment and habitat: Alkali primrose occurs in wet, alkaline meadows, at the headwaters of three spring-fed creeks in the large, intermontane valleys of east-central Idaho. It occurs in the lowest topographic positions in the meadows, where the soil is saturated to the surface throughout the growing season. Elevations of the six populations range from 6,294 to 6,720 feet. Common associates include Potentilla fruticosa, Deschampsia cespitosa, Muhlenbergia richardsonis, and Thalictrum alpinum.

B. Physical characteristics.

1. Climate.

a. Koppen climate classification: Type Df, a cold climate with humid winters (Trewartha 1954).

b. Regional macroclimate: The broad intermontane valleys of east-central Idaho receive the strongest continental weather patterns of anywhere in the central Idaho mountain mass. The "wet season" occurs from May to July and provides 30 to 40 percent of the yearly precipitation, which varies from 7 to 11 inches (18 to 28 cm) in the valleys. This wet cycle results mainly from the high altitude convectional storms originating over the Gulf of Mexico and California Coast. Most moisture in low altitude cyclonic storms from the Pacific Ocean received by the rest of central and northern Idaho is intercepted by numerous mountain ranges to the west, creating a relatively dry winter.

Temperatures are typically cool most of the year, with the annual average at median elevation of about 31.8°F. The broad intermontane valleys collect considerable cold air, creating severe winter conditions. Cold arctic air lying east of the Continental Divide occasionally invades this section and further lowers winter temperatures (Steele et al. 1981).

c. Local microclimate: Alkali primrose occurs close to the stream channel of spring-fed creeks. The local microclimate created by the relatively constant flow and temperature has not been measured, but it is expected that it would ameliorate winter and spring temperatures to some degree. Water temperature measurements on Summit Creek, two miles below its headwater spring, fluctuated between 49°F to 60°F from mid-January to mid-May 1978 (Keller et al. 1979).

2. Air and water quality requirements: Unknown.

3. Physiographic provinces: All populations of alkali primrose occur within the Northern Rocky Mountain Physiographic Province. The Northern Rocky Mountain Province has been classified and described at the section level (Arnold 1975). All populations of

alkali primrose fall within the Open Northern Rockies Section. The dominant topography in this section is largely the result of fault block activity. Much of the area displays a lineal basin and range topography typical of the Great Basin. The extreme northern portion has characteristics more similar to the faulted and folded mountains to the northeast. Mountain ranges in this section are among the highest in the state, with numerous peaks above 10,000 feet. Intervening valleys are broad and gentle, with base elevations about 5,000 feet.

4. Physiographic and topographic characteristics: The meadows along spring-fed creeks containing alkali primrose occur in the center of the intermontane valleys described above. Elevations of the six populations are as follows:

Population	Elevation (feet)
(001) Upper Birch Creek	6480-6553
(002) Lower Birch Creek	6378-6450
(003) Upper Summit Creek	6320-6500
(004) Texas Creek	6632-6720
(005) Mud Flats	6290
(006) Moffett Creek	6330

Slope gradients are very gentle, less than 3%. Within the meadow systems, alkali primrose populations occupy the lowest topographic positions, on "micro-terraces" closest to the water table.

5. Edaphic factors: As mentioned above, alkali primrose populations occur in the lowest topographic position within the meadows. They occupy habitats closest to the water table, allowing capillary action to subirrigate the soil to the surface throughout the growing season. Adjacent "micro-terraces", just a few inches higher in elevation that dry to the soil surface by late July and August, do not contain alkali primrose.

Kelso (1987) found that members of section Aleuritia show a strong affinity for soil derived from carbonate bedrock. Alkali primrose is no different, being found in meadows formed by alluvium derived from outwash from the predominantly carbonate Beaverhead Mountains and Lemhi Range.

The alluvial soils are fine-textured and light in color. Soil pH as high as 9.3 has been measured at the Lower Birch Creek (002) alkali primrose population (D.M. Henderson, 1986, personal communication).

6. Dependence of this taxon on natural disturbance: Alkali primrose appears restricted to the relatively stable habitats existing along spring-fed creeks that have a relatively constant flow of water, causing little fluctuation in the water table of adjacent meadows. It was never found in meadows along creeks that have any seasonal fluctuations and channel scouring, such as that caused by flooding during spring and early summer snow-melt. Geomorphic processes that take place along streams of this type appear to preclude alkali primrose habitat.

Within the meadows containing alkali primrose, however, it appears that a certain degree of small-scale disturbance is necessary to support viable primrose populations. Alkali primrose generally occurs on patches of bare soil within relatively dense graminoid communities. Frost heaving appears to have been the primary process that historically created this small scale disturbance. Grazing by native ungulates probably also contributed to this process. This corresponds well with Kelso's (1987) investigations of all North American species of Primula, which show a preference for cool, moist, open habitats, often with small-scale disturbance including frost action.

7. Other unusual physical features: None.

C. Biological characteristics.

1. Vegetation physiognomy and community structure: Alkali primrose occurs in wet alkaline meadows that may or may not contain hummocks. Communities containing alkali primrose have not been quantitatively described in the literature. Members of the Poaceae, Cyperaceae, and Juncaceae are the dominant species in these communities, especially Eleochorus palustris, Deschampsia cespitosa, Muhlenbergia richardsonis, and Juncus balticus. Two species of low-growing willows, Salix candida and S. planifolia, occur in low density on hummocks with alkali primrose at the Birch Creek and Texas Creek populations. A diverse number of small forbs occur in these communities, but are widely scattered in the stands and comprise little cover.

The microhabitat differences relative to the depth to the water table noted in section I.6.B.5. has a subtle yet apparent effect on the distribution of species in the alkaline meadow communities. For instance, although Phlox kelseyi var. kelseyi has been noted by several collectors as being associated with alkali primrose (c.f. Cholewa and Henderson 1984), I never observed this. Phlox kelseyi consistently occurred in adjacent microhabitats (communities) on higher topographic positions where subirrigation did not saturate the soil to the surface in July and August. Although only a few feet separated these communities, habitat differences are readily apparent in August. This phenomenon deserves further study.

2. Regional vegetation type: All populations of alkali primrose occur in wetlands that are surrounded by Kuchler's (1964) Sagebrush Steppe (Artemisia - Agropyron) vegetation unit. Sagebrush habitat types that surround the wetlands include the following (Hironaka et al. 1983): Artemisia tripartita/Festuca idahoensis and Artemisia arbuscula/Agropyron spicatum. Aquatic communities occurring in streams adjacent to alkali primrose populations are classified as the following by Cowardin et al. (1979):

System	Riverine
Subsystem	Lower perennial
Class	Aquatic bed
Subclass	Floating vascular
Dominance type	Ranunculus aquatilis/ Ceratophyllum demersum

and as the following by Rabe and Savage (1977):

Class	Lotic
Type	1st - 4th order streams
Subtype	Spring stream

While not a complete list, wetland community types (ct) listed below have been observed adjacent to alkali primrose populations at Summit Creek (Moseley 1986). They correspond well with communities described from surrounding areas by Tuhy and Jensen (1982), Mutz and Queiroz (1983), and Youngblood et al. (1985). Undoubtedly, other described and undescribed types occur at Birch Creek and Texas Creek.

Juncus balticus ct
Carex nebraskensis ct
Carex rostrata ct
Carex douglasii ct
Salix boothii/Carex rostrata ct

3. **Frequently associated species:** The following species have been noted as occurring with alkali primrose (please note that some these species may occur in adjacent communities, as noted in section I.6.C.1.):

Betula glandulosa
Carex aquatilis
Carex simulata
Deschampsia cespitosa
Dodecatheon pulchellum
Eleocharis palutris
Juncus balticus
Lomatogonium rotatum
Muhlenbergia richardsonis
Parnassia palustris
Phlox kelseyi var. kelseyi
Potentilla fruticosa
Salix candida
Salix planifolia
Senecio cymbalrioides
Sisyrinchium idahoensis
Solidago nana
Thalictrum alpinum
Triglochin maritima
Valeriana edulis

4. **Dominance and frequency:** Alkali primrose density varies from widely scattered to moderately dense within appropriate habitats depending on the amount of bare soil patches. In stands dominated by densely tufted or rhizomatous graminoids, primrose density is low. If these graminoid turfs are moderately disturbed by frost heaving or cattle grazing, alkali primrose occurs in higher densities. In no stands was it observed to be a dominant.

5. **Successional phenomena:** Communities containing alkali primrose appear successionally advanced, that is, they occupy stable landscape positions and probably have for a long period of time.

6. **Dependence on dynamic biotic features:** Unknown.

7. **Other endangered species:** No federally listed endangered or threatened plant or animal taxa are known to be sympatric with alkali primrose. The following two plant species are rare in Idaho:

   a. **Lomatogonium rotatum** - Henderson (1981b) reviewed this taxon as part of the Idaho rare plant project, but concluded that, although it was reported for Idaho (Hitchcock 1959b), no herbarium records were known to verify this report. In 1986, it was found growing with alkali primrose at Upper Summit Creek (Moseley 1986). In 1988, it was also found at the Texas Creek and Lower Birch Creek populations. In 1989, Lomatogonium rotatum was added to the Idaho Natural Heritage Program's Review List, with a rank of G5 S1.

   b. **Salix candida** - This distinctive willow was placed on the State Watch List by Brunsfeld (1983) and is now on the Idaho Natural Heritage Program's list as a Priority 3 taxon, with a rank of G5 S1. It occurs at the Birch Creek and Texas Creek populations of alkali primrose.

7. Population biology.

A. General summary: Six extant populations of alkali primrose are known from three meadow systems in east-central. A total of approximately 11,000 individuals occur in scattered subpopulations on 440 acres of habitat. The populations range in size from an estimated 1,000 to 4,000 individuals. Alkali primrose flowers early in the season, usually in May. The basal rosettes remain green throughout the growing season. Fruits mature in August or early September. Alkali primrose does not disperse vegetatively; new individuals arise from seeds. Few specific data are available for alkali primrose on pollination, seed dispersal, seed biology, seed ecology, and survival and mortality. It is known, however, that alkali primrose has a relatively rare breeding system known as distyly, making it an obligate outcrosser.

B. Demography.

1. Known populations: Six populations of alkali primrose are known, occurring in meadow systems at the headwaters of three spring-fed creeks in east-central Idaho. Refer to maps in Appendix 4 for the location and geographical relationship of the three sites. The three sites are between 18 and 24 miles from each other. Below is a summary of the aerial extent and estimated population size of the six populations. Please note that the acreage given for each population is the maximum area of the perimeter of suitable habitat of the six populations. Alkali primrose does not occupy the total area; it actually occurs in several, smaller subpopulations within this area.

Site/Population	Size (acres)	Individuals
Birch Creek Populations		
(001) Upper Birch Creek	27	1,500
(002) Lower Birch Creek	53	2,000
Birch Creek Subtotal	80	3,500
Summit Creek Populations		
(003) Upper Summit Creek	42	2,000
(005) Mud Flats	13	1,000
(006) Moffett Creek	14	1,000
Summit Creek Subtotal	69	4,000
Texas Creek Population		
(004) Texas Creek	291	3,500
Total	440	11,000

2. Demographic details.

a. Upper Birch Creek (001)

1. **Area:** Alkali primrose occurs scattered in several, small subpopulations over approximately 27 acres.
2. **Number and size of plants:** 1,000 to 2,000 average size plants occur at this site.
3. **Density:** Average.
4. **Presence of dispersed seeds:** Unknown.
5. **Evidence of reproduction:** Mature fruits seen in August 1988.
6. **Evidence of expansion/contraction:** None.

b. Lower Birch Creek (002)

1. **Area:** Alkali primrose occurs scattered in several, small subpopulations over approximately 53 acres.
2. **Number and size of plants:** Approximately 2,000 average size plants occur at this site.
3. **Density:** Average.
4. **Presence of dispersed seeds:** Unknown.
5. **Evidence of reproduction:** Mature fruits seen in August 1988.
6. **Evidence of expansion/contraction:** None.

c. Upper Summit Creek (003)

1. **Area:** Alkali primrose occurs scattered in several, small subpopulations over approximately 42 acres.
2. **Number and size of plants:** Approximately 2,000 average size plants occur at this site.
3. **Density:** Average.
4. **Presence of dispersed seeds:** Unknown.
5. **Evidence of reproduction:** Mature fruits seen in August 1988.
6. **Evidence of expansion/contraction:** None.

d. Texas Creek (004)

1. **Area:** Alkali primrose occurs scattered in several, small subpopulations over approximately 291 acres.
2. **Number and size of plants:** 3,000 to 4,000 average size plants occur at this site.
3. **Density:** Average.
4. **Presence of dispersed seeds:** Unknown.
5. **Evidence of reproduction:** Mature fruits seen in August 1988.
6. **Evidence of expansion/contraction:** None.

e. Mud Flats (005)

1. **Area:** Alkali primrose occurs scattered in several, small subpopulations over approximately 13 acres.
2. **Number and size of plants:** Approximately 1,000 average size plants occur at this site.
3. **Density:** Average.
4. **Presence of dispersed seeds:** Unknown.
5. **Evidence of reproduction:** Mature fruits seen in August 1988.
6. **Evidence of expansion/contraction:** None.

f. Moffett Creek (006)

1. **Area:** Alkali primrose occurs scattered in several, small subpopulations over approximately 14 acres.
2. **Number and size of plants:** Extensive population along creek.
3. **Density:** Average.
4. **Presence of dispersed seeds:** Unknown.
5. **Evidence of reproduction:** Flowering plants collected in 1988.
6. **Evidence of expansion/contraction:** None.

C. Phenology.

1. **Patterns:** Alkali primrose generally flowers in May and early June,

soon after temperatures in these high valleys begin to increase. Fruits develop through June, July, and August and seed set generally takes place in August or September. The basal rosettes, with their distinctive crenulate leaves, of both fertile and vegetative plants remain green at least to the end of August. This allows alkali primrose to be easily identifiable in late summer.

Because most Primula species bloom soon after snowmelt, their leaves are not fully expanded at anthesis. The leaves and scape enlarge over the growing season, and by the time the capsules are ripe they may be up to several times their length at early anthesis (Kelso 1987).

2. Relation to climate and microclimate: Since alkali primrose is an early bloomer, it is expected that spring weather plays an important role in determining the onset of green-up and flowering. The effect of the adjacent spring creeks, with their relatively constant flow and temperature regime, is unknown, but would be expected to moderate late winter and spring temperatures. Since alkali primrose is subirrigated throughout the growing season, yearly variation in precipitation patterns are expected to affect the phenology little.

D. Reproductive ecology.

1. Type of reproduction: Alkali primrose does not disperse vegetatively; new individuals arise from seed.

2. Pollination.

a. Mechanisms: The floral morphology of alkali primrose suggests that insect pollination is the primary mechanism.

Alkali primrose has a relatively rare breeding system known as heterostyly, which refers to a floral polymorphism in which two or three morphs differ in placement of style and stamens. In modern usage, the term implies di-allelic genetic control and a concomitant intra-morph sporophytic incompatibility system. Of the two types of heterostyly, distyly and tristyly, alkali primrose contains the former, having two morphs controlled by a single locus S. A heterozygous individual Ss is called a "thrum". It has a short style, with short stigmatic papillae, large pollen, and anthers positioned high in the corolla tube. A homozygous recessive individual ss is called a "pin". It has a long style, long stigmatic papillae, small pollen, and anthers positioned low in the corolla tube. Due to the accompanying sporophytic incompatibility system, pollen from a pin individual can successfully fertilize only a thrum individual and visa versa. A homozygous dominant individual should therefore theoretically not occur (Kelso 1987). For a drawing of the two floral morphs in alkali primrose, see Appendix 2.

Distylous species, such as alkali primrose, are almost always xenogamous (obligate outcrossers), as opposed to homostylous species, such as Primula incana, which are almost always autogamous (selfing). In fact, Kelso (1987) found that in P. incana individuals that she studied, anthers and stigma are in

contact throughout the entire period of anthesis, leading almost inevitably to a high degree of self-fertilization.

Kelso (1987) summarized the characteristics of xenogamous species (e.g. alkali primrose) and their autogamous relatives (e.g. P. incana):

XENOGAMOUS	AUTOGAMOUS
self incompatible	self compatible
flowers many	flowers fewer
pedicels long	pedicels shorter
sepals large	sepals shorter
petals large	petals shorter
petals emarginate	petals entire
nectaries present	nectaries reduced
flowers scented	flowers scentless
nectar guides conspicuous	nectar guides absent
anthers long	anthers shorter
anthers extrorse	anthers introrse
anthers distant from stigma	anthers close to stigma
pollen grains many	pollen grains few
pistil long	pistil shorter
style exerted	style included
many ovules/flower	few ovules/flower
some fruits not maturing	all fruits maturing
distribution narrow	distribution wide

While not all taxa, including alkali primrose and P. incana, are textbook examples, for the most part these two fit the morphological models summarized above for outcrossing and selfing species. All distylous taxa studies by Kelso (1987), except one, were diploid.

b. Specific known pollinators: Unknown.

c. Other suspected pollinators: Unknown.

d. Vulnerability of pollinators: If insects are the primary pollinators of alkali primrose, they are vulnerable to insecticide spraying. Although insecticide spraying probably does not take place in the three meadows systems, wholesale spraying of southern Idaho rangelands for grasshoppers may have a detrimental effect. Heavy livestock grazing, which takes place in most populations of alkali primrose, has been shown to have a detrimental effect on pollinators of a rare plant in California (Sugden 1985).

3. Seed dispersal.

a. General mechanisms: The specific mechanism is unknown for alkali primrose. In primroses studied by Kelso (1987), she found that as capsules ripen and elongation of the scape slows and eventually ceases, elongation and stiffening of the pedicels begins. In fruit, much elongation and stiffening occurs and the fruiting umbel looks very different from the blooming umbel. She speculated that these changes relate to seed dispersal; seeds are shaken out of the capsules by wind or passing animals, and erect elongated pedicels may increase dispersal distance from the parent plant. The process of pedicel elongation begins as scape elongation ceases, and is very rapid.

Patterns of development outlined above for arctic and boreal species appear similar to those observed in alkali primrose, where pedicels elongate and stiffen through the growing season. By August, the pedicels are considerably longer than at anthesis and the capsules become erect from the somewhat nodding flower positions at anthesis.

b. Specific agents: Unknown but possibly wind or passing animal.

c. Vulnerability of dispersal agents and mechanisms: Unknown but probably not vulnerable.

d. Dispersal patterns: Unknown.

4. Seed biology.

a. Amount and variation of seed production: Unknown.

b. Seed viability and longevity: Unknown.

c. Dormancy requirements: Unknown.

d. Germination requirements: Unknown.

e. Percent germination: Unknown.

5. Seedling ecology: Unknown.

6. Survival and mortality: Unknown.

7. Overall assessment of reproductive success: No assessment can be made at this time due to lack of specific reproductive data for alkali primrose.

8. Population ecology of the taxon.

A. General summary: One population from Monida, Montana, is considered extinct. The six extant populations of alkali primrose are highly localized within the three meadow systems in Idaho. Populations are relatively dense, although interspecific competition for space appears to limit alkali primrose is some areas. No herbivore, parasite, or disease damage was observed. Trampling by domestic livestock is occurring in several areas. Alkali primrose populations are isolated from other Primulas and the genetic integrity of the taxon does not appear in jeopardy.

B. Positive and neutral interactions: None known.

C. Negative interactions.

1. Herbivores, predators, pests, parasites and diseases: No herbivore (invertebrate or vertebrate) grazing was observed on any alkali primrose plants. No parasites or disease damage was observed. Trampling by livestock is causing mortality in some areas.

2. Competition.

a. Intraspecific: Unknown.

b. Interspecific: As mentioned above, alkali primrose does not occur or occurs in low density where there is continuous cover of densely tufted or rhizomatous graminoids. The highest density of alkali primrose occurs where space competition appears to be the least, such as bare soil patches and on the slopes of hummocks. Water does not appear to be limiting in these communities.

3. Toxic and allelopathic interactions with other organisms: None known.

D. Hybridization.

1. Naturally occurring: Primula incana is the only other member of section Aleuritia that may occur in the vicinity of alkali primrose. Natural hybridization between P. incana and alkali primrose is doubtful, however, since alkali primrose is a distylous (outcrossing) diploid and P. incana is a homostylous (selfing) hexaploid (Kelso 1987)

2. Artifically induced: None known.

3. Potential in cultivation: Many species and cultivars primroses are widely cultivated worldwide. It is unknown whether alkali primrose can be successfully planted in an artificial setting.

E. Other factors of population ecology: None known.

9. Current land ownership and management responsibility.

A. General nature of ownership: Most alkali primrose occurs on private land, with numerous owners, followed by the Bureau of Land Management (BLM), Forest Service (FS), and Idaho Department of Fish and Game (FG).

B. Specific landowners: Below is a summary of land ownership/management responsibility for the six alkali primrose populations, indicating acreage and percent of populations owned/administered.

Site/Population	Private acres/%	BLM acres/%	FS acres/%	FG acres/%	Total acres
Birch Creek Populations					
(001) Upper Birch Creek	20/74	7/26	---	---	27
(002) Lower Birch Creek	24/45	3/6	18/34	8/15	53
Birch Creek Subtotal	44/55	10/12	18/23	8/10	80
Summit Creek Populations					
(003) Upper Summit Creek	21/50	21/50	---	---	42
(005) Mud Flats	13/100	---	---	---	13
(006) Moffett Creek	---	14/100	---	---	14
Summit Creek Subtotal	34/49	35/51	---	---	69
Texas Creek Population					
(004) Texas Creek	252/87	39/13	---	---	291
Total	330/75	84/19	18/4	8/2	440

C. Management responsibility: Below are known management responsibilities for the six populations:

Birch Creek Populations

(001) Upper Birch Creek:	Private owner(s) Salmon District BLM
(002) Lower Birch Creek -	Private owner(s) Targhee National Forest Idaho Fish and Game, Region 6 Idaho Falls District BLM
Summit Creek Populations	
(003) Upper Summit Creek:	Salmon District BLM Idaho Falls District BLM Private owner(s)
(005) Mud Flats:	Private owner(s)
(006) Moffett Creek:	Idaho Falls District BLM
Texas Creek Population	
(004) Texas Creek:	Private owner -Ellsworth Angus Ranch, Leadore Salmon District BLM

D. Easements, conservation restrictions, etc.: None known and doubt any exist on private land. A portion of the Summit Creek (003) population is within a Research Natural Area/Area of Critical Environmental Concern administered by the Salmon District BLM (see section I.10.A.3. for details)

10. Management practices and experience.

A. Habitat management.

1. Review of past management and land-use experiences.

a. This taxon:

Birch Creek Populations
(001) Upper Birch Creek - heavily grazed by cattle

(002) Lower Birch Creek - Private portion grazed by cattle and/or sheep; Forest Service by horses; Fish and Game by horses in winter.

Summit Creek Populations
(003) Upper Summit Creek - BLM portion excluded from grazing, heavily used by recreationists; Private portion heavily grazed.

(005) Mud Flats - Heavily grazed. An old dam flooded the meadows between Upper Summit Creek (003) and this population, eliminating habitat for alkali primrose and possibly splitting a larger population into two.

(006) Moffett Creek - Heavily grazed.

Texas Creek Population
(004) Texas Creek - Heavily grazed; some of BLM portion fenced and grazing appears to be excluded.

Monida Population - considered extinct from unknown causes, possibly either through physical destruction of habitat or alteration of hydrologic regime associated with construction of I-15 through Monida.

b. Related taxa: None present.

c. Other ecologically similar taxa: Unknown.

2. Performance under changed conditions: Since no long-term data exist, the effect of past and current management can only be speculated on. The first collection of alkali primrose was made at the heavily grazed Upper Birch Creek (001) population in 1941 (Davis 53118). The population appears viable and stable after 40 years. Presettlement (prelivestock grazing) population levels of alkali primrose are unknown.

The effect of heavy recreational use on population levels at Upper Summit Creek (003) and Lower Birch Creek (002) populations is unknown, but may be significant. Alkali primrose still occurs in a few patches in the Summit Creek Campground, but is absent from the west side of Birch Creek, the most highly impacted portion of the Fish and Game Access site.

At sometime in the past, a dam was constructed just downstream from the Upper Summit Creek (003) population. It has since been excavated and water is no longer impounded. Remnants of the dam can be seen on Map 4, Appendix 4. While the dam impounded water, the valley bottom silted in and widened. When it was eliminated, open water and marsh vegetation remained, dominated by Carex rostrata, C. aquatilis, and other aquatic emergents, a habitat unsuitable for alkali primrose. The upper Summit Creek population has its lower limit at the upper edge of the area effected by the dam. Habitat for alkali primrose was eliminated. The dam may have actually split a continuous population, with the Upper Summit Creek (003) and Mud Flats (005) populations remaining.

3. Current management policies and actions: Current management is similar to that outlined in the section on past management (section I.10.A.1.), with one exception. Approximately 2 miles of Summit Creek was excluded from livestock grazing following the 1975 grazing season (Keller et al. 1979; Keller and Burnham 1982; Thomas 1986). The fenced section includes the upper portion of the Upper Summit Creek (003) population (see Map 4, Appendix 4). A campground is included within the exclosure and much of the area is heavily impacted by recreationists. A 230 acre portion of the Summit Creek exclosure was designated a Research Natural Area/Area of Critical Environmental Concern (RNA/ACEC) by the Salmon District BLM in 1988 (Moseley 1986; USDI Bureau of Land Management 1988). The ACEC portion of the exclosure encompasses the least disturbed portion of wetland vegetation and includes only the two isolated subpopulations of the Upper Summit Creek population (see Map 4, Appendix 4).

4. Future land use: Future management actions of the Forest Service and BLM are unknown. Fish and Game anticipates no change in management of their tract at Lower Birch Creek (002) (Frank Deshon, Regional Land Manager, 1988, personal communication).

B. Cultivation.

1. Controlled propagation techniques: None known.

2. Ease of transplanting: Unknown.

3. Pertinent horticultural knowledge: Much knowledge exists on the horticultural use of Primulas in general.

4. Status and location of presently cultivated material: None known.

11. Evidence of threats to survival.

A. Present or threatened destruction, modification, or curtailment of habitat or range.

1. Past threats: Evidence of the following past habitat destruction or modification has been observed in the vicinity of alkali primrose populations:

a. Dam building: Immediately below the Upper Summit Creek (003) population a dam was constructed at sometime in the past. It has since been excavated and no longer impounds water (see Map 4, Appendix 4). The effect of the dam on riparian habitats along Summit Creek negatively impacted alkali primrose by replacing the complex mosaics of microhabitats with relatively simple communities dominated by graminoid emergent species (see section I.10.A.2.; Slide 13, Appendix 3). The lower limit of the Upper Summit Creek population coincides with the upper limit of the area affected by the dam pool. The dam may have actually split a larger population into two small ones: Upper Summit Creek and Mud Flats.

b. Campgrounds: Two campgrounds or recreational facilities exist within alkali primrose populations: a BLM campground at the Upper Summit Creek (003; Slide 12, Appendix 3) population and a Fish and Game Sportsmen's Access site, which is used as a campground, at Lower Birch Creek (002). Both areas are heavily used during the snowfree season. Exact impacts are unknown. Alkali primrose does not occur on the west side of Birch Creek, were camping occurs at the Fish and Game access site. It does occur in small patches in the Summit Creek Campground. It is clear, however, that some alkali primrose habitat was lost due to development of these two sites.

c. Road building: Numerous roads, including State Highways, improved gravel, unimproved dirt, and campground roads, have been constructed through alkali primrose populations at the Upper Birch Creek (001), Lower Birch Creek (002), and Summit Creek (003) populations (Slide 12, Appendix 3). Alkali primrose habitat at these populations was probably eliminated as a result of road construction.

Construction of Interstate 15 through Monida, Montana, may have been responsible for the extirpation of alkali primrose there.

d. Livestock grazing: Livestock has eliminated potential alkali primrose habitat in the vicinity of existing populations, largely

through severe trampling of the streambank vegetation (Slide 10, Appendix 3). The small microsite habitats of alkali primrose area are highly susceptible to heavy grazing. For further discussion see section I.11.C., below.

e. Recreational trampling: Much of the habitat of alkali primrose occurs near streambanks, an ideal habitat from which to fish. The effect of this type of trampling may have been locally significant at the Lower Birch Creek (002) and Upper Summit Creek (003) populations. The Mud Flats (005) and Texas Creek (004) populations are protected from this disturbance, somewhat, because they are on private land.

2. Existing threats: The following habitat destruction or modification was observed in the vicinity of alkali primrose populations:

a. Campgrounds: As stated above, two campgrounds or recreational facilities exist within and continue to impact alkali primrose populations.

b. Livestock grazing: Livestock grazing continues to be locally severe within alkali primrose habitat. For further discussion see section on "Disease, predation, and grazing" below.

c. Recreational trampling: Much of the habitat of alkali primrose occurs near streambanks, an ideal habitat from which to fish. The effect of this type of trampling continues to be locally significant at the Lower Birch Creek (002) and Upper Summit Creek (003) populations.

d. Water diversion: Habitat suitable for alkali primrose is closely related to the depth of the water table. Differences in elevation of just a few inches appear to preclude alkali primrose. Therefore, lowering of the water table through upstream diversion could eliminate existing or available potential habitat. A ditch was recently excavated on private land at the Upper Summit Creek (003) population, immediately downstream of the private - BLM property boundary (Slide 11, Appendix 3). Although no water was being diverted with this ditch in August 1988, there appears to be no other reason for its construction. A small dam at the head of the ditch was keeping water from flowing into it.

A ditch seen on the USGS topographic maps (see Map 3, Appendix 4) begins below the springs at the head of Texas Creek, above the alkali primrose population. This ditch was not seen in the August 1988, survey, so it is not known whether or not it is currently diverting water from the creek.

3. Potential threats: All of the threats listed in the above section are expected to continue. No others are foreseen.

B. Overutilization for commercial, sporting, scientific, or educational use.

1. Past threats: It is clear from herbaria records that extant populations of alkali primrose have been well collected (see section III.17.B), especially Upper Birch Creek (001) and Upper Summit Creek (003). It is

recommended that collections be made only of newly discovered populations.

2. Existing threats: See above.

3. Potential threats: See above statement concerning scientific collection. Resistance of a certain faction within the American Primrose Society to institute conservation measures governing collection activities of wild primroses may be a potential threat (Steven Krumm, Berry Botanic Garden, 1989, personal communication).

Two recent articles in a publication prepared for an international Rock Garden Plant Conference in Boulder, Colorado, highlight the recently described alkali primrose from east-central Idaho (Davidson 1986; Evert 1986). This "advertising" could be a potential threat to native populations through increased collecting of live plants and seeds for gardens.

C. Disease, predation, or grazing.

1. Past threats: No disease problems were observed or are known for alkali primrose. All populations have been grazed by sheep, horses and/or cattle in the last 120+ years, probably at levels above those at which native ungulates historically used the meadows. Areas of very severe grazing impacts, largely from trampling riparian vegetation on streambanks (Slide 10, Appendix 3), have probably negatively impacted alkali primrose populations in the past. It appears that livestock do not feed directly on alkali primrose.

2. Existing threats: Horses, cattle, and possibly sheep grazing still take place in most of the range of alkali primrose. The only exception is that portion of the Upper Summit Creek (003) population in the Summit Creek Exclosure (Map 4, Appendix 4). Impacts to streamside habitats from heavy grazing pressure are locally severe and have probably negatively impacted alkali primrose populations. It is documented by herbarium records, however, that alkali primrose has persisted in areas of heavy grazing for over 40 years at Upper Birch Creek (001). The long-term effect of grazing on population dynamics is unknown, but pollinator populations of rare species are known to be negatively impacted by livestock grazing (Sugden 1985).

3. Potential threats: Locally intense livestock grazing will probably continue to negatively impact alkali primrose populations. Light to moderate levels of grazing may have no impact, but further study is needed to determine this conclusively.

D. Inadequacy of existing regulatory mechanisms.

1. Past threats: Enforcement of Section 404 of the Clean Water Act, concerning the filling of wetlands.

2. Existing threats: Past threats: Enforcement of Section 404 of the Clean Water Act, concerning the filling of wetlands.

3. Potential threats: Past threats: Enforcement of Section 404 of the Clean Water Act, concerning the filling of wetlands.

E. Other natural or manmade factors.

1. Past threats: None known.

2. Existing threats: None known.

3. Potential threats: None foreseen.

II. Assessment and Recommendations.

12. General assessment of vigor, trends and status: One historical record of alkali primrose is considered extinct. It is presently known from six populations in meadow systems at the headwaters of three spring-fed creeks in east-central Idaho. An estimated 11,000 alkali primrose individuals occupy habitat within a total area of approximately 440 acres. It occupies very specific, relatively stable microsites within the meadows, a habitat that is highly susceptible to disturbance.

Genetic evidence also indicates that alkali primrose may be vulnerable. Alkali primrose is a diploid and a narrow endemic restricted to a stable, relatively rare habitat. Investigators have found that species with low ploidy levels (Stebbins 1971) and that are narrow endemics (Hamrick et al. 1979) are generally less variable genotypically. There is some evidence for greater genetic diversity in higher polyploid taxa of section Aleuritia (Kelso 1987). Studies by Kelso (1987, 1988) suggest that alkali primrose is a Pleistocene relict.

The chance of finding more populations is low. Extant populations appear to be stable and vigorous, however, past and ongoing destruction and modification of habitat has been documented. Many of these threats are expected to continue.

13. Recommendations for listing or status change.

A. Recommendation to U.S. Fish and Wildlife Service: On the basis of known information summarized in this report, it is recommended that alkali primrose be listed as Threatened, with a listing priority of 5 (threats of high magnitude, non-imminent immediacy). While the extant populations appear stable, low numbers of individuals, small areal extent, wetland habitat highly susceptible to disturbance, past destruction of habitat, possible low genetic variability, and numerous and varied current and potential threats to its habitat make alkali primrose likely to become an endangered species within the foreseeable future throughout all of its range. Also, approximately 75% of its known range occurs on private land. There are few to no protection mechanisms available to ensure viability of alkali primrose on this land. The remaining habitat occurs on land administered by Federal (BLM and Forest Service) and State (Department of Fish and Game) agencies.

B. Recommendations to other U.S. Federal Agencies.

1. Bureau of Land Management: The Idaho Falls and Salmon Districts of the BLM administer approximately 84 acres of alkali primrose habitat, or approximately 19% of its total known range. This

includes all or a portion of five populations (see "Specific landowners" section). It is currently on the Idaho State BLM Sensitive Plant Species list as a threatened species. It should be upgraded to the endangered category of their list.

The BLM administers the only ungrazed populations of alkali primrose at the Summit Creek Exclosure. A monitoring study should be established in cooperation with the Targhee National Forest and Idaho Fish and Game to determine the long-term effects of grazing and recreational trampling disturbance on population dynamics.

2. Forest Service: The Targhee National Forest administers a quarter-section on Birch Creek, which contains Kaufman Guard Station. Within this tract, alkali primrose occupies approximately 18 acres, or 4% of the total known range. Alkali primrose is currently on the Intermountain Region Sensitive Plant Species list for the Targhee National Forest, with a medium priority (USDA, Forest Service 1989). I recommend that it be made a high priority species. A monitoring study should be established in cooperation with the BLM and Idaho Fish and Game to determine the long-term effects of horse grazing and recreational trampling disturbance on population dynamics.

3. Army Corps of Engineers: Since all alkali primrose habitat would be classified as wetland, a permit from the Corps, as specified under Section 404 of the Clean Water Act, is needed to fill alkali primrose habitat. The Corps, should carefully scrutinized potential wetland-altering projects in the intermontane valleys of east-central Idaho, especially on Texas, Summit, and Birch creeks.

C. Other status recommendations.

1. Counties and local areas: No recommendations.

2. State.

a. Idaho: Alkali primrose is currently listed as "critically imperiled in Idaho" (state rank = S1) by the Idaho Natural Heritage Program. No status change is recommended.

Idaho Department of Fish and Game owns approximately eight acres of the Lower Birch Creek (002) population, or approximately 2% of its known range. The Department should cooperate with the Targhee National Forest and BLM to establish a monitoring program for alkali primrose on their land to determine the long-term effects of horse grazing and recreational trampling on population dynamics.

b. Montana: Alkali primrose is currently listed as "of historical occurrence" in Montana (state rank = SH) by the Montana Natural Heritage Program, with the implied expectation that it may be rediscovered. I believe that alkali primrose has been extirpated from Montana and recommend that the state rank be changed to SX.

3. Other Nations: No recommendations.

4. International: No recommendations.

14. Recommended critical habitat.

A. Concise statement of recommended critical habitat: The three meadows containing alkali primrose in Idaho, are separated from each other by between 18 and 24 miles. Genetic isolation has surely taken place in these three clusters of populations, probably allowing a certain amount of genetic drift to take place within them. In order to maintain the full range of genetic diversity within the species, therefore, critical habitat should encompass the entire extent of the six known alkali primrose populations. I estimated this to be approximately 440 acres. The known extent of primrose populations is displayed on Maps 2, 3, and 4, Appendix 4. Buffer areas should be included within the critical habitat where wetland communities extend beyond the primrose populations.

B. Legal description of boundaries:

C. Latitude and longitude: See legal description above.

D. Publicity/sensitivity of critical habitat area: None expected.

15. Conservation/recovery recommendations.

A. General conservation recommendations.

1. Recommendations regarding present or anticipated activities: Extant populations of alkali primrose appear to be stable, therefore, the only recommendations made here concern current management actions that directly destroy habitat. Such activities include water impoundment and diversion and any wetland filling activity. This type of activity is regulated on both private and public lands. Regulating and land-administering agencies should be vigilant in their permitting and review procedures to ensure that no more alkali primrose habitat is destroyed.

2. Areas recommended for protection: An existing RNA/ACEC exists in portion of the Summit Creek Exclosure that encompasses two isolated subpopulations of the Upper Summit Creek (003) population. All other populations should be protected to some degree from deleterious habitat alteration. The Nature Conservancy is currently pursuing the protection of at least two parcels of private land that contain alkali primrose.

3. Habitat management recommendations: Horse, cattle, and possibly sheep grazing and recreational trampling take place in all alkali primrose populations. The long-term effects of this locally severe disturbance is unknown. It is documented in herbarium records that it has persisted for over 40 years in the Upper Birch Creek (001) population. No alteration of grazing regimes or recreational activity on public lands is recommended here, but their effect on primrose populations should be studied to gain insights for the long-term management of the species.

4. Publicity sensitivity: No deleterious effects anticipated.

5. Other recommendations: None.

B. Monitoring activities and further studies recommended: The effects of persistent trampling disturbance from livestock grazing and recreational activity is unknown. These disturbances are locally severe. Although they do no immediate, observable damage, they may subtly alter habitat conditions over time and negatively affect alkali primrose populations. To gain management insights into this, a long-term monitoring study should be established at the Summit Creek and Birch Creek populations that occur largely on public lands, especially Lower Birch Creek (002), Upper Summit Creek (003), and Moffett Creek (006). The BLM, Forest Service, and Idaho Fish and Game should cooperate on this monitoring study. A monitoring study should include, but not be limited to, the following aspects: detailed mapping of distribution; environmental and habitat classification and description; demographic details; reproductive biology; population ecology. Information such as this will allow the land-managing agencies to make informed management decisions regarding activities in alkali primrose habitat.

16. Interested parties:

Douglass Henderson
Department of Biological Sciences
University of Idaho
Moscow, ID 83843

Anita Cholewa
Department of Botany
220 Biological Science Center
University of Minnesota
St. Paul, MN 55108

Idaho Natural Heritage Program
Idaho Fish and Game
P.O. Box 25
Boise, ID 83707

Bob Parenti
Boise Field Office
U.S. Fish and Wildlife Service
4696 Overland Road, Rm 576
Boise, ID 83705

Roger Rosentreter
Idaho State Office
Bureau of Land Management
3380 Americana Terrace
Boise, ID 83706

Duane Atwood
Intermountain Region
U.S. Forest Service
324 25th Street
Ogden, UT 84401

Forest Supervisor
Targhee National Forest
420 North Bridge Street

St. Anthony, ID 83445

District Manager
Idaho Falls District Office
Bureau of Land Management
940 Lincoln Road
Idaho Falls, ID 83401

District Manager
Salmon District Office
Bureau of Land Management
P.O. Box 430
Salmon, ID 83467

Tom Parker
Idaho Fish and Game
P.O. Box 25
Boise, ID 83707

Herb Pollard
Region 6
Idaho Fish and Game
1515 Lincoln Road
Idaho Falls, ID 83401

John Olsen
Environmental Protection Agency
422 W. Washington St.
Boise, ID 83702

Montana Natural Heritage Program
State Library Building
1515 E. 6th Ave.
Helena, MT 59620

Peter Lesica
Division of Biological Sciences
University of Montana
Missoula, MT 59812

Tass Kelso
Department of Biology
Colorado College
Colorado Springs, CO 80903

Steven Krumm
The Berry Botanic Garden
11505 S.W. Summerville Ave.
Portland, OR 97219

Larry Morse
The Nature Conservancy
1815 North Lynn Street
Arlington, VA 22209

III. Information Sources.

17. Sources of information.

A. Publications.

1. References cited in report: See Appendix 1.

2. Other pertinent publications.

a. Technical: None known.

b. Popular: None known.

B. Herbaria consulted: Specimens of alkali primrose are known to be in the following herbaria: University of Idaho Herbarium (ID), Rocky Mountain Herbarium (RM), New York Botanical Garden (NY), University of Idaho Forestry Research Herbarium (IDF), and Idaho Bureau of Land Management (BLM). Following is a list of known herbarium specimens, indexed by population:

001 - Henderson and Cates 1372 (ID, NY) TYPE
Bond 20235 (ID)
Cholewa 858 (ID)
Christ s.n.; 51-301 (ID)
Davis 3118 (ID)
Hitchcock 23860 (RM)
Rosentreter 4948 (BLM)

002 - Henderson 4221; 6530 (ID)

003 - Henderson et al. 4484 (ID)
Anderson and Davies 133 (ID)
Rosentreter 4852 (BLM)
Elzinga 4293, 4309 (BLM)

004 - Brunsfeld 2065 (IDF)

005 - None

006 - Rosentreter 4863; 4869 (BLM)

Monida (extirpated) - Rose 471 (MONTU)

C. Fieldwork: Over the past 15 years considerable effort has been made to find additional populations of alkali primrose in east-central Idaho and adjacent Montana by field workers from the University of Idaho Herbarium, University of Montana Herbarium, Salmon District BLM, Idaho State Office BLM, Idaho Natural Heritage Program, and The Idaho Nature Conservancy. Contributions of this group have been summarized in this report.

D. Knowledgeable individuals:

Douglass Henderson
Department of Biological Sciences
University of Idaho
Moscow, ID 83843

Anita Cholewa
Department of Botany

220 Biological Science Center
University of Minnesota
St. Paul, MN 55108

Bob Moseley
Idaho Natural Heritage Program
Idaho Fish and Game
P.O. Box 25
Boise, ID 83707

Roger Rosentreter
Idaho State Office
Bureau of Land Management
3380 Americana Terrace
Boise, ID 83706

Steve Shelly
Montana Natural Heritage Program
State Library Building
1515 E. 6th Ave.
Helena, MT 59620

Peter Lesica
Division of Biological Sciences
University of Montana
Missoula, MT 59812

Tass Kelso
Department of Biology
Colorado College
Colorado Springs, CO 80903

E. Other information sources: None known.

18. Summary of materials on file: Color slides, field forms, maps and all published and unpublished references pertaining to alkali primrose are on file at the Idaho Natural Heritage Program office.

IV. Authorship.

19. Initial authorship:

Bob Moseley, Plant Ecologist
Idaho Natural Heritage Program
Idaho Fish and Game
P.O. Box 25
Boise, ID 83707
208/334-3402

20. Maintenance of status report: The Idaho Natural Heritage Program will maintain current information and update the status report as needed. Should alkali primrose be listed as an endangered or threatened species by the U.S. Fish and Wildlife Service, the Service, through its Boise Field Office, should maintain the primary file on information, encourage others to provide new information, and distribute new findings, as received, to the interested parties (section II.16.).

V. New Information.

21. Record of revisions: Not applicable.

APPENDIX 1.

Literature Cited.

Arnold, J.F. 1975. Descriptions of sections and subsections of that portion of the Northern Rocky Mountain Physiographic Province containing the Idaho Batholith. Unpublished report on file at: USDA, Forest Service, Intermountain Research Station, Ogden, UT.

Brunsfeld, S.J. 1983. Salix candida. Page 18. In: Rare and Endangered Plants Technical Committee of the Idaho Natural Areas Council, compilers. 1983 status changes and additions to: Vascular Plant Species of Concern in Idaho. Bull. No. 34. Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow.

Brunsfeld, S.J., and F.D. Johnson. 1985. Field guide to the willows of east-central Idaho. Bull. No. 39. University of Idaho, Forest, Wildlife and Range Experiment Station, Moscow. 95 p.

Cholewa, A.F., and D.M. Henderson. 1984. Primula alcalina (Primulaceae): A new species from Idaho. Brittonia 36:59-62.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. FWS/OBS-79/31, USDI, Fish and Wildlife Service, Office of Biological Services, Washington, D.C. 103 p.

Davidson, B.L. 1986. Some "Idamont" limestones. Pages 63-68 In: Alpine '86 Publications Committee, editors, Rocky Mountain Alpines: Choice rock garden plants of the Rocky Mountains in the wild and in the garden. Timber Press, Portland, OR.

Davis, R.J. 1952. Flora of Idaho. Brigham Young University Press, Provo, UT. 836 p.

Evert, E.F. 1986. The Yellowstone Region: Endemics and other interesting plants. Pages 81-90 In: Alpine '86 Publications Committee, editors, Rocky Mountain Alpines: Choice rock garden plants of the Rocky Mountains in the wild and in the garden. Timber Press, Portland, OR.

Hamrick, J.L., Y.B. Linhart, and J.B. Milton. 1979. Relationships between life history characteristics and electrophoretically detectable genetic variation in plants. Annual Review of Ecology and Systematics 10:173-200.

Henderson, D.M. 1981a. Primula incana. Page 83. In: Rare and Endangered Plants Technical Committee of the Idaho Natural Areas Council, compilers. Vascular Plant Species of Concern in Idaho. Bull. No. 34. Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow.

Henderson, D.M. 1981b. Lomatogonium rotatum. Page 118. In: Rare and Endangered Plants Technical Committee of the Idaho Natural Areas Council, compilers. Vascular Plant Species of Concern in Idaho. Bull. No. 34. Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow.

Hironaka, M., and M.A. Fosberg, and A.H. Winward. 1983. Sagebrush - grass habitat types of southern Idaho. Bull. No. 35. Forest, Wildlife, and Range Experiment Station, University of Idaho, Moscow. 44 p.

Hitchcock, C.L. 1959a. Primula. In: C.L. Hitchcock, A. Cronquist, M. Ownbey, and J.W. Thompson. Vascular plants of the Pacific Northwest. 4:50-53. University of Washington Press, Seattle.

Hitchcock, C.L. 1959b. Lomatogonium. In: C.L. Hitchcock, A. Cronquist, M. Ownbey, and J.W. Thompson. Vascular plants of the Pacific Northwest. 4:73-74. University of Washington Press, Seattle.

Hitchcock, C.L. 1973. Primula. Page 355. In: C.L. Hitchcock and A.

Cronquist. Flora of the Pacific Northwest:and illustrated manual. University of Washington Press, Seattle.

Keller, C., L. Anderson, and P. Tappel. 1979. Fish habitat changes in Summit Creek, Idaho, after fencing the riparian. Pages 46-52. In: O.B. Cope, editor. Proceeding of the forum - Grazing and riparian/stream ecosystems. Trout Unlimited, Inc.

Keller, C.R., and K.P. Burnham. 1982. Riparian fencing, grazing, and trout habitat preference on Summit Creek, Idaho. North American Journal of Fisheries Management 2:53-59.

Kelso, S. 1987. Systematics and biogeography of the arctic and boreal species of Primula. Ph.D. Dissertation, University of Alaska, Fairbanks. 212 p.

Kelso, S. 1988. Evolution in the Genus Primula sect. Aleuritia: Isolation, secondary contact, polyploidy, homostyly. Abstract No. 602 from 1988 American Institute of Biological Sciences Meeting, Davis CA.

Kuchler, A.W. 1964. Potential natural vegetation of the conterminous United States. Spec. Publ. No. 36. American Geographical Society, N.Y.

Lesica, P. 1986a. Letter of 16 January to Nancy Grulke and Steve Shelly. On file at: Montana Natural Heritage Program, Helena. 1 p.

Lesica, P. 1986b. Primula alcalina. Unpublished report on file at: Montana Natural Heritage Program, Helena. 1 p. plus maps.

Lesica, P., G. Moore, D.M. Peterson, and J.H. Rumley. 1984. Vascular plants of limited distribution in Montana. Monograph No. 2. Montana Academy of Science, Supplement to the Proceedings, Vol. 43. 61 p.

Lesica, P., K. Lackschewitz, J. Pierce, S. Gregory, and M. O'Brien. 1986. Noteworthy Collections: Montana. Madrono 33:310-312.

Moseley, R.K. 1986. Research natural area recommendation for Summit Creek Exclosure, Bureau of Land Management, Salmon District, Idaho. Unpublished report on file at: Idaho Department of Fish and Game, Idaho Natural Heritage Program, Boise. 13 p.

Mutz, K.M., and J. Queiroz. 1983. Riparian community classification for the Centennial Mountains and South Fork Salmon River, Idaho. Contract No. 53-84M8-2-0048. Meiiji Resource Consultants, Layton, UT. 170 p.

Rabe, F.W., and N.L. Savage. 1977. Aquatic natural areas in Idaho. Idaho Water Resources Institute, University of Idaho, Moscow. 103 p.

Shelly, J.S. 1988. Plant species of special concern. Unpublished report on file at: Montana Natural Heritage Program, Helena. 12 p.

Stebbins, G.L. 1971. Chromosomal evolution in higher plants. Arnold, London. 216 pp.

Steele, R., R.D. Pfister, R.A. Ryker, and J.A. Kittams. 1981. Forest habitat types of central Idaho. General Technical Report INT-114. USDA, Forest Service, Intermountain Research Station, Ogden, UT. 138 p.

Sugden, E.A. 1985. Pollinators of Astragalus monoensis Barneby (Fabaceae): New host records; potential impact of sheep grazing. Great Basin Naturalist 45:299-312.

Thomas, A.E. 1986. Riparian protection/enhancement in Idaho. Rangelands 8:224-

227.

Trewartha, G.T. 1954. An introduction to climate. McGraw-Hill Book Co., Inc., New York. 402 p.

Tuhy, J.S., and S. Jensen. 1982. Riparian classification for the upper Salmon/Middle Fork Salmon rivers, Idaho. Whitehorse Associates, Smithfield, UT. 200 p.

USDA, Forest Service. 1989. Threatened, endangered, and sensitive plant program action plan. Intermountain Region, Ogden, UT. 42 p.

USDI, Bureau of Land Management. 1987. Plan Amendment and Environmental Assessment considering proposed Areas of Critical Environmental Concern (ACECs) and Research Natural Areas (RNAs). Salmon District Office, Salmon, ID. 25 pages plus maps.

Youngblood, A.P., W.G. Padgett, and A.H. Winward. 1985. Riparian community type classification of eastern Idaho - western Wyoming. R4-Ecol-85-01, USDA Forest Service, Intermountain Region, Ogden, UT. 78 p.

APPENDIX 2.

Line drawing of *Primula alcalina*.

Page 1. Reproduced from Cholewa and Henderson (1984) showing: A. Plant habit. B. Longitudinal view of pin flower. C. Calyx. D. Camera lucida drawing of meiotic chromosomes at diakinesis.

Page 2. Reproduced from Kelso (1987) showing: A. Thrum flower. B. Pin flower.

APPENDIX 3.
Slides of Primula alcalina and habitat.

Slide 1. Primula alcalina (courtesy of Douglass Henderson, University of Idaho).

Slide 2. Upper Summit Creek (003) population within Summit Creek Exclosure ACEC/RNA. The bright green basal rosettes of alkali primrose are visible in the foreground within the graminoid turf matrix. Photo taken July 1986.

Slide 3. Overview of Mud Flats (005) population along Summit Creek. Alkali primrose occurs in the area that is densely vegetated in the center of the photo. It does not occur on the white, exposed surface to the right that has dried to the soil surface. Photo taken August 1988.

Slide 4. Overview of Texas Creek (004) population. Alkali primrose occurs near the creek running through the center of the photo. Photo taken August 1988.

Slide 5. Heavily grazed hummocks at Texas Creek (004). Alkali primrose occurs on the hummocks, but not in swales. Photo taken August 1988.

Slide 6. Alkali primrose rosettes on hummock at Texas Creek (004). Photo taken August 1988.

Slide 7. Overview of Birch Creek meadows. Upper Birch Creek (001) population occurs along the small creek between the road (State Hwy 28) and the base of the hill to the right. Photo taken August 1988.

Slide 8. Alkali primrose habitat at Lower Birch Creek (002) population. It occurs on densely vegetated terrace along the creek in the lower center of the photo. It does not occur on the whitish areas of the next higher terrace seen in the center left. Photo taken August 1988.

Slide 9. Heavily grazed terrace on private land along Summit Creek between Upper Summit Creek (003) and Mud Flats (005) populations. It is apparently suitable habitat but contains no alkali primrose. Photo taken August 1988.

Slide 10. Results of prolonged overgrazing on streambanks. Compacted soil and erosion has left no original wetland/riparian vegetation on this BLM section of Summit Creek, downstream from Mud Flats (005) population. Photo taken August 1988.

Slide 11. Recent attempted diversion of water from Summit Creek on private land at Upper Summit Creek (003). The ditch, seen in upper right, is not yet connected to the creek. Alkali primrose occurs on both sides of Summit Creek at this point. Photo taken August 1988.

Slide 12. Roads and facilities at BLM Summit Creek Campground in the middle of Upper Summit Creek (003) population. Photo taken August 1988.

Slide 13. Area affected by the backwater sedimentation of a small dam on Summit Creek between Upper Summit Creek (003) and Mud Flats (005) populations. Remains of the dam can be seen in the center of the photo. Considerable alkali primrose habitat was replaced by open water and aquatic emergents. Photo taken August 1988.

APPENDIX 4.

Maps of *Primula alcalina* distribution.

Map 1. Overview of the distribution of known and historical populations.
Modified from Cholewa and Henderson (1984).

Map 2. Birch Creek populations (001, 002).
Portions of the following USGS 7.5' quadrangles:
Blue Dome 1969
Italian Canyon 1987 Provisional Edition

Map 3. Texas Creek population (004).
Portions of the following USGS 7.5' quadrangles:
Gilmore 1987 Provisional Edition
Purcell Spring 1987 Provisional Edition

Map. 4. Summit Creek populations (003, 005, 006).
Portions of the following USGS 7.5' quadrangles (reduced 64%):
Moffett Springs 1987 Provisional Edition
Big Windy Peak 1987 Provisional Edition
Mulkey Bar 1987 Provisional Edition

Key to Maps 2 through 4:

= *Primula alcalina* population

Land Ownership

= Private

= Bureau of Land Management

= Forest Service

= State of Idaho, Department of Fish and Game

= State of Idaho, Department of Lands

APPENDIX 5.

Occurrence records for *Primula alcalina* populations.