REPORT ON THE CONSERVATION STATUS OF *HAPLOPAPPUS RADIATUS*, IN IDAHO

by

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June, 1993

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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

HAPLOPAPPUS RADIATUS, IN IDAHO

Taxon Name:	*Haplopappus radiatus* (Nutt.) Cronq.
Common Name:	Snake River goldenweed
Family:	Asteraceae (Compositae)
States Where Taxon Occurs:	U.S.A.; Idaho, Oregon
Current Federal Status:	Category 1 Candidate
Recommended Federal Status:	Threatened
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Original Date of Report:	June 18, 1993
Date of Most Recent Revision:	N/A
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ABSTRACT

Snake River goldenweed (*Haplopappus radiatus*) has been recognized as a possible conservation concern for at least twenty years. Until 1991, field inventories in Idaho were limited. In 1991, the Idaho Conservation Data Center completed a field investigation for Snake River goldenweed on the Payette National Forest. Through funding provided by the U.S. Fish and Wildlife Service, additional fieldwork was completed throughout the rest of the species' range in Idaho, during 1992. Survey work has also been done in Oregon. Besides field inventories, research biologists associated with the Conservation Biology Program, Oregon Department of Agriculture, have done cytological and pollination investigations, and presently are monitoring several populations in Oregon.

Snake River goldenweed is endemic to the dry, rolling hills, canyons and lower mountain slopes near the Snake River in Washington County, Idaho and adjacent eastern Oregon, where it occurs within bunchgrass and sagebrush-bunchgrass communities.

Recent collections of *H. carthamoides* var. *carthamoides*, previously unknown from the range of Snake River goldenweed, has raised some interesting taxonomic questions concerning the *radiatus-carthamoides* complex, but as presently understood, both are distinct and separate taxa.

Sixteen extant populations supporting an estimated 20,000 plants have been documented for Idaho. Two additional populations have not been relocated in recent years and may be extirpated. Most populations are small and their long-term viability is judged to be tenuous. Although prospects for the few remaining large populations in Idaho appears better, proactive management decisions that will confer protection to these populations are needed. Highlighting concerns for this species are its limited distribution, potentially unfavorable demographics within and between populations, and most critical, the cumulative effects of its varied and widespread threats. Of these threats, the most widespread, severe and difficult to mitigate is the loss of high quality native grassland and sagebrush-steppe habitat. Exotics, exemplified by annual grasses such as cheatgrass, now dominate much of Snake River goldenweed's geographic range. Field observations strongly suggest Snake River goldenweed has declined throughout its range, and in a large part this is attributable to ongoing habitat degradation.

In light of its declining status, threats, and other population maintenance problems, we recommend that the federal status of Snake River goldenweed be changed from C1 to Threatened.

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I. Species Information.

1. Classification and nomenclature.

A. Species.

1. Scientific name.

a. Binomial: *Haplopappus radiatus* (Nutt.) Cronq.

b. Full bibliographic citation: Cronquist, A. 1955. *Haplopappus radiatus*. Page 223 *In*: Vascular plants of the Pacific Northwest, Part 5, By C.L. Hitchcock, A. Cronquist, M. Ownbey, and J.W. Thompson. University of Washington Press, Seattle.

c. Type specimen: Nuttall s.n. Oregon: Baker Co., plains of Oregon near Walla Walla, 1838. Holotype at K (Kew Herbarium, Royal Botanic Gardens, England), Isotypes at GR (Laboratoire de Botanique et Biologogie Vegetale, Grenoble, France), GH (Harvard University Herbaria, U.S.A.), and NY (New York Botanical Garden Herbarium, U.S.A.). Cronquist comments the type locality is "probably actually taken along the Snake River near Huntington, Oregon".

2. Pertinent synonym(s): *Pyrrocoma radiata* Nutt., Trans. Am. Phil. Soc. II, 7:33. 1840.
Haplopappus carthamoides var. *maximus* Gray, Syn. Fl. 12:126. 1884.
Haplopappus carthamoides ssp. *maximus* (Gray) Hall, Publ. Carnegie. Inst. Wash. 389: 102. 1928.

3. Common name(s): Snake River goldenweed

4. Taxon codes: PDAST4F120 (Natural Heritage Conservation Data Center Network).

5. Size of genus: About 150 species, equally distributed between North and South America. In North America occurring mostly in the western cordillera (Cronquist 1955).

B. Family classification.

1. Family name: Asteraceae

2. Pertinent family synonyms: Compositae.

3. Common name(s) for family: Aster, Sunflower

C. Major plant group: Dicotyledonea (Class Magnoliopsida)

D. History of knowledge of taxon: Snake River goldenweed was originally collected by Nuttall in Oregon, in 1838, and only rarely collected after that until 1974, when taxonomic studies and especially conservation concerns increased interest in this taxon. It was first discovered in Idaho in 1974 by Ertter, in Washington County (Siddall and Chambers 1978).

Snake River goldenweed was originally recommended as an endangered species by the Smithsonian Institution, and proposed for listing by the U.S. Fish and Wildlife Service in 1976. Since 1980, its federal status has been as either a Category 1 or 2 candidate. Snake River goldenweed appeared in the original Endangered and Threatened Plants of Idaho publication (Johnson 1977), where retention of its federally proposed endangered status was recommended, noting it to be very uncommon in Idaho. It was also considered an endangered regional endemic by the Oregon Rare and Endangered Plant Species Task

Force (Meinke 1978).

Meinke (1978 and 1979) was the first to intensively study the distribution of Snake River goldenweed in Oregon. Additional inventory work in Oregon was done by Kaye et al. (1990), who also did a cytogeographical investigation of the species as part of their study. For the most part, inventory work in Idaho was less systematic until 1991, when a field investigation for the Payette National Forest was completed as a Challenge Cost-share project between the Payette National Forest and the Conservation Data Center (Mancuso 1991). In 1992, the Conservation Data Center was contracted by the U.S. Fish and Wildlife Service to conduct field inventories and prepare a status survey report for Snake River goldenweed throughout the rest of the species suspected range in Idaho.

E. Comments on current alternative taxonomic treatment(s): Snake River goldenweed is closely related to *Haplopappus carthamoides* (Columbia goldenweed), a species widespread in the Pacific Northwest east of the Cascade Mountains, and extending into adjacent areas of California and Nevada. Columbia goldenweed is comprised of two varieties; var. *cusickii* has a range overlapping that of *H. radiatus*, but it is readily distinguishable and presents no identification problems. The other taxon is var. *carthamoides*, and until recently discovered in west-central Idaho, was unknown from the range of *H. radiatus*, occurring mainly to its north and northwest. This becomes problematic because several identifying characters such as stem color and pubescence of the involucre bracts overlap between *H. radiatus* and *H. carthamoides* var. *carthamoides*. In fact, it appears there may be a morphological continuum between the two taxa for characters previously used to differentiate them. Tom Kaye (pers. comm., 1993), with the Oregon Department of Agriculture, has studied *H. radiatus* extensively, and is in agreement with Cronquist (1955) that the most significant morphological difference between the two taxa is that *H. radiatus* tends to be bigger.

Both Gray (1884) and Hall (1928) treated Snake River goldenweed as a variety or subspecies of Columbia goldenweed. However, more recent treatments by Cronquist (1955) and Mayes (1976) treat it at the specific level, primarily "because of its restricted geographical distribution, the fact that it falls well outside the range of morphological variation in *Haplopappus carthamoides*, and its hexaploid nature" (Mayes 1976, p. 7).

Several segregate genera have been proposed for *Haplopappus*. Cronquist (1955) notes that this segregation is based principally on variation in habit, but despite the great habitual differences in the group, the genus seems to represent a natural group, and is generally well distinguished from its relatives. For the most part, Cronquist's taxonomic treatment of *Haplopappus* is similar to that proposed in an earlier monograph of the genus by Hall (1928). It was in this monograph that the genus *Pyrrocoma* (along with several others) was reduced to a section within *Haplopappus*. Mayes (1976) elevated the rank of *Pyrrocoma* back to the generic level as a result of his studies, including reestablishment of the name *Pyrrocoma radiata* (for *Haplopappus radiatus*) originally proposed by Nuttall. Although the lack of consensus concerning the circumscription for the genus *Haplopappus* has resulted in disagreement over the name for *Haplopappus radiatus*, there has been modern agreement that the taxon is valid and separate. Collections of var. *carthamoides* within the range of *H. radiatus* has blurred relationships and reopens some taxonomic uncertainties in the *radiatus-carthamoides* group, but as presently understood *H. radiatus* is a distinct species and is treated as such in this report. Additional studies will be necessary to fully address any taxonomic uncertainty.

It should also be noted that Lee (1969) did not recognize *Haplopappus radiatus* in her review of the genus in Idaho.

2. Present legal or other formal status

A. International: None.

B. National.

1. Present designation of proposed legal protection or regulation: Snake River goldenweed is presently a Category 1 candidate species for federal listing (U.S. Fish and Wildlife Service 1990).

2. Other current formal status recommendation: Snake River goldenweed is currently ranked as "imperiled throughout its range because of extreme rarity or because of some other factor of its biology making it very vulnerable to extinction" (global rank = G2), by The Nature Conservancy.

Snake River goldenweed is listed as a Sensitive Plant Species for the Payette National Forest, Region 4 of the U.S. Forest Service (Spahr et al. 1991), and for the Bureau of Land Management in Idaho (Moseley and Groves 1992).

3. Review of past status: The U.S. Fish and Wildlife Service listed Snake River goldenweed as a Category 1 candidate in 1980 (U.S. Fish and Wildlife Service 1980), and then as a Category 2 candidate in the 1983 Federal Register of candidate plants (U.S. Fish and Wildlife Service 1983). Reflecting the increased knowledge about the species, it was reinstated as a Category 1 candidate in 1990 (U.S. Fish and Wildlife Service 1990).

C. Idaho.

1. Present designation or proposed legal protection or regulation: None.

2. Other current formal status recommendation: Snake River goldenweed is currently listed as "critically imperiled in Idaho because of extreme rarity or because of some other factor of its biology making it especially vulnerable to extinction" (state rank = S1) by the Idaho Conservation Data Center and The Nature Conservancy (Moseley and Groves 1992).

Since it is a federal candidate species, no Idaho Native Plant Society category applies to Snake River goldenweed (Idaho Native Plant Society 1993).

3. Review of past status: None.

D. Oregon.

1. Present designation or proposed legal protection or regulation: Snake River goldenweed is a State Endangered Species in Oregon (Oregon Natural Heritage Data Base 1991).

2. Other current formal status recommendation: None.

3. Review of past status: None.

3. Description.

A. General nontechnical description: Snake River goldenweed is an erect, herbaceous perennial with a woody taproot. Most individuals are greater than 40 cm tall. Basal leaves are large, mostly greater than 5 cm wide, while the stem leaves are smaller and usually sessile. The leaves are typically entire, but may be serrated to varying degrees. Upper portions of the flowering stems are light, with a yellow-green, tawny color. The plants are often without any pubescence except for a few scattered, small, light-colored hairs that sometimes can be found along the upper stem and/or on the involucre (bracts below the flower head). Occasionally this pubescence will be quite noticeable, but does not obscure the light color of the stem. The involucre is large and herbaceous-looking. Plants have

1-several flowering heads each, these heads with yellow rays. Snake River goldenweed is green and flowers later in the season than most other species in the grassland habitats where it typically occurs, and is therefore quite easy to spot surrounded by the brown, dormant vegetation of these grasslands. See Appendix II for a line drawing, and Appendix V for color slides of Snake River goldenweed.

It should be noted that most populations in Idaho contain individuals that fall outside the species previously published range of variability for several morphological characteristics. This is likely due to the relative paucity of material earlier descriptions were based upon. The characters include: 1) ray florets up to 17 mm long. 2) basal leaves less than 5 cm wide. 3) upper portions of the flowering stem can sometimes be more than just sparingly pubescent, this is less common towards the basal portion of the stem. 4) flowering plants less than 40 cm tall, to as short as 20 cm in height.

The smaller stature plants are often, but not always associated with rockier, shallow soil sites or higher elevations. There is some speculation that the smaller stature of many individuals may be a response to drought conditions. In most populations, robust, more typical-sized plants occur sympatric with the smaller plants to help with identification.

B. Technical Description: Herbaceous perennial, 45.5-92 cm tall; stems usually erect, pale, rarely red-tinged, glabrous, 1-8 arising from a woody taproot; basal leaves elliptic to obovate, entire or undulate, occasionally spinulose-dentate, 18-43.5 cm long, 5-15.5 cm wide, glabrous; cauline leaves numerous, oblanceolate to ovate, usually sessile with clasping base, spinulose-serrate, rarely entire or undulate, 4.5 cm long, 2.5-4 cm wide, glabrous; heads (1)-3-12 in an open corymbose inflorescence, occasionally solitary and terminal, long peduncled, 2.5-4 cm wide; involucre hemispheric, subtended by foliaceous bracts, 2.1-3.2 cm high; phyllaries in 5-6 series, imbricate, subequal, ovate to oblong, mucronate, tip reflexed, herbaceous green with scarious base and pale margin, 11-17.1 mm long, 2.5-6 mm wide, glabrous; ray florets 17-30, 7.5-13.5 mm long, 0.5-1.1 mm wide; disk florets 80-100 or more, 10-15 mm long, 1.2-1.7 mm wide; achenes subcylindric, 4-angled; pappus of about 40-60 rigid, unequal, brownish bristles, 9-13.1 mm long; n = 18 (Mayes 1976).

C. Local field characters: Snake River goldenweed is most similar to the closely related species *Haplopappus carthamoides* (Columbia goldenweed), especially var. *carthamoides*. Differences in several morphological characteristics usually allow for field differentiation of these two species and are noted in the key below. Although Columbia goldenweed is known to occur within the range of Snake River goldenweed, the two were never found to be sympatric in Idaho. Two other common, yellow-flowered composites that can be in flower at the same time and superficially look like Snake River goldenweed, at least from a distance, are *Grindelia squarrosa* (curly-cup gumweed) and *Helianthella uniflora* (little-sunflower). The very glandular involucre and smaller foliage of *Grindelia*, and the generally taller stature, larger flower head and very hirsute and scabrous foliage of *Helianthella* make both species readily distinguishable upon closer inspection. The following key, modified from Kaye et al. (1990) should help distinguish Snake River goldenweed from the two varieties of Columbia goldenweed. The generally more pubescent stems and involucre bracts of var. *carthamoides* will help differentiate the more robust-sized individuals/populations that may otherwise key to *H. radiatus*. This key will prove most helpful when at least several plants are looked at in a given population.

1. Plants usually robust, mostly 35-95 cm tall; basal leaves mostly 5-19 cm wide; stems glabrous (without hairs) to rather sparsely pubescent, this generally restricted to the upper stem; upper stem tawny to light brown, involucral bracts glabrous to only slightly pubescent at the base ..... *Haplopappus radiatus*

1. Plants usually smaller, mostly 6.5-50 cm tall; basal leaves 1-4.2 cm wide; stems rather pubescent, often villous (long, soft, mostly bent hairs), especially above; upper stem usually red-tinged to brown, involucral bracts puberulent (minutely pubescent), often ciliate..... 2

2. Involucral bracts oblong, strongly imbricate; heads hemispheric-campanulate .... *Haplopappus carthamoides* var. *carthamoides*

2. Involucral bracts lanceolate, loosely if at all imbricate; heads campanulate-turbinate ..... *Haplopappus carthamoides* var. *cusickii*

D. Identifying characteristics of material which is in interstate or internation commerce or trade: No interstate or international trade is known. See above section for differences with closely related genera/species.

E. Photographs and/or line drawings: Line drawings of Snake River goldenweed appears in Cronquist (1955) and Hitchcock and Cronquist (1973). In addition, Spahr et al. (1991) and USDA Forest Service (n. d.) contain reproductions of the drawing from Cronquist. Photographs (35 mm slides) of Snake River goldenweed and its habitat in Idaho are in the slide collection of the Idaho Conservation Data Center, Boise, Idaho. Several have been reproduced in Appendix V.

4. Significance:

A. Natural: None known.

B. Human: None known.

5. Geographical distribution.

A. Geographical range: Snake River goldenweed is endemic to the dry, rolling hills, ridges, and canyon slopes near the Snake River in eastern Oregon and adjacent western Idaho. In Oregon, it is restricted to Baker County, centered around Huntington, and adjacent portions of very northeastern Malheur County. In Idaho, it is known only from Washington County.

B. Precise occurrences.

1. Populations currently or recently known extant: Eighteen populations of Snake River goldenweed have been documented for Idaho. Two of these populations (002, 004) could not be relocated in 1992 and may be extirpated. Six populations were discovered in 1991 and six were discovered in 1992. The remaining four populations discovered prior to the summer of 1991 were revisited in 1992 and updated information was collected. Note that the number in parentheses refers to the occurrence number for *Haplopappus radiatus* in the Conservation Data Center's data base.

Idaho

1. Mineral East (001)
   a. USA: Idaho, Washington County
   e. First observed in 1978.
   f. Most recently observed in 1991.

2. Monroe Creek (002)
   a. USA: Idaho, Washington County
   e. First observed in 1941.
   f. Most recently observed in 1941; not relocated in 1992.

3. Idaho Almaden Mine (003)
   a. USA: Idaho, Washington County
   e. First observed in 1974.
   f. Most recently observed in 1992.

4. Brownlee Creek (004)
  a. USA: Idaho, Washington County
  e. First observed in 1952.
  f. Most recently observed in 1952; not relocated in 1992.

5. Upper Adams Creek (005)
  a. USA: Idaho, Washington County
  e. First observed in 1991.
  f. Most recently observed in 1991.

6. Lower Payette Ditch/Hill Road (006)
  a. USA: Idaho, Washington County
  e. First observed in 1987.
  f. Most recently observed in 1992.

7. Monroe Butte (007)
  a. USA: Idaho, Washington County
  e. First observed in 1991.
  f. Most recently observed in 1991.

8. Chinamans Hat (008)
  a. USA: Idaho, Washington County
  e. First observed in 1991.
  f. Most recently observed in 1991.

9. Middle Fork Dennett Creek (009)
  a. USA: Idaho, Washington County
  e. First observed in 1991.
  f. Most recently observed in 1991.

10. Benton Creek (010)
  a. USA: Idaho, Washington County
  e. First observed in 1991.
  f. Most recently observed in 1991.

11. Benton Saddle (011)
  a. USA: Idaho, Washington County
  e. First observed in 1992.
  f. Most recently observed in 1992.

12. Barton Reservoir Northeast (012)
  a. USA: Idaho, Washington County
  e. First observed in 1992.
  f. Most recently observed in 1992.

13. Raft Creek (013)
  a. USA: Idaho, Washington County
  e. First observed in 1992.
  f. Most recently observed in 1992.

14. Upper Raft Creek Ridges (014)
  a. USA: Idaho, Washington County
  e. First observed in 1992.
  f. Most recently observed in 1992.

15. Trail - Wolf Creeks (015)
  a. USA: Idaho, Washington County
  e. First observed in 1992.
  f. Most recently observed in 1992.

16. Sumac Creek (016)
  a. USA: Idaho, Washington County
  e. First observed in 1992.
  f. Most recently observed in 1992.

17. Lower Dennett Creek (017)
  a. USA: Idaho, Washington County
  e. First observed in 1992.
  f. Most recently observed in 1992.

18. Barton Reservoir (018)
  a. USA: Idaho, Washington County
  e. First observed in 1992.
  f. Most recently observed in 1992.

2. Populations known or assumed extirpated: Two populations of Snake River goldenweed in Idaho may be extirpated, neither being relocated during thorough survey work in 1992. Most of the alluvial terrace areas along Monroe Creek north of Weiser as described in the original location data for the Monroe Creek population (002), are heavily used rangeland or have been converted to agricultural or other commercial uses. The prevalence of inaccessible private land did prevent some areas from being searched, however. The Brownlee Creek (004) population is also based on vague location data. Most of the potentially suitable habitat where this population most likely occurred is badly degraded rangeland and primarily supports exotic annual grasses. A few places where the topography allows have been converted to hayfields.

3. Historically known populations where current status not known: Both the Monroe Creek (002) and Brownlee Creek (004) populations are believed to be extirpated, but primarily due to originally vague location data, their is reasonable doubt to the exact status of both populations.

4. Locations not yet investigated believed likely to support additional natural populations: The completion of recent survey work has generally defined the geographic range of Snake River goldenweed in Idaho. The full extent of several populations remains unknown, however. This is especially true for the Monroe Butte (007) and Chinamans Hat (008) populations. Both populations have been delineated at their upper elevation limits, but not their midslope position, and it remains unknown how far downslope (generally to the west) they extend. It is possible that these two populations are contiguous with those known from adjoining lower slopes near Brownlee Reservoir. In addition, portions of the lower and middle Sturgill Creek drainage were not surveyed due to our inability to contact the private landowner for permission to access the area. This area may support additional populations.

5. Reports having ambiguous or incomplete locality information: The original location data for both the Monroe Creek (002) and Brownlee Creek (002) populations are vague. This is elaborated on in Section 5.B.2, above.

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

C. Biogeographical and phylogenetic history: *Haplopappus* belongs to the tribe Astereae in the Asteraceae. Concerning its phylogenetic position, it is difficult to derive *Haplopappus* from any present-

day genera (Hall 1928). Within the genus, *Haplopappus radiatus* is part of section *Pyrrocoma*, an assemblage of roughly 13 species native to the western United States and adjacent southwestern Canada. This group is characterized by its herbaceous perennial habit, production of flavones as its major flavonoid component, and base chromosome number of x = 6. It is considered one of the sections more advanced members, as is its closest relative, *Haplopappus carthamoides* (Mayes 1976). *Haplopappus radiatus* is a hexaploid, and may have originated through chromosome doubling events within populations of *Haplopappus carthamoides* coupled with backcrossing. *Haplopappus radiatus* is typically much larger than its presumed diploid progenitor, and may represent a product of local evolution that, because of seed weight, has been less able to disperse geographically (Meinke pers. comm., 1992).

Besides several widespread species, section *Pyrrocoma* also contains four narrow endemics, including *Haplopappus radiatus*. Based on its morphology and associates (such as *Artemisia* and *Chrysothamnus*), and its presumed generic relatives (such as *Grindelia*), ancestral *Pyrrocoma* was probably a member of the Madro-Tertiary Geoflora (Mayes 1976). It should be noted that the very inclusive concept of *Haplopappus* adopted by Hall (1928) and Cronquist (1955) is being questioned by recent workers on this group, and there is a growing trend to reestablish sections such as *Pyrrocoma* at the generic level (Atwood and Charlesworth 1987).

6. General environment and habitat description.

A. Concise statement of general environment: Snake River goldenweed occurs on dry, non-forested, often rocky sites. It has an elevational amplitude of 4000 feet in Idaho, occurring from about 2100 feet to 6100 feet. It can occur along ridgecrests and from upper to lower slope positions. Slopes vary from very steep to basically flat, with southeast to southwest aspects the most common. However, at several low elevation sites above Brownlee Reservoir, plants most commonly occur on north aspects. The largest populations in Idaho occur on calcareous substrates, but populations from volcanic soils are also known.

The habitat of Snake River goldenweed is usually sparsely covered or devoid of shrubby vegetation. In Idaho, Snake River goldenweed occurs in several bunchgrass and sagebrush/ bunchgrass habitat types. Years of intense grazing pressure has modified most of these habitats, so that to varying degrees, native plant communities have been replaced by exotic species, predominately annuals. Snake River goldenweed is inevitably absent or much sparser where weedy species are most prominent.

B. Physical characteristics.

1. Climate.

a. Koppen climate classification: Habitat for Snake River goldenweed is classified as Koppen's unit BSk: middle latitude steppe, with average annual temperature under 64.4°F (Trewartha 1968).

b. Regional macroclimate: The following characterization of the climate of west-central Idaho is largely adapted from Ross and Savage (1967). During the late fall, winter, and early spring months, the climate is influenced primarily by Pacific Maritime air. Resulting winters are therefore warmer and milder than might be expected. Periodically, the westerly flow of air is interrupted by outbreaks of cold, clear, continental air from Canada. During summer months, the westerly winds weaken, and continental climatic conditions prevail. Rainfall, cloud cover, and relative humidity are at their minimum in summer, and daily temperature variations of 40° to 50°F (22° to 28°C) can occur.

Climatological data from Weiser, located in west-central Idaho, at 11N, R5W, and at an altitude of 2103 feet, gives an indication of climatic trends within the geographic range of Snake River goldenweed. Mean annual temperature for Weiser is 54.2°F (11.0°C) and the mean annual

precipitation is 12.4 inches (316 mm). The annual temperature range for Weiser averages between 29.7°F (-1.3°C) and 79.9°F (25°C), with highest temperatures occurring in July and the lowest in December. Mean annual precipitation peaks in the winter months (November through January) with approximately 49% of the total annual precipitation (Johnson 1978).

c. Local microclimate: Dry, mostly southerly slopes, except at lowest elevation sites, where Snake River goldenweed commonly occurs and attains its largest size on northerly aspects. This indicates that the duration of available moisture may be limiting at these hottest, driest sites. Ambient temperatures may exceed 100° F during its July reproductive period.

2. Air and water quality requirements: Unknown.

3. Physiographic provinces: Snake River goldenweed occurs within the Columbia Intermontane Province (Ross and Savage 1967).

4. Physiographic and topographic characteristics: Snake River goldenweed occurs on steep to gentle terrain, and on all aspects, but is most common on southeast to southwest-facing slopes, except at its lowest elevation sites, where it frequently occurs on northerly aspects. Populations can extend across a variety of topographic positions, including ridgecrests, upper to lower slopes, and occasionally bottomlands.

5. Edaphic factors: Mayes (1976) comments that the species occurs on alkaline sites. Kaye et al. (1990) notes all Snake River goldenweed populations he visited occurred on slightly to very calcareous substrate that often overlaid a shale formation. The largest populations in Idaho also occur on calcareous substrates. All populations in the Brownlee Reservoir area are restricted to a slightly calcareous phyllite, with no populations found on the volcanics to the north or south of this phyllitic rock. However, populations east of the Hitt Mountains and in the Weiser area do occur on volcanic substrates.

6. Dependence of this taxon on natural disturbance: Snake River goldenweed is frequently absent, sparser, or of reduced vigor in areas that are very weedy. In the vicinity of Brownlee Reservoir, plants were often found along slump margins. Such disturbed sites are relatively sparsely vegetated and provide ample openings of reduced competition. Both of these observations hint that this species requires openings for establishment, and may be related to a relatively poor competitive capability.

7. Other unusual physical features: None.

C. Biological characteristics.

1. Vegetation physiognomy and community structure: Snake River goldenweed is most commonly associated with bunchgrass-dominated communities and openings within sagebrush dominated communities. Associate shrub cover is usually low. Habitat types include, *Agropyron spicatum/Poa sandbergii/Balsamorhiza sagittata* (bluebunch wheatgrass/Sandberg's bluegrass/arrowleaf balsamroot), *Festuca idahoensis/Agropyron spicatum* (Idaho fescue/bluebunch wheatgrass), *Festuca idahoensis/Koeleria cristata* (Idaho fescue/prairie Junegrass), *Artemisia wyomingensis/Agropyron spicatum* (Wyoming sagebrush/bluebunch wheatgrass), and *Artemisia tridentata/Agropyron spicatum* (big sagebrush/bluebunch wheatgrass) habitat types (Hironaka et al. 1983; Tisdale 1986). Snake river goldenweed was never observed in forested habitats or areas supporting a dense cover of sagebrush species.

In most cases, the community structure of Snake River goldenweed sites has been modified, sometimes severely, by overgrazing, increased fire frequencies and other anthropogenic causes. The result is a large weedy component, especially annual grasses such as cheatgrass (*Bromus tectorum*), medusahead rye (*Taeniatherum caput-medusae*), and bulbous bluegrass (*Poa bulbosa*). The overall

native plant diversity of these degraded sites is also reduced.

2. Regional vegetation type: Kuchler (1964) places the lower Snake River area of Idaho into the potential vegetation type of Sagebrush-Steppe (*Artemisia-Agropyron*).

3. Frequently associated species: Associated species include *Artemisia tridentata* ssp. *tridentata* (big sagebrush), *Artemisia tridentata* ssp. *wyomingensis* (Wyoming sagebrush), *Chrysothamnus viscidiflorus* (green rabbitbrush), *Chrysothamnus nauseosus* (gray rabbitbrush), *Agropyron spicatum* (bluebunch wheatgrass), *Poa sandbergii* (Sandberg's bluegrass), *Festuca idahoensis* (Idaho fescue), *Balsamorhiza sagittata* (arrowleaf balsamroot), *Crepis acuminata* (tapertip hawksbeard), *Achillea millefolium* (yarrow), *Lupinus sericeus* (silky lupine), *Calochortus macrocarpus* (sagebrush mariposa), and the exotics *Bromus tectorum* (cheatgrass), *Sisymbrium altissimum* (tumbling mustard), and *Tragopogon dubius* (yellow salsify).

4. Dominance and frequency: Many populations consist of widely scattered individuals or small clusters. In a few cases where the native vegetation is more intact, a more uniform pattern can occur. Small, but very dense clusters of non-flowering (younger?) plants occur in parts of a few populations. Snake River goldenweed was never observed to be a community dominant.

5. Successional phenomena: Snake River goldenweed is present in late seral or climax bunchgrass communities. Perhaps representing an early successional stage, in reduced numbers, it also occurs in habitat seriously degraded and mostly replaced by exotic species.
6. Dependence on dynamic biotic features: None known.

7. Other endangered species: No federally listed or candidate species, or other rare plants were found sympatric with Snake River goldenweed. Populations of *Camassia cusickii* (Cusick's camas) and *Astragalus vallaris* (Snake Canyon milkvetch) are known from nearby areas, however. Cusick's camas is a federal 3c, BLM Sensitive Species, and Idaho Native Plant Society Sensitive Species. Snake Canyon milkvetch is endemic to the Snake River canyon and is an Idaho Native Plant Society Monitor Species.

7. Population biology.

A. General summary: Snake River goldenweed is endemic to the open, dry, rolling hills, canyons, and lower mountain slopes near the Snake River in Washington County, Idaho, and adjacent eastern Oregon. Eighteen populations have been documented from Idaho. Two populations are believed to be extirpated, although both are based on rather vague location data. Populations vary from about 0.1 acre to several square miles in extent, and range in size from less than ten to nearly 10,000 individuals. The large populations discovered in 1991 and 1992 were overwhelmingly dominated by non-flowering genets. Most populations consist of widely scattered individuals or scattered small clusters of plants. Larger populations may have a more uniform distribution pattern in places. To varying degrees and extent, habitat at all Snake River goldenweed populations in Idaho has been degraded, predominately by the effects of livestock overgrazing. In addition, most are subject to some level of insect herbivory and seed predation which may be affecting overall population vigor.

B. Demography.

1. Known populations: Eighteen populations of Snake River goldenweed are known from Idaho, all in the western half of Washington County. Sixteen of these populations are known to be extant, while two may be extirpated. These populations are estimated to support a total of approximately 20,000 individuals, with the Upper Raft Creek Ridges population (014) accounting for about half this total. Concerning estimates for the other populations; two contain over 1000 individuals, seven contain between 100 and 1000 individuals, and six support less than 100 plants. Several populations probably

support additional plants in adjacent areas not fully surveyed. The extent of populations in Idaho varies from approximately 0.1 acre to several miles.

2. Demographic details: (see also Appendix IV)

1. Mineral East (001)
   b. Area: >100 acres
   c. Number and size of plants: 1000-10,000 plants in 1989, and 500-1000 in 1991
   d. Density: Low
   e. Presence of dispersed seeds: Unknown
   f. Evidence of reproduction: 1991: some plants with maturing fruits
   g. Evidence of expansion/contraction: Fewer plants reported for 1991 compared to 1989, but this may be due to a less intensive search in the lower elevation parts of the population in 1991.

2. Monroe Creek (002)
   b. Area: Unknown
   c. Number and size of plants: Unknown
   d. Density: Unknown
   e. Presence of dispersed seeds: Unknown
   f. Evidence of reproduction: Unknown
   g. Evidence of expansion/contraction: Population not relocated in 1992, and may be extirpated.

3. Almaden Mine (003)
   a. Location: T11N, R03W, sec. 33 W2
   b. Area: 2+ acres
   c. Number and size of plants: 100-1000 plants in 1989, ca 100 in 1992
   d. Density: Low
   e. Presence of dispersed seeds: Unknown
   f. Evidence of reproduction: A small percentage of reproductive plants reported for both 1989 and 1992
   g. Evidence of expansion/contraction: Fewer plants reported for 1992 compared to 1989, but entire population not surveyed in 1992 due to inability to obtain permission from private landowner.

4. Brownlee Creek (004)
   b. Area: Unknown
   c. Number and size of plants: No population data reported for 1952 when first observed; population could not be relocated in 1992
   d. Density: Unknown
   e. Presence of dispersed seeds: Unknown
   f. Evidence of reproduction: Unknown
   g. Evidence of expansion/contraction: Despite thorough searching, this population was not relocated in 1992, and may be extirpated.

5. Upper Adams Creek (005)
   b. Area: ca 2 acres
   c. Number and size of plants: 40-50 plants in 1991
   d. Density: Low
   e. Presence of dispersed seeds: Unknown
   f. Evidence of reproduction: Most plants in flower in 1991
   g. Evidence of expansion/contraction: Unknown

6. Lower Payette Ditch/Hill Road (006)
   b. Area: Population extends for ca 0.75 mi (1.2 km)
   c. Number and size of plants: 100-1000 in 1989, 500-600 in 1992
   d. Density: Low
   e. Presence of dispersed seeds: Unknown
   f. Evidence of reproduction: ca 10% of plants in flower or fruit in 1992
   g. Evidence of expansion/contraction: All additional potential habitat near this population has been converted to agricultural use or is in very degraded condition. It is very likely this population has contracted in size over the years.

7. Monroe Butte (007)
   b. Area: ca 0.1 acre
   c. Number and size of plants: 7 plants in 1991; its possible this population extends further west across Forest Service boundary onto private land
   d. Density: Low
   e. Presence of dispersed seeds: Unknown
   f. Evidence of reproduction: Most plants in flower in 1991
   g. Evidence of expansion/contraction: Unknown

8. Chinamans Hat (008)
   b. Area: ca 2 acres
   c. Number and size of plants: 5 plants in 1991; population may extend further along slopes/ridge system to west
   d. Density: Very low
   e. Presence of dispersed seeds: Unknown
   f. Evidence of reproduction: Plants in flower in 1991
   g. Evidence of expansion/contraction: Unknown

9. Middle Fork Dennett Creek (009)
   b. Area: 25+ acres
   c. Number and size of plants: ca 120 plants in 1991; the population may extend further westward than surveyed
   d. Density: Low
   e. Presence of dispersed seeds: Unknown
   f. Evidence of reproduction: Some plants with maturing seed in 1991
   g. Evidence of expansion/contraction: Unknown

10. Benton Creek (010)
    b. Area: 10-15 acres
    c. Number and size of plants: ca 800 plants in 1991
    d. Density: Medium to low
    e. Presence of dispersed seeds: Unknown
    f. Evidence of reproduction: Some plants with maturing seeds in 1991
    g. Evidence of expansion/contraction: Unknown

11. Benton Saddle (011)
    b. Area: ca 0.3 acre
    c. Number and size of plants: 12 plants in 1991
    d. Density: Low
    e. Presence of dispersed seeds: Unknown
    f. Evidence of reproduction: Majority of plants flowering in 1991
    g. Evidence of expansion/contraction: Unknown

12. Barton Reservoir Northeast (012)
    b. Area: ca 3 acres
    c. Number and size of plants: 16 plants in 1992
    d. Density: Very low
    e. Presence of dispersed seeds: Unknown
    f. Evidence of reproduction: Several flowering plants observed in 1992
    g. Evidence of expansion/contraction: Area is very weedy and supports few plants.

13. Raft Creek (013)
    b. Area: Four small areas along ca 1 mile of lower Raft Creek drainage; it is unknown if this population is eventually continuous with the Upper Raft Creek Ridges (014) population
    c. Number and size of plants: 2000-2500 plants in 1992
    d. Density: High to low
    e. Presence of dispersed seeds: Unknown
    f. Evidence of reproduction: Flowering plants rare in 1992
    g. Evidence of expansion/contraction: This population has likely contracted over the years due to severe weed infestation and associated habitat degradation of adjacent areas.

14. Upper Raft Creek Ridges (014)
    a. Location: T15N, R06W, sec. 34 N2, sec. 22 SE4, sec. 27 E2, sec. 33 S2 and SE4NE4; T14N, R06W, sec. 04 W2, and sec. 05 E2
    b. Area: Centered along ca 3.5 miles of ridge system
    c. Number and size of plants: 5000-10,000 plants in 1992;
    d. Density: High to low
    e. Presence of dispersed seeds: Unknown
    f. Evidence of reproduction: Flowering plants rare in 1992
    g. Evidence of expansion/contraction: No evidence

15. Trail - Wolf Creeks (015)
    b. Area: ca 10 acres
    c. Number and size of plants: ca 750 plants in 1992; unknown if population extends further up Wolf Creek or on ridge system separating Trail and Wolf Creeks
    d. Density: Low
    e. Presence of dispersed seeds: Unknown
    f. Evidence of reproduction: ca 25% of plants in flower or fruit in 1992
    g. Evidence of expansion/contraction: Unknown

16. Sumac Creek (016)
    b. Area: ca 15 acres
    c. Number and size of plants: 1500-2500 plants in 1992; population may extend further up Sumac Creek
    d. Density: Medium to low
    e. Presence of dispersed seeds: Unknown
    f. Evidence of reproduction: ca 10% of population flowering in 1992
    g. Evidence of expansion/contraction: No evidence

17. Lower Dennett Creek (017)
    b. Area: ca 2 acres
    c. Number and size of plants: 100-200 plants in 1992
    d. Density: Low
    e. Presence of dispersed seeds: Unknown
    f. Evidence of reproduction: ca 20% of plants with maturing fruits 1992
    g. Evidence of expansion/contraction: No evidence

18. Barton Reservoir (018)
    b. Area: ca 1 acre
    c. Number and size of plants: ca 50 in 1992
    d: Density: Low
    e. Presence of dispersed seeds: Unknown
    f. Evidence of reproduction: ca 30% of plants in flower in 1992
    g. Evidence of expansion/contraction: Population apparently restricted to a protected, fenced area. No plants observed in adjacent areas degraded by weed infestation.

C. Phenology.

1. Patterns: Snake River goldenweed blooms from late June into early August, rarely as late as September, and peaks around mid-July. Seeds are dispersed soon after maturation.

2. Relation to climate and microclimate: Flowering typically occurs earlier at lower elevations compared to higher elevation sites.

D. Reproductive Ecology.

1. Type of reproduction: By seed only, as no evidence of asexual reproduction has been observed for this species.

2. Pollination.

a. Mechanisms: Some self-pollination is successful, but insect pollinators are required for maximum seed set (Kaye et al. 1990; Kaye and Meinke 1992).

b. Specific known pollinators: Snake River goldenweed is cross-pollinated by a diverse

assemblage of bumble bees, solitary bees, flies, and butterflies (see Kaye et al. 1990; Kaye and Meinke 1992).

c. Other suspected pollinators: None known.

d. Vulnerability of pollinators: Throughout its range, much of the habitat of Snake River goldenweed has been degraded. It is unknown, to what degree, if any, this habitat degradation has affected the vulnerability of pollinators.

3. Seed dispersal.

a. General mechanisms: No specialized mechanisms are known. Seeds probably fall directly to the ground, where wind, sheets of rain, or possibly animal vectors may move them. Large seeds in relation to the size of the pappus limits the efficiency of wind as a direct, primary dispersal agent.

b. Specific agents: Gravity, and to a lesser extent wind are the likely initial means of dispersal. It is unknown what role animals, especially birds have in dispersing seeds fallen on the ground.

c. Vulnerability of dispersal agents and mechanisms: It is unknown if the habitat degradation present at many Snake River goldenweed sites has increased the vulnerability of any animals that may be important for dispersal.

d. Dispersal patterns: Unknown. The large seed weight relative to the dispersal capabilities of the attached pappus may be a limiting factor for Snake River goldenweed compared to related species. Long distance wind dispersal is very likely limited.

4. Seed biology.

a. Amount and variation of seed production: Insect seed predation is known to occur at most populations and does effect the amount of seed production. The number of seeds effected in any one flowering head varies from 100% to just a few or none. There can apparently also be wide variation in the degree of overall predation between populations. See Kaye et al. (1990) for information on the frequency of insect seed predation, and a list of predators for many of the Oregon and three Idaho populations.

b. Seed viability and longevity: Unknown.

c. Dormancy requirements: Results from seed germination studies at Oregon State University have not found any dormancy requirements (Kaye et al. 1990).

d. Germination requirements: Apparently none, seeds will germinate readily under a range of temperatures soon after dispersal, and some seeds will continue to germinate through fall, winter, and spring if kept moist (Kaye et al. 1990). However, in the field most germination appears to occur in the spring. This may be due to dry fall conditions coupled with freezing temperatures (Meinke pers. comm., 1992).

e. Percent germination: Unknown.

5. Seedling ecology: Unknown.

6. Survival and mortality: Unknown, but seedlings have generally been observed in low numbers in Oregon (Kaye et al. 1990), and in Idaho (Mancuso pers. observ.). Several Idaho populations contain small, but dense clumps of small plants (consisting of only a small pair of basal leaves) that are not seedlings. Because of their identical size and dense proximity to each other, these may be cohorts

established during a recent period of favorable conditions. Other demographic attributes for these clumps are presently unknown, including if seedling establishment is highly episodic. Monitoring studies underway at several Oregon populations (Kaye and Meinke 1992; Kaye and Kirkland 1993) will hopefully soon provide more definitive demographic information for Snake River goldenweed.

7. Overall assessment of reproductive success: Specific details are unknown. At many, if not all populations, seed and ovule predation seems to be on a large enough scale to negatively impact reproductive success, at least in some years. Many flowering heads also contain ovules that have aborted for unknown reasons, and may be another measure of reduced reproductive success. Results of monitoring studies underway in Oregon (Kaye and Meinke 1992; Kaye and Kirkland 1993) will provide a much better assessment of reproductive success for Snake River goldenweed.

8. Population ecology of the taxon.

A. General summary: Populations in Idaho range in size from about ten to greater than 10,000 individuals, and from less than an acre to several square miles in extent. Snake River goldenweed occurs within grassland or openings in sagebrush-grassland habitats. Population density is generally low, with plants occurring as widely scattered individuals or small, scattered patches which may be quite dense at the larger populations. Habitat at most populations has been disturbed, sometimes severely. Exotic species, especially annual grasses such as cheatgrass (*Bromus tectorum*) now dominate much of the species range. Sites supporting the highest quality habitat typically contain the most plants, cover the largest areas, and also seem to have a wider range of age classes represented. Plants are fewer in number or absent, lower in density, and with little evidence of younger individuals in sites that are more degraded. Because of these patterns, loss of high quality habitat is regarded as the most serious threat to the long-term persistence of Snake River goldenweed.
B. Positive and neutral interactions: None known.

C. Negative interactions.

1. Herbivores, predators, pests, parasites and diseases: Populations have been negatively impacted by the widespread invasion of weedy exotics throughout the species range. These weeds compete with the native vegetation and may be a major reason Snake River goldenweed populations seem to have few seedlings. The problem of introduced weeds is largely the indirect result of grazing by domestic herbivores. It seems likely that until grazing became intense and exotic weeds became dominant on sites with deeper soils, Snake River goldenweed was much more common than at present (Kaye et al. 1990). More direct effects of livestock such as knocking over flower stems, and eating flower heads has been noted at several Oregon, and at least one Idaho population.

Insect seed predation and herbivory are other negative interactions. Most, if not all populations are impacted by seed and ovule predators. See Kaye et al. (1990) for information on the frequency of insect seed predation, and a list of predators for many of the Oregon and Idaho populations.

In California, heavy seed predation in *Haplopappus venetus* and *H. squarrosus* reduces seedling recruitment and may even limit their geographic range (Louda 1982, 1983). Another study by Hegazy and Eesa (1991) reports that insect seed predation could ultimately limit recruitment and population growth for the rare legume *Ebenus armitagei*. Cavers (1983) suggests that the fate of a plant population may be decided by the pattern of mortality exhibited by its seeds; and further, the results of the interactions between populations of different species may be decided by the relative mortality pattern of the seeds in these populations. It is unknown if any of these processes are operating concerning Snake River goldenweed, but offer reasonable questions to be asked in any future studies.

Meinke (1980) has reported a fungus that destroys developing seeds. This fungus has been noted during several different years.

2. Competition.

a. Intraspecific: Most Snake River goldenweed populations are characterized by a low density of plants where intraspecific competition is likely minimal. Several large populations contain small, but dense patches of what appear to be younger plants, identified only by their pair of small basal leaves. Under these conditions, intraspecific competition may be important.

b. Interspecific: Interspecific competition from exotic weeds has likely reduced the extent of, and the number of plants in most extant populations. It has also likely contributed to the extirpation of an unknown number of additional populations.

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

D. Hybridization.

1. Naturally occurring: None known.

2. Artificially induced: Unknown.

3. Potential in cultivation: Unknown.

E. Other factors of population ecology: None known.

9. Current land ownership and management responsibility.

A. General nature of ownership: Private land, U.S. Forest Service, Bureau of Land Management, and possibly Idaho Department of State Lands.

B. Specific landowners: Five populations (003, 006, 008, 017, 018) occur solely on private land. The precise locations of two populations believed extirpated are unknown, with one (002) likely occurring on private land, and the other (004) on either private or State land. Four populations (005, 007,010, 011) occur solely on the Weiser District of the Payette National Forest. One population (012) occurs solely on land administered by the Cascade Resource Area of the Boise District, BLM. Two populations (009, 014) occur on a mix of private, Forest Service and BLM land. Three populations (013, 015, 016) occur on both private and BLM land, and one (001) on both Forest Service and BLM land. Because their full extent has not been fully determined, the land ownership of some populations may be even more complex than stated above.

C. Management responsibility: Same as above.

D. Easements, conservation restrictions, etc.: Snake River goldenweed is presently listed as "Sensitive" for Region 4 of the Forest Service (Spahr et al. 1991) and the BLM in Idaho (Moseley and Groves 1992). Land supporting Snake River goldenweed populations would be managed according to the agencies respective regulations for sensitive species. Presently, no conservation agreements exist with any of the private landowners.

10. Management practices and experience.

A. Habitat management.

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

a. This taxon: Livestock grazing occurs throughout the range of Snake River goldenweed and is a primary cause for much of the habitat conversion and/or degradation now prevalent in Washington County.

b. Related taxa: Snake River goldenweed is closely related to *Haplopappus carthamoides* (Columbia goldenweed).

c. Other ecologically similar taxa: Except for a few regional endemics such as *Astragalus cusickii*, most species commonly associated with Snake River goldenweed are widespread. It is unknown how ecologically similar any of these are to Snake River goldenweed.

2. Performance under changed conditions: Changing habitat conditions have apparently been detrimental to the long-term population maintenance of Snake River goldenweed. Kaye et al. (1990) suggest that until grazing became intense and exotic weeds became dominant on sites with deeper soils, Snake River goldenweed was much more common than at present.

3. Current management policies and actions: *Haplopappus radiatus* is a sensitive species for the Payette NF (Spar et al.), and the BLM in Idaho (Moseley and Groves 1992). Both the Forest Service (see USDA Forest Service 1988) and BLM (see Bureau of Land Management 1988) have management policies to protect sensitive species.

4. Future land use: Livestock grazing occurs throughout the range of Snake River goldenweed, and this land use is expected to continue. Several populations (001, 003, 005) occur within areas impacted by mining operations, and at least two others are found in the vicinity of mining claims (012, 014). Any other specific future land use plans are unknown, including at the mining operations.

B. Cultivation.

1. Controlled propagation techniques: As part of their cytological study of Snake River goldenweed, Kaye et al. (1990) have experimented with propagation techniques.

2. Ease of transplanting: Unknown.

3. Pertinent horticultural knowledge: None known.

4. Status and location of presently cultivated material: Some cultivated material exists in the laboratories of Tom Kaye and his colleagues at Oregon State University, Corvallis, Oregon.

11. Evidence of threats to survival.

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

1. Past threats: The loss of high quality grassland and sagebrush-grassland habitat to invading weeds, especially annual grasses such as cheatgrass, medusahead rye and bulbous bluegrass, has been, and continues to be the most serious threat Snake River goldenweed faces. Largely an indirect effect of over of century of livestock grazing, this habitat degradation is widespread throughout the species' range. Competition from these weeds appears to be a primary cause for poor seedling recruitment. Associated with changes to the native vegetation are changes in other ecological attributes such as fire frequency. All of these changes make large scale habitat restoration very doubtful, at least in the near future. Kaye et al. (1990) report habitat loss and degradation impacts from livestock grazing to be the most serious long-term threat to populations in Oregon too.

Portions of several populations have been impacted by mining operations and related activities. These operations include an open pit gypsum mine (001), a large gravel pit (005), and a mountain previously

mined for mercury, but presently undergoing gold exploration (003). Other activities such as road construction, maintenance, and perhaps weed control measures have disturbed several populations to at least some degree.

Portions of populations around Brownlee Reservoir (013, 015, 016, 017) that were below about 2100 ft. elevation were flooded when the reservoir was filled. Portions of the Barton Reservoir population (018) near may have also been lost when Barton Reservoir was filled. It is unknown how extensive the loss was to each population. Some of the area adjacent to one population (017) was cleared and converted to irrigated cropland in the past. Portions of this population may have been lost when this was done. Two populations were not relocated during recent survey work and may be extirpated. Some of the area where these populations were believed to be located are also now cropland. It is unknown how much Snake River goldenweed has been lost over the years due to agricultural land conversions. The area around Weiser is where most of this loss has occurred.

2. Existing threats: The loss of high quality habitat, as outlined above, continues to be a serious and widespread threat. The consumption of flower heads and knocking over of others are impacts directly attributable to cattle in Oregon (Kaye et al. 1990), and also observed at one population in Idaho. Insect seed predation, seed destruction by a fungus, and grasshopper herbivory are also threats. The severity of these latter threats are likely episodic, and would probably be of relatively minor long-term consequence if habitat loss and accompanying population maintenance problems were not so widespread.

Threats posed by the mining operations noted above can all be minimized by careful planning. Road construction, maintenance, and weed control measures such as herbicide spraying continue to threaten at least portions of several populations.

3. Potential threats: Potential threats are a continuation or possible worsening of threats outlined above. At least three populations (001, 012, 014) are in areas where mining claims are present. If developed, threats posed by mining operations will be minimized with careful planning. The Upper Adams Creek population (005) is partly encircled by forested slopes. Logging operations have occurred in the general vicinity of this population and if initiated very close by could cause incidental, inadvertent destruction of some Snake River goldenweed plants. This would be avoidable with careful planning.

One final factor that may be a threat to Snake River goldenweed conservation is the mixed land ownership where several populations occur. If comprehensive conservation measures are initiated for this species, coordination among Payette NF, Boise District BLM, State of Idaho, and private entities will likely be necessary.

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

1. Past threats: Minimal to no past threats.

2. Existing threats: Minimal to no existing threats.

3. Potential threats: Several populations are small enough that collecting for any purpose could cause adverse impacts and should be discouraged.

C. Disease, predation, or grazing.

1. Past threats: Indirect effects of livestock grazing, such as soil disturbance and reduced vegetative cover have resulted in the widespread invasion of weedy exotics throughout the range of Snake River goldenweed. The increased competition from these weeds is believed to be the most significant past, current and potential threat to population maintenance, seedling recruitment, and the species overall

long-term persistence. More direct effects of livestock grazing such as knocking over or eating flower heads are other concerns.

Insect seed predation and herbivory can be intense, undoubtedly effecting demographic attributes such as seedling establishment and mortality. Their effects on the species' long-term survival would probably be minor if not greatly compounded by the large scale loss of high quality habitat noted above.

An unknown fungus can infect and destroy developing seeds. The extent of infection apparently can vary greatly from year to year.

2. Existing threats: The past impacts of grazing, predation and disease continue to exist.

3. Potential threats: Potential threats include a continuation of the grazing, predation and disease impacts already noted.

D. Inadequacy of existing regulatory mechanisms.

1. Past threats: Snake River goldenweed has been a conservation concern for at least 15 years. However, no direct measures to protect any populations has ever been initiated. This lack of protection continues.

2. Existing threats: Snake River goldenweed occurs on private, Forest Service, BLM, and perhaps State land. Presently there are no statutes directing the protection of rare plant species on private or State land in Idaho. Because of its sensitive species status for the two federal agencies, the conservation of Snake River goldenweed must be considered in land use decisions where it occurs.

3. Potential threats: Same as above.

E. Other natural or manmade factors.

1. Past threats: About half of the Snake River goldenweed populations in Idaho have been impacted by the filling of reservoirs, the conversion of native habitats to cropland, road construction and maintenance, or mining operations.

2. Existing threats: Mining operations continue to threaten portions of several populations. Road construction, maintenance, and weed control measures such as herbicide spraying are still threats to several populations.

3. Potential threats: Logging and associated activities such as road construction are potential threats at one and perhaps additional populations. Expanded mining operations would undoubtedly destroy some plants in proximate populations. Raising the level of Brownlee Reservoir would destroy some plants at populations near the reservoir. The clearing of land for agricultural or other purposes is a potential threat at some of the populations in the Weiser area.

II. Assessment and Recommendations.

12. General assessment or vigor, trends, and status: In Idaho, 18 populations are known for Snake River goldenweed, all in Washington County. Of these, two populations (002 and 004) may be extirpated. The 16 extant populations support a total of approximately 20,000 individuals in Idaho. Additionally, there are at least 30 extant populations in adjacent Oregon estimated to support a minimum of 50,000 individuals. The Oregon Natural Heritage Program maintains updated records for all Snake River goldenweed populations in Oregon. Also see Kaye et al. (1990) for recent information concerning Oregon populations.

Six populations (005, 007, 008, 011, 012, 018) support less than 100 individuals, with less than 50 plants documented at four of these. Such low population numbers call into question their long-term viability. Of the six populations (003, 006, 009, 010, 015, 017) supporting between 100 and 1000 individuals, only one (010) seems fairy secure from most threats. Long-term outlooks for at least portions of the other five are potentially unfavorable due to a number of threats, especially habitat loss or modification. Most of the more than 2,000 individuals comprising the Raft Creek population (013) are restricted to one small area easily impacted by cattle. The remaining portions of this population are restricted to small microsites with little chance of expanding due to the near total cover of weedy exotics. The long-term prospects of the other two populations (001, 016) supporting between 1,000 and 5,000 individuals are better, even though portions of each are subject to threats. The Upper Raft Creek Ridges population (014) is easily the largest and most extensive with over 10,000 individuals centered along a ridge complex several miles long. Much of the habitat in this area is in relatively good ecological condition, although it is obvious some areas have been negatively impacted by cattle grazing.

The geographic range of Snake River goldenweed has likely always been quite limited, but was likely more abundant and widespread within this range than at present. An unknown number of populations have been extirpated over the years, most likely due to problems associated with habitat loss. Field observations suggest that all the remaining Idaho populations, to some degree, have been reduced in size and vigor, most notably due to the loss of high quality habitat.

13. Recommendations for listing or status change.

A. Recommendations to the U.S. Fish and Wildlife Service: Even though several new populations of Snake River goldenweed have been discovered in Idaho the past few years, its overall abundance remains low and distribution limited. In both Idaho and Oregon many populations are very small and their long-term maintenance seems tenuous. The long-term prospects for the few remaining large populations appears better, but proactive management decisions that confer protection to these populations are needed. Highlighting concerns for this species are its limited distribution, the cumulative effects of its varied and widespread threats, and potentially unfavorable demographics within and between populations.

Being narrowly endemic to eastern Oregon and adjacent western Idaho, the global distribution of Snake River goldenweed is estimated to cover an area of only 30 x 40 miles (Kaye et al. 1990). It is rare from a biogeographic perspective.

Of all the threats Snake River goldenweed faces, the most widespread, severe, and difficult to reconcile or mitigate is the loss of high ecological quality native grassland and sagebrush-steppe habitat throughout its limited range. Exotic weeds, exemplified by annual grasses such as cheatgrass, now dominate much of the landscape once supporting native vegetation, including presumably much more Snake River goldenweed than persists today. This large- scale vegetation change has affectively removed a very large portion of potential habitat from the range of Snake River goldenweed.

Several other threats such as mining, the filling of reservoirs, and herbicide spraying, already discussed in more detail, pose threats to at least portions of some Idaho populations. These anthropogenic-related threats are compounded by problems associated with insect seed predation and herbivory and a seed destroying fungus.

Of the 16 extant Snake River goldenweed populations in Idaho, one population (014) supports approximately one-half of all known plants in the state. Only two other populations are known to support more than 1,000 plants, while six are estimated at less than 100 individuals. A parallel situation exists in Oregon, where the two largest populations (over 20,000 each in 1989) account for well over one-half of the plants in that state. Less than half of the remaining populations contain more than 1,000 plants, and at least five populations are estimated at less than 100 individuals. The implication of this population demography is that there may be only a few sites available to provide long-term, evolutionary

persistence at the genetic, individual and population levels. With Snake River goldenweed populations skewed to small in size and low in plant number, there are less buffers in place to withstand and recover from either natural (such as disease) or man-caused (such as land- use conversions or introduced pests) perturbations, many of which cannot be foreseen at this time.

Tom Kaye and his colleagues at the Oregon Department of Agriculture, in cooperation with the Oregon Bureau of Land Management (BLM), has initiated a demographic monitoring project for Snake River goldenweed (Kaye and Meinke 1992; Kaye and Kirkland 1993). Preliminary modelling results predict all the monitored populations to decline under the drought conditions that have prevailed the first years of the study (Kaye and Kirkland 1993). Some of the suspected demographic and related problems facing Snake River goldenweed will become better understood as this study progresses.

In summary, the long-term viability of most small populations appears tenuous, especially in light of the threats all are subject to. Field observations suggest Snake River goldenweed has declined throughout its range, with the few large remaining populations in both Oregon and Idaho offering, by far, the most potential and best opportunities to insure the species long-term conservation. All populations warrant protection wherever possible, especially the few remaining large populations. In Idaho, at least eleven populations are located solely or partly on federal lands, including all the largest ones. In Oregon most populations occur on federal lands too. It is clear that federal agencies will have to be leaders in any conservation strategy.

In light of the evidence contained in this report, it is recommended the federal status for *Haplopappus radiatus* be changed from Category 1 to Threatened. If a sufficient number of populations can be protected from any further habitat degradation, and monitoring studies indicate a favorable conservation response to such protection, this recommendation can be reevaluated at that time.

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

1. U.S. Forest Service: Six populations of Snake River goldenweed are known from the Weiser District of the Payette National Forest along the western flanks of the Hitt Mountains. This includes a small portion of the largest one known in Idaho (Upper Raft Creek Ridges - 014). Additionally, at least one other population (Chinamans Hat - 008), is known from very close to the Forest boundary. Snake River goldenweed should remain on the Payette National Forest's sensitive species list.

If the gypsum mine at the Mineral East population (001) or the gravel pit at the Adams Creek population (005) are expanded, every effort should be made to prevent destruction of any part of these populations and monitoring plots established to study the impacts of the expansion. If logging operations were to commence adjacent to the Adams Creek population (005), preventing destruction of this small population should not be too difficult to ensure.

A rare plant clearance should be done at the proper time of year (mid to late July in most years) for all habitat-altering projects. If Snake River goldenweed is located in project areas, every effort should be made to prevent the loss of plants or good quality habitat.

The Payette National Forest should enter into an agreement with the Boise District BLM, Cascade Resource Area, to monitor several populations such as Mineral East (001), North Fork Dennett Creek (009), and Upper Raft Creek Ridges (014), which cross administration boundaries.

2. Bureau of Land Management: One population solely (012), and six populations partly (001, 009, 013, 014, 015, 016), occur on lands administered by the Boise District BLM, Cascade Resource Area. Snake River goldenweed should remain a BLM sensitive species in Idaho.

Herbicide spraying in the Brownlee Reservoir area, especially near the 'Mineral Road' which bisects three populations (001, 015, 016), should be carefully planned and done by people who have learned

what Snake River goldenweed looks like, to prevent any inadvertent spraying. At least two populations in the Mineral area (001, 014) and the Barton Reservoir Northeast population (012) have mining claims. The conservation of Snake River goldenweed should be considered in any mining-related decisions. Mining should be discouraged at any of these sites, especially at the relatively large and vigorous populations near Mineral. All populations on BLM lands west of the Hitt Mountains are grazed. Review of grazing allotment plans need to consider conservation concerns for Snake River goldenweed. Monitoring of Snake River goldenweed should be incorporated into existing plans and also those being updated. In Oregon, a BLM-sponsored monitoring project was established with the Vale District in 1991. Tom Kaye with the Natural Resource Division of the Oregon Department of Agriculture, and Jean Findley of the Vale District are the coordinators for this project (Kaye pers. comm., 1993). They should be contacted for recommendations to help facilitate coordination and compatibility of any monitoring programs. Coordination and funding of monitoring projects should include the Payette NF. Private landowners should be contacted and their cooperation solicited concerning populations that will be monitored by federal agencies, but extend onto adjacent private lands.

C. Other status recommendations.

1. Counties and local areas: If Washington County is responsible for any herbicide spraying along the 'Mineral Road' along Brownlee Reservoir, road crews should be trained to recognize Snake River goldenweed to avoid any inadvertent spraying.

2. State: Currently, Snake River goldenweed is ranked S1 by the Idaho Conservation Data Center (Moseley and Groves 1992). Based on new data collected in 1992, it is recommended this ranking be changed to S2.

3. Other Nations: No recommendations.

4. International: No recommendations.

14. Recommended critical habitat: Areas supporting three of the most vigorous populations are recommended for critical habitat in Idaho. At least portions of these areas are also presently in relatively good ecological condition, and the majority of each occurs on federal lands. The areas include most of the elevational amplitude for Snake River goldenweed in Idaho. See Appendix IV for additional location, habitat, population and ownership information. See Appendix III for precise mapped locations for these populations.

1. Benton Creek population (010) -
2. Upper Raft Creek Ridges (014) -
3. Sumac Creek (016) -

15. Conservation/recovery recommendations.

A. General conservation recommendations.

1. Recommendations regarding present or anticipated activities: See recommendations already discussed for the U.S. Fish and Wildlife Service (see II.13.A.), U.S. Forest Service (II.13.B.1.), and Bureau of Land Management (see II.13.B.2.). In addition, considering the complex land ownership for many populations (Forest Service, BLM, private, and possibly State lands), an important responsibility of the U.S. Fish and Wildlife Service will be to help coordinate and support monitoring and protection measures for Snake River goldenweed.

2. Areas recommended for protection: Beside areas recommended for critical habitat in II.14., the U.S. Fish and Wildlife Service should attempt to coordinate some level of protection for the Idaho Almaden Mine population (003), the easternmost population of Snake River goldenweed known. With

some protective measures in place this population stands a much better chance of persisting long-term.

3. Habitat management recommendations: Habitat degradation appears to be a serious threat to Snake River goldenweed. Several of the larger populations which occur at least partly on federal lands contain habitat in relatively good ecological condition. This is especially true for the Upper Raft Creek Ridges (014) and Benton Creek (010) populations. To a lesser extent this is also the case for portions of the Mineral East (001), Sumac Creek (016) and Trail - Wolf Creeks (015) populations. Maintenance of these populations are a high priority for the conservation of Snake River goldenweed.

4. Publicity sensitivity: Because some changes in present grazing plans may be implemented, public sensitivity is potentially high.

5. Other recommendations: None.

B. Monitoring activities and further studies recommended: Monitoring of selected populations on Payette NF and Boise District BLM land have been recommended; see 13.B.1 and 13.B.2. Monitoring design should be able to evaluate the effects of present and anticipated land use management activities on the conservation of Snake River goldenweed.

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III. Information Sources.

17. Sources of information.

A. Publications.

1. References cited in report: See Appendix I.

2. Other pertinent publications.

a. Technical: None.

b. Popular: None.

B. Herbaria consulted: Specimens of Snake River goldenweed are known to be deposited at the University of Idaho (ID), the College of Forestry Herbarium at the University of Idaho (IDF), the Snake River Plains Herbarium at Boise State University (SRP), the Albertson College of Idaho (CIC), the Boise District, BLM (Boise BLM), Oregon State University (OSC), Brigham Young University (BRY), and the New York Botanical Garden (NY). It is unknown where several collections have been deposited (n.a.). The following is a list of known herbarium specimens, indexed by population:

001 G. Secrist 287 (CIC)
D. Atwood 12311 (BRY)
S. Massey & W. Messinger 1138-1143 (0SC)
M. Mancuso 588 (ID)

002 J.H. Christ 12905 (NY)

003 B. Ertter 130/4 (n.a.); B. Ertter 588 (n.a.)
W. Messinger & S. Massey 1228-1130 (OSC)
M. Mancuso 681 (ID)

004 E.B. Caswell 68 (IDF)

006 A. DeBolt 740 (CIC, Boise BLM)
R. Rosentreter 4257 (n.a.)
W. Messinger 1133-1137 (OSC)
M. Mancuso 595 (ID)

009 M. Mancuso 590 (ID)

010 M. Mancuso 593 (ID)

013 M. Mancuso 690 (ID,OSC,SRP)

014 M. Mancuso 691, 691 (ID,OSC)

015 M. Mancuso 688 (ID,OSC)

016 M. Mancuso 689 (ID)

018 M. Mancuso 679 (OSC)

C. Fieldwork: In Idaho, prior to 1991, BLM botanists conducted limited surveys for Snake River goldenweed on lands they administer. Researchers associated with the Conservation Biology Department, Oregon Department of Agriculture also made collections and included some Idaho populations in their ongoing studies of Snake River goldenweed. In late July, 1991, the Idaho Conservation Data Center completed a survey for Snake River goldenweed on the Payette NF as part of a Challenge Cost-share project. This survey concentrated on the western slopes of the Hitt Mountains, and to a lesser extent, on the southwestern slopes of the Cuddy Mountains. During early July, 1992, the Idaho Conservation Data Center conducted further field investigations on lands of all ownerships in the Weiser, Olds Ferry, Cuddy Mountains, Brownlee Reservoir and Mineral areas.

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E. Other information sources: None known.

18. Summary of material on file: Color slides, field forms, maps, and all published and unpublished references pertaining to Snake River goldenweed are on file at the Idaho Conservation Data Center office in Boise, Idaho.

IV. Authorship.

19. Initial authorship:

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20. Maintenance of status report: The Idaho Conservation Data Center will maintain current information on all Idaho populations and update this status reports as needed.

V. New information.

21. Record of revisions: Not applicable.

APPENDIX I

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APPENDIX II

Line drawing of *Haplopappus radiatus*
(From Cronquist 1955)

APPENDIX III

Maps showing locations of *Haplopappus radiatus* in Idaho.

Map 1. Overall distribution of known Snake River goldenweed populations in Idaho. From Idaho Atlas and Gazetteer, DeLorme Mapping, 1992.

Map 2. Idaho Almaden Mine (003) population..

Map 3. Lower Payette Ditch/Hill Road (006) population.

Map 4. Barton Reservoir Northeast (012), and Barton Reservoir (018) populations.

Map 5. Mineral East (001), and Middle Fork Dennett Creek (009) populations.

Map 6. Upper Adams Creek (005), Monroe Butte (007), and Chinamans Hat (008) populations.

Map 7. Upper Raft Creek Ridges (014) population.

Map 8. Raft Creek (013) population..

Map 9. Portion of Sumac Creek (016) population.. Also see Map 10.

Map 10. Trail - Wolf Creeks (015), and a portion of Sumac Creek (016) populations. Also see Map 9.

Map 11. Lower Dennett Creek (017) population..

Map 12. Benton Creek (010) population.

Map 13. Benton Saddle (011) population.

Note: The number in parentheses refers to the occurrence number for *Haplopappus radiatus* in the Conservation Data Center's data base.

APPENDIX IV

Occurrence records for *Haplopappus radiatus* in Idaho.

APPENDIX V

Slides of *Haplopappus radiatus* and its habitat.

Slide 1. Close-up of *Haplopappus radiatus* flowers.

Slide 2. Close-up of *Haplopappus radiatus* flowers with insect damage.

Slide 3. Close-up of *Haplopappus radiatus* plant.

Slide 4. *Haplopappus radiatus* habitat; *Artemisia tridentata* ssp. *tridentata/Agropyron spicatum* habitat type.

Slide 5. *Haplopappus radiatus* habitat; *Agropyron spicatum/Poa sandbergii/Balsamorhiza sagittata* habitat type.