

Status of *Boechea pusilla* (Small Rockcress)  
in Wyoming



Prepared for  
Bureau of Land Management  
Rock Springs Field Office and Wyoming State Office

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## ABSTRACT

*Boechea pusilla* (syn. *Arabis pusilla*; small rockcress) was designated a sensitive species by the Bureau of Land Management (BLM) in Wyoming (2001, 2002). It is only known from one population throughout its range. The results of survey and monitoring for *Boechea pusilla* were first documented by Hollis Marriott (1986) and a second status report was prepared by Robert Dorn (1990). Management questions and considerations were also identified (Marriott 1988a). Subpopulations were digitized by Barbara Amidon (BLM files). Potential distribution models were subsequently developed for BLM sensitive species (Fertig and Thurston 2003) including this species. The objectives set for this study were to resurvey the known population, replicate the monitoring, test the potential distribution models with expanded surveys, and update species status information.

*Boechea pusilla* was re-surveyed in 2003 and the original potential distribution model for it was tested. No additional populations were found. Mapping and monitoring was also conducted in 2003. Despite every precautionary measure that has been taken to maintain *B. pusilla*, this study suggests that there has been significant population decline over the past fifteen years in the absence of any obvious habitat disturbance. The population numbers declined from about 800-1000 flowering plants in 1988 to 150-250 flowering plants in 2003. The trend may be drought-related and warrants further monitoring and investigation that is best pursued in combination and coordination with the rest of Habitat Management Plan actions.

## ACKNOWLEDGEMENTS

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Cover photo: South Pass landscape bordering *Boechea pusilla* habitat, by B. Heidel

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## INTRODUCTION

The primary purpose of this project was to survey for *Boecheera pusilla* Rollins (small rockcress) using a new model and additional geology information, and to update its status. Monitoring and mapping of the *Boecheera pusilla* population that were initiated in 1988 by Marriott were replicated in 2003 as part of this study to gauge baseline conditions.

*Boecheera pusilla* was known from only one extant population (Marriott 1986, Dorn 1990). Management concerns were identified for the population (Marriott 1988a; Dorn 1990) that have been addressed in a habitat management plan for the species (USDI BLM 1994) and designation of its habitat as Area of Critical Environmental Concern (USDI BLM 1997). Accompanying actions were also taken to remove threats, as in mining withdrawal (USDI 1995).

## METHODS

Prior to the field season, information on the known habitat and distribution of *Boecheera pusilla* was studied. The previous survey data and monitoring plot from Marriott (1986) and Dorn (1990) were reviewed. Specimens were examined at the Rocky Mountain Herbarium (RM). BLM aerial photographs of the areas were copied for reference in the field (scale) along with topographic maps and BLM surface management maps.

A potential distribution model was reformatted for use in revised field inventory by projecting the polygons of potential habitat onto a GIS lays showing BLM-administered lands. In addition, a geological reference on pegmatites of the South Pass area was used to expand the previous inventory targeting this unique substrate (Bayley et al. 1973). Field surveys in and near the known population was conducted June 1-2. Monitoring and expanded field surveys were conducted June 6-8.

## SPECIES INFORMATION

### Classification

Scientific Name: *Boecheera pusilla* (Rollins) Dorn (Rollins 1982). Holotype: Wyoming, Fremont County, off Wyoming State Highway 28, 39 miles SW of Lander, in cracks and crevices of huge metamorphosed rocks, 20 Jun 1981, Rollins and Rollins 81366 (GH).

Common Name: Small Rockcress.

Family: Brassicaceae (mustard family).

Synonyms: *Arabis pusilla* Rollins.

Many North American species once treated as members of the *Arabis* are now placed in a separate *Boecheera* genus (Dorn 2002). This is based on their distinct chromosome numbers, and on molecular data indicating that American and Eurasian species of *Arabis* sens. lat. have more

dissimilarities between them than they do with many other widely-recognized genera in the mustard family. The *Arabis* of Eurasian affinity have erect fruits 3-6 cm long, with a single row of seeds, and hairy lower stems. The scientific name *Boechera pusilla* is used throughout this report except in citing references to it by the earlier taxonomic treatments.

Phylogenetic Relationships: The biogeographical and phylogenetic histories of *Boechera pusilla* are not known. Rollins (1983) places *B. pusilla* in the same group as *B. demissa* var. *languida*, *B. pendulina* var. *russeola*, and *B. oxylobula*. *Boechera pusilla* is sympatric with both *B. demissa* var. *languida* and *B. pendulina* var. *russeola*, while *B. oxylobula* is endemic to west-central Colorado. As Rollins pointed out, (1982) the *Arabis* genus sensu lato is characterized by a taxonomic complexity reflecting hybridization, apomixis and polyploidy.

There are five additional species of rockcress occurring in or near *B. pusilla* besides the two close relatives, representing a high diversity in the genus. This set was vouchered for reference.

Dorn (1990) hypothesized that: "*Arabis pusilla* is a local endemic which is exploiting a highly specialized habitat of very limited extent. It is likely that this habitat was never very extensive and is relatively recent in being exposed suggesting that *A. pusilla* is a relatively recently derived species."

History of the Taxon: *Boechera pusilla* was first collected by Reed and Kathryn Rollins on June 20, 1981, near South Pass in Fremont County, Wyoming (Rollins 1982). Robert Dorn and Robert Lichvar, attempting to pinpoint the type locality based on a hand drawn map received from Reed Rollins, collected at the type locality on June 30 1986. Hollis Marriott also visited the population on June 30, 1986, independently, while conducting five additional days of surveys (Marriott 1986). She again visited the population on June 20, 1988, conducted monitoring, and estimated the population size at 800-1000 individuals (Marriott 1988b). Additional surveys and a collection were made on June 27-30, 1990 by Robert Dorn (Dorn 1990). The above-mentioned history of the taxon was taken from Dorn (1990), with updates as follows.

A visit and estimate of the *Boechera pusilla* population were made by Walter Fertig on June 13, 1991, and a collection made as part of floristic inventories on the west slope of the Wind Rivers (Fertig 1992a, b, c). A population survey with GPS unit, and a collection, was made by Barbara Amidon on July 7, 1993, in addition to other visits made by Amidon and other BLM staff in developing the habitat management plan. Mapping results were stored in BLM files. A population visit and collection were made by Tom Cramer on June 23, 1995 as part of floristic inventory on the Upper Green River Basin, addressed in Cramer and Hartman (1996). A report was also made by Laura Welp as part of floristic inventories in the Great Divide and Upper Sweetwater Plateau (Welp 1997). *Boechera pusilla* was addressed in a synopsis on rare plants of southwest Wyoming (Fertig et al. 1998). A population survey with GPS unit and monitoring were conducted by Bonnie Heidel, along with surveys conducted during June 1-2 and 6-8, 2003, described in this report.

## Legal Status

*Boechera pusilla* does not have current US Fish & Wildlife Service status, though it was first made a Category 2 species in 1985 (USDI FWS 1985) was proposed as a C1 candidate for listing under the Endangered Species Act in 1992 (USDI FWS 1992) and was dropped in 1999. It is listed as sensitive by the Bureau of Land Management in Wyoming (2001, 2002).

The goals of the BLM policy for sensitive species are to:

- Maintain vulnerable species and habitat components in functional BLM ecosystems
- Ensure sensitive species are considered in land management decisions
- Prevent a need for species listing under the Endangered Species Act
- Prioritize needed conservation work with an emphasis on habitat

The population of *Boechera pusilla* occurs in a Special Status Plant Area of Critical Environmental Concern created in the 1997 BLM Green River Resource Area Resource Management Plan (USDI BLM 1997). As part of this designation, its habitat was withdrawn from mineral entry (USDI BLM 1995).

## Natural Heritage Rank

Global: NatureServe (formerly the heritage division of The Nature Conservancy) and the Wyoming Natural Diversity Database have assigned *Boechera pusilla* a rank of G1, indicating that it is critically imperiled rangewide.

State: *Boechera pusilla* is restricted to Wyoming, so the state rank of S1 is the same as the global rank, indicating that it is critically imperiled in the state.

## Description

Small rock cress is a perennial herb with 1-few (several) decumbent, unusually slender stems up to 17 cm long. The basal leaves are linear and erect with relatively sparse simple, biforked, or triforked spreading hairs. The 3-5 stem leaves are sessile, non-clasping and widely spaced. Flowers are light-lavender, 4-petaled, and 3.5-4.5 mm long. The fruits are glabrous, linear siliques (1-3.8 cm long and 2 mm wide) that spread at right angles from the drooping main stem on pedicels 3 mm or shorter (Rollins 1982, Marriott 1986, Dorn 1990, Fertig et al. 1994, Weynand and Amidon 1994) (Figures 1 and 2).

It flowers from May to mid June. Mature fruits are present from mid-June to July.

## Similar Species

*Boechera demissa* var. *languida* differs in having narrower (usually 1.5 mm wide) drooping fruit on pedicels 3-6 mm long. *B. pendulina* var. *russeola* has mostly simple, ciliate hairs on the basal leaves and spreading to drooping fruit. Rollins (1983) places these three species in the same group along with *B. oxylobula*. *Boechera pusilla* and its two closely-related species are in the same vicinity, while *B. oxylobula* is endemic to west-central Colorado.

Figure 1. *Boechera pusilla* illustration, by Isobel Nichols

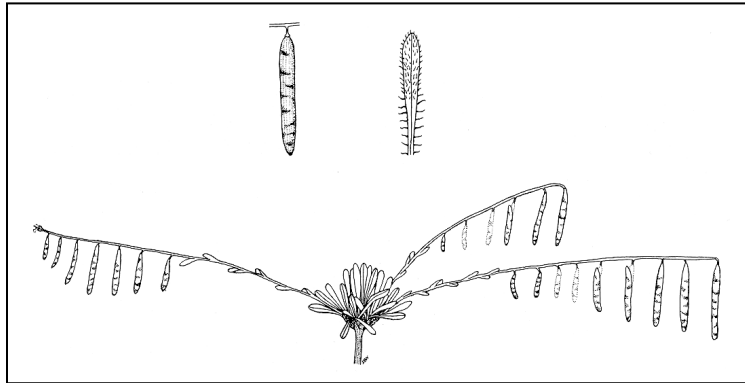


Figure 2. *Boechera pusilla* close-up, by B. Heidel



In addition to these three related species, five other species of *Boechera* were collected among, above, or around the site of *Boechera pusilla* during the course of this study. The similarities and distinctions among this set of eight species are profiled in order to make positive identifications in the field and as a reference in considering the possible origins of *B. pusilla* (Table 1). This comparison draws from and expands the table prepared by Marriott (1986) based on Rollins (1982), that provided comparisons between *B. pusilla*, *B. demissa* var. *languida* and *B. pendulina* var. *russeola*.

Dorn (1990) added: "The genus is very difficult and complex. All members of the genus are important for understanding the genus, its biology and evolution."

Table 1. Characteristic features of *Boecheera pusilla*, related species and sympatric species

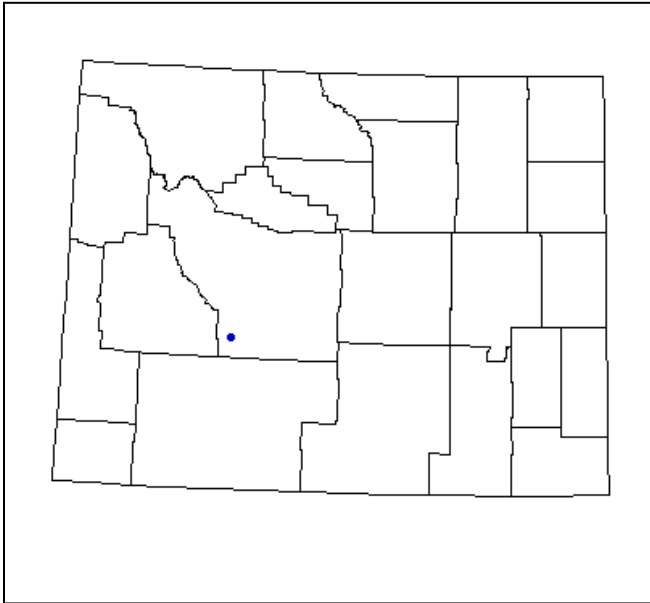
Species	Synonym	Coll. No.	Proximity to <i>B. pusilla</i>	Basal leaf pubescence	Siliqua shape	Siliqua disposition	Siliqua dimensions	Pedicel length	Growth form
<i>Boecheera pusilla</i>	<i>Arabis pusilla</i>	NA	NA	2- to 3-branched trichomes, sparse	acuminate	spreading at right angles to rachis, slightly ascending or descending	1-3.8 cm long; some fruits up to 2 mm wide	2-3 mm	Solitary or few stems from simple caudex, perennial
<i>Boecheera brachycarpa</i>	<i>Arabis confinis</i> ; <i>A. x divaricarpa</i>	2288	Above	3- to 5-ray branched trichomes, appressed		erect or ascending		6-12 mm	Solitary or few stems from simple caudex; biennial or perennial
<i>Boecheera holboellii</i> var. <i>pinetorum</i>	<i>Arabis holboellii</i> var. <i>pinetorum</i>	2294	Vicinity	dendritic hairs, densely and closely hairy	obtuse-acute	gradually curved-descending	3-7 cm	6-16 mm	Solitary or few stems from simple caudex; biennial or perennial
<i>Boecheera holboellii</i> var. <i>secunda</i>	<i>Arabis holboellii</i> var. <i>secunda</i>	2284	Above	dendritic hairs, densely and closely hairy	obtuse-acute	straight-descending or at least sharply bent near base	3-7 cm	6-16 mm	Solitary or few stems from simple caudex; biennial or perennial
<i>Boecheera microphylla</i>	<i>Arabis microphylla</i>	2586	Above	dendritic hairs, sparsely to moderately hairy	blunt to slightly attenuate	predominantly ascending to horizontally spreading	1.5 or less wide	5-15mm	Usually many stems from a much-branched caudex
<i>Boecheera pendulina</i> var. <i>russeola</i>	<i>Arabis pendulina</i> var. <i>russeola</i>	2293	Among	essentially all simple	obtuse to acute	pendulous, spreading to drooping	2-4 cm long; 1.5-2 mm wide	5-8 mm	Few-several stems from a simple or branched caudex; perennial
<i>Boecheera demissa</i> var. <i>languida</i>	<i>Arabis demissa</i> var. <i>languida</i>	2283	Vicinity	simple trichomes only (mostly on margins)	obtuse	pendulous	2-4 cm long; 1.5-2 mm wide	3-6 mm	Cespitose, several to many stems from a simple or branched caudex



## Geographic Range

*Boechera pusilla* is a state endemic restricted to the southern Wind River Range (South Pass area) in Fremont County, Wyoming (Figure 3). It occurs on lands administered by the BLM Rock Springs Field Office, and lies on the South Pass City Quadrangle. Additional location information is provided in Appendix A.

Figure 3. Distribution of *Boechera pusilla*



## Extent of Surveys in Wyoming

Systematic surveys of *Boechera pusilla* were initiated in Fremont and Sublette counties in 2003 to relocate the extant population and expand known distribution using a model of potential distribution (Fertig and Thurston 2003) as well as geology reference (Bayley et al. 1973).

The species was previously surveyed by Marriott (1986) and all prior negative survey data was compiled in a table. The species had also been surveyed by Robert Dorn (1990) using Bayley (1965). The new surveys based on the potential distribution model focused in the immediate vicinity of the known population. The new surveys based on the geological information expanded surveys in the surrounding townships including some areas not previously covered. The contrasting survey approached conducted by three botanists reinforces the negative survey results. One area mentioned by Marriott (the canyon of the Sweetwater River) has not been surveyed, and one large pegmatite outcrop area as mapped by Bayley et al. (1973) has not been surveyed either. These are remaining gaps in survey coverage.

The extant occurrence of *Boechera pusilla* is presented in Appendix A. The compilation of all negative survey results is presented in Appendix B and stored in an excel database for ease of sorting or converting into a database file for GIS use. Collections of all *Boechera* species in the

vicinity were made for reference, and small populations or subpopulations of *Psilocarphus brevisissimus* (dwarf wooly-head), a Wyoming plant species of concern, were documented incidental to the upland field surveys.

### Potential Distribution in Wyoming

The criteria used in the original classification tree model of potential habitat for *Boechea pusilla* included the following combination of categorical and continuous variables (Fertig and Thurston 2003).

Bedrock Geology: Precambrian felsic

Land Cover: Wyoming big sagebrush

Soil: Mainly cryorthents, including Rock outcrop and lithic cryorthents, loamy-skeletal

Surface Geology: Grus mixed with alluvium, aeolian, slopewash, grus, and/or bedrock outcrops

Elevation: 2312-2556 m

Relief: 56-114 m

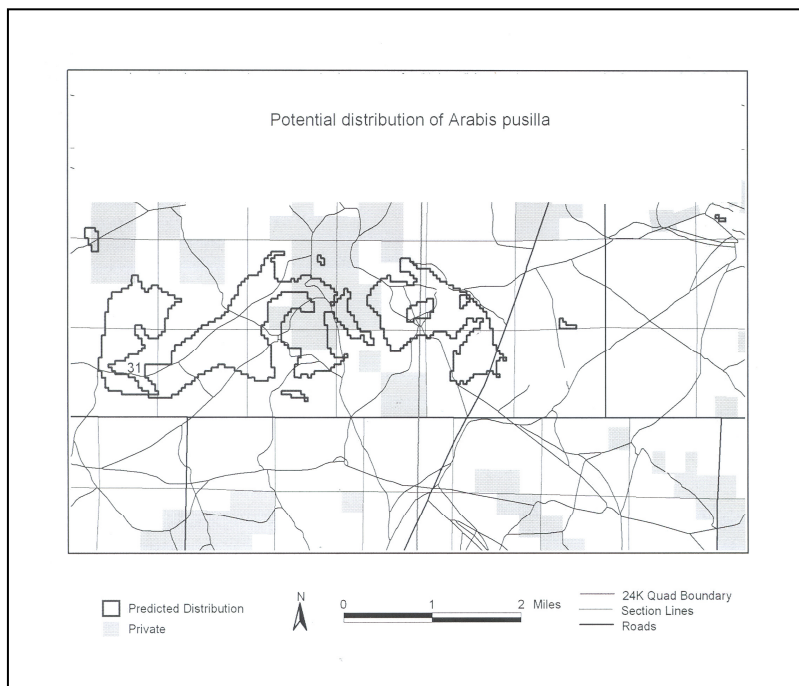
Precipitation in January, April, July and October

Average air temperature in January, April, July and October

Shortwave radiation in January and July

This model identified potential habitat only in the immediate vicinity of the Wind River Range. The areas of potential habitat for *Boechea pusilla* were in two polygons close to one another located in one township, with outlying small polygons in an adjoining township (Figure 4).

Figure 4. Potential distribution model for *Boechea pusilla*



## Habitat

*Boechera pusilla* occupies sparsely vegetated, coarse granite soil pockets in exposed granite-pegmatite outcrops, with slopes generally 0-10 degrees, surrounded by sagebrush grassland at 8000-8100 feet. The soils are poorly developed and very shallow, and it has been suggested that they are subirrigated by runoff from the exposed bedrock (Dorn 1990).

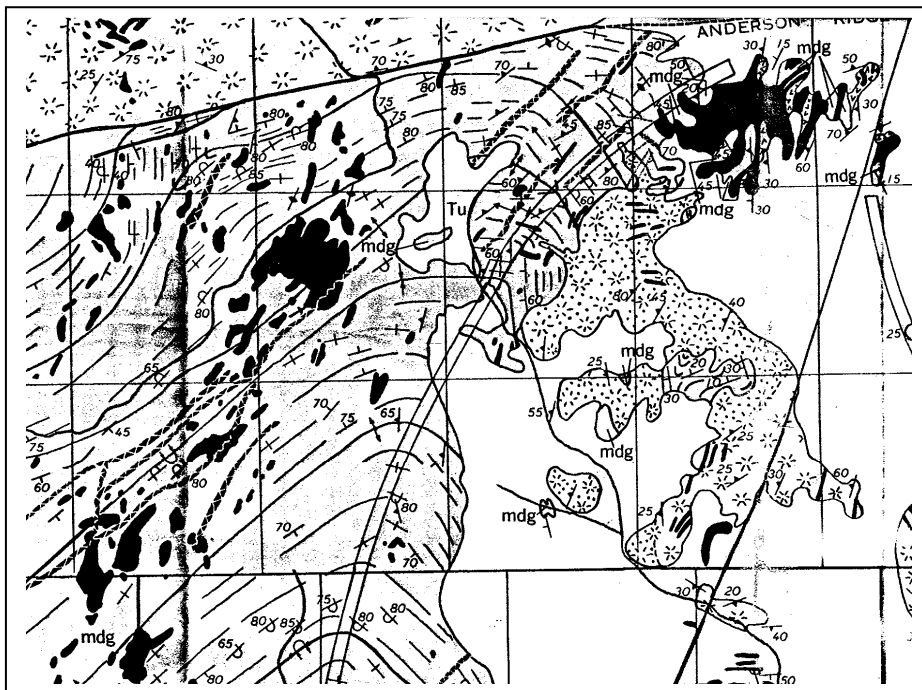
The setting adjoins Pine Creek, part of the South Pass landscape in the transition zone between the montane conifer forests and the high sagebrush desert of the plains below. The general landscape consists of rolling hills on a gradual sloping pediment (see cover).

The area has complex Precambrian geology, with widespread granodiorite and pegmatitic granite in particular, dissected by faults and diabasic gabbro dikes (Bayley et al. 1973). The South Pass region is part of an Archean (>2.5 billion year old) granite-greenstone belt with several old gold mines and a few ghost towns. The South Pass greenstone belt consists primarily of metamorphosed sedimentary and volcanic rock deposited in an ancient sea. These rocks were compressed into a regional syncline and intensely folded such that most rock units are now sitting on end. This montane landscape is open, interrupted by localized monadnock landforms that represent plutons from the Louis Lake Batholith, and it is incised by streams.

The restricted distribution of *Boechera pusilla* corresponds with the distribution of one of the larger pegmatites in the area (Figure 5).

Figure 5. Geologic Map of the South Pass Area (Scanned from: Bayley et al. 1973).

The black polygons represent pegmatites, and the pegmatite to the left of center corresponds with *Boechera pusilla* habitat.



A pegmatite is a very coarse grained igneous rock that usually occurs in dikes or lenses. They are commonly formed at the margin of a batholith. Because of their common spatial association with plutonic granite, many pegmatites are believed to be derived from high density aqueous fluid that separates from the granite magma after 90-95% has crystallized, or from the residual magma, itself. The origin of pegmatites may enrich trace elements. Many exotic and important minerals, including many gemstones, are found in them, though most pegmatites are simple pegmatites of quartz, orthoclase, and unimportant percentages of micas. It is possible that the parent material represents unique edaphic conditions, but soil chemistry has not been documented.

The vegetation has less than 10% cover, with many mat-forming perennial herbs (Table 2).

Table 2. Plant species associated with *Boechea pusilla*

Scientific Name	Common Name	Growth Form
<i>Achnatherum hymenoides</i>	Indian ricegrass	Perennial grass
<i>Androsace septentrionalis</i>	Pygmy rock-jasmine	Annual herb
<i>Antennaria parvifolia</i>	Littleleaf pussytoes	Perennial herb
<i>Antennaria umbrinella</i>	Brown-bract pussytoes	Perennial herb
<i>Artemisia arbuscula</i>	Dwarf sagebrush	Shrub
<i>Artemisia tridentata ssp. vaseyana</i>	Mountain big sagebrush	Shrub
<i>Boechea microphylla</i>	Small-leaf rockcress	Perennial herb
<i>Boechea pendulo</i>	Drooping-fruit rockcress	Perennial herb
<i>Collinsia parviflora</i>	Blue-eyed Mary	Annual herb
<i>Cryptantha spp.</i>	Miner's candle	Perennial herb
<i>Draba oligosperma</i>	Few-seed whitlow-grass	Perennial herb
<i>Elymus spicatus</i>	Bluebunch wheatgrass	Perennial grass
<i>Erigeron caespitosus</i>	Tufted fleabane	Perennial herb
<i>Erigeron compositus</i>	Cut-leaved fleabane	Perennial herb
<i>Eriogonum caespitosum</i>	Matted wild-buckwheat	Perennial herb
<i>Eriogonum ovalifolium var. purpureum</i>	Cushion wild-buckwheat	Perennial herb
<i>Eriogonum umbellatum</i>	Sulfur-flower wild-buckwheat	Perennial herb
<i>Eromogone hookeri</i>	Hooker's sandwort	Perennial herb
<i>Festuca idahonis</i>	Idaho fescue	Perennial grass
<i>Navarretia breweri</i>	Yellow pincushion-plant	Annual herb
<i>Paronychia depressa</i>	Spreading nailwort	Perennial herb
<i>Phlox hoodii</i>	Hood's phlox	Perennial herb
<i>Pinus flexilis</i>	Limber pine	Tree
<i>Poa fendleriana</i>	Muttongrass	Perennial grass
<i>Poa secunda</i>	Curly bluegrass	Perennial grass
<i>Potentilla pensylvanica</i>	Pennsylvania cinquefoil	Perennial herb
<i>Sedum lanceolatum</i>	Lance-leaf stonecrop	Perennial herb
<i>Selaginella densa</i>	Dense spike-moss	Fern-like plant
<i>Stenotus acaulis</i>	Stemless mock goldenweed	Perennial herb

The associated vegetation is generally free of exotic species. Noxious weeds were not noted in the area. High numbers of caterpillars were noted at the time of the 2003 visit, but their herbivory was not specific to *Boechera pusilla*.

The following text accompanies the habitat pictures that are on the following pages. The monitoring plot photos are presented as representing typical habitat with barren, rocky flats accompanied by gravelly pockets and bands. The photo pairs provide evidence for the lack of change over the past 15 years (Figures 6-7), though there are noticeable differences between their early June and late June appearances. These monitoring photos represent the highest density of *Boechera pusilla* and the largest subpopulation numbers. They are followed by three photos (Figures 8-10) that represent the most extensive subpopulation. The habitat barrens have an abrupt edge even at the margin of sagebrush steppe (Figures 11), reflecting substrate gradients that have not been determined. All but one subpopulation site has bedrock outcrop as the predominant surface cover; the exception signs of frost-heaving activity (Figure 12).

Dorn (1990) postulated that the species may be adapted to wide fluctuations in moisture availability, occupying shallow soils that dry out rapidly and then are saturated by subirrigation after each precipitation event. Likewise, the extremes in temperature exert influence. The setting is exposed to strong, frequent winds year-round.

Signs of drought were noted in the habitat of *Boechera pusilla* in 2003. These included complete and partial mortality in large mats of *Selaginella densa* (dense spike-moss). It is possible that *Selaginella densa* has a significant influence on habitat conditions and local succession patterns.

There are no climate stations that represent weather conditions in the immediate vicinity, but the local precipitation is thought to average 12 inches, the majority of which falls as heavy winter snows (USDI BLM 1994). The growing season is very short; spanning about 30 frost-free days between mid-June and mid-July.

The Wind River Region was in a major drought period from 2000-2003, though overall conditions have been closer to normal in 2004 (USDI NOAA 2005). The recent drought period is of greater intensity but apparently not nearly as long as the drought conditions of 1985-1990 (USDI NOAA 2005).

Figure 6. Monitoring baseline - habitat of main *Boecheera pusilla* subpopulation, to SW (1988), by D. Horning



Figure 7. Monitoring baseline - habitat of main *Boecheera pusilla* subpopulation, to SW (2003), by B. Heidel



Figure 8. Overview of habitat in the most extensive *Boechera pusilla* subpopulation; from west margin looking east, by B. Heidel



Figure 9. Pluton to the south of the most extensive subpopulation, by B. Heidel

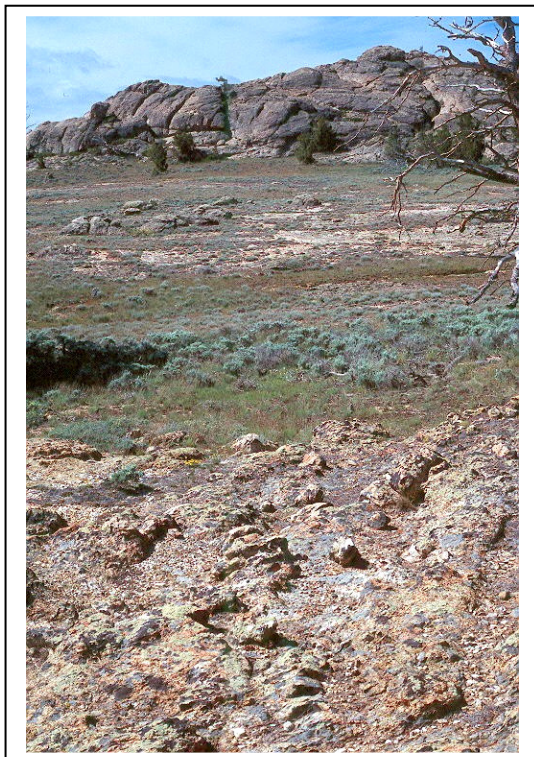


Figure 10. Mat-forming plants are locally-common in *Boechera pusilla* habitat, by B. Heidel

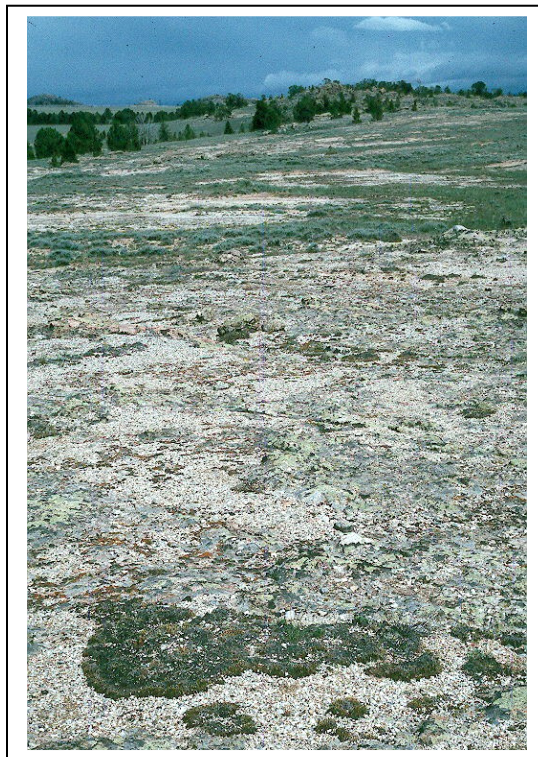


Figure 11. Abrupt habitat margins mark the barrens where *Boechera pusilla* occurs (lower area), by B. Heidel



Figure 12. Atypical setting harboring a small subpopulation, without bedrock outcrop (Note: frost heaving), by B. Heidel





## Population Size and Trends

The population estimates made in 1988 ranged from 800-1000 individuals, including census of 671 individuals in 400 m<sup>2</sup> of the easternmost subpopulation (Marriott 1988b), which appears to have the greatest number of individuals. The census focused on flowering plants but did record a small number of nonflowering plants. All estimates of population size are based on flowering plants unless otherwise stated. Each flowering plant was characterized in terms of the numbers of flowering stems, and the numbers of fruits per plant. In discussing results, Marriot (1988) indicated that there was no evidence that *Boechea pusilla* had been affected by the 1988 drought, and that plants were more abundant than in 1986. The monitoring baseline was established in 1988 with the intent that it should be monitored every two years, at least initially, to provide baseline data and alert managers to unforeseen threats to this very rare species (Marriott 1988b).

Later estimates in 1990 indicated that the numbers were down to about 600 (Dorn 1990). This is consistent with a pattern of short-term decline under drought conditions.

The 1988 census was replicated in 2003, using the original photographic records to drive rebar at endpoints of the original 50 m baseline (see Figures 6-9). The original monitoring recorded individuals in 1 m-wide lanes on either side of 25 m tape. In 2003, effort was made to also map each individual of *B. pusilla*, and note the presence of a sympatric species, *B. pendulina* var. *russeola*. In 2003, only 133 individuals (87 flowering plants and 46 vegetative plants) of *B. pusilla* were found in the census area. This represents a significant decline from 671 plants.

Census information has not previously been compiled at the subpopulation level, and has been instituted with the preliminary subpopulation estimates made in this study. The monitored subpopulation, though small in area, appeared to represent the majority of plants in 2003 as it did in 1988. Since most of the plants in that subpopulation fall within the plot area, total subpopulation numbers in 2003 were estimated at 100-150.

A priority was placed on demarcating other polygons and taking GPS readings rather than in censusing them. Only two other polygons apparently had over 10 flowering plants in 2003, including a large irregular polygon to the west of ca. 30-60 plants, and the largest polygon in a north-central cluster of ca. 10-15 plants. Five small polygons had less than 5 plants observed. Total flowering plant numbers in 2003 were estimated at 150-250. The 2003 monitoring indicated that nonflowering plant numbers were ca. 50% of flowering plant numbers, so the total population numbers could be 33% higher.

A comparison between the mean density of flowering plants in 1988-2003 indicated that the density dropped (1.68 - 0.33 flowering plants per m<sup>2</sup>). A comparison between the number of flowering stems per flowering plant in 1988-2003 indicated that the mean remained about the same (3.01 - 2.63 flowering stems per plant). A comparison between the number of fruits per plant in 1988-2003 indicated that the mean dropped (10.38 - 5.41 fruits per flowering plant).

Rainfall patterns in 2000-2003 were among the more severe droughts on record in the Wind River Range, though drought conditions were longer in 1985-1990 (USDI NOAA 2005), coinciding with previous survey work. The 2004 and 2005 conditions may be close to normal. Dorn (1990) hypothesized that reproductive success probably "...varies considerably from year to year depending on climate conditions. As a result, population size may fluctuate widely."

Estimates of occupied habitat have ranged between 6-16 acres (Dorn 1990; this report). The latter is based on digitized polygons, but over half of the largest polygon seems to be suitable but unoccupied (Appendix A; Figures 9-12). It is recommended that the aerial photo in this report be used as reference, and GPS readings taken for any revisions or more detailed mapping (using UTM NAD83 for DOQ projection).

### Population Biology and Ecology

Vegetative plants of *Boechera pusilla* were observed in 2003 that had persisting remnants of flowering stalks from the previous year (Figure 13), so it is likely that the species can live to at least three years. Some herbarium specimens at RM have over 1 cm of dead basal leaf sheaths representing multiple years. Dorn (1990) raised the question whether the species might be biennial. Other information is not available on species' life history and population demography, and greenhouse studies have not been conducted.

Figure 13. Vegetative plant of *Boechera pusilla*, by B. Heidel  
(Note the rosette in the lower left, with last year's flowering stalks, and a dead rosette to right).



The flowering stalk elongates in spring, and the inflorescence is indeterminate. The different flowering stalks on the same plant generally have the same phenological stages, but often vary in stature. The fruit matures and shatters during the short frost-free period in the middle of summer. All reproduction is presumably by seed. Information on pollinators and dispersal vectors are not available. The seed is not winged, and likely drops close to the parent plant, with limited movement downwind and downslope by wind and water (Dorn 1990). It has relatively few seeds per fruit compared to some other *Boechera* species (Dorn 1990). It is not known whether it has a seedbank.

Some flowering plants in the monitoring plot failed to produce any fruits in 2003 (12 of 87), and many of the flowering stems failed to produce fruits. There were no plants still in flower on 1 June 2003, and it is possible that many flowers failed to develop or the fruit aborted. This could have

been influenced by freezing conditions during spring or by drought. Flowering plants in 2003 had up to six flowering stems per plant and up to 28 fruits per plant in 2003. By contrast, only a few lacking fruits in 1988 and there were up to 11 flowering stems per plant and up to 37 fruits per plant.

Prior to monitoring, the number of rosettes per plant was hypothesized to represent a stage that indicates age, and which might be used in stage-based transition matrices. This was not supported by the data collected in 2003. The number of rosettes per plant was similar for both flowering and nonflowering plants (1.77 and 1.54, respectively). Only a couple plants had more than four rosettes. The merits of recording rosette numbers cannot be evaluated with data from only one year, and might be included if a monitoring plan is implemented.

Figure 14. Motorized vehicle restriction at the South Pine Special Management Area enclosure boundary, by B. Heidel



#### Current Management

There are three protection measures in place for *Boechnera pusilla* habitat. First, the Pine Creek area was designated a Special Management Area (SMA) in 1978 within the Pine Creek Allotment, and an enclosure was constructed in 1984 to prevent livestock-recreation conflicts. Second, the entire population was addressed in a species habitat management plan (USDI BLM 1994) that sought to:

- 1) Protect *Arabis pusilla*, its habitat, and the ecosystem on which it depends
- 2) Eliminate management threats and impacts to the plant and its habitat
- 3) Map, monitor and inventory existing and future habitat
- 4) Initiate off-site studies to understand species' biology, population dynamics and habitat needs, and to provide a seedbank
- 5) Possible augmentation of the known population, or introduction into additional habitats.

Finally, the entire population was designated a Special Status Plant Area of Critical Environmental Concern in the final Green River Resource Area Resource Management Plan (1997). Due to the conservation actions taken by the BLM, *B. pusilla* was dropped as a candidate for listing under the Endangered Species Act in 1999.

### Past, Present and Potential Threats

Dorn (1990) identified recreation activity from off-road vehicle use as the main existing threat to *Boechnera pusilla*. Prior to the habitat management plan, actual and potential recreational uses of the habitat included camper parking, hunting, fishing access, picnicking, unauthorized ORV use, horse boarding and feeding, plant collecting, mountain biking, and pedestrian use. At present, motorized traffic is not admitted to the exclosure (Figure 14) and the former roadbed has been torn up and reseeded.

Some quarrying was done in the past on one of the granite-pegmatite outcrops near the single known occurrence (Marriott 1986). The withdrawal from minerals (USDI BLM 1995) curtailed this threat. At present, the area has been withdrawn from mineral entry, all the more important with new explorations for gold taking place in the vicinity.

The HMP also identified other actions to meet overall objectives and circumvent unforeseen threats and the work represented in this report is included among them:

- Inventory, mapping and monitoring
- Off-site seed banking and living plant collections
- Compliance monitoring
- Introduction of the species to new habitat if studies document feasibility and necessity
- Protection for new populations (not applicable with the information at hand)
- Report of annual studies, made available upon request
- Five-year review conducted for HMP

### SUMMARY

The status surveys previous conducted (Marriott 1986, Dorn 1990) remain the primary bodies of information on this taxon. The current effort to inventory, map and monitor the population has provided evidence of significant decline and is best pursued in combination and coordination with the rest of HMP actions. Trend information is the only noteworthy addition to current species' status. Despite every precautionary measure that has been taken to maintain *Boechnera pusilla*, this study suggests that there has been significant population decline over the past fifteen years. Three measures are identified for action in the short-term:

1. First, there is a need to pursue the trend analysis with census and possibly demographic monitoring in 2005 or 2006, particularly to determine if the responses are primarily related to climate.

2. Second, there is need to compile all information on the HMP initiatives (see preceding section) in order to take stock of actions and options. There is no information available to indicate that there has been off-site seedbanking or collection of living plant material.

3. Finally, a closer investigation and consultation mode may be warranted by BLM to determine underlying causes and affects of decline, and options. It might be pursued with the U.S. Fish and Wildlife Service and with botanical consultants. Other botanists who are most familiar with the species include Hollis Marriott, Robert Dorn, Barbara Amidon and Walter Fertig. This measure might be timed after the first two steps, or initiated concurrently with the distribution of this report once it is made final.

Dorn (1990) concluded that the population gave the impression of good vigor, but the restriction to a very limited and specialized habitat and the small population size made the species extremely vulnerable to extinction. The population could be reduced to a very small size in a bad year. This study included monitoring that indicated the population could be in serious decline. Therefore, continued and expanded assessment is warranted to determine causes, affects, and options for effective BLM sensitive species policy.

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