

THE TAXONOMY AND PRELIMINARY CONSERVATION STATUS OF

*ERIOGONUM SHOCKLEYI* S. WATS. IN IDAHO

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## ABSTRACT

*Eriogonum shockleyi* S. Wats. is a rare species in Idaho, being disjunct from the main portion of its distribution in the Great Basin. Two varieties have been recognized in the state, the endemic var. *packardae* (Packard's buckwheat) and the typical var. *shockleyi* (Shockley's buckwheat). Since the endemic variety was first recognized in the mid-1970's, there has been considerable confusion as to the identity of populations in the state. This has hindered conservation planning for the two taxa. Our study objectives were to conduct a taxonomic assessment of *Eriogonum shockleyi* in Idaho to aid in identification and make a preliminary assessment of its conservation status in the state.

Taxonomic analysis revealed that two entities do exist in Idaho. We prepared descriptions for *E. shockleyi* and its varieties in Idaho and constructed a key to aid in identifying populations. We also discuss the biogeographic significance of the Idaho populations of *E. shockleyi* in the context of conservation planning. Emphasis was placed on determining the taxonomic status, but we used existing data to make preliminary assessments of the conservation status of the two varieties. Packard's buckwheat is known from 11 extant populations and is globally rare. Populations are small, localized and some are threatened. It deserves recognition at the federal level as a candidate taxon. Shockley's buckwheat is globally common and secure, but rare within Idaho. It is also known from 11 populations, but in general they tend to be larger than Packard's buckwheat and three occur in state parks or a national monument, where they are relatively well protected. Thorough rangewide/statewide field surveys are needed to determine the full extent of their distributions and abundance in Idaho and their true conservation status.

TABLE OF CONTENTS

ABSTRACT ..... i

TABLE OF CONTENTS ..... ii

LIST OF APPENDICES ..... ii

PREFACE ..... 1

SECTION 1 - TAXONOMY ..... 2

SECTION 2 - CONSERVATION STATUS ..... 14

*ERIOGONUM SHOCKLEYI* VAR. *PACKARDAE* ..... 15

*ERIOGONUM SHOCKLEYI* VAR. *SHOCKLEYI* ..... 22

REFERENCES ..... 28

LIST OF APPENDICES

- Appendix 1. Morphometric data from 19 *Eriogonum shockleyi* collections made by Bob Moseley during 1995.
- Appendix 2. Occurrence Records for *Eriogonum shockleyi* var. *packardae* from the Conservation Data Center data base.
- Appendix 3. Location of *Eriogonum shockleyi* var. *packardae* populations known to be extant.
- Appendix 4. Occurrence records for Idaho populations of *Eriogonum shockleyi* var. *shockleyi* from the Conservation Data Center data base.
- Appendix 5. Location of *Eriogonum shockleyi* var. *shockleyi* populations in Idaho.

## PREFACE

*Eriogonum shockleyi* S. Wats. is a rare species in Idaho, being disjunct from the main portion of its distribution in the Great Basin. Two varieties have been recognized in the state, the endemic var. *packardae* (Packard's buckwheat) and the typical var. *shockleyi* (Shockley's buckwheat). Since the endemic variety was first recognized in the mid-1970's, there has been considerable confusion as to the identity of populations in the state. This has hindered conservation planning for the two taxa. To rectify this situation, the Lower Snake River District, BLM, and the Idaho Department of Fish and Game's Conservation Data Center (CDC) entered into a cooperative project to (1) conduct a taxonomic assessment of *Eriogonum shockleyi* in Idaho to aid in identification, and (2) make a preliminary assessment of its conservation status in the state.

The project study plan also called for determining the disposition of a population of *Eriogonum* from the summit of War Eagle Mountain, in the Silver City Range, that had been mentioned by Reveal (1989) as a possible new species. Searches by Ann DeBolt (pre-1994), Bob Moseley (in 1994), and Jim Reveal (in 1995) failed to locate the population. More work is needed on this entity.

Two sections comprise the summary of our work. Section 1 covers the taxonomy of *Eriogonum shockleyi* in Idaho and the identification of the two varieties. It is in the form of a manuscript that we plan to submit to *Great Basin Naturalist*. Section 2 is a preliminary assessment of the conservation status of the two varieties in Idaho, including a review of conservation designations, distribution, habitat, population biology, and recommendations to various agencies regarding their management and conservation.

As a follow-up to this project, I annotated all collections of *E. shockleyi* during late October and early November, 1995, at the following herbaria: Albertson College of Idaho (CIC), Snake River Plain Herbarium, Boise State University (SRP), Boise District BLM, Shoshone District BLM, and Idaho Power Company. I plan to annotate those at the University of Idaho Herbarium (ID) in the spring of 1996.

## SECTION 1

### TAXONOMY

This section contains a manuscript for submission to the peer-reviewed journal *Great Basin Naturalist*. The form and style differ somewhat from the rest of the report in order to conform to editorial guidelines of the journal. For instance, the tables and figures mentioned in the text are at the end of the section.

THE TAXONOMY OF *ERIOGONUM SHOCKLEYI* S. WATS.  
(POLYGONACEAE) IN IDAHO

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ABSTRACT.--- *Eriogonum shockleyi* is widespread in the Intermountain Region, with disjunct populations in southern Idaho. Several of these disjunct populations have been described as var. *packardae*, but identification problems have hindered conservation efforts by land managers. We undertook this study to clarify the taxonomy of *E. shockleyi* in Idaho to aid in identification and conservation planning. Analysis of morphometric data using principal components analysis corroborated observations made in the field, that is, *E. shockleyi* is represented in Idaho by two infraspecific taxa, var. *shockleyi* and var. *packardae*. We provide descriptions of the species and varieties in Idaho and a key to the infraspecific taxa. We also discuss the biogeographic significance of the Idaho populations and make recommendations concerning their conservation.

*Keywords:* *Eriogonum shockleyi*, Idaho, Intermountain Region, taxonomy, rare flora, Polygonaceae.

*Eriogonum shockleyi* S. Wats. is widely distributed throughout the Intermountain Region of the western United States, where it occurs on barren rocky, clayey or sandy substrates in shrublands or pinyon-juniper communities (Reveal 1985). Idaho populations are disjunct from the main range to the south by approximately 100 km and at least some populations have differentiated enough from the type variety to be considered a unique taxon, described as var. *packardae* Reveal (Reveal 1989). In addition to *E. shockleyi*, volcanic and related lacustrine deposits along the Snake River in southwestern Idaho are habitat to other Great Basin disjuncts, including *Peteria thompsoniae* S. Wats., *Langloisia punctata* (Cov.) Goodd., *Blepharidachne kingii* (S. Wats.) Hackel, *Cleomella plocasperma* S. Wats., *Psathyrotes annua* (Nutt.) Gray and *Mentzelia torreyi* A. Gray. Similar to *E. shockleyi*, Idaho populations of the latter species have differentiated from their southern counterparts and comprise the endemic *M. torreyi* var. *acerosa* (M.E. Jones) Barneby.

Both varieties of *E. shockleyi* are considered rare in Idaho, with the endemic var. *packardae* apparently globally rare (Packard and Grimes 1981, Conservation Data Center 1994). Since the presence of the endemic variety was brought to the attention of botanists in the mid-1970's, there has been considerable difficulty identifying populations (DeBolt and Rosentreter 1988). This problem has confounded conservation efforts for these rare taxa by land managers. We undertook this study to clarify the taxonomy of *E. shockleyi* in Idaho to aid in conservation planning.

#### METHODS

Because flowering stem length is the most important morphological feature separating the two taxa (Reveal 1989), it was important to collect all samples at or just past anthesis, when the flowering stems had fully elongated. After monitoring selected populations through the late spring and early summer, Moseley made collections at 19 of the 25 known *E. shockleyi* populations in Idaho during 27-29 June 1995 (Table 1). Six populations were not sampled because of limited access or vague location information.

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In the herbarium, measurements, or characterizations of non-numeric features, were made on each collection for 32 morphological features of the leaves, inflorescences and flowers (Table 2; Appendix 1). Each sample consisted of at least five plants. A minimum of 20 measurements were made for each feature, using all plants in the sample. The mean of each numeric feature was used to analyze the morphological relationships between the 19 collections using principal components analysis (PCA). Non-numeric attributes did not vary among collections and, therefore, were not used in studying morphological relationships. The multivariate statistical package CANOCO (v. 3.12) was used for the PCA.

## RESULTS

### Morphometric Analysis

Figure 1 displays the ordination diagram of the 19 collections along the first two axes extracted by PCA. Plots are arranged in the ordination space based on differences in morphological attributes, with 94% of the variation accounted for by axis 1. Of all morphological attributes used in the analysis, four had the greatest effect on how collections are aligned along this dominant axis (reported as "fraction of variance," in parentheses): flowering stem length (0.99), leaf blade width (0.89), leaf blade length (0.78) and petiole length (0.75). The relationship of collections in the ordination space was affected little by the other attributes.

This analysis corroborates observations originally made by Reveal (1989), when few *E. shockleyi* populations were known in Idaho. That is, *E. shockleyi* is represented in Idaho by two infraspecific taxa, var. *shockleyi* and the narrow endemic var. *packardae*. Collections with positive values on axis 1 represent var. *shockleyi* by having longer flowering stems (mean = 14.2 mm) and larger leaves (Figure 1). With one exception, those with negative values have short stems (mean = 4.2 mm) and small leaves and correspond to var. *packardae*. The exception is the intermediate collection 2893. When measurements of this collection were averaged together it appears to be a morphological intermediate between the "packardae" and "shockleyi" groups. In the field, however, the population appears to be a mixture of both exclusively long-stemmed and exclusively short-stemmed individuals. This situation is discussed further below.

### Taxonomy

***Eriogonum shockleyi* S. Wats.** --- Pulvinate-caespitose, mound-forming perennial, 0.5-6.2 dm across, 1-5 cm high, from a woody, much branched caudex, the branches clothed in macrescent leaf bases and terminated by rosettes; *leaves* in dense compact rosettes, the leaf blades 2-8 (10) mm long, 1-5 mm wide, obovate, oblanceolate, elliptic, or spatulate, tomentose on both surfaces, petiole 0-9 mm long, *flowering stems* scapose, 0-23 mm long, tomentose; *inflorescences* capitate and terminal; *bracts* tomentose, mostly scalelike, membranous, ternate, 0.5-2 mm long, occasionally 3-5 (8) mm long and thick, green; *involucre* congested, (2) 3 (4,5) per head, broadly campanulate, 2-6 mm long, tomentose, the (4) 5 (6) lanceolate teeth 1-4 (5) mm long, sessile or pedicels <0.5 mm, glabrous; *flowers* 3-10 (13) per involucre, pale yellow, occasionally suffused with red at the base, 3 mm long, densely tomentose, united from one quarter to two thirds of their length, the segments oblong; *stamens* exerted, the filaments 3-4 mm long, glabrous, the anthers yellow, 0.3-0.5 mm long, oval; *achenes* light brown, 2-3 mm long, densely tomentose, the subglobose base tapering to a short, 3-angled beak..

*Eriogonum shockleyi* is distributed throughout the Intermountain Region from east-central California, east across Nevada and Utah, to western Colorado, and south to northern Arizona and New Mexico. It is disjunct in southern Idaho, with populations scattered along 135 km of the Snake River

canyon and the lower valleys of several tributaries (Figure 2). All Idaho populations are highly localized, occupying barren habitats within sagebrush-steppe. *E. shockleyi* is represented in Idaho by two varieties, described below.

***Eriogonum shockleyi* S. Wats. var. *shockleyi*.** --- Shockley's buckwheat. [*E. villiflorum* A. Gray var. *candidum* M.E. Jones; *E. acule* var. *shockleyi* (S. Wats.) M.E. Jones; *E. pulvinatum* Small; *E. shockleyi* subsp. *candidum* (M.E. Jones) S. Stokes ]. Plants densely to loosely pulvinate-caespitose, 0.5-6.2 dm across, 2-5 cm high; *leaves* with obovate, oblanceolate, elliptic, or spatulate blades, 3-8 (10) mm long, 2-5 mm wide, petiole (1) 3-9 mm long; *flowering stems* (6) 9-23 mm long (mean = 14.2 mm); *flowers* united one quarter to half of their length.

SPECIMENS EXAMINED. --- **USA, Idaho**, Owyhee Co., T7S R5E S1, Horse Hill, *Moseley* 2889 (ID, SRP), *Mancuso* 1381 (ID); T7S R6E S19, Sugar Valley Badlands, *Moseley* 2891 (ID, SRP), *Rosentreter* 100, 131, 3134 (CIC, ID, Boise BLM Office); T7S R5E S20, Prominent Buttes, *Moseley* 2892 (ID, SRP), *Rosentreter* 137 (Boise BLM Office); T6S R5E S35, Lower Sugar Valley, *Moseley* 2895 (ID, SRP), *DeBolt* 828 (CIC, Boise BLM Office); T5S R6E S27, Bruneau Dunes, *Moseley* 2897 (ID, SRP); T6S R8E S13, Lower Sailor Creek, *Moseley* 2899 (ID, SRP), *DeBolt* 1714 (Boise BLM Office); Elmore Co., T6S R9E S8, South of Schoffs Island, *Moseley* 2898 (ID, SRP), *Fite s.n.* (Idaho Power Company); Twin Falls Co., T7S R13E S9, Fossil Gulch, *Moseley* 2900 (ID, SRP), *Popovich* 5080 (RM, ID, Shoshone BLM Office); Gooding Co., T6S R13E S35, Malad Gorge, *Moseley* 2882 (ID, SRP), *Rosentreter* 7920 (Boise BLM Office), *Cole s.n.* (Idaho Power Company), *Popovich* 5081 (RM, ID, Shoshone BLM Office).

The var. *shockleyi* is primarily distinguished from the endemic var. *packardae* by having a much longer flowering stem, which is especially noticeable in the field where the inflorescences extend well above the cushion of rosetted leaves. In general, the leaves are larger in var. *shockleyi*, although this feature is variable and there is considerable overlap with var. *packardae*. When surveying an entire population in the field, however, the leaves of var. *shockleyi* are considerably wider, a characteristic that is not always obvious on herbarium specimens.

All *E. shockleyi* populations on the eastern end of its Idaho distribution are var. *shockleyi* (Figure 2). Populations of both taxa occur in the Bruneau River drainage and, in one instance, there appears to be a mixed population (see discussion below). Most populations of var. *shockleyi* occur on lacustrine deposits consisting of a cobbly desert pavement on the surface, over deep, sandy-loam sediments. Several of the eastern populations occur on gravelly deposits of calcrete lying on lacustrine sediments or basalt.

***Eriogonum shockleyi* S. Wats. var. *packardae* Reveal.** --- Packard's buckwheat. Plants densely compact, caespitose, 0.5-4 dm across, 1-4 cm high; *leaves* with elliptic blades, 2-5 (7) mm long, 1-3 mm wide, petiole 0-4 mm long, *flowering stems* 0-10 (11,13) mm long (mean = 4.1 mm); *flowers* united from half to two thirds of their length.

SPECIMENS EXAMINED. --- **USA, Idaho**, Ada Co., T1S R1W S32, Halverson Lakes, type locality, *Reveal* 3686 (US, BRY, NY, RSA, UC, UTC), *Moseley* 2885 (ID, SRP); T1S R1W S28, East of Halverson Lakes, *Moseley* 2884 (ID, SRP); T1S R1W S36, North of Priest Ranch, *Moseley* 2883 (ID, SRP); Owyhee Co., T5S R1E S21, East of Castle Creek, *Moseley* 2887 (ID, SRP); T7S R3E S4, Shoofly Oolitic Limestone, *Moseley* 2888 (ID, SRP), *Grimes* 1742 (CIC); T8S R6E S28, Deer Water-Hot Creek, *Moseley* 2890 (ID, SRP), *DeBolt* 1743 (Boise BLM Office); T7S R5E S8, Little Valley, *Moseley* 2894 (ID, SRP); T6S R6E S18, Bruneau Rim, *Reveal* 3852 (BRY, MICH, NY, US), *Moseley* 2896 (ID, SRP); 10 miles south of Bruneau, Devil's Bathtub, *Bright s.n.* (MIN); T5S R1E S20, Castle Creek Mines, *Moseley* 2886 (ID, SRP), *DeBolt* 1465 (CIC, Boise BLM Office); T5S R1E S16, Castle Creek North, *DeBolt* 1438 (Boise BLM Office); T7S R2E S14, Perjue Canyon, *DeBolt* 908 (Boise BLM Office).

The var. *packardae* is distinguished from the typical variety by having a flowering stem that is very short. In the field the flowering stems appear to be absent, the inflorescences apparently positioned

within or sitting directly on the tightly-matted cushion of leaves. The leaves of var. *packardae* are consistently short and narrow. The leaves of var. *shockleyi*, by comparison, are more variable but have larger average dimensions in a population. This combination of characters gives the cushions of var. *packardae* a tighter, more compact appearance in the field than var. *shockleyi*.

The var. *packardae* exclusively occupies the western end of *E. shockleyi*'s distribution in Idaho (Figure 2). As mentioned above, the taxa are allopatric in the Bruneau River drainage. At least one of the Bruneau populations [T7S R5E S31, Upper Sugar Valley, *Moseley 2893* (ID, SRP)] appeared to be a mixture of individuals of both varieties. This population occurs within 4-6 km of populations of both taxa (Figure 2). Substrates occupied by var. *packardae* include oolitic limestone outcrops, sandy loess over basalt, and cobbly desert pavement.

**Key to the varieties.** --- Following is a key to the two varieties of *E. shockleyi* in Idaho, using both morphological measurements of herbarium specimens collected at anthesis and characterization of diagnostic features of the plant's habit from field observation:

1. Flowering stems at anthesis average less than 10 mm long, most less than 5 mm; flowering stems apparently absent in the field, the inflorescences sitting directly on or within the cushion; leaf blades elliptic, short and narrow, 2-5 mm long by 1-3 mm wide; petiole less than 4 mm long

..... *E. shockleyi* var. *packardae*

- Flowering stems at anthesis greater than 10 mm long, the capitate inflorescences obviously extending above the cushion; leaves larger, the blades obovate, oblanceolate, elliptic, or spatulate, 3-10 mm long by 2-5 mm wide; petiole generally greater than 4 mm long

..... *E. shockleyi* var. *shockleyi*

## DISCUSSION

The short to nonexistent flowering stems of *E. shockleyi* var. *packardae* is a morphological extreme unique in *E. shockleyi*. The var. *packardae* also lies at the distributional extreme for *E. shockleyi*, being at the northwestern limit of the species range. Although published descriptions of var. *shockleyi* indicate that it is a morphologically variable taxon, especially the leaves (Welsh et al. 1987, Hickman 1993), specimens from the disjunct populations in Idaho are small in nearly all respects when compared to specimens from Great Basin populations. A specimen from a geographically intermediate position in northeastern Nevada [Elko Co., Salmon Falls Creek drainage, 7 miles southeast of Jackpot, *Erter 5052* (UC)], is also considerably smaller than those to the south and may indicate geographic and phylogenetic links with the Idaho populations ca. 100 km to the north. Other Great Basin taxa reach their northern limit in the lowland corridor of the Salmon Falls Creek valley, including *Astragalus newberryi* A. Gray var. *castoreus* M.E. Jones, *A. tetrapterus* A. Gray, *Townsendia scapigera* D.C. Eaton, and *Glyptopleura marginata* D.C. Eaton. Only the latter species extends as far north as the Snake River, where it occurs with *E. shockleyi*. The evolutionary relationships between var. *packardae* and the disjunct populations of var. *shockleyi*, as well as these disjunct populations with ones in the Great Basin, are worthy of further study using molecular phylogenetic techniques (Baldwin 1995).

We know of 11 extant populations of var. *packardae*, plus an additional three that have not been relocated since their discovery 7-24 years ago. Although several populations are relatively dense, all are small in area and isolated from one another by as much as 24 km. Most extant populations have been disturbed or are threatened by off-road vehicle travel, irrigation pipeline construction, plowed fire breaks, mining and other activities directly impacting their habitat. In addition, the habitat of var. *packardae* lies within the sagebrush-steppe of the Snake River Plain, an ecosystem that has experienced drastic losses in area and ecological integrity and is considered endangered (Noss et al. 1995). These factors conspire to

make this narrow endemic vulnerable to at least local extirpation. We recommend that *var. packardae* be considered a candidate for Federal listing under the Endangered Species Act. We also recommend that a conservative approach be taken with mixed populations and that they be considered *var. packardae* in conservation planning efforts. Future work on the population genetics of *E. shockleyi* in Idaho may clarify their relationship better.

Eleven populations of *var. shockleyi* are known from Idaho. Similar to the endemic taxon, all populations are localized and vulnerable. Because of their disjunct nature and possible genetic differentiation from central populations (Lesica and Allendorf 1995), they should be protected from inappropriate disturbances by public land managers. Now that their taxonomy and identification has been clarified, we recommend that intensive field inventories be conducted to determine the full extent of the distribution, abundance and conservation status of the two *E. shockleyi* taxa in Idaho.

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TABLE 1. Collections of *Eriogonum shockleyi* from Idaho used in the taxonomic analysis. Collection numbers are those of Moseley.

Collection Number	County	Site Name	Legal Description
2882	Gooding	Malad Gorge	
2883	Ada	North of Priest Ranch	
2884	Ada	East of Halverson Lakes	
2885	Ada	Halverson Lakes	
2886	Owyhee	Castle Creek Mines	
2887	Owyhee	East of Castle Creek	
2888	Owyhee	Shoofly Oolitic Limestone	
2889	Owyhee	Horse Hill	
2890	Owyhee	Deer Water-Hot Creek	
2891	Owyhee	Sugar Valley Badlands	
2892	Owyhee	Prominent Buttes	
2893	Owyhee	Upper Sugar Valley	
2894	Owyhee	Little Valley	
2895	Owyhee	Lower Sugar Valley	
2896	Owyhee	Bruneau Rim	
2897	Owyhee	Bruneau Dunes	
2898	Elmore	South of Schoffs Island	
2899	Owyhee	Lower Sailor Creek	
2900	Twin Falls	Fossil Gulch	

TABLE 2. Morphological features used in the taxonomic analysis of *Eriogonum shockleyi*. Features with numeric attributes that were used in the PCA are indicated with an asterisk.

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<i>LEAF</i>	<i>FLOWER</i>
*blade width (mm)	*number/involucre
*blade length (mm)	shape
*petiole length (mm)	color
pubescence type	*length (mm)
<i>INFLORESCENCE</i>	pubescence type
*flowering stem length (mm)	texture
bract texture	*length united (%)
*bract length (mm)	<i>STAMEN</i>
pubescence type	disposition
<i>INVOLUCRE</i>	*filament length (mm)
*number/head	filament pubescence type
shape	anther color
texture	*anther length (mm)
*length (mm)	anther shape
involucre pubescence type	<i>ACHENE</i>
*teeth number	color
*teeth length (mm)	length (mm)
*pedicel length (mm)	pubescence type
pedicel pubescence type	

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Fig. 1. PCA ordination diagram of 19 *Eriogonum shockleyi* collections from Idaho. Points are labeled with Moseley's collection numbers (Table 1).

Fig. 2. Distribution of *Eriogonum shockleyi* in Idaho. The var. *shockleyi* is indicated with a solid circle, var. *packardae* with a diamond, and the mixed population with an open circle.

fig 1

fig2

SECTION 2

CONSERVATION STATUS

***Eriogonum shockleyi* S. Wats. var. *packardae* Reveal (Packard's buckwheat)**

**LEGAL OR OTHER FORMAL STATUS**

**National:**

**U.S. Fish and Wildlife Service:** Packard's buckwheat has no status under the Endangered Species Act (Conservation Data Center 1994).

**Bureau of Land Management:** Packard's buckwheat is currently an Idaho BLM Sensitive Species (Conservation Data Center 1994).

**Other current formal status recommendations:** Because it is a rare, narrow endemic, Packard's buckwheat has been given a global conservation rank of 1 (on a scale of 1 to 5) by the Association for Biodiversity Information (the International Association of Natural Heritage Programs and Conservation Data Centres) and The Nature Conservancy (Conservation Data Center 1994).

**State:** (Packard's buckwheat is endemic to Idaho.)

***Idaho:***

**Idaho Native Plant Society:** Packard's buckwheat is a Priority 2 species on the Idaho Native Plant Society list of the state's rare flora. The Priority 2 list includes taxa that are likely to become Priority 1 (state-endangered) within the foreseeable future, if factors contributing to their population decline or habitat degradation or loss continue (Idaho Native Plant Society 1995).

**Conservation Data Center:** Because Packard's buckwheat is endemic to Idaho, the state (S) conservation rank assigned by the Conservation Data Center (the Idaho node of the Association for Biodiversity Information) equals the global (G) rank of 1, discussed above (Conservation Data Center 1994).

**Review of past status:** In their review of this taxon (as *E. shockleyi* var. nov.) for the Rare and Endangered Plants Technical Committee of the Idaho Natural Areas Council, Packard and Grimes (1981a) recommended a federal Watch List status.

**DISTRIBUTION**

**Global/Idaho distribution:** Packard's buckwheat is endemic to the vicinity of the Snake River canyon, and several confluent tributaries, as it courses through the western Snake River Plain in Ada and Owyhee counties, Idaho. The Idaho Conservation Data Center (CDC) data base contains 14 occurrence records for this taxon (Appendix 2). An occurrence record is an information management convenience to track data regarding a population or several subpopulations in a localized area and is identified with a three-digit code (e.g., 012). The general distribution of Packard's buckwheat is mapped in Figure 2 of Section 1, and more precise locations appear in Appendix 3.

Packard's buckwheat is distributed as widely scattered populations from Halverson Lakes on the west, upstream (east) along the Snake River to the Bruneau River drainage, spanning a distance of approximately 58 air miles. The western populations occur on the north side of the river in Ada County, while the eastern populations are all on the south side of the river in Owyhee County. Populations in the Bruneau River drainage are contiguous with populations of *E. shockleyi* var. *shockleyi*.

**Extant occurrences:** Eleven populations of Packard's buckwheat have been visited since 1990 (most in 1995). Appendix 2 contains the occurrence records for all populations. These records contain detailed information on the location, population size, population area, habitat characteristics, occurrence documentation, and comments. Below is a summary of Packard's buckwheat populations that are known to be extant:

Occurrence		
Number	County	Site
002	Ada	East of Halverson Lakes
003	Ada	North of Priest Ranch
005	Owyhee	East Of Castle Creek
006	Owyhee	Shoofly Oolitic Limestone
007	Owyhee	Deer Water-Hot Creek
008	Owyhee	Upper Sugar Valley
009	Owyhee	Little Valley
010	Owyhee	Bruneau Rim
011	Owyhee	Castle Creek Mines
012	Ada	Halverson Lakes
013	Owyhee	Castle Creek North

**Extirpated occurrences:** No populations of Packard's buckwheat are known to be extirpated.

**Unverified/undocumented reports:** The following three occurrences have not been visited for several years (see occurrence records in Appendix 2):

Occurrence			
Number	County	Site	Last Observed
001	Ada	Swan Falls	1971
004	Owyhee	Indian Bathtub	1975
014	Owyhee	Perjue Canyon	1988

I tried to relocate all three populations in 1995, but to no avail. Ann DeBolt, BLM Botanist, has also tried to relocate 001.

A population of *E. shockleyi* (variety unverified) was reported north of C.J. Strike Wildlife Management Area in T5S R5E S14 (DeBolt and Rosentreter 1988). This report is now believed to be a mistake.

**Synopsis of past and needed inventories:** No thorough, systematic field inventory has been conducted for Packard's buckwheat. Our 1995 study was largely conducted to clarify the taxonomy of *E. shockleyi* in Idaho. All populations have been documented through opportunistic collections or during inventories as part of other studies. A thorough field investigation on the distribution and abundance of Packard's buckwheat is needed.

## HABITAT

**General habitat description:** All populations of Packard's buckwheat occur within the sagebrush-steppe zone of the western Snake River Plain, an ecosystem that has been highly degraded over the past 130 years and is now considered endangered (Noss et al. 1995). Within this zone, it occurs in azonal microhabitats that have open vegetation and a low number of vascular species. These conditions are largely the result of unique substrates. Noe (1991) reports that Grand View, Idaho, more or less in the center of Packard's buckwheat range, receives an average of 7 inches of precipitation per year. The average annual temperature is 52°F. During the summer, the average temperature is 62°F and the average daily maximum is 87°F.

**Geology and Soils:** Substrates occupied by Packard's buckwheat include oolitic limestone outcrops, sandy loess over basalt, and lacustrine deposits consisting of a cobbly desert pavement on the surface over a deep sandy-loam substrate.

**Associated species:** The communities occupied by Packard's buckwheat are very open and have low cover of vascular species. Below are the species observed as widely scattered individuals at populations in 1995. In addition, several populations have high cover of microbiotic soil crust, especially the Ada County sites.

Shrubs - *Tetradymia glabrata*, *Ceratoides lanata*, *Chrysothamnus nauseosus*, *C. viscidiflorus*, *Artemisia tridentata* ssp. *wyomingensis*, *A. arbuscula*, *Salvia dorrii*, *Eriogonum microthecum*, *Gutierrezia sarotherae*, *Atriplex confertifolia*

Graminoids - *Oryzopsis hymenoides*, *Bromus tectorum*, *Stipa comata*, *Poa secunda*, *Sitanion hystrix*

Forbs - *Castilleja chromosa*, *Langloisia punctata*, *Astragalus lentigenosus*, *Salsola kali*, *Mentzelia torreyi* var. *acerosa*, *Stanleya pinnata*, *Townsendia florifer*, *Enceliopsis nudicaulis*, *Brickellia microphylla*, *Penstemon acuminatus*, *Halogeton glomerata*, *Cryptantha* sp.,

**Other rare plant species:** The Federal candidate, *Astragalus mulfordiae*, occurs in the vicinity of Packard's buckwheat at the Castle Creek North (013) and Shoofly Creek (006) populations. In addition, the state-rare *Astragalus purshii* var. *ophiogenes*, and *Glyptopleura marginata* (Conservation Data Center 1994) occur at the three var. *packardae* populations in Castle Creek and the one in Shoofly Creek. These sites are all underlain with oolitic limestone.

## POPULATION BIOLOGY

**Phenology:** Seed germination probably occurs early in the spring (or possibly in late fall). Flowering begins in late May and early June most years, but only a few flowers on the south-sides of the cushion flower this early. Plants are at peak anthesis during late June. Fruit maturation proceeds through July, with most probably dehiscing sometime in July or early August. There is wide variation in all these dates, possibly by as much as four weeks, depending on the temperature pattern during the spring.

**Population size and condition:** Appendix 2 contains the CDC data base records for the 14 occurrences of Packard's buckwheat. These occurrence records contain information on location, survey dates, occurrence rank, population and habitat data, population size, area occupied, and various comment fields related to protection, management, and occurrence documentation. Below is a summary of selected occurrence record fields related to population size and condition. The Occurrence Rank is a relative ranking between A (highest) and D (lowest) based on population size, structure, and habitat quality. An Occurrence Rank of H refers to the three historical collections that have not been revisited since they were discovered in the 1970's and 1980's. As stated previously, this study was not a thorough field inventory, so population numbers and areas, as well as the occurrence rank, are estimates that may change with additional surveys.

<u>Occurrence Number</u>	<u>Occurrence Rank</u>	<u>Number Individuals</u>	<u>Area (acres)</u>
001	H		
002	A	1500	0.25 ac
003	C	500	0.25 ac
004	H		
005	A	2000	1 ac
006	B	100	0.1 ac
007	C	500	0.1 ac
008	A	10,000+	10+ ac
009	B	1000	1 ac
010	C	1000	1 ac
011	B	300	??
012	C	150	0.1
013	B	200-500	10 ac
014	H		

**Reproductive Biology:** Packard's buckwheat reproduces by seed, but beyond this little is known about its reproductive biology.

**Competition:** It appears that Packard's buckwheat is not a good competitor. As stated previously, occupied habitats are very open, with considerable bare ground between plants.

**Herbivory:** I did not observe any herbivory on Packard's buckwheat plants in 1995.

**Land ownership:** Below is a table summarizing the ownership information for Packard's buckwheat sites (see also Appendix 2). The BLM manages all or a portion of ten of the 11 occurrences known to be extant. The BLM shares management of the remaining extant population with a private land owner.

Occurrence Number	Land Manager/Owner
001	???
002	BLM, Bruneau Resource Area
003	BLM, Bruneau Resource Area, and private
004	???, probably BLM, Bruneau Resource Area
005	BLM, Bruneau Resource Area
006	BLM, Bruneau Resource Area
007	BLM, Bruneau Resource Area
008	BLM, Bruneau Resource Area
009	BLM, Bruneau Resource Area
010	BLM, Jarbidge Resource Area
011	BLM, Owyhee Resource Area
012	BLM, Bruneau Resource Area
013	BLM, Owyhee Resource Area
014	???, probably BLM, Bruneau Resource Area

**Land use:** The primary land use of virtually all habitat occupied by Packard's buckwheat is livestock grazing, mostly cattle. No sites are protected to any extent, although the Shoofly Oolitic Limestone population (006) is in an area that has been recommended as an Area of Critical Environmental Concern (ACEC) to protect unique plant communities and rare plants (Amicangalo and Rosentreter 1982; Moseley 1987; as Mud Flat Oolite). Only five acres of the recommended 190-acre ACEC has been established. It is not known if the var. *packardae* population is within the established area. Below is a summary of land use and threats at each of the populations:

Occurrence Number	Land Use
001	???
002	apparently isolated from disturbance
003	impacted by irrigation pipeline development
004	???
005	undisturbed; mining a possible threat
006	undisturbed; mining a possible threat
007	random recreational (?) bulldozing may have destroyed habitat in past
008	undisturbed
009	undisturbed; adjacent to very disturbed land
010	plowed by firebreak along highway; used as parking area for overlook
011	roads traverses population; active mining in area
012	undisturbed; adjacent to very disturbed and weedy ground
013	grazed; mining a potential threat
014	???

## ASSESSMENT AND MANAGEMENT RECOMMENDATIONS

**Threats to currently known populations:** Based on the cursory inventory conducted in 1995, the greatest threat to the long-term viability of Packard's buckwheat may be mining of oolitic limestone. Occurrences affected by this activity are the three in Castle Creek (005, 011, and 013) and Shoofly Oolitic Limestone (006). Other direct disturbances to Packard's buckwheat habitat are also threatening, for example the fire-break that was plowed through the Bruneau Rim population (010). Indirect factors, such as the declining ecological condition of the sagebrush-steppe ecosystem on the Snake River Plain, is a general concern, but not to the degree that is for other rare species, such as *Lepidium papilliferum* (Moseley 1994). The weed invasions usually associated with this phenomena do not appear to directly affect habitats occupied by Packard's buckwheat. Livestock grazing of Packard's buckwheat habitat appears minimal, probably due to the paucity of forage.

### Recommendations:

- o Preliminary data suggest that Packard's buckwheat is a rare, narrow endemic that occupies small and unique habitats. Population numbers are generally small and it is vulnerable to direct habitat disturbances. I recommend that the U.S. Fish and Wildlife Service consider this taxon as a C2 candidate (or equivalent) for listing under the Endangered Species Act.
- o The BLM should maintain Packard's buckwheat as a sensitive Special Status Species and that the Idaho Native Plant Society should move it from their state Priority 1 list to their list of recommended federal candidates. The global and state rank assigned by the CDC should remain at G1 and S1, respectively.
- o As discussed in Section 1, at least one population appears to be a mixture of individuals of the two varieties. It is possible that additional mixed populations will be discovered. For conservation planning, these populations should be treated as Packard's buckwheat, as we treated the Upper Sugar Valley population (008) in Section 1. This conservative approach is warranted until phylogenetic studies elucidate the inter- and intrapopulational relationships of mixed populations.
- o Recommendations to the Lower Snake River District, BLM:
  - > Conduct a thorough field inventory for Packard's buckwheat to better assess its distribution, abundance and conservation status. The conservation assessment contained herein is only preliminary and needs further refinement before a conservation strategy can be developed.

It is important that field surveys for both *E. shockleyi* taxa be conducted close to full anthesis, generally in late June or early July, and that the entire population be assessed. The few plants selected for a sample sometimes do not reflect the characteristics of the population as a whole and are often difficult to identify from a herbarium sheet, especially if it was collected before or long after anthesis.
  - > Preliminary data indicate that all populations should be protected from direct habitat disturbance.

- > Relocate the three historical sightings and assess their current status.
- > Conduct intensive clearances of all proposed land development or land exchange projects that occur within the range of Packard's buckwheat outlined above.
- > Establish the remaining Shoofly Oolitic Limestone area as an ACEC as soon as possible.

*Eriogonum shockleyi* S. Wats. var. *shockleyi* (Shockley's buckwheat)

## LEGAL OR OTHER FORMAL STATUS

### National:

**U.S. Fish and Wildlife Service:** Shockley's buckwheat has no status under the Endangered Species Act (Conservation Data Center 1994).

**Bureau of Land Management:** Shockley's buckwheat is currently an Idaho BLM Sensitive Species (Conservation Data Center 1994).

**Other current formal status recommendations:** Both the species, *E.shockleyi*, and var. *shockleyi* are secure rangewide and have a global conservation rank of G5 (on a scale of 1 to 5) (Conservation Data Center 1994).

**State:** Shockley's buckwheat is apparently secure throughout most of its range, that being Colorado, Utah and Nevada. Peripheral populations in California are uncommon enough to warrant its entry onto the California Native Plant Society List 4, which includes plants having a limited distribution in the state. Peripheral or disjunct populations in New Mexico are also rare in that state (Nancy Cole, Idaho Power Co., Boise, ID, personal communication, October 1995). The conservation status of Shockley's buckwheat in Idaho is discussed below.

### Idaho:

**Idaho Native Plant Society:** Shockley's buckwheat is Sensitive on the Idaho Native Plant Society list of the state's rare flora. The Sensitive list includes taxa with small or localized distributions in Idaho that presently do not meet the criteria for classification as Priority 1 or 2, but whose populations may be jeopardized without active management or removal of threats (Idaho Native Plant Society 1995).

**Conservation Data Center:** The state (S) conservation rank assigned by the Conservation Data Center for Shockley's buckwheat in Idaho is S2 (Conservation Data Center 1994).

**Review of past status:** In their review of this taxon for the Rare and Endangered Plants Technical Committee of the Idaho Natural Areas Council, Packard and Grimes (1981b) recommended State Watch List status.

## DISTRIBUTION

**Global distribution:** Shockley's buckwheat is distributed throughout the Intermountain Region from east-central California, east across Nevada and Utah, to western Colorado, and south to northern Arizona and New Mexico. It is disjunct in southern Idaho along the Snake River canyon.

**Idaho distribution:** Shockley's buckwheat occurs along the Snake River Canyon in Owyhee, Elmore, Gooding, and Twin Falls counties. The (CDC) data base contains 11 occurrence records for this taxon (Appendix 4). The general distribution of Shockley's buckwheat is mapped in Figure 2 of Section 1, and

more precise locations appear in Appendix 5.

In general, Shockley's buckwheat is distributed as widely scattered populations from Little Valley (lower Jacks Creek) in the Bruneau River drainage on the west, upstream (east) along the Snake River to the Hagerman Valley, spanning a distance of approximately 50 air miles. Only one population is known from the north side of the Snake River, that is occurrence 009 in Malad Gorge State Park. Populations in the Bruneau River drainage are contiguous with the eastern-most populations of Packard's buckwheat.

**Extant occurrences:** All 11 occurrences of Shockley's buckwheat in Idaho have been visited since 1994 (all but one in 1995). Appendix 4 contains the CDC occurrence records for all occurrences. These records contain detailed information on the location, population size, population area, habitat characteristics, occurrence documentation, and comments. Below is a summary of Shockley's buckwheat population in Idaho:

Occurrence Number	County	Site
001	Owyhee	Horse Hill
002	Owyhee	Sugar Valley Badlands
003	Owyhee	Prominent Buttes
004	Owyhee	Lower Sugar Valley
005	Owyhee	Bruneau Dunes
006	Elmore	South of Schoffs Island
007	Owyhee & Elmore	Lower Sailor Creek
008	Twin Falls	Fossil Gulch
009	Gooding	Malad Gorge
010	Twin Falls	Lower Salmon Falls Dam Transmission Line
011	Owyhee	East of Horse Hill

**Extirpated occurrences:** No populations of Shockley's buckwheat are known to be extirpated.

**Unverified/undocumented reports:** As discussed previously, a population of *E. shockleyi* (variety unverified) was erroneously reported north of C.J. Strike Wildlife Management Area in T5S R5E S14 (DeBolt and Rosentreter 1988).

**Synopsis of past and needed inventories:** No thorough, rangewide field inventory has been conducted for Shockley's buckwheat in Idaho. This 1995 study was largely conducted to clarify the taxonomy of *E. shockleyi* in Idaho. All populations to date have been documented through opportunistic collections or during inventories as part of other studies, such as those of Idaho Power Company along the Snake River between Buhl and King Hill (Cole 1995; Cole et al. 1995a; 1995b). A thorough field investigation of the distribution and abundance of Shockley's buckwheat in the state is needed.

## HABITAT

**General habitat description:** All populations of Shockley's buckwheat occur within the sagebrush-

steppe zone of the Snake River Plain, an ecosystem that has been highly degraded over the past 130 years and is now considered endangered (Noss et al. 1995). Similar to Packard's buckwheat, it occurs in azonal microhabitats that have open vegetation and a low number of vascular species. These conditions are largely the result of unique substrates. Climatic data reported for Packard's buckwheat applies to the range of Shockley's buckwheat as well.

**Geology and Soils:** Substrates occupied by Shockley's buckwheat in the Bruneau Valley area are lacustrine deposits consisting of a cobbly desert pavement on the surface over a deep sandy-loam substrate. The upstream populations all occur on thin, gravelly calcium carbonate deposits (calcrete) overlying basalt.

**Associated species:** As with Packard's buckwheat, the communities occupied by Shockley's buckwheat are very open and have low cover of vascular species. Species observed as widely scattered individuals at populations in 1995 are as follows (see Appendix 4 for community and associated species information for each occurrence):

Shrubs - *Tetradymia glabrata*, *Chrysothamnus nauseosus*, *C. viscidiflorus*, *Artemisia tridentata* ssp. *wyomingensis*, *A. arbuscula*, *Eriogonum microthecum*, *Atriplex confertifolia*, *A. spinosa*.

Graminoids - *Oryzopsis hymenoides*, *Bromus tectorum*, *Poa secunda*, *Sitanion hystrix*, *Agropyron cristatum*.

Forbs - *Langloisia punctata*, *Salsola kali*, *Mentzelia torreyi* var. *acerosa*, *Stanley pinnata*, *Enceliopsis nudicaulis*, *Halogeton glomerata*, *Cryptantha* sp., *Astragalus malacus*, *Phlox hoodii*, *Machaeranthera canescens*, *Chaenactis macrantha*, *Comandra umbellata*, *Sisymbrium altissimum*, *Gilia leptomeria*

**Other rare plant species:** The state-rare *Penstemon janishiae* occurs with Shockley's buckwheat at Sugar Valley Badlands (002), albeit in differing habitats.

## POPULATION BIOLOGY

**Phenology:** Seed germination probably occurs early in the spring (or possibly in late fall). Flowering phenology was observed to be the same as Packard's buckwheat, beginning in late May and early June most years, but peaking in late June. Fruit maturation proceeds through July, with most probably dehiscing sometime in July or early August. There is wide variation in all these dates, possibly by as much as four weeks, depending on the temperature pattern during the spring.

**Population size and condition:** Appendix 4 contains the CDC data base records for the 11 occurrences of Shockley's buckwheat in Idaho. These occurrence records contain information on location, survey dates, occurrence rank, population and habitat data, population size, area occupied, and various comment fields related to protection, management, and occurrence documentation. Below is a summary of selected occurrence record fields related to population size and condition. The Occurrence Rank is a relative ranking between A (highest) and D (lowest) based on population size, structure, and habitat quality. As stated previously, this study was not a thorough field inventory, so population numbers and areas, as well as the occurrence rank, are estimates that may change with additional surveys.

Occurrence Number	Occurrence Rank	Number Individuals	Area (acres)
001	A	5000+	100+ ac
002	A	2000	3 ac
003	A	500-1000	2 ac
004	A	5000+	2 ac
005	C	200	1 ac
006	C	1300	0.5 ac
007	C	100's	50 ac
008	B	2301	1 ac
009	A	2000	2 ac
010	B	369	2 ac
011	B	100+	1.5 ac

**Reproductive Biology:** Shockley's buckwheat reproduces by seed, but beyond this little is known about its reproductive biology.

**Competition:** It appears that Shockley's buckwheat is not a good competitor. As stated previously, the occupied habitats are very open, with considerable bare ground between plants. Shockley's buckwheat invaded a newly bulldozed roadbed that was blazed through the South of Schoffs Island population (006) sometime in the past.

**Herbivory:** I did not observe any herbivory on Shockley's buckwheat plants in 1995.

**Land ownership:** Below is a table summarizing the ownership information for Shockley's buckwheat sites (see also Appendix 4). The BLM manages eight occurrences, the Idaho Department of Parks and Recreation two, and the National Park Service one.

Occurrence Number	Land Manager/Owner
001	BLM, Bruneau Resource Area
002	BLM, Bruneau Resource Area
003	BLM, Bruneau Resource Area
004	BLM, Bruneau Resource Area
005	State of Idaho, Bruneau Dunes State Park
006	BLM, Jarbidge Resource Area
007	BLM, Jarbidge Resource Area
008	NPS, Hagerman Fossil Beds National Monument
009	State of Idaho, Malad Gorge State Park
010	BLM, Jarbidge Resource Area
011	BLM, Bruneau Resource Area

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**Land use:** Three populations are relatively well protected. Two are managed by the Idaho Department of Parks and Recreation in Bruneau Dunes State Park (005 ) and Malad Gorge State Park (009), and one is in Hagerman Fossil Beds National Monument managed by the National Park Service. The Sugar Valley Badlands population (002) is in an area of unique, relatively undisturbed vegetation that has been recommended as an ACEC (Caicco and Wellner 1983; Hilty and Moseley 1991). The primary land use of virtually all remaining populations of Shockley's buckwheat is livestock grazing, mostly cattle. Below is a summary of land use and potential threats at each of the populations:

Occurrence Number	Land Use
001	some ORV and livestock use, threatened by ORV races
002	undisturbed
003	minor livestock grazing
004	undisturbed
005	undisturbed but adjacent land very weedy and possibly impacting population
006	weedy and disturbed habitat; roads traverse population
007	undisturbed but adjacent land very weedy and possibly impacting population
008	undisturbed
009	undisturbed; recreation use nearby
010	undisturbed; adjacent to agriculture land
011	undisturbed; mining exploration in vicinity

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## ASSESSMENT AND MANAGEMENT RECOMMENDATIONS

**Threats to currently known populations:** There are fewer populations of Shockley's buckwheat in Idaho than Packard's buckwheat, but they are generally larger in size. In addition, three are protected in State Parks or National Monuments, and one is in a proposed BLM ACEC. Similar to Packard's buckwheat, the greatest threat to the long-term viability of Shockley's buckwheat is direct habitat disturbance or destruction. Indirect factors, such as ecological degradation of habitat by invasive weeds, is a concern at several Shockley's buckwheat occurrences, but its habitat appears somewhat resistant. Livestock grazing of Shockley's buckwheat habitat appears minimal, probably due to the paucity of forage.

### Recommendations:

- o Preliminary data suggest that Shockley's buckwheat is a rare and localized in Idaho, although globally common. More Shockley's buckwheat populations are larger and more are protected than Packard's buckwheat. The BLM should maintain Shockley's buckwheat as a sensitive Special Status Species. Due to its rarity, the Idaho Native Plant Society should move it from their state Sensitive list to their Priority 2 list, a status that better reflects its conservation concern in the state. The state rank assigned by the CDC should remain S2.

o Recommendations to the Lower Snake River District, BLM:

- > Conduct a thorough field inventory for Shockley's buckwheat to better assess its distribution, abundance and conservation status. This inventory can probably be done along with Packard's buckwheat. The conservation assessment contained herein is only preliminary and needs further refinement before a conservation strategy can be developed.

It is important that field surveys for both *E. shockleyi* taxa be conducted close to full anthesis, generally in late June or early July, and that the entire population be assessed. The few plants selected for a sample sometimes do not reflect the characteristics of the population as a whole and are often difficult to identify from a herbarium sheet, especially if it was collected before or long after anthesis.

- > Preliminary data indicate that all populations should be protected from direct habitat disturbance.
- > Conduct intensive clearances of all proposed land development or land exchange projects that occur within the range of Shockley's buckwheat.
- > Establish Sugar Valley Badlands area as an ACEC as soon as possible.

Recommendation to the National Park Service:

- > The population above Fossil Gulch (008) in Hagerman Fossil Beds National Monument should be protected from direct habitat disturbance.
- > Habitat in and around the Monument was thoroughly surveyed and mapped by Steve Popovich, Shoshone BLM Botanist, in 1995. No additional surveys are needed on the Monument.

o Recommendations to the Idaho Department of Parks and Recreation:

- > The population on the canyon rim in Bruneau Dunes State Park (005) is relatively isolated, but should be protected from direct habitat disturbances that will enhance further invasion of weeds from surround habitats.
- > The population in Malad Gorge State Park is close to the road and a vehicle pullout. Pedestrian disturbance appeared to be minimal, but should be monitored and discouraged if heavy use appears to be affecting the population.

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## APPENDIX 1

Morphometric data from 19 *Eriogonum shockleyi* collections made by Moseley during 1995  
(Moseley's collection number heads each column; all collections deposited at ID and SRP).

	2882	2883	2884	2885	2886
<i>LEAF</i>					
blade width (mm)	3.1 (0.3;3-4)	1.4 (0.3;1.5-2)	1.4 (0.3;1-2)	1.6 (0.4;1-2)	1.3 (0.3;1-2.5)
blade length (mm)	6.1 (0.8;5-7)	3.6 (0.7;2-5)	3.3 (0.8;2-5)	3.5 (0.7;2-4)	3.9 (0.4;3-5)
petiole length (mm)	4.2 (0.7;3-5)	2.1 (0.4;2-3)	1.7 (0.7;1-3)	2.6 (0.7;1-4)	1.3 (0.4;1-2)
pubescence	d.t.	d.t.	d.t.	d.t.	d.t.
<i>INFLORESCENCE</i>					
flr stem length (mm)	16.4 (2.8;12-20)	6.6 (1.6;4-11)	3.8 (2.8;0-10)	4.2 (2.9;0-10)	3.6 (1.9;0-7)
bract texture	both	both	both	both	both
bract length (mm)	2.0(0.7;1-4)	1.3 (0.4;1-2)	1.1 (0.5;1-3)	1.6 (2.5;1-3)	1.6 (0.7;1-3)
pubescence	d.t.	d.t.	d.t.	d.t.	d.t.
<i>INVOLUCRE</i>					
number/head	3.1 (0.2;3-4)	2.3 (0.4;2-3)	2.4 (0.5;2-3)	2.4 (0.5;2-3)	3.0 (0;3)
shape	b.c	b.c	b.c	b.c.	b.c.
texture	thick green	thick green	thick green	thick green	thick green
length (mm)	3.5 (1.0;3-5)	3.4 (0.5;3-4)	3.0 (0.5;2-4)	3.6 (0.5;2-3)	4.0 (0.2;3.5-4)
pubescence	d.t	d.t.	d.t.	d.t.	d.t.
number teeth	5.0 (0.2;4-5)	5.0 (0.3;4-6)	5.0 (0;5)	5.0 (0;5)	5.0 (0;5)
teeth length (mm)	2.1 (0.5;1.5-4)	1.6 (0.4;1-2)	1.1 (0.2;1-1.5)	1.6 (1.5-2)	1.7 (0.4;1-2)
pedicel length (mm)	0.1	0.1	0.1	0.1	0.1
pedicel pub.	glabrous	glabrous	glabrous	glabrous	glabrous
<i>FLOWER</i>					
number/invol	5.3 (0.7;4-7)	6.0 (1.2;5-10)	5.8 (0.8;5-8)	6.4 (1.0;5-8)	6.0 (1.1;5-8)
shape	t-c	t-c	t-c	t-c	t-c
color	light yellow	light yellow	light yellow	light yellow	light yellow
length (mm)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)
pubescence	d.t	d.t.	d.t.	d.t.	d.t.
texture	dimorphic	dimorphic	dimorphic	dimorphic	dimorphic
length united (%)	0.33	0.5	0.5	0.5	0.5
<i>STAMEN</i>					
disposition	exerted	exerted	exerted	exerted	exerted
filament length (mm)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)
pubescence	glabrous	glabrous	glabrous	glabrous	glabrous
anther color	yellow	yellow	yellow	yellow	yellow
anther length (mm)	0.5 (0;0.5)	0.5 (0;0.5)	0.5 (0;0.5)	0.5 (0;0.5)	0.5 (0;0.5)
anther shape	oval	oval	oval	oval	oval
<i>ACHENE</i>					
color	immature	immature	immature	immature	light brown
length (mm)	immature	immature	immature	immature	2.0 (0;2)
pubescence	d.t.	d.t	d.t.	d.t.	d.t.

	2887	2888	2889	2890	2891
<i>LEAF</i>					
blade width (mm)	2.1 (0.5;1.5-3)	1.4 (0.4;1-2)	3.5 (0.6;3-5)	1.5 (0.3;1-2)	3.9 (3.0;2-4)
blade length (mm)	4.1 (0.9;3-5)	3.0 (0.6;2-4)	7.6 (1.6;5-10)	3.8 (0.5;3-5)	6.6 (1.0;5-8)
petiole length (mm)	2.7 (1.1;1-4)	1.5 (1.8;1-2)	6.0 (1.5;3-9)	1.5 (0.5;1-2)	4.1 (1.0;3-6)
pubescence	d.t.	d.t.	d.t.	d.t.	d.t.
<i>INFLORESCENCE</i>					
flr stem length (mm)	5.6 (3.7;1-11)	2.6 (2.0;0-8)	15.2 (4.0;9-21)	1.8 (1.2;0-5)	18.2 (3.4;13-23)
bract texture	both	both	both	both	both
bract length (mm)	1.9 (0.8;1-4)	1.5 (1.0;1-4)	2.4 (1.5;1-8)	1.1 (0.3;1-2)	2.5 (0.9;1-4)
pubescence	d.t.	d.t.	d.t.	d.t.	d.t.
<i>INVOLUCRE</i>					
number/head	2.7 (0.5;2-3)	3.0 (0;3)	3.0 (0.3;2-4)	3.0 (0;3)	2.9 (0.7;2-5)
shape	b.c	b.c	b.c	b.c.	b.c.
texture	thick green	thick green	thick green	thick green	thick green
length (mm)	3.6 (0.5;3-4)	3.1 (0.3;3-4)	4.8 (0.7;4-6)	3.6 (0.5;3-4)	3.8 (0.4 (3-4)
pubescence	d.t	d.t.	d.t.	d.t.	d.t.
number teeth	5.0 (0;5)	5.0 (0;5)	5.0 (0;5)	5.0 (0;5)	5.0 (0;5)
teeth length (mm)	2.4 (3.2;1-2)	1.3 (0.3;1-1.5)	2.8 (0.8;2-3.5)	1.5 (0.4;1-2)	2.5 (0.8;1-5)
pedicel length (mm)	0.1	0.1	0.1	0.1	0.1
pedicel pub.	glabrous	glabrous	glabrous	glabrous	glabrous
<i>FLOWER</i>					
number/invol	6.1 (1.0;5-8)	6.0 (0.8;5-7)	5.9 (2.1;3-13)	5.2 (1.0;4-8)	6.3 (1.1;5-9)
shape	t-c	t-c	t-c	t-c	t-c
color	light yellow	light yellow	light yellow	light yellow	light yellow
length (mm)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)
pubescence	d.t	d.t.	d.t.	d.t.	d.t.
texture	dimorphic	dimorphic	dimorphic	dimorphic	dimorphic
length united (%)	0.5	0.5	0.5	0.5	0.5
<i>STAMEN</i>					
disposition	exerted	exerted	exerted	exerted	exerted
filament length (mm)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)
pubescence	glabrous	glabrous	glabrous	glabrous	glabrous
anther color	yellow	yellow	yellow	yellow	yellow
anther length (mm)	0.5 (0;0.5)	0.5 (0;0.5)	0.5 (0;0.5)	0.5 (0;0.5)	0.5 (0;0.5)
anther shape	oval	oval	oval	oval	oval
<i>ACHENE</i>					
color	immature	immature	light brown	immature	light brown
length (mm)	immature	immature	3.0 (0;3)	immature	3.0 (0;3)
pubescence	d.t.	d.t.	d.t.	d.t.	d.t.

	2892	2893	2894	2895	2896
<i>LEAF</i>					
blade width (mm)	3.0 (0.6;2.5-4)	2.2 (0.4;1.5-3)	1.9 (0.3;1.5-2.5)	2.8 ((0.7;2-4)	1.9 (0.5;1-3)
blade length (mm)	5.8 (1.3;4-8)	4.9 (0.6;4-6)	3.4 (0.6;2-5)	4.6 (0.8;3-6)	4.7 (0.9;3-7)
petiole length (mm)	4.6 (1.1;3-7)	4.0 (1.4;2-6)	1.7 (0.7;1-3)	3.7 (0.9;2-5)	2.5 (0.8;1-4)
pubescence	d.t.	d.t.	d.t.	d.t.	d.t.
<i>INFLORESCENCE</i>					
flr stem length (mm)	15.2 (2.1;12-19)	8.5 (4.3;1-16)	5.2 (3.1;1-13)	13.8 (2.5;9-17)	3.7 (1.5;1-7)
bract texture	both	both	both	both	both
bract length (mm)	1.2 (0.5;1-3)	1.4 (1.0;1-5)	1.2 (0.5;1-3)	1.8 (0.9;1-5)	1.2 (0.5;1-3)
pubescence	d.t.	d.t.	d.t.	d.t.	d.t.
<i>INVOLUCRE</i>					
number/head	2.7 (0.5;2-3)	3.0 (0;3)	3.0 (0;3)	3.1 (0.2;3-4)	3.0 (0;3)
shape	b.c	b.c	b.c	b.c.	b.c.
texture	thick green	thick green	thick green	thick green	thick green
length (mm)	4.7 (0.6;4-6)	3.5 (0.5;3-4)	3.6 (0.9; 3-5)	5.0 (0;5)	3.6 (0.5;3-4)
pubescence	d.t	d.t.	d.t.	d.t.	d.t.
number teeth	5.0 (0;5)	5.0 (0;5)	5.0 (0;5)	5.0 (0;5)	5.0 (0;5)
teeth length (mm)	2.0 (0.3;1.5-3)	1.8 (0.3;1.5-2)	1.7 (0.2; 1.5-2)	2.0 (0;2)	1.8 (0.2;1.5-2)
pedicel length (mm)	0.1	0.1	0.1	0.1	0.1
pedicel pub.	glabrous	glabrous	glabrous	glabrous	glabrous
<i>FLOWER</i>					
number/invol	5.7 (0.8;4-7)	5.8 (1.0;4-8)	5.4 (1.0; 3-8)	5.4 (1.2;3-8)	5.6 (0.9;4-7)
shape	t-c	t-c	t-c	t-c	t-c
color	light yellow	light yellow	light yellow	light yellow	light yellow
length (mm)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)
pubescence	d.t	d.t.	d.t.	d.t.	d.t.
texture	dimorphic	dimorphic	dimorphic	dimorphic	dimorphic
length united (%)	0.5	0.66	0.66	0.5	0.5
<i>STAMEN</i>					
disposition	exerted	exerted	exerted	exerted	exerted
filament length (mm)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)
pubescence	glabrous	glabrous	glabrous	glabrous	glabrous
anther color	yellow	yellow	yellow	yellow	yellow
anther length (mm)	0.5 (0;0.5)	0.5 (0;0.5)	0.5 (0;0.5)	0.5 (0;0.5)	0.5 (0;0.5)
anther shape	oval	oval	oval	oval	oval
<i>ACHENE</i>					
color	immature	light brown	light brown	light brown	light brown
length (mm)	immature	2.0 (0;2.0)	2.5 (0;2.5)	3.0 (0;3)	2.0 (0;2)
pubescence	d.t.	d.t.	d.t.	d.t.	d.t.

	2897	2898	2899	2900
<i>LEAF</i>				
blade width (mm)	2.9 (0.6;2-4)	2.4 (0.5;2-3)	2.4 (0.5;2-3)	2.6 (0.6;2-4)
blade length (mm)	5.7 (0.7;4-7)	5.0 (0.6;4-6)	5.4 (0.7;4-7)	5.3 (0.9;4-7)
petiole length (mm)	5.7 (1.5;3-8)	3.1 (0.9;1-5)	4.3 (1.0;3-6)	3.4 (0.9;2-5)
pubescence	d.t.	d.t.	d.t.	d.t.
<i>INFLORESCENCE</i>				
flr stem length (mm)	14.7 (2.2;12-18)	12.8 (3.2;9-22)	12.0 (2.0;10-16)	11 (2.3;6-14)
bract texture	both	both	both	both
bract length (mm)	1.7 (0.8;1-3)	1.4 (0.7;1-4)	1.8 (0.7;1-3)	1.8 (0.8;1-3)
pubescence	d.t.	d.t.	d.t.	d.t.
<i>INVOLUCRE</i>				
number/head	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)
shape	b.c	b.c	b.c	b.c.
texture	thick green	thick green	thick green	thick green
length (mm)	4.1 (0.5;3-5)	4.3 (0.4;4-5)	3.8 (0.7;3-5)	4.0 (0.5;3-5)
pubescence	d.t	d.t.	d.t.	d.t.
number teeth	5.0 (0;5)	5.0 (0;5)	5.0 (0;5)	5.0 (0;5)
teeth length (mm)	4.3 (0.6;3-5)	1.8 (0.3;1.5-2)	1.6 (0.3;1-2)	1.5 (0;1.5)
pedicel length (mm)	0.1	0.1	0.1	0.1
pedicel pub.	glabrous	glabrous	glabrous	glabrous
<i>FLOWER</i>				
number/invol	6.4 (0.9;5-8)	5.9 (1.6;5-10)	4.8 (1.2;2-7)	4.2 (0.4;4-5)
shape	t-c	t-c	t-c	t-c
color	light yellow	light yellow	light yellow	light yellow
length (mm)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)
pubescence	d.t	d.t.	d.t.	d.t.
texture	dimorphic	dimorphic	dimorphic	dimorphic
length united (%)	0.25	0.5	0.5	0.5
<i>STAMEN</i>				
disposition	exerted	exerted	exerted	exerted
filament length (mm)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)	3.0 (0;3)
pubescence	glabrous	glabrous	glabrous	glabrous
anther color	yellow	yellow	yellow	yellow
anther length (mm)	0.5 (0;0.5)	0.5 (0;0.5)	0.5 (0;0.5)	0.5 (0;0.5)
anther shape	oval	oval	oval	oval
<i>ACHENE</i>				
color	immature	immature	immature	immature
length (mm)	immature	immature	immature	immature
pubescence	d.t.	d.t	d.t.	d.t.

## APPENDIX 2

Occurrence Records for *Eriogonum shockleyi* var. *packardae* from the Conservation Data Center data base.

## APPENDIX 3

Location of *Eriogonum shockleyi* var. *packardae* populations known to be extant (excludes the three historical occurrences, 001, 004, and 014).

- Map 1. Halverson Lakes (012) and East of Halverson Lakes (002) occurrences. Portion of the 1971 Initial Point 7.5' quad.
- Map 2. North of Priest Ranch (003) occurrence. Portion of the 1971 Initial Point 7.5' quad.
- Map 3. East of Castle Creek (005), Castle Creek Mines (011), and Castle Creek North (013) occurrences. Portion of the 1972 Rough Mountain NE 7.5' quad.
- Map 4. Shoofly Oolitic Limestone (006) occurrence. Portion of the 1992 Chalk Hills 7.5' quad.
- Map 5. Deer Water-Hot Creek (007) occurrence. Portion of the 1980 Broken Wagon Flat 7.5' quad.
- Map 6. Upper Sugar Valley (008) occurrences. Portion of the 1979 Little Valley 7.5' quad.
- Map 7. Little Valley (009) occurrence. Portion of the 1979 Little Valley 7.5' quad.
- Map 8. Bruneau Rim (010) occurrence. Portion of the 1978 Bruneau 7.5' quad.

## APPENDIX 4

Occurrence records for Idaho populations of *Eriogonum shockleyi* var. *shockleyi* from the Conservation Data Center data base.

## APPENDIX 5

Location of *Eriogonum shockleyi* var. *shockleyi* populations in Idaho.

- Map 1. Horse Hill (001) and East of Horse Hill (011) occurrences. Portion of the 1978 Sugar Valley 7.5' quad.
- Map 2. Sugar Valley Badlands (002) occurrence. Portion of the 1978 Sugar Valley 7.5' quad.
- Map 3. Prominent Buttes (003) occurrence. Portion of the 1979 Little Valley 7.5' quad.
- Map 4. Lower Sugar Valley (004) occurrence. Portion of the 1978 Sugar Valley 7.5' quad.
- Map 5. Bruneau Dunes (005) occurrence. Portion of the 1992 Bruneau Dunes and Hot Creek 7.5' quads.
- Map 6. South of Schoffs Island (006) occurrence. Portion of the 1992 Hammett 7.5' quad.

Map 7. Lower Sailor Creek (007) occurrence. Portion of the 1992 Hammett 7.5' quad.

Map 8. Fossil Gulch (008) and Lower Salmon Falls Dam Transmission Line (010). Portion of the 1978 Hagerman 7.5' quad.

Map 9. Malad Gorge (009) occurrence. Portions of the 1978 Hagerman and Tuttle 7.5' quad.