

**REPORT ON THE CONSERVATION STATUS OF
*LEPIDIUM PAPILLIFERUM***

by

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*LEPIDIUM PAPILLIFERUM***

Taxon Name:	<i>Lepidium papilliferum</i> (L. Henderson) A. Nels. & J.F. Macbr.
Common Name:	Slick spot peppergrass
Family:	Brassicaceae
States Where Taxon Occurs:	U.S.A.; Idaho
Current Federal Status:	Category 2 Candidate
Recommended Federal Status:	Threatened
Author of Report:	Robert K. Moseley
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SUMMARY

Lepidium papilliferum (slick spot peppergrass) is an ephemeral monocarpic species restricted to unique microsites of small-scale openings of the sagebrush-steppe on and adjacent to the western Snake River Plains. The current status of known *L. papilliferum* populations are as follows:

Twenty-one populations are known to be extirpated due to habitat destruction at a rate of approximately two populations per decade from when it was first discovered in 1892. This documented rate of extirpation is unprecedented for any of Idaho's rare flora, however, the actual (i.e., undocumented) rate has probably been much higher during the past century. The cause of this decline can be attributed to the pervasive loss and degradation of the sagebrush-steppe ecosystem on the western Snake River Plain, through conversion to irrigated agriculture, urban/suburbanization, and exotic annual grasslands following severe overgrazing in the 1800's.

Thirty-eight occurrences are known to be extant. Many of these remaining populations are small but, even for the relatively large populations, as the habitat becomes more fragmented due to ongoing habitat loss, populations are becoming more isolated from each other making them vulnerable to deleterious environmental and genetic events.

Seven occurrences have not been revisited recently and are considered historical, with the implied expectation that they may be relocated.

Based on the information compiled in this report, I recommend that *L. papilliferum* be listed as a Threatened species under the Endangered Species Act, a step that I see as necessary to stem the ongoing decline of the species and its habitat, as well as the ecosystem in which it occurs. It is clear that the decline of *L. papilliferum* is just one symptom in a much larger and more ominous ecological phenomenon, that is, the decline of the sagebrush-steppe ecosystem on the western Snake River Plain. Any conservation strategies developed to stem the decline of *Lepidium* must take the decline of the ecosystem into account. Maintaining metapopulation structure and dynamics should be an important aspect of any conservation strategy developed for *L. papilliferum*, where many of the populations have become isolated from one another as suitable habitat has become highly fragmented. Maintaining multiple populations over a wide range of geography and habitats will serve as a source for colonists as a hedge against a shifting mosaic of habitats and environmental stochasticity, and will buffer the effects of land management and future natural habitat changes.

All agencies and organizations managing extant populations of *Lepidium papilliferum* have an important role to play in maintaining its evolutionary viability. This includes both the large populations on the Snake River Plain, primarily managed by the BLM and Idaho Army National Guard, and the small populations in the Boise Foothills, managed by Boise City, Ada County, the BLM, and many private landowners. Toward this end, I make specific agency recommendations in the report, including several pre-listing Conservation Agreements.

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I. Species Information.

1. Classification and nomenclature.

A. Species.

1. Scientific name.

a. Binomial: *Lepidium papilliferum* (L. Henderson) A. Nels. & J.F. Macbr.

b. Full bibliographic citation: Nelson, A., and J.F. Macbride. 1913. Western plant studies. II. Botanical Gazette 56:469-479.

c. Type specimen: *Henderson 4121* "Growing amongst species of *Artemisia* and *Bigelovia* (?) on the plains about Nampa, southern Idaho" July 30, 1897." Isotypes at *ID*, *WS*, *US* (Henderson 1900).

2. Pertinent synonym(s): *L. montanum* Nutt. ex Torrey & A. Gray var. *papilliferum* L. Henderson (Henderson 1900); *L. montanum* ssp. *papilliferum* (L. Henderson) C.L. Hitchcock (Hitchcock 1950).

3. Common name(s): Slick spot peppergrass.

4. Taxon codes: PDBRA1M140 (Biodiversity Information Network and The Nature Conservancy).

5. Size of genus: Well over 100 species occurring on all continents, except Antarctica (Hitchcock 1964).

B. Family classification.

1. Family name: Brassicaceae.

2. Pertinent family synonyms: Cruciferae.

3. Common name(s) for family: Mustard.

C. Major plant group: Dicotyledonea

D. History of knowledge of taxon: *Lepidium papilliferum* was first collected by Isabella Mulford in 1892 near Nampa, and again by Louis Henderson in 1897, from the same area. Several collections were made during the first half of the 20th century from throughout the western Snake River Plain and Payette Valley. Because of an extended hiatus in collections during the 1950's, 1960's, and early 1970's, Hitchcock and Cronquist (1973) thought that it was perhaps extinct. There were, however, a few sporadic collections of *L. papilliferum* made during the 1970's and early 1980's (Steele 1981). As concern arose for the health of the sagebrush-steppe ecosystem of the western Snake River Plain in general, and dependent species in

particular, so did the status of our knowledge of the distribution and abundance of this taxon. Many surveys were conducted for this species between 1989 and 1994. We have a good historical record from which to assess long-term trends for *L. papilliferum*, as well as recent comprehensive surveys to assess its current conservation status.

E. Comments on current alternative taxonomic treatment(s): *Lepidium papilliferum* was originally described by Louis Henderson (1900) as *L. montanum* var. *papilliferum*. He states that he would have described it as a species were it not for the variability of *L. montanum* specimens, which he felt included many of the characteristics of his new taxon. Nelson and Macbride (1913), working with more specimens, disagreed and elevated it to *L. papilliferum* because of its unusual growth habit, biennial life span, and unusual pubescence. Later, Hitchcock (1936; 1950; 1964) disagreed with Nelson and Macbride's liberal interpretation and relegated it again to infraspecific status.

Reed Rollins of the Gray Herbarium, Harvard University, has recently reviewed the systematics of the mustard family in North America (Rollins 1993) and is preparing the treatment of *Lepidium* for the Flora of North America Project (Morin 1986). He treats *L. papilliferum* as a species, with justification resting mainly on three features: (1) The most notable is the presence of clavate to elatorlike trichomes on the filaments of the stamen, a feature unique among North American *Lepidiums*; (2) All leaves are at least pinnately divided, which contrasts with *L. montanum* where there are always some entire leaves; and (3) the siliques are broadly ovate to nearly orbicular, not tapered near the apices and without even vestiges of wings at their apices, which differs in all respects from *L. montanum*.

2. Present legal or other formal status

A. International: None.

B. National.

1. Present designation of proposed legal protection or regulation: *Lepidium papilliferum* (as *L. montanum* var. *papilliferum*) appears in the 1990 and 1993 Notices of Review for candidate plants as a category 2 candidate (U.S. Fish and Wildlife Service 1990; 1993). Category 2 candidates include those taxa for which information now in the possession of the U.S. Fish and Wildlife Service indicates that proposing to list as endangered or threatened is possibly appropriate, but for which sufficient data on biological vulnerability and threat are not currently available to support a proposed rulemaking for listing under the Endangered Species Act (U.S. Fish and Wildlife Service 1993).

2. Other current formal status recommendation: The Idaho Native Plant Society maintains *Lepidium papilliferum* on its list of current and recommended Federal Candidate Species, which includes all globally rare and threatened taxa in Idaho (Idaho Native Plant Society 1994).

The Biodiversity Information Network (International Association of Natural Heritage Programs and Conservation Data Centers) ranks *L. papilliferum* G2, a rank that includes taxa that are globally imperiled because of rarity or because of other factors demonstrably making it vulnerable to extinction (Moseley and Groves 1992).

3. Review of past status: In his review of the taxon for the Rare and Endangered Plants Technical Committee of the Idaho Natural Areas Council, Bob Steele (1981) recommended Federal Watch List status. The Federal Watch List included those taxa in Idaho that were globally rare and could potentially become threatened, but had no apparent threats to their survival.

C. State.

1. Idaho.

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

b. Other current formal status recommendation: Because *Lepidium papilliferum* is endemic to Idaho, the Biodiversity Information Network state rank (S) equals the global (G) rank (see above; Moseley and Groves 1992)

c. Review of past status: Prior to being recommended for candidate status and eventually being published in the Federal Register as such (U.S. Fish and Wildlife Service 1990), the Idaho Native Plant Society considered *Lepidium papilliferum* to be a Priority 1 species (Idaho Native Plant Society 1989). Priority 1 is the state endangered category, that is, it includes taxa that are in danger of becoming extinct in Idaho in the foreseeable future if identifiable factors contributing to its decline continue to operate.

3. Description.

A. General nontechnical description: Annual or biennial from a taproot. The plant is intricately branched above the root crown and reaches 1-4 dm in height. The stems and leaves are pubescent. Leaves are pinnate to bipinnate with linear segments. Numerous, many-flowered inflorescences terminate the branches. The small flowers are white petaled, and the filaments of the anthers are covered with club-shaped hairs. The small orbicular, flattened fruits are about 3 mm long.

B. Technical Description: Annual or biennial with a taproot but no caudex, usually with numerous branches from the root crown and these intricately branched to the inflorescences; stems 1-4 dm long, pubescent especially densely toward the inflorescences with obovate to broadly clavate trichomes, these scalelike when dry; leaves pinnate or the lower somewhat bipinnate with linear to narrowly oblong lobes, glabrous to pubescent especially on the petioles and undersides of the lobes of the upper leaves; sepals glabrous with narrowly scarious margins, erect; petals white, spatulate or the blade broader, ca. 3 mm long; stamens 6, filaments covered with clavate to elatorlike trichomes; fruiting pedicels widely spreading, sometimes slightly arched downward, densely to sparsely pubescent, 4-6 mm long; siliques broadly ovate to nearly orbicular, 2.5-3 mm long, glabrous or with a few trichomes on the lower part of the replum; styles exerted from a small

but definite U-shaped notch (Rollins 1993).

C. Local field characters: *Lepidium papilliferum* is a monocarpic plant displaying two life cycle types. Emergence takes place in the early spring for both types. The annual type sets fruit the summer following emergence. The biennial type persists as a basal rosette and sets fruit the following spring (Meyer et al. 1994). Occasional plants flower both years. All leaves, on both the rosette and mature plants, are pinnately compound with narrow lobes. Internodes elongate in the spring eventually forming a multibranched plant that is ovoid in shape. The stems leaves are sparse, most of the plant being comprised of a mass of inflorescences with many white flowers. When in flower, the plant is quite noticeable growing in the interstices of sagebrush and bunchgrasses on small, barren slick spots. To distinguish *L. papilliferum* from the closely related *L. montanum*, use the following key adapted from Rollins (1993):

Filaments of the stamens covered with clavate to elatorlike trichomes from the base to just beneath the anthers; leaves all at least pinnately divided with linear divisions and the lower and basal ones usually bipinnate; siliques broadly ovate to nearly orbicular, not tapered toward their apices and without even vestiges of wings at their apices.

Lepidium papilliferum

Filaments not covered with clavate trichomes; some leaves entire and the leaf divisions on the pinnate leaves are oblong to ovate rather than linear; siliques ovate, usually somewhat tapered toward their apices and with apical wings of varying degrees of prominence.

Lepidium montanum

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

E. Photographs and/or line drawings: No drawings of *Lepidium papilliferum* are known. Photographs (35 mm slides) of this species and its habitat are in the slide collection of the Conservation Data Center. Several have been reproduced in Appendix 3. Photographs also exist in the files of the Boise District, BLM, and the Idaho Army National Guard.

4. Significance.

A. Natural: As discussed later in this report, *Lepidium papilliferum* appears to be an excellent indicator species for the health of the sagebrush-steppe ecosystem on the western Snake River Plain. Also, it has a unique adaptation to unusual microhabitats in the sagebrush-steppe, variously termed mini-playas, slick spots, or natric sites.

B. Human: None known.

5. Geographical distribution.

A. Geographical range: The main portion of the range of *Lepidium papilliferum* is the western Snake River Plain and adjacent northern foothills in Payette, Gem, Canyon, Ada and Elmore counties, Idaho (Figure 1). This is an elongate, northwest-southeast trending area about 90 miles long and 25 miles wide. Because many botanists collected *Lepidium papilliferum* between 1892 and 1950 on the Snake River Plain and vicinity, it was probably fairly common and widely distributed in this area prior to white settlement. Two disjunct population centers are also known, both in Idaho. One occurs on the Owyhee Plateau of Owyhee County, approximately 50 miles south of the Snake River Plain. The other occurs in the mountains of Bannock County, southeastern Idaho, approximately 150 miles east of the nearest population.

B. Precise occurrences in Idaho.

1. Populations currently or recently known extant: The CDC data base contains 59 occurrences of *Lepidium papilliferum*. Of these, 38 occurrences (64%) are known to be extant, based on field observations between 1989 and 1994. Occurrence records for the 38 extant occurrences appear in Appendix 1, each one being identified by a three-digit code (i.e., 005, 047, etc.). Among other things, each record contains information on the county of occurrence, site name, narrative of the location, date of initial discovery, date of most recent observation, pertinent USGS quads, township, range and section, and latitude and longitude.

2. Populations known or assumed extirpated: Twenty-one populations are documented to be extirpated, based on field observations between 1989 and 1994. This total includes 14 occurrences (25%) that are completely extirpated, some of which include separate observations that have been lumped into one occurrence for convenience. For example, the two collections from the vicinity of Barber Dam in the 1950's, have been combined into occurrence 003. Occurrence records for completely extirpated sites appear in Appendix 2. Also, some destroyed populations are included as part of occurrences 012 and 020, which are partially extant (Appendix 1). All told, this represents a documented extirpation rate of approximately 2 populations per decade since 1892, when the first collection was made. This documented rate of extirpation is unprecedented for any of Idaho's rare flora, however, the actual (i.e., undocumented) rate has probably been much higher during the past century.

3. Historically known populations where current status not known: Seven occurrences (12%) have not been relocated recently and are considered historical, with the implied expectation that they may be relocated. These occurrences are based on collections made between 1911 and 1974. CDC records for these historical occurrences appear in Appendix 3.

4. Locations not yet investigated believed likely to support additional natural populations: Within the core of its range on the western Snake River Plain, additional populations will certainly be discovered, as not all suitable habitat has been inventoried. Habitat in the vicinity of the two disjunct occurrences in Bannock and Owyhee counties,

Fig 1. Distribution of *Lepidium papilliferum*.

has not been thoroughly inventoried and there is a possibility that additional populations may be found in these areas. Two populations considered extirpated (lumped as occurrence 009) are close to the Oregon border, where suitable habitat occurs. No inventories have been conducted in Oregon for *Lepidium papilliferum*.

5. Reports having ambiguous or incomplete locality information: Several of the historical occurrences have vague location information, and to some extent, this resulted in not being able to relocate that occurrence.

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

C. Biogeographical and phylogenetic history: There is no information of which I am aware concerning the biogeographical and phylogenetic history (e.g., fossil record, Pleistocene refugia, migrational patterns, etc.) of *Lepidium papilliferum* or its close relative, *L. montanum*.

6. General environment and habitat description.

A. Concise statement of general environment: *Lepidium papilliferum* occurs in the semiarid, sagebrush-steppe ecosystem of southern Idaho. Its habitat is on the extensive volcanic plains of the Snake River Plain and Owyhee Plateau, and adjacent foothills. Within the sagebrush-steppe communities, *L. papilliferum* occurs in a unique microenvironment created by unusual edaphic conditions. It occurs in run-on microsites variously termed slick spots, mini-playas, or natric sites, that have soils significantly higher in sodium and especially clay content than adjacent, unoccupied habitat.

B. Physical characteristics.

1. Climate.

a. Koppen climate classification: Populations of *Lepidium papilliferum* lie in an area classified as Koppen's unit BSk: semiarid climate or steppe, with an average annual temperature under 64.4° F (Trewartha and Horn 1980).

b. Regional macroclimate: The average monthly maximum temperature on the western Snake River Plain reaches its highest point during the month of July, a month which also marks the beginning of a pronounced dry season; about 15% of the total annual precipitation falls during the period from July through October. Two periods of peak precipitation occur, one in January and the other in May. The winter precipitation peak is greatest with more than 38% of the mean annual precipitation falling between December and February (Soil Conservation Service 1980)..

Mean annual precipitation ranges from 8 to 13 inches and the mean annual temperature ranges from 50° to 52° F. The frost-free period ranges from 140 to 160 days (Soil Conservation Service 1980).

c. Local microclimate: *Lepidium papilliferum* is a low-growing plant, relative to most of its associates in native sagebrush-steppe stands, and is largely protected from direct winds, although the foothill populations are probably more exposed to winds than ones on the plain. Although generally surrounded by shrubs, it grows in the larger openings usually in direct sunlight for most of the day. For the most part, the shrub communities in which it occurs have relatively well-drained soils. However, the microsites on which *Lepidium papilliferum* occurs is much higher in clay than other microhabitats and probably retains soil moisture longer. On the Snake River Plain these "mini-playas" appear to have unique micro-hydrological properties whereby water accumulates in these small basins.

2. Air and water quality requirements: Unknown.

3. Physiographic provinces: A majority of the range of *Lepidium papilliferum* lies within the Malheur-Boise-King Hill Section of the Columbia Intermountain Geomorphic Province. The Bannock County population (003) occurs in the Basin and Range Geomorphic Province (Ross and Savage 1967; Wellner and Johnson 1974).

4. Physiographic and topographic characteristics: All occurrences of *Lepidium papilliferum* occur on or adjacent to extensive volcanic plains, mostly the Snake River Plain, and one site on the Owyhee Plateau. The volcanic plains are underlain by Tertiary basalt or rhyolite, while the sites in adjacent foothills are underlain by Pliocene/ Quaternary lacustrine deposits. Most populations occur on flat to gently sloping terrain, although it can occur on steep slopes and on all aspects. Slopes are relatively smooth with only very small-scale microtopography. On the plains, *Lepidium papilliferum* occurs in "mini-playas", that is, small depositional areas. These mini-playas do not occur at the foothill populations. Most populations occur between 2200 and 3400 feet, with the three disjunct populations occurring at much higher elevations (Bannock County 002 - 5100 feet; Owyhee County 051 and 059 - 5200 feet).

5. Edaphic factors: Edaphic characteristics of *Lepidium papilliferum* habitat have been investigated by Susan Meyer of the USFS Shrub Science Lab and Dana Quinney of the Idaho Army National Guard (Meyer 1993; Meyer and Quinney 1993). Their conclusions apply primarily to the Snake River Plains population and may not be entirely applicable to the foothills populations, especially their conclusions about run-off run-on relationships.

The following summary is from Meyer (1993; for detailed discussion see Meyer and Quinney 1993). *Lepidium papilliferum* microsites are small-scale run-on sites (the "mini-playas" concept reported by others) characterized by some clay and salt enrichment in the surface horizon. Their soils show reduced levels of organic matter and bound nutrients as a consequence of lower biomass production relative to the surrounding shrubland vegetation. The exclusions of seedlings of species of the surrounding vegetation is probably more related to consequences of small-scale flooding and associated disease problems than to edaphic differences per se. The edaphic differences are themselves a consequence of run-off run-on relationships and of differences in vegetative cover.

6. Dependence of this taxon on natural disturbance: On an evolutionary time scale, the single most important natural disturbance factor in *Lepidium papilliferum* habitat was fire. However, *Lepidium papilliferum* was probably not highly dependant on fire to maintain populations. Small-scale disturbance factors, such as soil frost-heaving and shrink-swell cycles in the clay loam soils, may contribute to maintaining open-soil areas, although the unique edaphic and hydrologic factors mentioned above are probably more important here.

7. Other unusual physical features: None known.

C. Biological characteristics.

1. Vegetation physiognomy and community structure: Plant communities containing *Lepidium papilliferum* habitat generally fall into two *Artemisia tridentata* ssp. *wyomingensis*-series associations, the *A. tridentata* ssp. *wyomingensis*/*Stipa thurberiana* and *A. tridentata* ssp. *wyomingensis*/*Agropyron spicatum* habitat types (Hironaka et al. 1983). These communities are dominated by *A. tridentata* ssp. *wyomingensis*, which is a shrub 1 to 1.5 m in height. The bunchgrasses, *Poa secunda* and *Sitanion hystrix*, commonly occur in these habitat types. Other shrubs, such as *Purshia tridentata* and *Chrysothamnus nauseosus*, also occur in these types but constitute minor cover. In relatively undisturbed conditions there is a diversity of perennial bunchgrasses and forbs in the understory, as well as a relatively high cover of soil biotic crusts, consisting of mosses, lichens, and algae.

2. Regional vegetation type: *Lepidium papilliferum* habitat falls in the Mountain Home and Boise/Payette Valleys units of the Lower Snake River Plain Floristic Division (Ertter and Moseley 1992). Within Kuchler's (1964) scheme it lies within the Sagebrush Steppe (*Artemisia-Agropyron*). Under Bailey's (1980) map, *L. papilliferum* lies in the Sagebrush-Wheatgrass Section of the Intermountain Sagebrush Province, Steppe Division, Dry Domain. The ecoregion classification developed by Omernik and Gallant (1986) places *L. papilliferum* habitat largely in the Snake River Basin/High Desert Ecoregion, although the Bannock County occurrence (002) lies within the Northern Basin and Range Ecoregion.

3. Frequently associated species: In addition to species listed above, following are species frequently associated with *Lepidium papilliferum*, generally in areas adjacent to the sparsely-vegetated slick spots:

<i>Bromus tectorum</i>	<i>Eriogonum strictum</i>
<i>Phacelia heterophylla</i>	<i>Achillea millefolium</i>
<i>Sisymbrium altissimum</i>	<i>Crepis</i> sp.
<i>Lepidium perfoliatum</i>	<i>Erodium cicutarium</i>
<i>Artemisia tridentata</i> ssp. <i>tridentata</i>	<i>Machaeranthera canescens</i>
<i>Ranunculus testiculatus</i>	<i>Astragalus purshii</i>
<i>Descurainia pinnata</i>	<i>Phlox longifolia</i>
<i>Oryzopsis hymenoides</i>	<i>Aristida longiseta</i>
	<i>Helianthus annuus</i>

4. Dominance and frequency: *Lepidium papilliferum* can be a dominant species on a small scale in the slick spot microhabitats. In the overall sagebrush stands, however, it only constitutes low or moderate cover. When it is flowering, however, it appears at least to be an aspect dominant in some sagebrush stands.

5. Successional phenomena: Prior to arrival of white settlers, fire-return intervals in the sagebrush-steppe communities of the Snake River Plain probably varied between 60 and 110 years. With the arrival of irrigated agriculture and ranching in the late-1800's, and the consequent decline in the ecological condition of the sagebrush ecosystem because of livestock grazing, much of the region now burns at intervals of less than five years. *Bromus tectorum*, an introduced annual, increases fire frequencies by creating a more continuous fuelbed. More-frequent fires and reduced patchiness prevents, or greatly retards, normal vegetation succession sequences leading to vegetation resembling less-frequently burned areas (Whisenant 1990).

The scenario described above has probably had a major impact in the distribution, abundance, and viability of *Lepidium papilliferum*. In most cases *Lepidium* populations decline or are extirpated after the natural community is replaced by annuals. Also, as the sagebrush habitats become more fragmented due to this unnatural fire regime, gene flow between populations may be reduced. In small sagebrush fragments, tumbleweed (*Salsola iberica*), blowing across many square miles of burned-over plain, pile up in the sagebrush stands and physically limit *Lepidium* occupation of otherwise suitable habitat.

The effect on population viability of reseeding and rangeland improvement efforts following fire or degradation from livestock grazing is less clear-cut. While disking the site during *Agropyron cristatum* seeding certainly destroys the habitat (e.g., 044), drill seeding may be less detrimental. In the latter case, if the *Lepidium papilliferum* seed bank survives the disturbance and the slick spot-microsites reform, the populations appear to persist. Observations suggest that this restoration scenario may actually be better than large stands of *Bromus tectorum*.

6. Dependence on dynamic biotic features: See above discussion.

7. Other endangered species: *Lepidium papilliferum* occurs in similar habitats and is virtually sympatric with the distribution of *Texosporium sancti-jacobi* on the Snake River Plain. This soil crust lichen is a category 2 candidate (U.S. Fish and Wildlife Service 1993). The *L. papilliferum* populations in the Boise Foothills occur with populations of two category 1 candidates, *Astragalus mulfordiae* and *Allium aaseae* (U.S. Fish and Wildlife Service 1993).

7. Population biology.

A. General summary: Twenty-one populations (represented by all or portions of 16 CDC occurrences) of *Lepidium papilliferum* are considered extirpated and 38 occurrences are known to be extant. An additional seven sightings from 1974 or before have not been revisited recently and their current status is not known. All but two of the populations occur on the western Snake River Plain. Estimates of above-ground plants range from less than ten to as many as several

thousand individuals, although *Lepidium papilliferum* has considerable soil seed banks. Germination of first-year seeds is virtually nonexistent even though seed viability is very high. Seeds germinating from the seed bank in any given year, therefore, represent the offspring of many generations.

B. Demography.

1. Known populations: Thirty-eight occurrences are known to be extant, based on observations between 1989 and 1994, while twenty-one populations (represented by all or a portion of 16 CDC occurrences) are considered extirpated. An additional seven sightings are considered historical, with the implied expectation that they could be relocated. Most extant, extirpated, and historical populations occur on the western Snake River Plain and adjacent northern foothills. These populations were probably more or less contiguous prior to white settlement. Two disjunct populations occur to the south and east of the main range of the species by 50 to 150 miles. Estimates have been made of above-ground plants at all extant sites between 1989 and 1994. *Lepidium papilliferum* has considerable seed banks, however, so these above-ground estimates do not necessarily reflect absolute population levels. I estimate that *L. papilliferum* currently occupies less than 6,800 acres.

2. Demographic details: Appendices 1, 2, and 3 contain the occurrence records for extant, extirpated, and historical occurrences, respectively. No population data is available for the extirpated and historical occurrences, but the records for the extant occurrences (Appendix 1) contain such demographic details as (1) estimated area occupied by population(s); (2) number of plants; (3) density (if known); (4) evidence of reproduction; and occasionally (5) evidence of expansion or contraction of the population. In general, no data has been collected on presence of dispersed seeds.

Each extant population has been given an occurrence rank ("EORANK" field in the records in Appendix 1). The "A" (highest), "B", "C", and "D" (lowest) ranks for each occurrence are based primarily on occupied area, ecological quality of the site, and above-ground population numbers. Secondary considerations include population isolation and habitat fragmentation, imminent threats, and proximity to developed sites (with the implied expectation that habitat will be degraded in the near-term). Specific occurrence rank definitions appear at the beginning of Appendix 1. Below is a listing of the occurrences by rank:

A-RANKED OCCURRENCES (6):	008	024
	015	027
	019	032
 B-RANKED OCCURRENCES (13):	 018	 048
	021	049
	022	051
	029	052
	030	056
	040	059
	042	

C-RANKED OCCURRENCES (9):	010	037
	020	041
	026	050
	028	057
	031	
D-RANKED OCCURRENCES (10):	012	038
	023	039
	025	047
	035	053
	036	058

C. Phenology.

1. Patterns: Seed germination and emergence of the basal rosette takes place in early spring, probably March. Some germination may also take place in the fall. In plants having an annual life cycle, flowering takes place in late April and May, and sets fruit in June. Those plants having a biennial habit persists as rosettes through the year and flower and fruit the following year.

2. Relation to climate and microclimate: The weather patterns in late winter and early spring, especially relating to the amount of sunshine (i.e., heat) and precipitation, will affect the timing of green-up and first growth, which in turn will affect the timing of the various phenological stages. Phenological stages can vary by as much as a month or more from one year to the next.

It has been observed on the Orchard Training Area that in some years the abundance of the annual component of the population can outnumber the biennial plants by three times. These tiny, single-stemmed annual "morphs" are less than 2 cm tall and bear only 1-4 flowers and perhaps one or two seeds. The annual variation in the ratio of annual to biennial morphs is probably related to climatic patterns.

D. Reproductive ecology. Much of this discussion comes from Meyer (1993).

1. Type of reproduction: *Lepidium papilliferum* does not reproduce vegetatively; new individuals arise from seeds. Her data needs to be analyzed, but unlike its weedy annual relative and associate, *Lepidium perfoliatum*, Meyer (1993) speculates that *L. papilliferum* appears to be quite limited in its ability to self.

2. Pollination.

a. Mechanisms: *Lepidium papilliferum* reproduces by seeds, but the fertilization mechanism is not known, although it appears to be primarily an outcrosser.

b. Specific known pollinators: Unknown.

c. Other suspected pollinators: None known.

d. Vulnerability of pollinators: Unknown.

3. Seed dispersal.

a. General mechanisms: Specific details unknown, but gravity is probably the primary dispersal agent. Wind and water may possibly play a limited role, although the seed has no structures to facilitate either of these mechanisms.

b. Specific agents: Unknown, but gravity is probably the most important.

c. Vulnerability of dispersal agents and mechanisms: Unknown.

d. Dispersal patterns: Specific details unknown.

4. Seed biology. The following discussion is from Meyer (1993), which should be referred to for more details.

a. Amount and variation of seed production: The annual plants produce less seed per plant than do the biennial plants. Annual variations in overall seed production probably also responds to climate patterns during the year.

b. Seed viability and longevity: *Lepidium papilliferum* seeds were found to have high viability, greater than 95%. Seeds are probably programmed for long-term persistence in the soil seed bank. Only a small fraction become germinable the first year, as strongly suggested by Meyer's field and laboratory experiments, where most germinated seeds were not produced by the previous year's cohort. Seeds germinating from the seed bank in any given year probably represent the offspring of many generations.

c. Dormancy requirements: The mechanism of seed dormancy is not known, but appears to be related to characteristics of the testa and its mucilaginous coating. Embryos are fully formed at dispersal and germinate readily when the testa is removed.

d. Germination requirements: In greenhouse treatments, only a small fraction of seeds germinated in a few of the multitude of temperature and light treatments attempted. Because chilling is the only treatment that rendered even a small fraction of these seeds germinable, Meyer hypothesized that germination takes place in the winter or early spring.

e. Percent germination: *Lepidium papilliferum* failed to germinate in most treatments, using factorial combinations of temperature and light, and the remaining were mostly less than 5%. The only treatments with germination greater than 5% included an 8-week chilling period.

5. Seedling ecology: No data.

6. Survival and nature of mortality of plants: The following summary is from Meyer et al. (1994), but see Meyer (1993) for detailed discussion. *Lepidium papilliferum* is largely a

monocarpic plant displaying two life cycle types. Emergence takes place in the early spring for both types. The annual type sets fruit the summer following emergence. The biennial type persists as a basal rosette and sets fruit the following spring. Reproductive output is an order of magnitude larger for biennials, but the probability of survival to reproduction is substantially lower. Mortality risks to biennials include late summer drought and winter flood. These risks are variable from year to year and from microsite to microsite and affect the relative contribution of the two types to a microsite seed bank in any given year. The seed bank is persistent, so that current-year seedlings represent the progeny of plants produced over a range of years.

7. Overall assessment of reproductive success:

8. Population ecology.

A. General summary: There is little knowledge of the effect of herbivores, disease, competition, hybridization, or allelopathy on population viability.

B. Positive and neutral interactions: None known.

C. Negative interactions.

1. Herbivores, predators, pests, parasites and diseases: Seed herbivores, such as rodents and birds, may have a negative effect on seed survival, but specific details are lacking.

2. Evidence of competition.

a. Intraspecific: *Lepidium papilliferum* is a short-lived species that produces a lot of seed. Although we are just beginning to learn about the seed and seedling biology for this species, there is probably some intraspecific competition at germination and the early stages of growth for moisture and space during certain years.

b. Interspecific: Few vascular plants are immediately sympatric with *Lepidium papilliferum* on its unique slick-spot habitat. The vegetation cover is low on all sites and interspecific competition is probably not significant on most sites. Occasionally, on what possibly are marginal sites, cheatgrass and other annual weeds, such as *Lepidium perfoliatum*, reach relatively high densities and may limit or otherwise outcompete *L. papilliferum*.

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: Known populations occur on a complex mixture of public and private ownerships and, in some cases, complex management arrangements. The private-land component occurs on many small ownerships. A wide variety of public ownerships is involved, including federal, state, county, and municipal. In some instances the Idaho Army National Guard shares management of populations with the Bureau of Land Management.

B. Specific landowners: The ownership of the 36 extant occurrences is listed in the occurrences record in Appendix 1. Similarly, ownership of the extirpated and historical occurrences is listed in Appendices 2 and 3, respectively. Below is a summary of ownership of the extant, extirpated, and historical occurrences (referenced by occurrence number), where known:

1. Extant.

a. Private:

023	037
036	039

b. Boise City (Parks Department):

012

c. Ada County (Solid Waste Management):

038

d. State of Idaho (Department of Lands):

021 (& private)
022 (& private)

e. Bureau of Land Management (Boise District).

1. Cascade Resource Area:

040 (& private)	052
047	056

2. Bruneau Resource Area.

i. Populations managed primarily by BLM:

010	029
015 (& private)	030 (& private)
018	031 (& private)
019 (& state)	032 (& private)
020	048
024	049
025	050
026	057

ii. Populations on the Orchard Training Area (jointly managed by BLM and Idaho Army National Guard):

027	041
028	042
035	053

3. Jarbidge Resource Area:

008 (& private)	058
051	059

2. Extirpated.

a. Private:

001	014
003	017
004	034
007	043
009	055
011	

b. Bureau of Land Management (Boise District).

1. Bruneau Resource Area.

i. Populations managed primarily by BLM:

054

ii. Populations on the Orchard Training Area (jointly managed by BLM and Idaho Army National Guard):

044

c. Unknown ownership:

045

3. Historical.

a. Private:

005 016 (and/or state)
013 033

b. Bureau of Land Management (Boise District).

2. Bruneau Resource Area.

i. Populations managed primarily by BLM:

046

c. U.S. Forest Service (Caribou National Forest):

002

d. Unknown:

006

C. Management responsibility: For the most part, management responsibility mirrors the ownership of the occurrence, so refer to the above section. Private occurrences occur on numerous small ownerships, although most are extirpated. Of special interest are those occurrences on the Orchard Training Area, which is public land under the jurisdiction of the BLM, but for which management responsibility lies jointly with the BLM and the Idaho Army National Guard. The Guard environmental staff brief every soldier who trains in the Orchard Training Area on the importance of avoiding damaging *Lepidium papilliferum* plants and their habitat. Information about *L. papilliferum* is included in the Guard's annual Environmental Training School, which trains soldiers from every armory in Idaho.

D. Easements, conservation restrictions, special designations, etc.: Of the 36 extant sites, only six are protected to any extent.

Occurrence 056, managed by the Cascade Resource Area, BLM, occurs within the Willow Creek Area of Critical Environmental Concern (ACEC). The ACEC was established in 1993 to protect another federal candidate, *Allium aaseae*.

A portion of occurrence 024, managed by the Bruneau Resource Area, BLM, was fenced to exclude livestock grazing in 1994.

Four occurrences occurring on the Orchard Training Area, 027, 028, 041, and 042, were made off limits to tank training by the Idaho Army National Guard in 1991, and all military training in 1993, except on maintained roads. Permanent "Off-limits by Order of the Commanding General" signs have been placed around two population centers on the training area. At least occurrences 041 and 042, however, are still heavily grazed by cattle and sheep (grazing on the Orchard Training Area is managed by the BLM).

10. Management practices and experience.

A. Habitat management.

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

a. This taxon: The three most important land-uses throughout the range of *Lepidium papilliferum* since white settlement include urban/suburbanization, irrigated agriculture, and rangeland livestock grazing. More recently, military tank training has become an important land-use within its range. Many populations appear to have been extirpated since the 1890's due to conversion of portions of the Snake River Plain (especially in Canyon County) and Payette Valley to irrigated agriculture. Urban/suburbanization has also caused extirpation of *Lepidium* populations in Boise, Nampa, Caldwell, probably Parma, and possibly elsewhere. The long-term viability of many of the remaining populations in the Boise Foothills is questionable due to the continued rapid expansion of residential development around Boise.

The management and impact of rangeland livestock grazing on the viability of *Lepidium papilliferum* is less direct than the other two. High levels of livestock grazing in the late 1800's and early 1900's degraded the sagebrush-steppe ecosystem to the point where introduced annuals, especially *Bromus tectorum*, became dominant over large areas. This is especially true on the western Snake River Plain (Yensen 1980). Stewart and Hull (1949) estimated that by 1949, cheatgrass was common on 4 million acres of Idaho rangelands. In addition to physically displacing native vegetation and species, *B. tectorum* also created a more continuous, highly flammable fuelbed and reduced the fire frequency from between 60-110 years, to less than 5 years (Pellant 1990; Whisenant 1990). This conversion of sagebrush-steppe to annual grasslands apparently reduced the suitable habitat for and destroyed populations of *L. papilliferum*, as well as fragmenting and isolating extant populations.

There are, however, direct effects of livestock grazing on *Lepidium papilliferum* populations. Evidence from the Orchard Training Area suggests that there is significant trampling damage from livestock use of the habitat. It is especially damaging in the spring when soil moisture is high. Observations over four years on the training area indicate that trampling of *L. papilliferum* microsites leads to the invasion of *L. perfoliatum* and *Ranunculus testiculatus*, both annual exotic weeds, and the disappearance of *L. papilliferum*. Also, in 1993 several *L. papilliferum* microsites were destroyed on state lands adjacent to the Orchard Training Area by construction of an earth-berm stock watering hole.

Tank training and related facilities at the Orchard Training Area have impacted some populations, although it is not known to what extent.

b. Related taxa: Not known.

c. Other ecologically similar taxa: N/A

2. Performance under changed conditions: While we need more research on the subject, it is felt by most biologists familiar with *Lepidium papilliferum* and its habitat, that the microsites supporting *Lepidium* are altered significantly following wildfire and subsequent conversion of sagebrush-steppe vegetation to annual grasslands. Microsites are altered to the point where they are lost or greatly reduced or rendered unsuitable for maintenance of *L. papilliferum*. Excellent evidence for this can be seen at occurrence 020 in Elmore County. In 1980, Jim Grimes and others found *Lepidium* in slick spots between I-84 and the old US 30. In 1991, the area between the I-84 and the old road thoroughly burned, but the high quality sagebrush stand on the opposite side (north) of the old road remained unburned. In 1993, I found no *Lepidium* in the burned area while slick spots a few feet away on the unburned side of the road contained vigorous populations. The persistence and the role of the seed bank in possibly reestablishing these populations at some point in the future is unknown and in need of research.

Studies on the Orchard Training Area by the Army National Guard found that the most important recruitment pulse for *Lepidium papilliferum* is from April through June. Seedlings are vulnerable to trampling, especially during times when the soils are moist. Livestock grazing in the late spring seems to be a significant threat to the species.

I consider populations and habitat destroyed by irrigated agriculture and urbanization to be permanently lost.

3. Current management policies and actions: One population is protected in a BLM ACEC. Four occurrences are closed to tank training on the Orchard Training Area, although livestock grazing still occurs on these sites and the ecological condition of at least one site has deteriorated recently. Most of the extant sites managed by the BLM continue to be grazed by livestock, cattle and/or sheep. The BLM is trying to limit the amount of the remaining sagebrush stands that are destroyed by wildfire through aggressive suppression and limiting fire spread through "greenstripping" (Pellant 1990).

Several management problems have occurred recently on or near the Orchard Training Area that suggest better coordination between the BLM and the Idaho Army National Guard is needed to maintain high habitat quality in the area. Three examples follow:

a. The area supporting the largest population on the training area is always heavily grazed by cattle and sheep during the spring/fall grazing period, but in 1993-1994 the population was grazed by sheep during the winter period as well because the permittee, who had little forage near his allotment near Mountain Home Air Force Base, was allowed "compensation," that is, permission to graze his spring/fall allotment in the winter.

b. The Army National Guard has requested that the BLM not locate any stocky watering tanks within at least 0.25 mile of research sites that the Guard has established to study the population biology *Lepidium papilliferum*. During the winter of 1993-1994, however, sheep watering tanks were placed within a few meters of their sites. As a result, 17 long-term study sites were impacted to the point that the demography data sets are no longer useful. Many marked plants were trampled and more were bitten off and/or pulled from the ground (although the plant is generally not palatable to livestock).

c. A BLM-contracted study of Townsend ground squirrels on the training area requested that an area be intentionally tracked at an intense level by tanks, to study the impacts of tanks on squirrels. The Guard informed the BLM and study contractors there were two *Lepidium papilliferum* microsites there, and the proposed tracking sites was in the center of one of the few high quality sagebrush stand where there was little invasion of exotic weeds and that the area was off-limits to military training. But the tank training proceeded. The tracking destroyed the two microsites, and now the entire area is being invaded by exotic weeds at a rapid rate. The site also supports a population of another federal candidate, *Texosporium sancti-jacobi*.

4. Future land use(s): Most of the past and current management regimes discussed above continue on habitat containing extant *Lepidium* populations. Boise Foothill populations within the city's Area of Impact continue to be threatened by housing development, with at least one population (043) being destroyed in 1993. Inventories have been conducted in the Area of Impact (Moseley et al. 1992) and these data have been incorporated into recently released planning documents (Boise City 1994a; 1994b). These efforts may eventually result in protection of rare plant populations in the Boise Foothills through zoning ordinances.

B. Cultivation.

1. Controlled propagation techniques: *Lepidium papilliferum* is apparently difficult to propagate because of low seed germination, although techniques are being developed by Meyer (1993).

2. Ease of transplanting: Unknown.

3. Pertinent horticultural knowledge: There is very low seed germination the first year in the laboratory and probably the field. However, the embryos are fully formed at dispersal and the seeds germinate readily when the testa is manually removed. This discovery will aid in artificial propagation (Meyer 1993).

4. Status and location of presently cultivated material.

a. Specimen plants: Greenhouses of the USDA Forest Service, Intermountain Research Station, Shrub Science Laboratory, Provo, Utah. The quantity of plants is unknown.

b. Stored seed/propagule banks: Several thousand seeds were collected by the Boise District BLM Botanist in 1990, and deposited in the Berry Botanical Garden as partial fulfillment of recommended tasks outlined in the Cooperative Agreement between the

11. Evidence of threats to survival.

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

1. Past threats: Significant reduction in habitat and populations due to past land-uses was reviewed earlier. In summary, direct habitat loss from conversion of habitat to irrigated agriculture and urban/suburbanization has been documented. The loss of habitat and populations due to the indirect effects of livestock grazing, through weed invasion and consequent increase in fire frequency, has also been documented.

2. Existing threats: The threat of habitat and population loss through continued expansion of Boise City into the foothills is real. In 1993 at least one population of *Lepidium papilliferum* was destroyed by a new housing development. The ecological deterioration of sagebrush habitats containing *Lepidium* from ongoing livestock grazing has been observed. The most pernicious threat, however, is the continued loss of sagebrush habitats across the Snake River Plain from wildfire and exotic annuals. Wildfire and annual invasion is also causing further fragmentation and isolation of extant populations making them increasingly vulnerable to stochastic extinction phenomena.

Reseeding attempts following wildfire also may present significant threats. A large area in southwestern Ada County was disked following wildfire in the 1980's (and presumably seeded, although nothing but exotic annuals now occupy the site). This extensive disking destroyed the small slick spot microsites severely limiting any chance *Lepidium papilliferum* has of reoccupying this habitat in the future. Occurrence 044 is considered extirpated. Also, disking during a failed greenstripping attempt in Military Reserve Park (occurrence 012) in late the 1980's destroyed the original population discovered there in 1972. Another small population was later discovered nearby on undisked ground. It appears that drill seeding does not destroy *Lepidium* habitat to the same degree as disking, and the slick spots are maintained more readily under this method.

3. Potential threats: See above.

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

1. Past threats: None known.

2. Existing threats: Minimal to no existing threats in Idaho.

3. Potential threats: Minimal to no potential threats foreseen in Idaho.

C. Disease, predation, or grazing.

1. Past threats: None known. While disease and seed and herbage herbivory certainly takes place it is not seen as a major past, existing, or potential threat. Habitat destruction is the most important threat to the survival of *Lepidium papilliferum*.

2. Existing threats: See Past Threats.

3. Potential threats: See Past Threats.

D. Inadequacy of existing regulatory mechanisms.

1. Past threats: In addition to being a federal candidate, *Lepidium papilliferum* is also a BLM Sensitive Plant, which is supposed to afford a certain amount of protection and proactive management to avoid listing. The Bruneau Resource Area Manager for the Boise District BLM found this inconvenient in 1991, however, and approved the trade of *L. papilliferum* occurrence 021 with the Idaho Department of Lands, even though he admitted that the action "could result in eventual direct or indirect eradication" of the population. He determined "that the public interest would best be served by fulfilling the United States' commitment to replace lands lost by the State of Idaho at statehood" (letter from Dennis Hoyem to Chuck Lobdell, January 28, 1991). The habitat in question is proposed for lease by the state for the mining of cinders.

2. Existing threats: None.

3. Potential threats: None.

E. Other natural or manmade factors.

1. Past threats: See below.

2. Existing threats: The small size of many populations, in terms of both size and numbers, presents a real threat to their survival due to deleterious environmental and genetic events. The continued isolation and fragmentation of populations due to habitat conversion compounds the threat to their survival.

3. Potential threats: See above.

II. Assessment and Recommendations.

12. General assessment of vigor, trends, and status: The current status of *Lepidium papilliferum* is as follows:

- o Twenty-one populations are known to be extirpated due to habitat destruction (lumped into 16 occurrences, including 012 and 020, part of which are extant). Documented extirpation of known populations has occurred at the rate of about 2 per decade since settlement.

- o Thirty-eight occurrences are known to be extant (populations at occurrence 012 and 020 are known to be extirpated, see above).

Many of these remaining populations are small and, as the habitat becomes more fragmented due to ongoing habitat loss, populations are becoming more isolated from each other making them vulnerable to deleterious environmental and genetic events.

- o Seven occurrences have not been revisited recently and are considered historical, with the implied expectation that they may be relocated.

13. Recommendations for listing, status change, and/or conservation actions.

A. Recommendations to the U.S. Fish and Wildlife Service: Based on the information compiled in this report, I recommend that *Lepidium papilliferum* be listed as a Threatened species under the Endangered Species Act, a step that I see as necessary to stem the ongoing decline of the species and its habitat, as well as the ecosystem in which it occurs. I feel a listing priority of 5 is appropriate, that is, the threats are of high magnitude but of non-imminent immediacy.

I recommend that pre-listing Conservation Agreements be developed with several agencies and organizations to begin recovery of this declining species as soon as possible. Conservation Agreements are recommended with the BLM, Idaho Army National Guard (jointly with the BLM), Boise City Parks (jointly for three candidate taxa), Ada County Solid Waste Management (jointly for three candidate taxa), and possibly Idaho Department of Lands and Caribou National Forest. Specific details are described in later sections.

It is clear that the decline of *Lepidium papilliferum* is just one symptom in a much larger and more ominous ecological phenomenon, that is, the 130 year decline of the sagebrush-steppe ecosystem on the western Snake River Plain (Ertter and Moseley 1992; Noss et al. 1993). Any conservation strategies developed to stem the decline of *Lepidium* must take the decline of the ecosystem into account. In this context, I offer this review of some important concepts and make a few general recommendations that should be considered when developing conservation and recovery plans. While the largest populations, those ranked "A" and "B", are often thought to make largest contribution to evolutionary viability, the importance of all extant populations to maintaining acceptable metapopulation structure and dynamics should not be discounted. A metapopulation is defined as a collection of "interdependent populations affected by recurrent extinctions and linked by recolonizations" (Murphy et al. 1990). In other words, while the loss of a few individuals may be deemed insignificant, it will generally be very important to maintain the overall geographic structure of the populations and their component subpopulations. The maintenance of the "distribution viability" of populations and subpopulations will serve as a good stand-in for maintaining less easily observed features that affect the viability of the population, including genetic variation patterns, pollinator relationships, seed dispersal patterns, and gene flow within and among populations (Shelly 1994).

Maintaining metapopulation structure and dynamics becomes critical in the case of *Lepidium papilliferum*, where many of the populations have become isolated from one another as suitable habitat has become highly fragmented. Maintaining multiple populations over a wide range of

geography and habitats will serve as a source for colonists as a hedge against a shifting mosaic of habitats and environmental stochasticity, and will buffer the effects of land management and future natural habitat changes (Shelly 1994).

All agencies and organizations managing extant populations of *Lepidium papilliferum* have an important role to play in maintaining its evolutionary viability. This includes both the large populations on the Snake River Plain, primarily managed by the BLM and Idaho Army National Guard, and the small populations in the Boise Foothills, managed by Boise City, Ada County, the BLM and many private landowners. Toward this end, specific agency recommendations are made below.

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

1. Bureau of Land Management: *Lepidium papilliferum* should remain a BLM Sensitive Species. The Idaho Army National Guard has drafted a three-way Conservation Agreement between the Guard, BLM and U.S. Fish and Wildlife Service to assure protection and long-term persistence of the large populations occurring on the Orchard Training Area. The BLM is currently reviewing the draft Agreement. It is clear that better coordination is needed between the Guard and the BLM in their shared responsibility of managing *L. papilliferum* populations on the Orchard Training Area.

Most of the extant A- and B-ranked *Lepidium papilliferum* populations are managed by the Boise District BLM. Management of BLM lands, therefore, is important to its long-term persistence. However, in developing a conservation strategy for *Lepidium papilliferum* the BLM should not discount the importance of all extant populations to maintaining acceptable metapopulation structure and dynamics. The primary goal of the BLM, therefore, in developing a conservation strategy for this species should be the maintenance, protection and recovery of a viable sagebrush-steppe ecosystem on the western Snake River Plain. The BLM should continue its vigorous campaign to limit further loss of sagebrush habitats on the western Snake River Plain through vigorous fire suppression and programs to limit fire spread.

2. U.S. Forest Service: One historical occurrence is known from the Caribou National Forest (002). This species was recently placed on the Intermountain Region Sensitive Species List. Field inventories should be conducted on the Forest as soon as possible to determine the distribution, abundance and conservation status of populations managed by the Forest Service. When and if *Lepidium papilliferum* is found to be extant on the Caribou National Forest, the Forest should enter into a pre-listing Conservation Agreement with the U.S. Fish and Wildlife Service for the protection and long-term conservation of populations that they manage.

C. Other status recommendations.

1. Municipalities (Boise):

a. Zoning Ordinances: Boise City is currently preparing a foothills development plan (Boise City 1994a; 1994b) that is supposed to help eliminate some of the social and

ecological conflicts taking place there, including the protection of important populations of the three federal candidate plants: *Astragalus mulfordiae*, *Allium aaseae*, and *Lepidium papilliferum*. Adequate data exist on the distribution, abundance, and conservation status of these species to develop a comprehensive conservation strategy and implement this through zoning ordinances. Moseley et al. (1992) made recommendations on which populations should be vigorously protected and these were incorporated into the draft planning documents (Boise City 1994a). The city should develop and enforce ordinances that protect all populations of *L. papilliferum*.

b. Boise City Parks: Boise City has two parks in the Boise Foothills that contain three federal candidate plants. Military Reserve contains *Lepidium papilliferum* (012), *Astragalus mulfordiae* and *Allium aaseae*, while Camelsback Park contains just the latter two. Because a majority of foothills rare plant populations occur on private lands, those occurring in city parks will make an important contribution to the long-term conservation in the foothills portion of their ranges. Due to lack of knowledge, one population of *Lepidium papilliferum* was extirpated in Military Reserve by a failed greenstrip attempt in the late 1980's. Excellent rare plant distribution data now exist for the two parks, so ignorance is no longer an excuse for improper management. The U.S. Fish and Wildlife Service and Boise City Parks should enter into a Conservation Agreement for protection and long-term conservation of all three federal candidates in the two parks.

2. Counties (Ada): Ada County is the only county that is known to directly manage a population of *Lepidium papilliferum*. Occurrence 038 occurs on the Hidden Hollow Landfill managed by Ada County Solid Waste Management. In addition to *Lepidium*, *Astragalus mulfordiae* and *Allium aaseae* also occur on the Hidden Hollow Landfill. As mentioned above, very few foothills rare plant populations occur on public land, making the ones that do important for maintaining species viability in this portion of their ranges. The U.S. Fish and Wildlife Service and Ada County Solid Waste Management should enter into a Conservation Agreement for protection and long-term conservation of all three federal candidates on the landfill.

3. State(s) (Idaho):

a. Idaho Army National Guard: The state National Guard shares management responsibility with the BLM for populations on the Orchard Training Area. The Guard controls various aspects of military training, while the BLM controls grazing and other management. The Guard has an extensive monitoring and research program started for *Lepidium papilliferum* and has closed habitat containing four populations to military training. The remaining extant populations are small and in disturbed habitat. The Idaho Army National Guard has drafted a Conservation Agreement with the U.S. Fish and Wildlife Service and the BLM to assure protection and long-term persistence of the large populations occurring on the Orchard Training Area (it is currently being reviewed by the BLM). The Guard has already implemented the management practices described in the Agreement.

042 - Orchard Training Area
048 - BLM (actually ranked BC)
049 - BLM
051 - BLM
052 - BLM
056 - BLM
059 - BLM

BOISE FOOTHILLS (5):

012 - Boise City Parks
023 - private
036 - private
037 - private
038 - Ada County Solid Waste Management

3. Habitat management recommendations: Habitat destruction is the ultimate threat and should be curtailed wherever possible. No regulatory mechanisms are available to enforce this on private land, but they do exist on publicly-administered land. Again, every effort should be made by all agencies and organizations to limit the degradation of the sagebrush-steppe ecosystem on the Snake River Plain.

4. Publicity sensitivity: None.

5. Other recommendations: None.

B. Monitoring activities and further research recommendations: The Idaho Army National Guard has established 17 permanent monitoring stations in *Lepidium papilliferum* populations on the Orchard Training Area in 1991 and 1992, and reread them annually. All of these sites were altered by unexpected winter sheep grazing authorized by the BLM in 1993-1994. The BLM has also established permanent monitoring stations at three populations. Habitat and population biology research being conducted by the Idaho Army National Guard, Shrub Sciences Laboratory, and BLM will aid in the recovery and restoration of *Lepidium* populations and habitats. Further research should be considered on the causes of the decline and extirpation of populations from areas converted to annual grasslands following fire. These data, along with other areas of research relating to metapopulation viability and dynamics will be important in developing conservation and recovery plans.

16. Interested parties:

Conservation Data Center
Idaho Department of Fish and Game
P.O. Box 25
Boise, ID 83707

Idaho Native Plant Society
P.O. Box 9451
Boise, ID 83707

State Director
Bureau of Land Management
3380 Americana Terrace
Boise, ID 83607

District Manager
Boise District
Bureau of Land Management
3948 Development Ave.
Boise, ID 83705

Commanding General
Idaho Army National Guard
Gowen Field
Boise, ID 83707

Director
Community Planning and Development Department
Boise City
150 N Capitol Blvd.
Boise, ID 83702

Director
Boise City Parks Department
1104 Royal Blvd.
Boise, ID 83706

Manager
Ada County Solid Waste Management
150 N. Capitol Blvd.
Boise, ID 83702

Director
Idaho Department of Lands
1215 W State
Boise, ID 83720

Area Supervisor
Southwestern Idaho Supervisory Area
Idaho Department of Lands
8355 W State
Boise, ID 83703

Forest Supervisor
Caribou National Forest
Federal Building, Suite 294
250 South 4th Ave

Pocatello, ID 83201

Regional Forester
USFS Intermountain Region
Federal Building
324 25th St.
Ogden, UT 84401

Director
Snake River Plain Herbarium
Biology Department
Boise State University
1910 University Drive
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III. Information Sources.

17. Sources of information.

A. Publications.

1. References cited in report:

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Meyer, S.E., D.L. Quinney, and J. Weaver. Population biology of *Lepidium papilliferum*, a Snake River Plains endemic. Abstract of paper presented at Botanical Society of America annual meeting.

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Moseley, R.K. 1989. Results of the 1989 search of regional herbaria for location information pertaining to Idaho's rare flora: The fourth generation search. Unpublished report on file at: Idaho Department of Fish and Game, Conservation Data Center, Boise, ID. 12 p., plus appendix.

Moseley, R.K., M. Mancuso, and J. Hilty. 1992. Rare plant and riparian inventory of the Boise Foothills, Ada County, Idaho. Unpublished report on file at: Idaho Department of Fish and Game, Conservation Data Center, Boise, ID. 20 p., plus appendices.

Moseley, R., and C. Groves, compilers. 1992. Rare, threatened and endangered plants and animals of Idaho. Second edition. Idaho Department of Fish and Game, Conservation Data Center, Boise, ID. 38 p.

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Omernik, J.M., and A.L. Gallant. 1986. Ecoregions of the Pacific Northwest. EPA/600/3-86/033. US Environmental Protection Agency, Environmental Research Laboratory, Corvallis, OR. 39 p.

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- Stewart, G., and A.C. Hull. 1949. Cheatgrass (*Bromus tectorum* L.) - an ecological intruder in southern Idaho. Ecology 30:58-74.
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- Trewartha, G.T., and L.H. Horn. 1980. An introduction to climate. McGraw-Hill Book Co., New York, NY. 412 p.
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- Whisenant, S.G. 1990. Changing fire frequencies on Idaho's Snake River Plain: Ecological and management implications. Pages 4-10 in E.D. McArthur, E.M. Rommey, and P.T. Tueller, compilers, Proceedings - Symposium on cheatgrass invasion, shrub die-off, and other aspects of shrub biology and management. General Technical Report INT-276. USDA Forest Service, Intermountain Research Station, Ogden, UT.
- Yensen, D.A. 1980. A grazing history of southwestern Idaho with emphasis on the Birds of Prey Study Area. USDI, Bureau of Land Management, Boise, ID. 82 p.

2. Other pertinent publications.

a. Technical:

DeBolt, A., and R. Rosentreter. 1988. An illustrated guide to the sensitive plants of Boise District, Bureau of Land Management, 1988. Technical Bulletin 88-4. Bureau of Land Management, Idaho State Office, Boise, ID.

Meyer, S. 1994. LEPAPOP data analysis - progress report 1994. Unpublished report on file at: State of Idaho Military Division, Army National Guard, Boise, ID.

b. Popular:

Proctor, D. 1994. Animals, plants will play role in foothills plans. Idaho Statesman, Wednesday, April 20, 1994.

B. Herbaria consulted: At least four major herbarium searches have been conducted for Idaho's rare plants over the years, including *Lepidium papilliferum*, most recently in 1989 (Moseley 1989). Specimens of *L. papilliferum* are known to be deposited at the herbaria listed below, along with the number of specimens in each collection [the standardized acronyms follow Holmgren et al. (1990) for national and regional herbaria and Moseley (1989) for local Idaho herbaria]. For specific collection information relating to each occurrence, refer to the "Specimen" field in the occurrence records found in Appendix 1, 2, and 3.

National Guard (1)
BOIS (2)
Boise BLM (5)
CIC (10)
CS (1)
ID (7)
IDF (1)
IDS (4)
NY (8)
RM (2)
RSA (1)
SRP (3)
US (1)
WS (6)
WTU (3)

C. Fieldwork: Aside from the sporadic collections made by botanists beginning in 1892, a large majority of the systematic field inventories for *Lepidium papilliferum* have been conducted by the Boise District BLM and the Idaho Army National Guard, between 1989 and 1994. Surveys were conducted on the Mountain Home Air Force Base and adjacent Small Arms Range in 1990, although no *L. papilliferum* was found there (Thompson 1990). The Conservation Data Center conducted a systematic inventory of the Boise Foothills in 1992 (Moseley et al. 1992) and we attempted to relocate all pre-1980 collections in 1993 and 1994.

D. Knowledgeable individuals:

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E. Other information sources: None known.

18. Summary of material on file: Color slides, field forms, maps, and most published and unpublished references pertaining to *Lepidium papilliferum* are on file at the Idaho Conservation Data Center office. Additionally, important information is also located at the Boise District BLM Office and with the Idaho Army National Guard.

IV. Authorship.

19. Initial authorship:

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20. Maintenance of status report: The Idaho Conservation Data Center will maintain current information and update the status report as needed. Should *Lepidium papilliferum* 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

Conservation Data Center records for
extant occurrences of *Lepidium papilliferum*.

NOT INCLUDED IN THE CDC HOME PAGE VERSION OF THIS REPORT

NOTE: Each extant population has an occurrence rank (EORANK) between A and D. These ranks are defined below. In some cases, an explanation of the rank appears in the EORANK COMMENTS field.

A-RANKED POPULATIONS: consist of those with large population numbers occurring in high quality shrub-steppe communities. The occurrences also tend to be large in area, consisting of many slick spots spread over a contiguous area. Populations generally consist of greater than 1000 above-ground individuals in sagebrush stands consisting mostly of native perennials; these sites generally have not burned and subsequently invaded by exotic annuals.

B-RANKED POPULATIONS: consist of about 400 to 2000 individuals. The "average" occurrence of this rank consists of several hundred plants in good to high quality sites. Populations at the low end of the range mentioned above must occur in high quality habitat and/or be protected to some degree from inappropriate disturbances (such as closed to military training). B-ranked occurrences consisting of thousands of individuals (high end of the range) occur in fair to low quality sites (burned over cheatgrass stands or crested wheatgrass seedings).

C-RANKED POPULATIONS: consist of as few as 25 to >1000 individuals. The "average" occurrence here consists of 100-200 individuals in fair to low-quality habitat. The occurrences with smaller populations occur in large tracts of high quality habitat, while populations at the large end of the range are in highly disturbed habitats or those that are adjacent to recent developments and are not expected to remain viable.

D-RANKED POPULATIONS: consist of generally less than 50 individuals (often less than 25) occurring as isolated populations in degraded habitats.

Appendix 2

Conservation Data Center records for
extirpated occurrences of *Lepidium papilliferum*.

Appendix 3

Conservation Data Center records for
historical occurrences of *Lepidium papilliferum*.

Appendix 4

Slides of the habit and habitat of *Lepidium papilliferum*.

- Slide 1. Close-up of flowers and immature fruits.
- Slide 2. Several plants on a slick spot on the Snake River Plain, Ada County.
- Slide 3. Close-up of non-flowering rosettes on slick spot with high cover of soil-crust lichens.
- Slide 4. Slick spot containing *Lepidium papilliferum* in unburned *Artemisia tridentata* spp. *wyomingensis* stand in Elmore County (occurrence 020).
- Slide 5. Slick spots that contained *Lepidium papilliferum* in 1980, but are now unoccupied following 1991 fire. This scene is adjacent to slide 4, which is across a road that acted as a fire break.
- Slide 6. *Lepidium papilliferum* occurrence 023 in the Boise Foothills (foreground) nearly surrounded by newly developed residential areas. The earth moving activities in background are part of the construction that led to the extirpation of occurrence 043.

Status. Confidence level. Source. Date supplied. *Lepidium montanum* var. *papilliferum* L.F. Hend. Synonym. TRO. 2012-04-18. *Lepidium montanum* subsp. *papilliferum* (L.F. Hend.) C.L. Hitchc. Synonym. TRO. 2012-04-18. Further information. The following databases may contain further information on this name. Please click on any button to follow a link to that database. In addition, restoration of *Lepidium papilliferum*'s native sagebrush-steppe ecosystem is considered one of the greatest restoration challenges in the Great Basin (Bunting et al. 2003, pp. 82-84). 2. Historical and Current Population Status. *Lepidium papilliferum* is endemic to southwest Idaho and is known only from the Snake River Plain and its adjacent northern foothills, which represents an area 145 by 40 kilometers (km) (90 by 25 miles (mi)), with a smaller disjunct population on the Owyhee Plateau, representing an area of approximately 18 by 19 km (11 by 12 mi). The definition of a single EO is based on the distance over which individuals of *L. papilliferum* are believed to be capable of genetic exchange through insect-mediated pollination (Colket and Robertson 2006, pp. 1-2). *Lepidium papilliferum*. NatureServe Explorer Species Reports -- NatureServe Explorer is a source for authoritative conservation information on more than 50,000 plants, animals and ecological communities of the U.S and Canada. NatureServe Explorer provides in-depth information on rare and endangered species, but includes common plants and animals too. NatureServe Explorer is a product of NatureServe in collaboration with the Natural Heritage Network. ITIS Reports -- ITIS (the Integrated Taxonomic Information System) is a source for authoritative taxonomic information on plants, animals, fungi,