

Rare Plants of Bighorn Canyon National Recreation Area

Prepared for the
National Fish and Wildlife Foundation
and
Bighorn Canyon National Recreation Area,
National Park Service

by
Bonnie Heidel and Walter Fertig

June, 2000



Rare Plants of Bighorn Canyon National Recreation Area

Prepared for
National Fish and Wildlife Foundation
1120 Connecticut Avenue NW, Suite 900
Washington, D.C. 20036
and
Bighorn Canyon National Recreation Area,
National Park Service

National Plant Conservation Initiative Grant No. 98-084-002

by
Bonnie Heidel
Montana Natural Heritage Program
Montana State Library
P.O. Box 201800
Helena, Montana 59620-1800

and

Walter Fertig
Wyoming Natural Diversity Database
University of Wyoming
P.O. Box 3381
Laramie, Wyoming 82071-3381

© 2000 Montana Natural Heritage Program

This document should be cited as follows:

Heidel, B. and W. Fertig. 2000. Rare plants of Bighorn Canyon National Recreation Area. Report to the National Fish and Wildlife Foundation and Bighorn Canyon National Recreation Area. Montana Natural Heritage Program, Helena, and Wyoming Natural Diversity Database, Laramie. 63 pp. plus appendices.

Executive Summary

We conducted systematic surveys of Bighorn Canyon National Recreation Area (NRA) and documented new records for 17 of 25 rare plant species known or suspected to occur in the area.

Six globally rare species were found in the NRA, of which five are sufficiently rare to warrant special management attention. For three of the species, Bighorn Canyon NRA is one of the few areas where they occur that is managed primarily for natural and wildlife values, and is critical to their long-term viability. They include:

- Bighorn fleabane (*Erigeron allocotus*; global rank - G3)
- Persistent-sepal yellowcress (*Rorippa calycina*; global rank - G3)
- Hairy prince's-plume (*Stanleya tomentosa* var. *tomentosa*; global rank - G3T3).

Based on survey results, we also identified key tasks that advance the conservation of rare plant species in Bighorn Canyon NRA:

- Control noxious weeds.
- Evaluate the effects of management actions on the five globally rare species in the course of planning.
- Initiate monitoring of three species
- Identify the most vulnerable habitats of globally rare species as places of special management concern

This report summarizes information on the identification, biology, habitat, and distribution of the 25 globally and state rare plant species that are within the Bighorn Canyon NRA. These data are intended to help resource managers develop and prioritize management and monitoring plans and to identify important concentrations and habitats of rare species. It also contributes to evaluation of rare plant conservation priorities rangewide and statewide.

Acknowledgements

We are grateful for the assistance and interest of National Park Service staff. The project was coordinated by Rick Lasko, with the able assistance of Martina Keil and Laura Hudson. Initial project plans benefited from reviews by Laura Hudson and Peggy Olwell. Oversight and helpful logistical comments were provided by Robert Byrne, Theo Hugs, and Bonnie Winslow. This project also benefited from information and observations provided by John Osgood, Jim Staebler, and Suzanne Morstad. Boat transportation was coordinated by Chris Ryan; with Wendy Bredow, Jenny Byrne, Chuck Huston, and Diane Jurgens at the helm.

Access to National Park Service land across private property in the Dryhead area was arranged with the kind permission of landowners.

The coordination and support of Gary Kania and Beth DeCarolis on behalf of the National Fish and Wildlife Foundation are gratefully acknowledged.

Laura Welp of the Wyoming Natural Diversity Database (WYNDD) assisted with field surveys in 1999. George Jones of WYNDD also contributed useful information on vegetation of the Bighorn Canyon.

The digitizing and production of GIS maps was coordinated by Cedron Jones, Montana Natural Heritage Program (MTNHP), with Montana element occurrence processing work by Martin Miller, report formatting by Margaret Beer, scanning of photographs and illustrations by John Hinshaw, and editing by Sue Crispin. The topographic relief map was produced by Duane Lund, Montana Natural Resource Information System. This project also benefited from the coordination contributions of Sue Crispin and Melony Bruhn of MTNHP.

The authors thank Hollis Marriott, The Nature Conservancy, for her contributions in defining and planning the project, and all botanists who reviewed specimens and were consulted in the course of this study, including Ronald Hartman, B. E. Nelson, Robert Dorn, Matt Lavin, Peter Stickney, A. A. Reznicek, and Mary Barkworth. Use of the herbarium facilities at University of Montana, University of Wyoming, and Bighorn Canyon NRA Interpretive Headquarters is greatly appreciated.

Special thanks are extended to Alma Snell, whose knowledge of culturally-significant plants is an inspiration.

This National Plant Conservation Initiative project was supported by a challenge cost-share grant agreement of the National Fish and Wildlife Foundation involving the Montana Natural Heritage Program, the National Park Service and the Wyoming Natural Diversity Database.

Table of Contents

Executive Summary	i
Acknowledgements	ii
Introduction	1
Study Area	1
Setting	1
Climate	3
Geology and Landforms	3
Vegetation	3
Flora	4
Methods	4
Results	5
Globally-rare Plant Species Summaries	7
<i>Erigeron allocotus</i>	7
<i>Eriogonum brevicaule</i> var. <i>canum</i>	10
<i>Lesquerella lesicii</i>	13
<i>Rorippa calycina</i>	16
<i>Stanleya tomentosa</i> var. <i>tomentosa</i>	20
<i>Sullivantia hapemanii</i> var. <i>hapemanii</i>	23
State Rare Plants	29
<i>Agrimonia gryposepala</i>	29
<i>Arabis demissa</i> var. <i>languida</i>	30
<i>Aster glaucodes</i>	31
<i>Astragalus aretioides</i>	32
<i>Astragalus geyeri</i> var. <i>geyeri</i>	34
<i>Astragalus oregonus</i>	36
<i>Carex gravida</i> var. <i>gravida</i>	37
<i>Cleome lutea</i>	39
<i>Delphinium geyeri</i>	40
<i>Eupatorium maculatum</i> var. <i>bruneri</i>	41
<i>Grayia spinosa</i>	43
<i>Leptodactylon caespitosum</i>	44
<i>Mentzelia pumila</i>	46
<i>Musineon vaginatum</i>	47
<i>Oxytropis besseyi</i> var. <i>fallax</i>	48
<i>Oxytropis besseyi</i> var. <i>ventosa</i>	50
<i>Senecio eremophilus</i> var. <i>eremophilus</i>	51
<i>Sphenopholis intermedia</i>	53
<i>Stipa lettermannii</i>	54
Discussion and Management Recommendations	56
Literature Cited	60

Tables

Table 1. Summary of the flora of Bighorn Canyon National Recreation Area.....	4
Table 2. Rare vascular plant species of Bighorn Canyon National Recreation Area.....	6
Table 3. Population sizes of <i>Sullivantia hapemannii</i> var. <i>hapemannii</i> in Bighorn Canyon.....	10

Figures

Figure 1. Bighorn Canyon NRA study area.....	1
Figure 2. Topography of Bighorn Canyon NRA.....	2
Figure 3. Climate diagrams for Yellowtail Dam, MT and Lovell, WY.....	3
Figure 4. Illustration of <i>Erigeron allocotus</i>	7
Figure 5. Photo of <i>Erigeron allocotus</i>	7
Figure 6. Montana and Wyoming county distribution of <i>Erigeron allocotus</i>	8
Figure 7. Distribution of <i>Erigeron allocotus</i> in Bighorn Canyon NRA.....	8
Figure 8. Mountain mahogany and escarpment habitats of <i>Erigeron allocotus</i>	8
Figure 9. Canyon rim habitat of <i>Erigeron allocotus</i>	9
Figure 10. Illustration of <i>Eriogonum brevicaule</i> var. <i>canum</i>	10
Figure 11. Photo of <i>Eriogonum brevicaule</i> var. <i>canum</i>	11
Figure 12. Montana and Wyoming county distribution of <i>Eriogonum brevicaule</i> var. <i>canum</i>	11
Figure 13. Distribution of <i>Eriogonum brevicaule</i> var. <i>canum</i> in Bighorn Canyon NRA.....	11
Figure 14. Chugwater Formation habitat of <i>Eriogonum brevicaule</i> var. <i>canum</i>	12
Figure 15. Limestone habitat of <i>Eriogonum brevicaule</i> var. <i>canum</i>	12
Figure 16. Photo of <i>Lesquerella lesicii</i>	14
Figure 17. Montana and Wyoming county distribution of <i>Lesquerella lesicii</i>	14
Figure 18. Distribution of <i>Lesquerella lesicii</i> in Bighorn Canyon NRA.....	14
Figure 19. Escarpment habitat of <i>Lesquerella lesicii</i>	15
Figure 20. Illustration of <i>Rorippa calycina</i>	16
Figure 21. Photo of <i>Rorippa calycina</i>	17
Figure 22. Montana and Wyoming county distribution of <i>Rorippa calycina</i>	17
Figure 23. Distribution of <i>Rorippa calycina</i> in Bighorn Canyon NRA.....	17
Figure 24. Inlet habitat of <i>Rorippa calycina</i>	18
Figure 25. Shoreline habitat of <i>Rorippa calycina</i>	18
Figure 26. Illustration of <i>Stanleya tomentosa</i> var. <i>tomentosa</i>	20
Figure 27. Photo of <i>Stanleya tomentosa</i> var. <i>tomentosa</i>	21
Figure 28. Montana and Wyoming county distribution of <i>Stanleya tomentosa</i> var. <i>tomentosa</i>	21
Figure 29. Distribution of <i>Stanleya tomentosa</i> var. <i>tomentosa</i> in Bighorn Canyon NRA.....	22
Figure 30. Ridge habitat of <i>Stanleya tomentosa</i> var. <i>tomentosa</i>	22
Figure 31. Illustration of <i>Sullivantia hapemannii</i> var. <i>hapemannii</i>	23
Figure 32. Photo of <i>Sullivantia hapemannii</i> var. <i>hapemannii</i>	24
Figure 33. Montana and Wyoming county distribution of <i>Sullivantia hapemannii</i> var. <i>hapemannii</i>	24
Figure 34. Distribution of <i>Sullivantia hapemannii</i> var. <i>hapemannii</i> in Bighorn Canyon NRA.....	24
Figure 35. Spring-fed habitat of <i>Sullivantia hapemannii</i> var. <i>hapemannii</i>	25
Figure 36. Montana and Wyoming County distribution of <i>Agrimonia gryposepala</i>	29
Figure 37. Distribution of <i>Agrimonia gryposepala</i> in the Montana portion of Bighorn Canyon NRA.....	29
Figure 38. Montana and Wyoming county distribution of <i>Arabis demissa</i> var. <i>languida</i>	30
Figure 39. Distribution of <i>Arabis demissa</i> var. <i>languida</i> in the Montana portion of Bighorn Canyon NRA.....	31
Figure 40. Montana and Wyoming county distribution of <i>Aster glaucodes</i>	32
Figure 41. Distribution of <i>Aster glaucodes</i> in the Montana portion of Bighorn Canyon NRA.....	32
Figure 42. Illustration of <i>Astragalus aretioides</i>	33

Figure 43. Montana and Wyoming county distribution of <i>Astragalus aretioides</i>	33
Figure 44. Distribution of <i>Astragalus aretioides</i> in the Montana portion of Bighorn Canyon NRA.....	33
Figure 45. Illustration of <i>Astragalus geyeri</i> var. <i>geyeri</i>	34
Figure 46. Montana and Wyoming county distribution of <i>Astragalus geyeri</i> var. <i>geyeri</i>	35
Figure 47. Distribution of <i>Astragalus geyeri</i> var. <i>geyeri</i> in the Montana portion of Bighorn Canyon NRA.....	35
Figure 48. Illustration of <i>Astragalus oregonus</i>	36
Figure 49. Montana and Wyoming county distribution of <i>Astragalus oregonus</i>	36
Figure 50. Distribution of <i>Astragalus oregonus</i> in the Montana portion of Bighorn Canyon NRA.....	37
Figure 51. Illustration of <i>Carex gravida</i> var. <i>gravida</i>	37
Figure 52. Montana and Wyoming county distribution of <i>Carex gravida</i> var. <i>gravida</i>	38
Figure 53. Distribution of <i>Carex gravida</i> var. <i>gravida</i> in the Montana portion of Bighorn Canyon NRA.....	38
Figure 54. Illustration of <i>Cleome lutea</i>	39
Figure 55. Montana and Wyoming county distribution of <i>Cleome lutea</i>	39
Figure 56. Distribution of <i>Cleome lutea</i> in the Montana portion of Bighorn Canyon NRA.....	40
Figure 57. Montana and Wyoming county distribution of <i>Delphinium geyeri</i>	40
Figure 58. Distribution of <i>Delphinium geyeri</i> in the Montana portion of Bighorn Canyon NRA.....	41
Figure 59. Illustration of <i>Eupatorium maculatum</i> var. <i>bruneri</i>	41
Figure 60. Montana and Wyoming county distribution of <i>Eupatorium maculatum</i> var. <i>bruneri</i>	42
Figure 61. Distribution of <i>Eupatorium maculatum</i> var. <i>bruneri</i> in the Montana portion of Bighorn Canyon NRA.....	42
Figure 62. Illustration of <i>Grayia spinosa</i>	43
Figure 63. Montana and Wyoming county distribution of <i>Grayia spinosa</i>	43
Figure 64. Distribution of <i>Grayia spinosa</i> in the Montana portion of Bighorn Canyon NRA	44
Figure 65. Illustration of <i>Leptodactylon caespitosum</i>	44
Figure 66. Montana and Wyoming county distribution of <i>Leptodactylon caespitosum</i>	45
Figure 67. Distribution of <i>Leptodactylon caespitosum</i> within Bighorn Canyon NRA.....	45
Figure 68. Montana and Wyoming county distribution of <i>Mentzelia pumila</i>	46
Figure 69. Distribution of <i>Mentzelia pumila</i> in the Montana portion of Bighorn Canyon NRA.....	46
Figure 70. Montana and Wyoming county distribution of <i>Musineon vaginatum</i>	47
Figure 71. Distribution of <i>Musineon vaginatum</i> in the Montana portion of Bighorn Canyon NRA.....	48
Figure 72. Montana and Wyoming county distribution of <i>Oxytropis besseyi</i> var. <i>fallax</i>	49
Figure 73. Distribution of <i>Oxytropis besseyi</i> var. <i>fallax</i> in the Montana portion of Bighorn Canyon NRA	49
Figure 74. Montana and Wyoming county distribution of <i>Oxytropis besseyi</i> var. <i>ventosa</i>	50
Figure 75. Distribution of <i>Oxytropis besseyi</i> var. <i>ventosa</i> in the Montana portion of Bighorn Canyon NRA	51
Figure 76. Illustration of <i>Senecio eremophilus</i> var. <i>eremophilus</i>	51
Figure 77. Montana and Wyoming county distribution of <i>Senecio eremophilus</i> var. <i>erimophilus</i>	52
Figure 78. Dist. of <i>Senecio eremophilus</i> var. <i>eremophilus</i> in the Mont. portion of Bighorn Canyon NRA.....	52
Figure 79. Illustration of <i>Sphenopholis intermedia</i>	53
Figure 80. Montana and Wyoming county distribution of <i>Sphenopholis intermedia</i>	53
Figure 81. Distribution of <i>Sphenopholis intermedia</i> in the Montana portion of Bighorn Canyon NRA.....	54
Figure 82. Illustration of <i>Stipa lettermanii</i>	54
Figure 83. Montana and Wyoming county distribution of <i>Stipa lettermanii</i>	55
Figure 84. Distribution of <i>Stipa lettermanii</i> in the Montana portion of Bighorn Canyon NRA.....	55

Appendices

- Appendix A. Globally and state rare vascular plant species considered as inventory targets in Bighorn Canyon National Recreation Area
- Appendix B. Draft Update to the Flora of Bighorn Canyon National Recreation Area

Introduction

Bighorn Canyon National Recreation Area (NRA) established in 1966 to promote recreational opportunities on the soon-to-be created Yellowtail Reservoir to protect historical sites including the Mason-Lov Ranch and Bad Pass Trail. As a unit of the National Park Service, Bighorn Canyon is also managed to conserve both common and rare native plants and animals (USDI National Park Service 1988). Although a vegetation survey (Knight et al. 1987) and florist survey (Lichvar et al. 1984, 1985) have been conducted in Bighorn Canyon, little attention has been directed towards the management of rare plant species in the NRA. To help resolve this problem, the National Park Service and the National Fish and Wildlife Foundation contracted with the Montana Natural Heritage Program and the Wyoming Natural Diversity Database in 1998 to assemble information on the distribution, relative abundance, habitat, and management needs of rare plant species found in the Bighorn Canyon. The study results are contained in this report.

Study Area

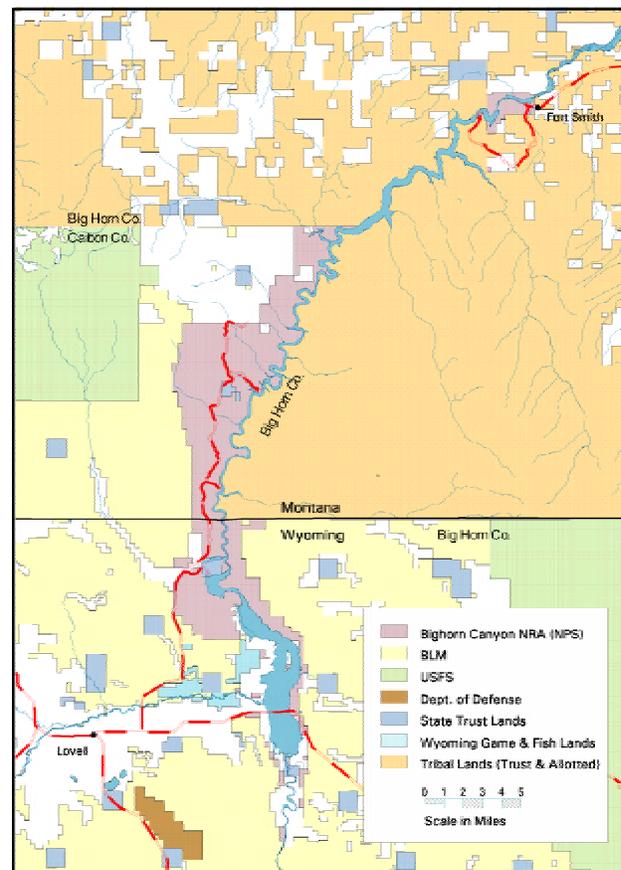
Setting

The Bighorn Canyon National Recreation Area (NRA) spans a north-south distance of approximately 113 km (70 miles) along the Bighorn River, straddling the Montana-Wyoming state line. It encompasses a land area of 22,499 ha (55,595 acres) plus approximately 5,140 ha (12,700 acres) of water. It is administered by the National Park Service (NPS) out of offices in Lovell, WY and Fort Smith, MT, and is surrounded by federal, tribal, state, and private lands (Figure 1).

Bighorn Canyon is the defining feature in this landscape, with sheer cliff faces along much of its length. The Bighorn River carved much of the canyon, but its flow is impeded today by Yellowtail Dam. This entire river channel segment is now occupied by Yellowtail Reservoir.

The NRA bisects three major North American ecoregions: Bighorn Basin Section, Bighorn Mountains Section, and Powder River Basin Section (Figure 2; Bailey et al. 1994). They are affected differently by the adjoining Bighorn Mountains to the east, and the Pryor Mountains to the west, in terms of their

Figure 1. Bighorn Canyon NRA study area



rainshadow effects and landscape continuity. The juxtaposition of these ecoregions helps account for the high species richness and diversity of vegetation types found in Bighorn Canyon NRA. More detailed description of the study area environment is provided in Knight et al. (1987).

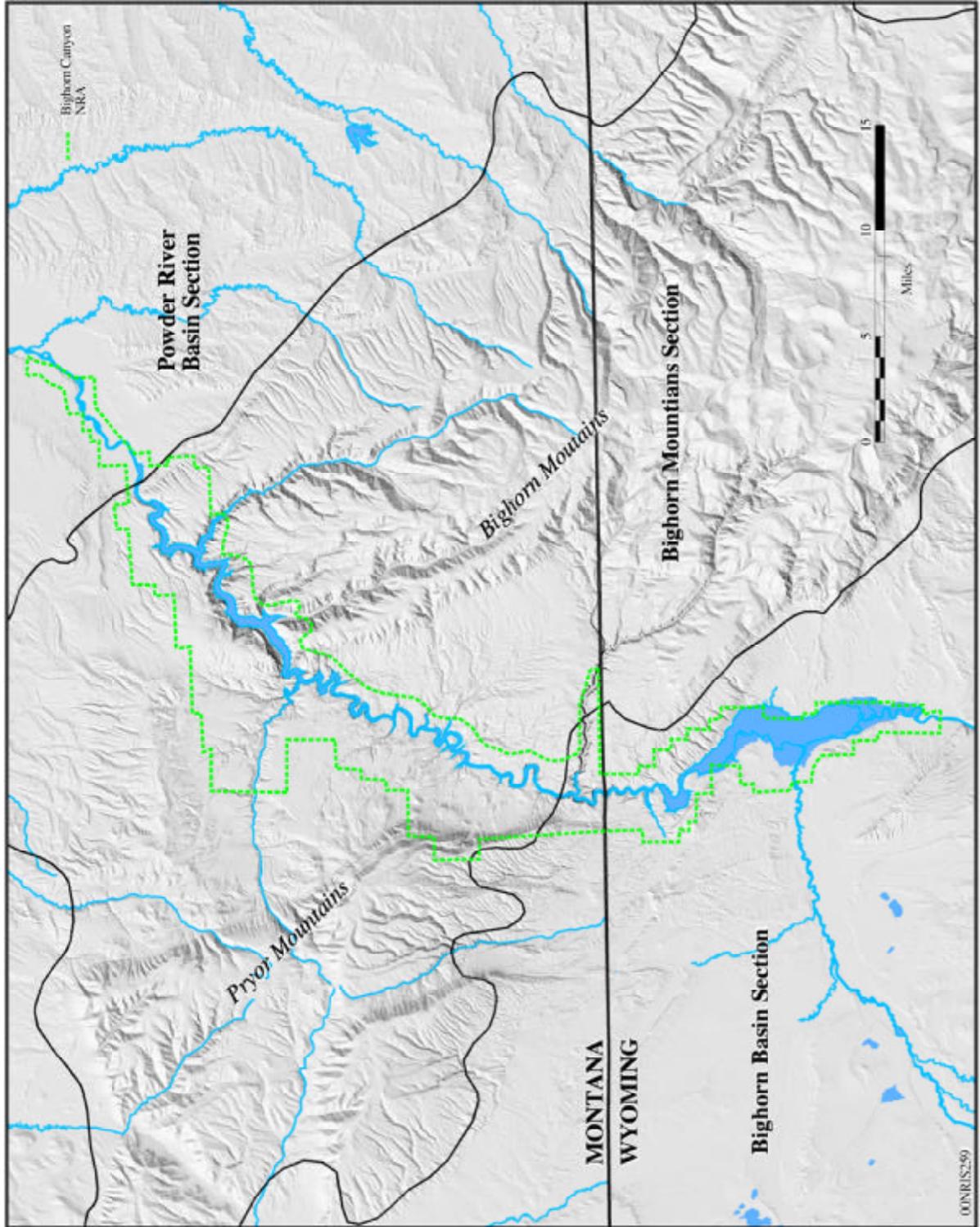
Bighorn Canyon National Recreation Area operates under a general management plan (USDI National Park Service 1981) in which management zones and subzones are delimited. Large areas of the study area fall within the “Natural Zone” which contains the most intact habitat. The following zones and subzones were considered in this study insofar as they fall within NPS administration or purview, and provide potential habitat for rare plants.

Natural Zone: Natural Environment, Wildlife Preservation, and Protected Natural Area subzones

Park Development Zone: (facilities, access developments)

Special Use Zone: Reservoir, Mining, Wildlife Management, Utilities, and Transportation subzones

Figure 2. Topography of Bighorn Canyon NRA area

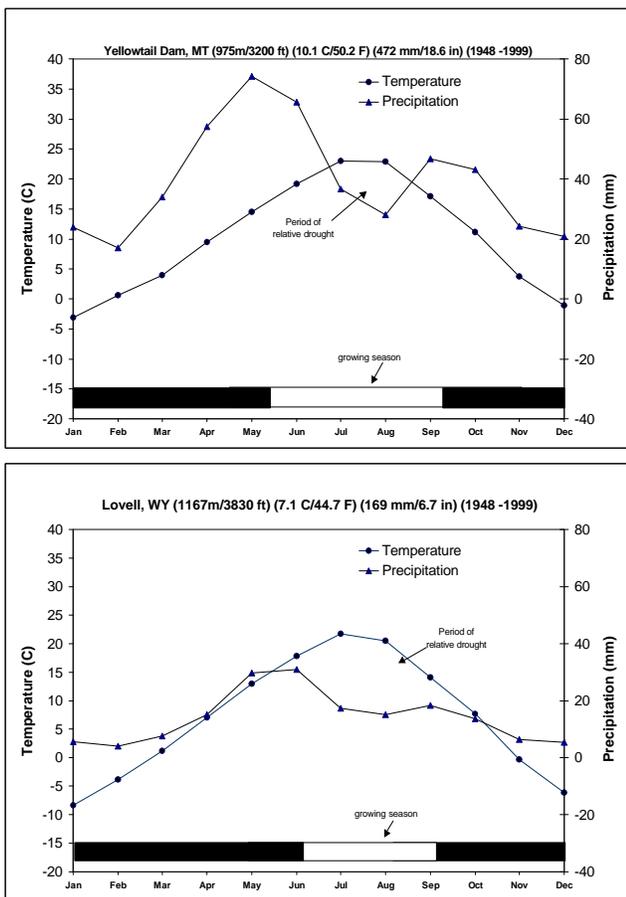


Climate

Bighorn Canyon NRA encompasses a range of climates along its length. The mean annual precipitation ranges from 17.0 cm (6.7 in) at its south end in Lovell, WY (NOAA records, 1948-1999) to 48.9 cm (18.9 in) at Yellowtail Dam, MT (NOAA records, 1948-1999).

The south end of the study area has a cold desert climate with a long period of relative drought. Lovell records may not represent the lowest mean annual rainfall values in the study area as found in the Pryor Mountains Desert of the Horseshoe Bend area. The north end of the study area, by contrast, has a mild foothills climate with high rainfall in the spring and a longer growing season (Figure 3).

Figure 3. Climate diagrams for Yellowtail Dam, MT and Lovell, WY, showing average monthly temperature and precipitation near north and south ends of Bighorn Canyon NRA. Growing season length is the number of frost-free days, i.e., with mean daily minimum above 0 degrees C.



Geology and Landforms

The Big Horn River follows a structural sag extending northward out of the Bighorn Basin. The Bighorn Mountains developed as a deep Laramide thrust fault and the Pryor Mountains as a fault block during regional uplifting about 50 million years ago (Alt and Hyndman 1986). More regional uplifting occurred over a prolonged period about 10 million years ago, allowing the Bighorn River to deeply incise its course into sedimentary beds of Paleozoic bedrock. Topographic relief ranges from 1114 – 2414 m (app. 3657-7920 ft). Paleozoic marine limestones are some of the most extensive and exposed outcrops on both the walls of the Canyon and the East Pryor Mountains escarpment (Richards 1955; discussed in Knight et al. 1987). Vast areas of the Bighorn Canyon are mantled by Tensleep Sandstone and Amsden Formation with beds of shale, red siltstone, and sandstone. Many springs and seeps are found where permeable sandstone overlies less permeable layers between the Hillsboro and Davis Ranches; and again above the rim of the Canyon south of Yellowtail Dam.

Perennial streams are few in this landscape, and many of the previously-mentioned springs and seeps disappear belowground before reaching the Bighorn River. The Shoshone River is the largest tributary of the Bighorn River, entering it in the open plains at the south end of the study area. The Porcupine Creek is the largest tributary within the Canyon. Cold-water tributaries include the Big Bull Elk Creek, East Cabin Creek, and Black Canyon Creek, at the northern end where the Canyon cuts through the Bighorn anticline.

Vegetation

The Bighorn Canyon NRA landscape is an open panorama where desert shrublands prevail at the southern end, arid woodlands cover vast expanses in the middle, and the landscape finally gives way to grassland at the far northern end. The canyon slices through and dissects the landscape; the deciduous woodland and other riparian vegetation types are confined to reservoir margins, tributaries and draws. Tall-stature conifer woodlands and forests are restricted to relatively mesic upland slopes, side-valleys and breaks on the Montana side. High plateaus, outwashes and ridges have grasslands or sagebrush steppe. Bighorn Canyon vegetation cover types are listed on the following page by their relative extent based on the preliminary mapping work of Myers et al. (1986):

Juniper and mountain mahogany woodlands	40%
Riparian vegetation (includes meadows, flats)	16%
Desert shrubland	15%
Sagebrush steppe	12%
Grasslands	8%
Coniferous woodland/forest	6%

This does not include the open water reservoir habitat that makes up over 18% of the total Bighorn Canyon NRA surface area. There are no human landscape alterations of similar magnitude in the uplands; only 1.7% of the land area has been plowed and used as agricultural land.

Flora

The diverse habitats of Bighorn Canyon NRA are reflected in its rich flora, which includes Great Basin species at the northern limits of their range, Rocky Mountain species, Great Plains species, a few eastern deciduous woodland species, regional endemics, and introduced species. A floristic overview is represented in Lichvar et al. (1985). The collections that were reported in this publication and over 30 species subsequently collected by NPS personnel are represented in the NPS database (USDI National Park Service 1998). Over 70 species were added in the course of this study to the NPS database (Table 1).

Table 1. Summary of the flora of Bighorn Canyon National Recreation Area

Taxonomic level	Tally in Lichvar et al. (1985)	Updated tally (NPS 1998 and this study)
Family	73	79
Genus	320	337
Species/ subspecific ranks	656	776*

* This tally includes species collected by NPS personnel since Lichvar et al. (1985), collected by Lichvar et al. but not reported, and collected or observed in this study. The NPS collection additions may include synonyms with the Lichvar et al. checklist. It does not include at least 22 more species reported in vegetation plots of Knight et al. (1987) that are probably part of the flora. There are also up to 23 specimens that have been annotated and which need to be subtracted from these tallies. Editing, curation, and additional collecting is warranted in producing a baseline flora.

Methods

Species were selected for field surveys by the Montana and Wyoming heritage programs based on global rarity, local or regional endemism, and state rarity. Highest priority was given to those species with limited geographic ranges (e.g., *Lesquerella lescicii*, *Eriogonum brevicaulum* var. *canum*), low population sizes (*Stanleya tomentosa* var. *tomentosa*), or specialized habitats (*Rorippa calycina*). Other species considered rare in one or both states, but not in jeopardy globally, were also surveyed (Appendix A). The list included all species previously documented in the study area, or with potential habitat in the study area based on available distribution and habitat information. They include species that are tracked as species of special concern or watch species, the latter including species of limited distribution and recent additions to the state flora under consideration for adding to the list of tracked species. Status review was built into the methods, and altogether a total of 55 species were targeted for survey over the course of the project.

Surveys were conducted in the summers of 1998 and 1999. Prior to conducting fieldwork, we assembled information on the biology, habitat needs, and known distribution of target species from heritage databases, published and unpublished literature, and herbarium specimens. Aerial photographs (black-and-white 10"/mile-1954, black-and-white 5"/mile-1954, and color 3"/mile-1978), USGS topographic maps, and geologic and vegetation maps were consulted to identify areas of potential habitat for ground survey. Bighorn Canyon NRA staff also provided valuable input on potential survey sites and their accessibility.

In the field, we collected data on the biology, habitat, population size, and potential management needs of the target species. Locations of rare plants were mapped on 7 ½ minute topographic quads. Information gathered in the field was entered into the computerized element occurrence database maintained by each state heritage program. Mapped locations were digitized into GIS coverages, including both point and polygon data.

Voucher specimens were collected for rare species and for documenting additions to the flora if the species was not already represented by specimens. Specimens

and accompanying label data are being submitted to the herbaria at Bighorn Canyon (BHC), University of Wyoming (RM) or University of Montana (MONTU). A working list of the study area flora was maintained, and additions to it were recorded in a copy of the NPS database noting repository and collection numbers (Appendix B). Photographs were also taken of species of concern and their habitats.

Fieldwork was conducted using current state floras as references (Dorn 1984, 1992). Nomenclature in this report follows the taxonomic conventions in these floras; similar to the original Bighorn checklist (Lichvar et al. 1985). Regional floras were used in the field for more detailed keys and descriptions (Hitchcock and Cronquist 1973, Great Plains Flora Committee 1986), and more detailed treatments and monographs were consulted as needed in processing collections.

Results

Six globally rare species were documented in Bighorn Canyon NRA, representing species of restricted distribution as local or regional endemics. Of these globally rare species, Rabbit buckwheat (*Eriogonum brevicaulle* var. *canum*) was found to be locally abundant and sufficiently widespread throughout the NRA to be considered secure under present management. Another of the species, Lesica's bladderpod (*Lesquerella lesicii*), barely enters the NRA, and is otherwise restricted to BLM-administered lands. For the other four globally rare species, Bighorn Canyon NRA has high numbers and is critical to their long-term survival. In total, 25 plant species of concern recognized by the Montana or Wyoming natural heritage programs are known from Bighorn Canyon NRA (Table 2), and we documented new populations for 17 of the 25 species.

The 19 "state priority" plants are mostly species at the northern or western margins of their distribution. These are mostly species that are rare in Montana but more common in Wyoming. Only the Sheathed musineon (*Musineon vaginatum*), a regional endemic, is rare in Wyoming. Its Montana status was evaluated in the course of the study.

Five of the species are new to the Bighorn Canyon NRA flora as represented by the NPS database, including:

- Gray Aster (*Aster glaucodes*);
- Sweetwater milkvetch (*Astragalus aretioides*) collected in 1953 near Bighorn Canyon; presumably outside current NRA boundaries;
- Pregnant sedge (*Carex gravida* var. *gravida*);
- Lesica's bladderpod (*Lesquerella lesicii*), first documented for Bighorn Canyon in Lesica 1995;
- Wind River milkvetch (*Oxytropis besseyi* var. *ventosa*)

In the following section, we present a summary of information on the identification, status, distribution, habitat, abundance, and management needs for 6 globally rare and 19 state rare plants from Bighorn Canyon NRA. They are a management reference for the Bighorn National Recreation Area and partners. This greatly enhances what is known about the respective species in each state, information that will be incorporated in updated field guides to plant species of special concern (Fertig et al. 1994, Montana Natural Heritage Program 1999). It is currently stored in databases that are available through technical services of MTNHP and WYNDD.

Apart from the species summary information, we have expanded the Bighorn Canyon NRA checklist (Appendix B). In addition, we have revised the contents as well as updated state and global ranks of Montana and Wyoming plant species of special concern and annual state list updates of species of special concern. This was most recently completed in 1999 (Fertig and Beauvais 1999, Heidel 1999). Finally, detailed maps and records are provided as hardcopy and electronic files as supplement to this report.

Scientific name	Common name	GRANK*	MT-SRANK*	No. in MT	WY-SRANK*	No. in WY
<i>Agrimonia gryposepala</i>	Common agrimony	G5	SU	1	S1	
<i>Arabis demissa</i> var. <i>languida</i>	Daggett rock cress	G4T4	S1	3	S2	
<i>Aster glaucodes</i>	Gray aster	G4G5	S1	1	S3	
<i>Astragalus aretioides</i>	Sweetwater milkvetch	G4	S2	1	S3	
<i>Astragalus geyeri</i> var. <i>geyeri</i>	Geyer's milkvetch	G3G4T3T4	S2	1	S3	P
<i>Astragalus oreganus</i>	Wind River milkvetch	G4?	S1	1	S3	P
<i>Carex gravida</i> var. <i>gravida</i>	Pregnant sedge	G5T?	S1	1	S2	
<i>Cleome lutea</i>	Yellow bee plant	G5	S1	1	S3	P
<i>Delphinium geyei</i>	Geyer's larkspur	G5	S1	2	S4	
<i>Erigeron allocotus</i>	Bighorn fleabane	G3	S3	3 (17)	S2S3	2 (20)
<i>Eriogonum brevicaulis</i> var. <i>canum</i>	Rabbit buckwheat	G3	S3	3 (52)	S2	2 (30)
<i>Eupatorium maculatum</i> var. <i>bruneri</i>	Joe-pye weed	G5TU	S2	3	S2	
<i>Grayia spinosa</i>	Spiny hopsage	G5	S2	1	S3S4S3	P
<i>Leptodactylon caespitosum</i>	Leptodactylon	G3G4	S1	4	S3	P
<i>Lesquerella lesicii</i>	Lesica's bladderpod	G1	S1	1	not in WY	
<i>Mentzelia pumila</i> var. <i>pumila</i>	Dwarf mentzelia	G4	S2	2	S3	P
<i>Musineon vaginatum</i>	Sheathed musineon	G3?	S3	4	S2	
<i>Oxytropis besseyi</i> var. <i>fallax</i>	Bighorn locoweed	G5T3	SU	2	S3	P
<i>Oxytropis besseyi</i> var. <i>ventosa</i>	Wind River locoweed	G5T3	SU	1	S3	
<i>Rorippa calycina</i>	Persistent sepal yellowcress	G3	S1	0	S2S3	1 (11)
<i>Senecio eremophilus</i> var. <i>eremophilus</i>	Cut-leaved groundsel	G5T5	S1	1	S3	
<i>Sphenopholis intermedia</i>	Slender wedgegrass	G5	S1	1	S2	
<i>Stanleya tomentosa</i> var. <i>tomentosa</i>	Hairy prince's-plume	G3T3	S3	12	S2	2 (4)
<i>Stipa lettermanii</i>	Letterman's needlegrass	G5	S1	2	S3S4	P
<i>Sullivantia hapemanii</i> var. <i>hapemanii</i>	Wyoming Sullivantia	G3T3	S1	9	S3	

*** Rank Definition**

A rank prefaced by “G” refers to global rank, i.e. rangewide rank. A rank prefaced by “S” refers to state rank, determined separately from grank but by much the same standards within state boundaries.

- 1 Critically imperiled because of extremerarity (usually 5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction.
- 2 Imperiled because of rarity (usually 6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extinction throughout its range.
- 3 Vulnerable because of rarity (usually 21 to 100 occurrences) or found in a restricted range even though it may be abundant at some of its locations.
- 4 Apparently secure, though it may be quite rare in parts of its range, especially at the periphery.
- 5 Demonstrably secure, though it may be quite rare in parts of its range, especially at the periphery.
- U Possibly in peril, but status uncertain, more information needed.
- H Historical, known only from records over 50 year ago, may be rediscovered.

Globally-rare Plant Species Summaries

Erigeron allocotus Blake Bighorn fleabane Asteraceae (Sunflower Family)

Status

Heritage Rank: Global - G3, Montana - S3 [watch; formerly listed as a species of special concern (Lesica and Shelly 1991), but downlisted to a watch species of limited distribution following the discovery of numerous occurrences in the Pryor Mountains by Lesica and Achuff (1992); Wyoming - S2S3 [Medium conservation priority].

Legal Status: USF&WS - former 3C; BLM (MT) - Watch, BLM (WY) - None. USFS - None.

Description

Bighorn fleabane is a perennial forb with leafy stems 13-18 cm tall surmounting a branched, woody taproot

Figure 4. Illustration of *Erigeron allocotus*



Illustration by Walter Fertig

(figures 4, 5). Stems and leaves are conspicuously pubescent with coarse, spreading hairs. The leaves may also be finely glandular and are divided at the tip into 3-5 teeth or linear segments. Basal leaves are 1.5-3 cm long, while stem leaves are mostly under 1 cm and simple to 3-toothed. Flowering heads are small and numerous, each having a 4-5 mm high involucre of glandular and hirsute bracts, 25-40 white to pinkish ray flowers that are 3-6 mm long, and a yellow-flowered disk 6-9 mm wide with disk corollas 2-3.5 mm long. The pappus consists of 12-20 bristles 2-2.5 mm long. Fruits are 2-nerved achenes with short stiff hairs (Blake 1937, Cronquist 1947, Dorn 1992, Marriott and Jones 1989).

Figure 5. Photo of *Erigeron allocotus*



Photo by Bonnie Heidel

Similar Species: *Erigeron compositus* has short pubescence, leafless (or nearly so) stems, leaf blades cleft into 5-10 narrow segments, and often has fewer and larger flowers. *E. pinnatisectus* has pinnately-divided leaf blades, purple ray flowers, leafless stems, and is not known from the Bighorn Range (Dorn 1992).

Flowering/Fruiting Period: Flowering occurs from May to early July. Fruits are present from June to late July.

Range and Habitat

Range: Bighorn fleabane is a regional endemic of the Bighorn and Pryor mountains and adjacent foothills in north-central Wyoming and south-central Montana. In Montana, it is restricted to the eastern end of the Pryor Mountains and adjoining Bighorn Canyon area in one large area that spans Big Horn and Carbon counties.

Figure 6. Montana and Wyoming county distribution of *Erigeron allocotus*

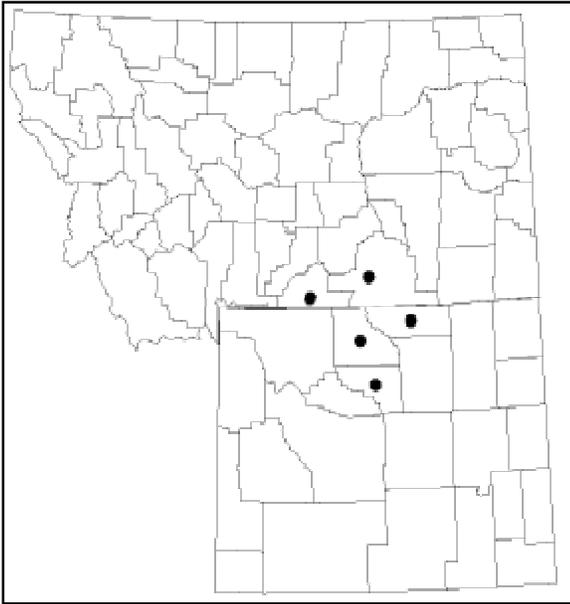
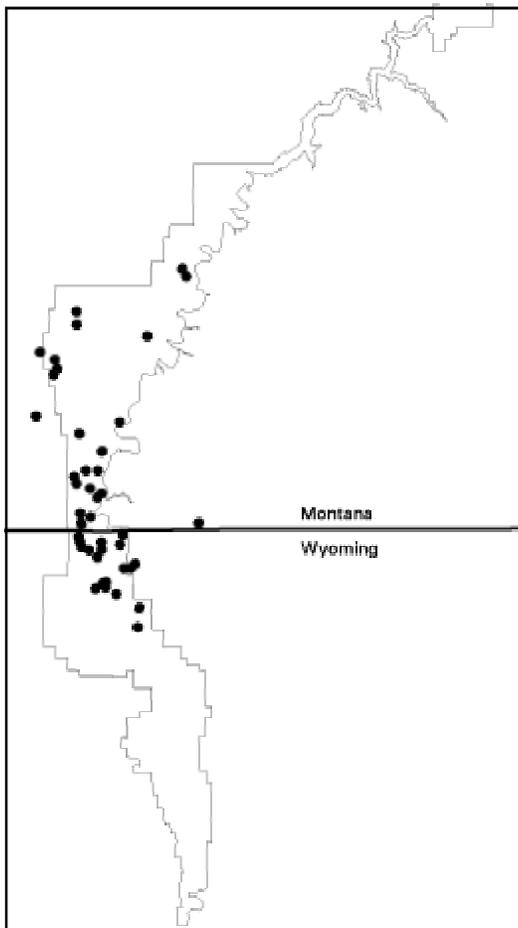


Figure 7. Distribution of *Erigeron allocotus* in Bighorn Canyon NRA



In the Bighorn Canyon, *Erigeron allocotus* forms three large population complexes on the east and west sides of Yellowtail Reservoir and the escarpment on the east flank of the Pryor Mountains. These three complexes converge in Montana and are more or less contiguous with populations in the east Pryor Mountains (Lesica and Achuff 1992). These contiguous population complexes might be a single metapopulation, very widely scattered over an area that is up to 15 miles long and 8 miles wide; the majority of the area lying within Bighorn Canyon NRA.

Habitat: Bighorn fleabane is found primarily on limestone and calcareous sandstone tablelands, rims, cliffs, and talus slopes. It is often part of cushion plant communities within sparse grasslands that lie within *Juniperus osteosperma* woodlands, *Cercocarpus ledifolius* scrub, or sagebrush (*Artemisia tridentata* or *A. nova*) steppe. It also grows in crevices of otherwise unvegetated outcrops. Bighorn fleabane is consistently found on the Madison, Amsden, and Tensleep formations, although large colonies have also been found on outcrops of the Chugwater Formation within sagebrush grasslands plains. Its exposed habitat is maintained in early stages of natural succession by the forces of wind and water. Populations range in elevation from 3680-7600 feet.

Figure 8. Mountain mahogany and escarpment habitats of *Erigeron allocotus*



Photo by Bonnie Heidel

In Bighorn Canyon NRA, Bighorn fleabane is commonly found in sparsely-vegetated cushion plant communities and outcrops on plateaus and rims of Tensleep Sandstone, Amsden sandstone and limestone, and Madison limestone (Figures 8 and 9). These

settings lie within a matrix of *Juniperus osteosperma* and *Cercocarpus ledifolius* woodlands, as well as on the barren rim and breaks above the canyon, and on the sparsely-vegetated escarpments marking the east flank of the Pryor Mountains. Plants are usually restricted to moisture-accumulating fissures in the bedrock covered by a thin layer of whitish rocky-sandy soil or sandstone and limestone gravel chips. Common associated species include *Haplopappus armerioides*, *Phlox hoodii*, *Gutierrezia sarothrae*, *Hedeoma drummondii*, *Leptodactylon caespitosum* (at the south end of the Canyon), and *Eriogonum pauciflorum*.

Figure 9. Canyon rim habitat of *Erigeron allocotus*



Photo by Bonnie Heidel

Bighorn fleabane also occurs in cushion plant communities on terrace rims of red clay covered with dolomite gravel. These sites are often dominated by *Hymenoxys acaulis*, *Arenaria hookeri*, *Phlox bryoides*, *Eriogonum brevicaulis* var. *canum*, and *Elymus spicatus*. On the east side of Yellowtail Reservoir, *E. allocotus* can also be found on steep upper slopes and rims of gravel and loose soil derived from the Goose Egg Formation. These sites may be locally dominated by *Artemisia nova*, *Phlox bryoides*, *Eriogonum pauciflorum*, *Elymus spicatus*, and occasional *Artemisia tridentata*. In all habitats, Bighorn fleabane is usually restricted to areas with less than 10% vegetative cover. Following the vegetation classification of Knight et al. (1987), *Erigeron allocotus* habitat falls into the Windswept Plateau, Juniper Woodland, and Mountain Mahogany Shrubland types.

Abundance

Population Size: In Montana, Bighorn fleabane is known from the Pryor Mountains/Bighorn Canyon area where it is widely distributed and uncommon to locally abundant (Lesica and Achuff 1992; and this study). There are currently 17 extant occurrences in Wyoming, consisting of at least 50 subpopulations, including two of the three vast Bighorn Canyon population complexes that span the state line and are the largest in the state. Wyoming populations range in size from fewer than 25 plants to over 20,000 individuals. There are currently 36 or more subpopulations in Montana. Total species numbers rangewide total in the millions, although confined to a total area that is much less than the size of a typical county in either state, and occupying a very small fraction of the terrain across that area.

There are over 20 subpopulations of this species along the west and east sides of Yellowtail Reservoir in the Wyoming portion of the Bighorn Canyon NRA (WY element occurrences 010 and 023) numbering between 13,600-19,500 individuals. There are over 16 subpopulations of this species along the west side of Yellowtail Reservoir in Montana as far north as the northern end of the Pryor Mountains and one collection from the east side. Bighorn Canyon subpopulations are contiguous with 19 other Montana locations known for the species in Carbon County (MTNHP element occurrence records prior to 1992; and Lesica and Achuff 1992). The highest densities are in cushion plant communities and broken terrain adjoining them, but cushion plant communities are not as extensive as the species' cliff and escarpment habitat where widely-scattered plants are present over very large areas.

Trends: Most populations are thought to be stable under present management.

Management

Threats: Threats are low overall, and limited mostly to habitat disturbance (road construction, heavy trampling). While most of the habitat is in a state of early succession, it is not prone to destabilizing erosion. Grazing appears to be a low threat due to the plants' largely inaccessible habitat. It is possible that lower-elevation segments of populations were lost when Yellowtail Reservoir inundated the canyon, and a very small fraction of current Bighorn Canyon populations are near the highwater mark.

Protection Status: The Bighorn Canyon NRA encompasses three population complexes; two of which extend into Wyoming. The East Pryor Mountains ACEC population complexes are basically contiguous with Bighorn Canyon population complexes. Elsewhere, in Wyoming, one large occurrence is protected within The Nature Conservancy's Tensleep Preserve and five others are found within the Spanish Peak Karst and Little Mountain ACECs, and Shell Canyon Research Natural Area. One population is also found within a TNC conservation easement on the east slope of the Bighorn Range. Six occurrences are found in the potential Elephant Head, Tensleep Canyon, and Dry Fork Research Natural Areas and the Medicine Lodge and Trapper Peak Wilderness Study Areas. All other occurrences are on public lands managed for multiple use.

Land Ownership: The species occurs on lands managed by Bighorn National Forest, Bighorn Canyon National Recreation Area, and the BLM Billings, Cody, and Worland Field Offices.

Management Comments: Most individual colonies of Bighorn fleabane in Bighorn Canyon NRA are protected by their inaccessibility and require no special management attention, especially those on the east side of Yellowtail Reservoir in Wyoming, and on cliffs and escarpments in Montana. Impacts to populations in more accessible areas by surface-disturbing activities, such as trampling or camp ground and road development, are to be avoided.

Bighorn Canyon NRA Significance

Surveys by Lesica and Achuff (1992) and Heidel, Fertig, and Welp in 1998-99 have demonstrated that Bighorn fleabane is widespread and locally common within suitable habitats of the Bighorn Canyon NRA and adjoining Pryor Mountains. Bighorn Canyon NRA harbors 3 of the 11 protected populations for this species rangewide. They are the most extensive and part of the largest populations of this species throughout its entire range. The long-term survival of this species is conditioned by its status in the NRA. Bighorn fleabane is recommended for consideration by the National Park Service as a rare species, emphasizing conservation of its cushion plant community habitats.

Eriogonum brevicaule* Nutt. var. *canum (Stokes) Dorn Rabbit buckwheat Polygonaceae (Buckwheat Family)

Synonym: *Eriogonum x lagopus* Rydb.

Status

Heritage Rank: Global – G3; Montana - S3 [watch; formerly listed as a species of special concern (Lesica and Shelly 1991) but downlisted to a watch species of limited distribution following the discovery of numerous large colonies in the Pryor Mountains by Lesica and Achuff (1992)]; Wyoming - S2 [Medium conservation priority]. May be removed from watch list in Montana based on this study.

Legal Status: USF&WS – former C2 (dropped as a candidate in 1996 with the elimination of the C2 program). BLM – None. USFS – None.

Description

Description: Rabbit buckwheat is a woody-based perennial with white-woolly stems 15-30 cm tall, surmounting a highly branched taproot (Figures 10,

Figure 10. Illustration of *Eriogonum brevicaule* var. *canum*

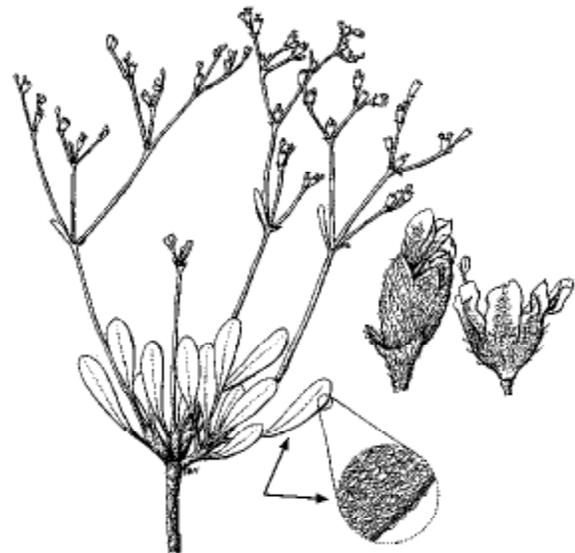


Illustration by Isobel Nichols
From "Wyoming Rare Plant Field Guide"

11). The leaves are linear-oblongate, densely white tomentose, and distinctly petioled. The yellow flowers are 1-2.5 mm long, hairy, lack a narrow, stipe-like base, and are arranged in an open, branched, woolly, umbel-like inflorescence (Clark and Dorn 1979, Fertig et al. 1994).

Figure 11. Photo of *Eriogonum brevicaule* var. *canum*



Photo by Bonnie Heidel

There has been much confusion in the literature regarding the taxonomy of this plant (Fertig 1999). It was originally described as a separate species (*Eriogonum lagopus*) by Rydberg in 1917 based on a Tweedy collection from the Dayton area in 1899 (Rydberg 1917) on the east slope of the Bighorns in Wyoming. Stokes (1936) created the name *E. multi-ceps* ssp. *canum* for Montana plants representing the same taxon. Reveal synonymized this name under *E. pauciflorum* var. *canum* in 1967, but later revived the name *E. lagopus* for the whole species (Reveal 1967, 1969). Reveal considered Rabbit buckwheat to be a fertile hybrid between *E. brevicaule* and *E. pauciflorum*. Dorn and others have studied the type specimen of *E. lagopus* and found that it does not cleanly represent the characteristic features of the taxon. Dorn proposed the name *E. brevicaule* var. *canum* to underscore its relationships with *E. brevicaule* (especially var. *micranthum*) (Clark and Dorn 1979, Dorn personal communication to Lesica 1992, Fertig 1999).

Similar Species: Other varieties of *Eriogonum brevicaule* differ in having glabrous stems and flowers or congested, head-like inflorescences. *E. pauciflorum* has pinkish-white flowers in a head-like inflorescence and matted stems. *E. flavum* has large, leaf-like bracts at the base of the umbel of flowers and

Figure 12. Montana and Wyoming county distribution of *Eriogonum brevicaule* var. *canum*

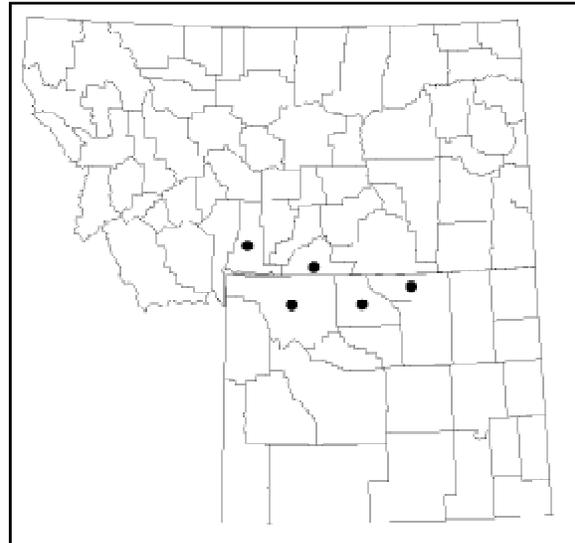
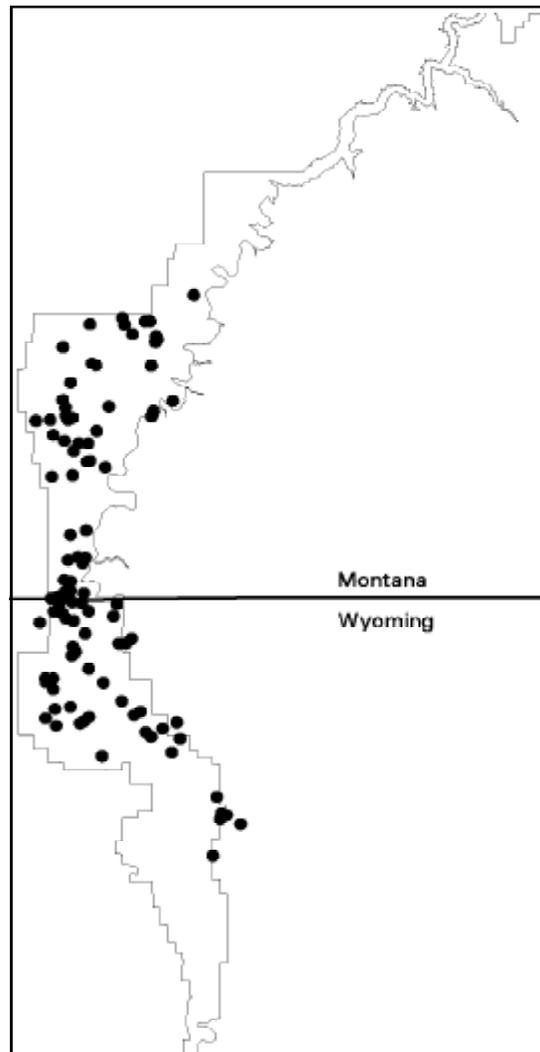


Figure 13. Distribution of *Eriogonum brevicaule* var. *canum* in Bighorn Canyon NRA



a stipe-like base above the true flowering pedicel. Vegetative specimens of *Senecio canus* have a more matted growth form.

Flowering/Fruiting Period: June-September.

Range and Habitat

Range: Rabbit buckwheat is a regional endemic of southern Montana and north-central Wyoming. In Wyoming, this species is known from the northern Bighorn Basin and east and west flanks of the Bighorn Range in Big Horn, Park, and Sheridan counties. Montana populations are centered in the Pryor Mountain desert region in Carbon County, where it was known from 45 sites. The species has also been reported from Treasure County and a historic collection near Livingston in Park Co. (MTNHP element occurrence records prior to 1992, and Lesica and Achuff 1992).

Habitat: Across its range, Rabbit buckwheat occurs commonly on barren to sparsely vegetated redbed clay or sandy soils in cushion plant, juniper woodland, and sagebrush steppe communities (Lesica and Achuff 1992; Fertig et al. 1994). It is also found on dolomite,

Figure 14. Chugwater Formation habitat of *Eriogonum brevicaule* var. *canum*



Photo by Laura Welp

sandstone, and siltstone outcrops and rims. Populations range in elevation from 3700-5500 feet. In Bighorn Canyon, *Eriogonum brevicaule* var. *canum* can be found on most upland shrub steppe and sparse grassland habitats at least as far north as Deadman Creek. It is abundant on Chugwater Formation redbed clay barrens dominated by scattered *Chrysothamnus nauseosus* var. *nauseosus*, *Artemisia tridentata* var.

wyomingensis, *Atriplex confertifolia*, or *Gutierrezia sarothrae* (total vegetative cover is usually 10-20%; Figure 14). Populations may also be locally abundant in cushion plant communities on terraces or gently dipping slopes of reddish clay and dolomite pebbles derived from the Goose Egg Formation. Common

Figure 15. Limestone habitat of *Eriogonum brevicaule* var. *canum*



Photo by Laura Welp

associated species at these sites include *Haplopappus nuttallii*, *Arenaria hookeri*, *Hymenoxys acaulis*, *Astragalus hyalinus*, and *Elymus spicatus*. In some areas, *E. brevicaule* var. *canum* itself may be one of the dominant forbs, and “*Chrysothamnus nauseosus*/*Eriogonum brevicaule* var. *canum* p. a.” was provisionally identified as a distinct plant association in the Pryor Mountains (DeVelice and Lesica 1993). Rabbit buckwheat is present, but less abundant, in *Cercocarpus ledifolius* woodlands and openings within *Juniperus osteosperma* woodlands on outcrops of Tensleep Sandstone, Madison Limestone, and dolomite covered by small gravel (Figure 15). These sites may be locally dominated by low shrubs, cushion plants, or sparse grasslands with total vegetative cover under 20%. It is consistently found in well-developed cushion plant communities, often in low numbers,

where it is associated with *Hymenoxys acaulis*, *Arenaria hookeri*, *Phlox bryoides*, *Erigeron allocotus*, *Townsendia spathulata* and *Elymus spicatus*. It is occasional or rare in *Artemisia nova* communities and grassland communities where it is associated with *Senecio canus*, *Artemisia frigida*, *Elymus spicatus*, *Bouteloua gracilis*, and *Linum lewisii*. Knight et al. (1987) reported “*Eriogonum brevicaule*” (presumably var. *canum*, following Lichvar et al. 1985) from the Mixed Desert Shrubland, Windswept Plateau, Basin Grassland, Sagebrush Desert Shrubland, Sagebrush Steppe, Juniper Woodland, and Mountain Mahogany Shrubland vegetation types.

Abundance

Population Size: Although they vary in size, most individual populations of Rabbit buckwheat are abundant or even locally dominant (DeVelice and Lesica 1993). Prior to 1998, this species was known from only six extant and one historical population in Wyoming, all of which were thought to be small. Surveys in the Wyoming portion of Bighorn Canyon NRA in 1998-99 resulted in the discovery of nearly 50 subpopulations numbering over 200,000 individuals. Lesica and Achuff (1992) reported 40 large populations in the Pryor Mountain desert area in 1992 and over 50 subpopulations have been reported in the Montana portion of the Bighorn Canyon NRA.

Trends: Although no long-term monitoring studies have been conducted, this species is presumed to be stable at present.

Management

Threats: Individual plants or small subpopulations may be threatened by recreational activities and road construction. There is little evidence that this species is regularly grazed by livestock or wild horses, though it is palatable. It appears to be present in similar numbers on both sides of fencelines that separated grazed from ungrazed conditions within the study area.

Protection Status: Two extensive Wyoming population complexes are protected within Bighorn Canyon National Recreation Area, two of which extend into the BLM Little Mountain Area of Critical Environmental Concern and the BLM East Pryor Mountain Area of Critical Environmental Concern. Other populations are on federal or state public lands managed for multiple use.

Land Ownership: Occurs in Bighorn Canyon National Recreation Area and lands managed by the BLM Billings and Cody Field Offices.

Management Comments: *Eriogonum brevicaule* var. *canum* is locally abundant in a number of vegetation types that cover large areas of the landscape, and has few threats. No special management is required to ensure the survival of this species. It is sometimes concentrated in or adjoining cushion plant communities, which may warrant more detailed documentation as habitats of special management concern.

Bighorn Canyon NRA Significance

Bighorn Canyon NRA supports the largest known populations of Rabbit buckwheat in Wyoming, conservatively estimated at over 200,000 plants, as well as extensive contiguous populations on the Montana side. Rabbit buckwheat is not considered a species of special concern in Montana and in light of discoveries at Bighorn Canyon, it will probably be downlisted to WYNDD’s “watch list” in the near future. This species is not recommended for consideration by the National Park Service as a rare species.

***Lesquerella lesicii* Rollins**

Lesica’s bladderpod

Brassicaceae or Cruciferae (Mustard Family)

Status

Heritage Rank: Global Rank - G1; Montana - S1; Wyoming - not present

Legal Status: USF&WS Status - None, BLM Status (MT) - Sensitive. USFS Status - None.

Description

Description: Lesica’s bladderpod is a short-lived perennial with few, unbranched, prostrate to ascending stems that arise from an unbranched rootcrown and taproot (Figure 16). The basal leaves have petioles that are 1-3 cm long and spade-shaped blades that are shorter than the petiole with entire margins. The alternate stem leaves are much smaller, broadly lance-shaped, and without petioles. Foliage is sparsely covered with sessile, star-shaped hairs. Yellow, stalked flowers are borne at the tops of the stems in a narrow inflorescence that elongates as the fruit matures. Each

Figure 16. Photo of *Lesquerella lesicii*



Photo by Peter Lesica

flower has 4 separate petals, 4 separate sepals, and 4 long and 2 short stamens. The globose siliques have a short style on top and are borne on reflexed stalks. It was first collected by Peter Lesica in 1991, and only recently described by Reed Rollins (1995).

Similar Species: The globose, unlobed siliques borne on reflexed stalks when mature separate this plant from other species of *Lesquerella* in our area, except for *L. ludoviciana*, which has narrowly elliptic to lance-shaped leaf blades. It is most closely related to *Lesquerella fremontii*, a state endemic of Wyoming, from which it differs in having basal leaves with very thin petioles that expand abruptly to the blade, and fruiting pedicels that are thread-like and fragile (Lesica 1995). It superficially resembles lax forms of the widespread *Lesquerella alpina*.

Flowering/Fruiting Period: Flowering in mid-late June; fruits needed for positive identification.

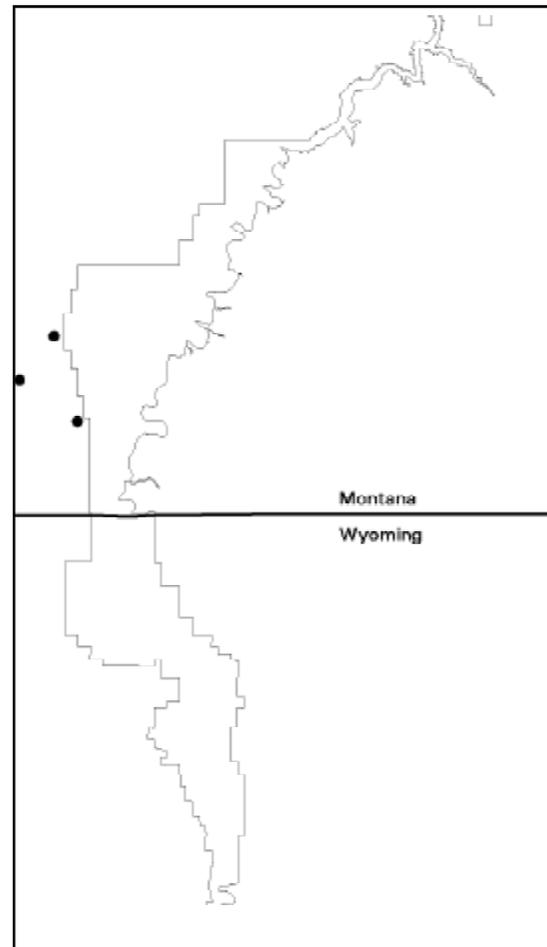
Range and Habitat

Range: Lesica's bladderpod is a state endemic known only from the Pryor Mountains of Carbon County, Montana. It has been documented from a total of three separate areas in the East Pryor Mountains, including two segments of Sykes Ridge, which

Figure 17. Montana and Wyoming county distribution of *Lesquerella lesicii*



Figure 18. Distribution of *Lesquerella lesicii* in Bighorn Canyon NRA



overlooks Bighorn Canyon NRA and represents the easternmost ridge in the Pryor Mountains. It has been surveyed over large areas of the Pryor Mountains on BLM and USFS land, but has not been surveyed on similar habitat in the Big Horn Mountains of the Crow Indian Reservation, or adjacent Big Horn National Forest of Big Horn and Sheridan counties, Wyoming. Outliers of the Sykes Ridge populations are found in Bighorn Canyon NRA scattered on rocky slopes near the head of Layout Creek and across the escarpment face. This is perhaps the most geographically restricted of globally rare species in the Bighorn Canyon study area, and the center of its known distribution is directly adjoining but outside of the study area.

Habitat: It is restricted to gravelly, limestone-derived soil of open ridges and slopes surrounded by woodlands of *Pinus flexilis*, *Pseudotsuga menziesii* and *Cercocarpus ledifolius* in the montane zone at 5300-7600 ft. Soils are derived from Madison limestone with a high proportion of coarse fragments. It occurs in two sparsely-vegetated plant associations with 50-80% of the soil surface barren (Lesica 1995). In the Bluebunch Wheatgrass – cushion plant fellfields it grows with *Draba oligosperma*, *Elymus spicatus*, *Eritrichium howardii*, *Lomatium cous*, *Haplopappus acaulis*, *Hymenoxys torreyana*, *Phlox hoodii*, and *Potentilla ovina*. In the *Juniperus scopulorum* – *Cercocarpus ledifolius* communities, it grows with *Juniperus osteosperma* (replacing *J. scopulorum* at lower elevations), *Artemisia nova*, *Artemisia tridentata*, *Symphoricarpos oreophilus*, *Carex rossii*, *Cerastium arvense*, *Haplopappus acaulis*, *Koeleria macrantha*, *Lesquerella alpina*, and *Musineon vaginatum*.

Figure 19. Escarpment habitat of *Lesquerella lesicii*



Photo by Bonnie Heidel

In Bighorn Canyon, it occurs on generally steep, rocky slopes of Bluebunch Wheatgrass – cushion plant community that are generally inclusions across the slope face among scree, or areas dominated by *Cercocarpus ledifolius* and *Pseudotsuga menziesii* (Figure 19).

Abundance

Population size: Lesica's bladderpod is known from three occurrences with estimated population numbers ranging from 1,000 – 100,000 individuals. It is often uncommon or occasional where it is found, but there are areas of notably high density on Sykes Ridge, where there is the largest population. It is most common on ridgetop settings, and sparser on ridge slopes. Two of the three occurrences have minor extensions into Bighorn Canyon NRA. The slopes above Layout Creek have 100+ plants as fringes or outliers of the main ridgetop population. The semi-sheltered nature of the area may be most conducive to this species of available Bighorn Canyon habitat. The East Pryor Mountains escarpment elsewhere has very low numbers that may be outliers from the nearest ridgetop populations.

Trends: This species has a delicate stature and unbranched caudex, suggesting that it is a short-lived perennial (Lesica 1995). As such, climate-induced population fluctuations are likely. The species has not been monitored to determine trends or demography.

Management

Threats: There may have been direct impacts to the species in the trailing and terracing through its habitat, most likely the results of horses foraging for grass, and the extent of trampling and terracing by wild horses in species' habitat may warrant monitoring on BLM land (Lesica 1995). The steep, remote sites on Bighorn Canyon NRA are not affected by trailing.

Considering the frail growth form and the harsh environment, it is likely to both benefit by and compete with surrounding vegetation, depending on the yearly climates. This phenomenon has been documented for other rare members of the genus and has the effect of buffering climate extremes (Greenlee and Callaway 1996). The vegetation characteristics of its habitat are not readily affected by management actions or policy, except as potential large-scale changes to the landscape, like fire and disease, are involved.

Protection Status: It is designated as a BLM sensitive species in Montana.

Land Ownership: All known occurrences of this species are on BLM-administered lands, with the exception of the population outliers extending into Bighorn Canyon NRA.

Management Comments: There are no immediate management needs for Lesica's bladderpod on Bighorn Canyon NRA, but management of horses and their traffic from the study area to the adjoining Wild Horse Management Range potentially affects the species. Species' establishment requirements and the affects of terracing warrant documentation on adjoining BLM lands.

This species occupies sparsely-vegetated habitat on otherwise forested ridges. Its response to fire is not known.

Bighorn Canyon NRA Significance

Lesica's bladderpod is the most globally rare of the species known from Bighorn Canyon NRA. It barely enters the area in having scattered plants in low numbers, representing population outliers. Considering that it is a narrow endemic, the intact environmental gradient represented by the east face of the Pryor Mountains escarpment is important buffer to the species. Management recommendations regarding wild horse trampling and terracing (Lesica 1995) pertain to the species' ridgetop habitat on adjoining BLM lands. This is among the highest species priorities for coordination with BLM in management affecting Sykes Ridge among the species shared in common with adjoining BLM lands.

***Rorippa calycina* (Engelm.) Rydb.** Persistent-sepal yellowcress Brassicaceae or Cruciferae (Mustard Family)

Status

Heritage Rank: Global – G3; Montana - S1; Wyoming - S2S3 [Medium conservation priority]; North Dakota - SH.

Legal Status: USF&WS – former C2 (dropped as a candidate in 1996 with the elimination of the C2 program). BLM – None. USFS – None.

Description

Description: Persistent-sepal yellowcress is a rhizomatous perennial herb with upright or spreading stems 10-40 cm tall (Figures 20, 21). The stems and foliage are pubescent throughout with stiff, unbranched hairs.

Figure 20. Illustration of *Rorippa calycina*

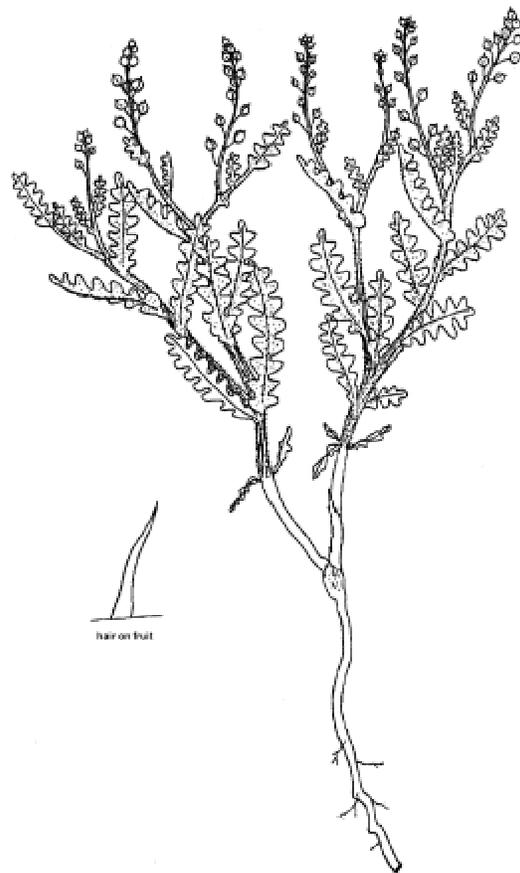


Illustration by Jane Dorn
From "Wyoming Rare Plant Guide"

Stem leaves are pinnately divided or wavy-lobed, sessile, and 2.5-5 cm long. The flowers are borne in terminal and axillary inflorescences and have 4 yellow petals 3-5 mm long and 4 sepals that persist in fruit. Fruits are ovoid to nearly globose, 2-4 mm long, and conspicuously pubescent with unbranched hairs that are broadest at the base. Styles in fruit are 1-2 mm long and glabrous (Stuckey 1972; Hitchcock et al. 1964; Clark and Dorn 1979; Dorn 1992; Rollins 1993; Fertig et al. 1994; Fertig and Welp 1998).

Similar Species: *Rorippa sinuata* has elongate, glabrous fruits over 5 mm long, deciduous sepals, and round, glassy, ball-like hairs on the leaves. *R. curvipes* often has white petals, finely hairy sepals, deeply pinnate leaves and glabrous to sparsely hairy fruits and leaves. All other Montana and Wyoming species of *Rorippa* are taprooted annuals or biennials with longer, more erect stems and fruits that are either round or narrowly elongate. Seedlings of *Ambrosia tomentosa* have wider leaves with whitish undersides. Seedlings of annual *Potentilla* species have 3-5 round-lobed leaflets (Fertig and Welp 1998).

Figure 21. Photo of *Rorippa calycina*



Photo by Jennifer Whipple

Flowering/Fruiting Period: Flowers from late May to August, although blooming may extend into October under favorable circumstances. May also reproduce asexually by rhizomes.

Range and Habitat

Range: Persistent-sepal yellowcress is a regional endemic of eastern Montana, adjoining North Dakota, and central Wyoming. Its seeds are carried by water-fowl and there is record of a disjunct population 2,500 miles to the north on the Arctic coast of Canada's

Figure 22. Montana and Wyoming county distribution of *Rorippa calycina*

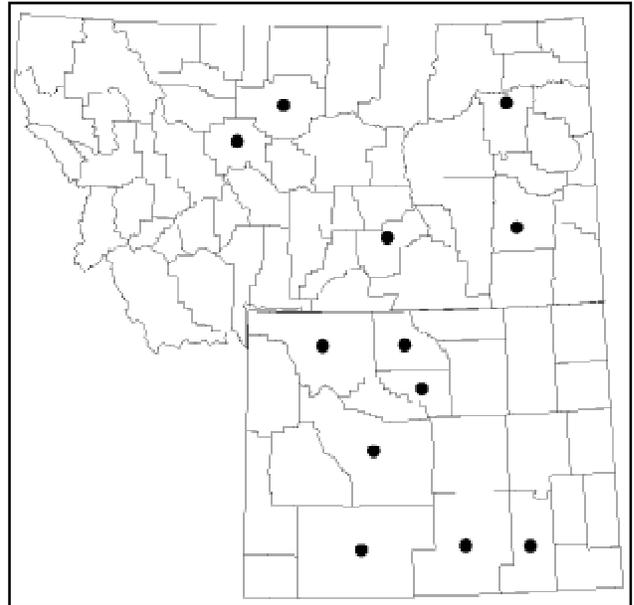
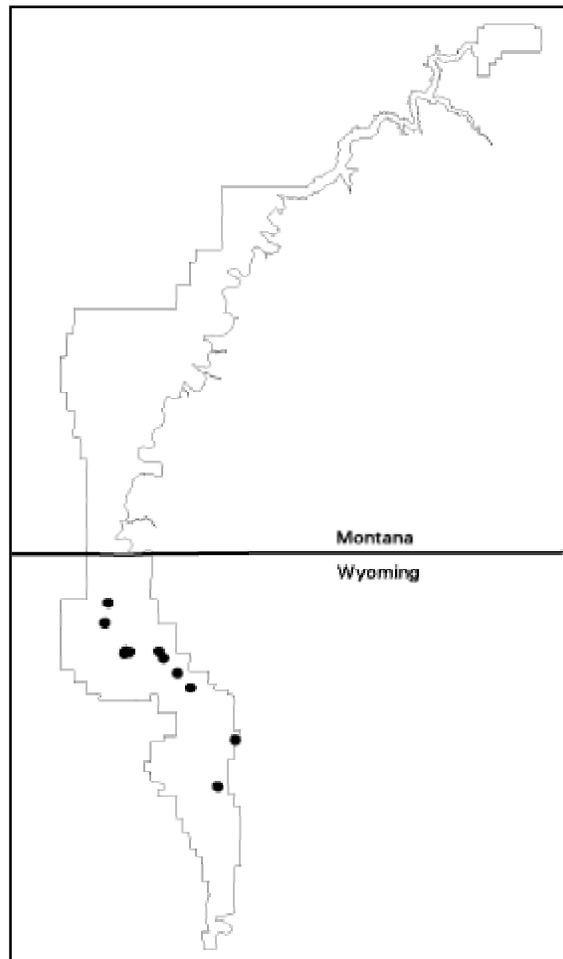


Figure 23. Distribution of *Rorippa calycina* in Bighorn Canyon NRA



Northwest Territories (Mulligan and Porsild 1966). In Wyoming, it is known from the Bighorn Basin, North Platte River drainage, and Great Divide, Green River, and Wind River basins in Albany, Big Horn, Carbon, Fremont, Park, Sweetwater, and Washakie counties (Fertig and Welp 1998). In Montana, it was known from the Missouri and Yellowstone River drainages, including historic records from Cascade, Custer and Yellowstone counties, and two recent records from Choteau and McCone counties that are likely to be extirpated (Heidel 1994). In North Dakota, it was historically known from McKenzie County at the mouth of the Yellowstone River.

Habitat: This species is found primarily along moist sandy to muddy banks of streams, stock ponds, and man-made reservoirs near the high-water line. The typical shoreline zone is a broad flat and includes sandy parent material. Early collections suggest that its natural habitat was confined to zones below the highwater mark of Great Plains rivers. It is considered a facultative wetland species (USDI Fish and Wildlife Service 1993). Most populations are in sparsely-vegetated settings that are semi-disturbed or recently flooded openings in small inlets or bays with scattered clumps of *Hordeum jubatum*, *Poa secunda*, *Elymus smithii* and a variety of native or exotic early successional forbs. Occasionally, plants can also be found on grassy shores or in openings amid *Salix exigua* or *Tamarix chinensis* thickets. One atypical population in Wyoming is found along a sandy roadcut, several miles from the nearest shore. Total vegetative cover at all sites averages 5-10%. The species ranges in elevation from 3660-6800 ft. (Fertig and Welp 1998).

Figure 24. Inlet habitat of *Rorippa calycina*; note Saltcedar



Photo by Walter Fertig

Figure 25. Shoreline habitat of *Rorippa calycina*



Photo by Walter Fertig

At Bighorn Canyon, it occurs on moist, reddish sandy-clay soils lining small inlets along the shore of Yellowtail Reservoir (Figures 24, 25). These sites are often dominated by Saltcedar and other weedy species, including *Salsola australis*, *Sisymbrium altissimum*, *Cirsium arvense*, and *Verbena bracteata*. The inlets are at least seasonally flooded, and may remain inundated during the summer during high water years as in 1999. Soils in these inlets are derived from the Goose Egg, Amsden, and Chugwater formations and Quaternary gravels. The habitat of *R. calycina* falls into the Floodplain meadows and mudflats vegetation type of Knight et al. (1987).

Abundance

Population Size: Persistent-sepal yellowcress is currently known from 23 occurrences in Wyoming, all of which have been discovered or relocated since 1977. These occurrences consist of at least 70 subpopulations covering a total area of ca. 110 acres. Individual colonies typically contain 10-300 plants in an area of 0.1-5 acres. Fertig and Welp (1998) conservatively estimated the total state population at 15,000-25,000 plants based on surveys of 27 subpopulations in 1997. By contrast, there are no known extant populations in Montana or North Dakota.

Trends: In Wyoming, *Rorippa calycina* has probably been increasing over the past half century due to its ability to colonize shores of artificial reservoirs. Rollins (1993) noted “it appears that the provision of suitable habitats by the construction of reservoirs has provided for an unusual increase in the number of populations of this species.” Fertig and Welp (1998) found the total Wyoming population to be essentially stable between 1997 and 1981 (Lichvar 1981). Long-

term trend data, however, are not available for most populations. Individual colonies appear to vary in size and area from year to year in response to flooding levels. For example, Heidel observed plants at the Crooked Creek colony in June 1999, but no plants remained after it had been inundated by high water later in the summer. Other populations in Wyoming have been periodically flooded, only to return during periods of low water, possibly from a remnant seedbank on site or in the near vicinity (Fertig and Welp 1998). In Montana, the paucity of recent records and extirpation of two small populations suggests that the species may be declining, though there has been little survey work.

Management

Threats: Changes in watershed management could have important impacts on reservoir populations of *Rorippa calycina* in Wyoming. Fluctuating water levels are critical for creating and maintaining the shoreline flats habitat favored by this plant. Maintaining reservoirs at a constant level could encourage later successional species to become established and crowd out this species. Permanently raising water levels could wipe out existing, low-lying colonies, but should create new habitat higher on the bank. Colonization of such sites, however, could be restricted if existing seedbanks are eliminated (Fertig and Welp 1998).

Competition from exotic plants, especially Saltcedar, is a serious threat at several reservoir sites, including Yellowtail Reservoir on Bighorn Canyon NRA. Dense growth of Saltcedar can shade out *Rorippa* and stabilize its shoreline habitats (Fertig and Welp 1998). Spotted knapweed is present at a number of Bighorn Canyon NRA public access sites and could become a serious threat through competition for habitat. Weed control efforts need to be planned carefully to ensure that herbicides do not directly kill *R. calycina* plants or negatively affect its pollinators. Other potential threats include soil compaction from off-road vehicles in shoreline habitats, development of shoreline recreational facilities or access, trampling of plants and their habitat from high concentrations of livestock and wildlife, and impacts from pollution associated with mining (Fertig and Welp 1998).

Protection Status: Four populations of *Rorippa calycina* are found on lands that receive some formal protection, including Bighorn Canyon NRA, the

Wyoming Nature Conservancy's Red Canyon Ranch, Pathfinder National Wildlife Refuge, and the BLM Red Canyon ACEC (managed by the Rawlins Field Office). Seven populations are also found on Wyoming state park lands (Boysen, Buffalo Bill, and Seminoe), but these sites are managed mainly for recreation rather than natural values. A collection in Montana came from private lands within the Wild and Scenic Missouri River corridor and the population may or may not be extant. All other extant populations are on public or private lands managed for multiple use.

Land Ownership: *Rorippa calycina* occurs in Wyoming on lands managed by Ashley National Forest (Flaming Gorge National Recreation Area), National Park Service (Bighorn Canyon National Recreation Area), U.S. Fish and Wildlife Service (Pathfinder National Wildlife Refuge), and the BLM Cody, Lander, Rawlins, and Worland Field Offices. The species is also present on Wyoming state park lands at Boysen, Buffalo Bill, and Seminoe Reservoirs, and on private lands.

Management Comments: Management of water levels is important for the maintenance of the shoreline habitat of *Rorippa calycina*, especially in reservoir settings that make up most of its known habitat. Current management practices and unpredictable annual precipitation rates are probably adequate to ensure fluctuating water levels in Yellowtail Reservoir. Impacts from invasive plants, especially Saltcedar, need to be carefully monitored. A control program for Saltcedar should be implemented in selected drainages to test possible effects on *R. calycina* populations. Control programs should focus on methods that are non-injurious to desirable native species and pollinators. Known colonies of *R. calycina* should be revisited periodically to ensure that populations are maintaining themselves, and additional areas of potential habitat should be investigated for new colonies. A monitoring program should be initiated at selected sites to assess overall population trends beyond the natural population fluctuations that occur due to alternating flooding/drying cycles.

Bighorn Canyon NRA Significance

Persistent-sepal yellowcress was first documented at one site near the Horseshoe Bend marina in Bighorn Canyon NRA by Robert Lichvar in 1983 (Lichvar et al. 1985). In 1998, 10 additional colonies were

discovered by Fertig along the east and west banks of Yellowtail Reservoir, extending from the Crooked Creek inlet south to the US Highway Alt 14 causeway. Much additional habitat probably exists in the NRA, especially in small inlets along the east shore of the reservoir. It was not found on the Montana side, but the survey was conducted under high water conditions. In the canyon, shoreline habitat is subject to flooding and confined to narrow bands. No habitat was observed on the west shore south of the causeway in 1998. Some potential habitat investigated by Welp in 1999 was flooded by high water and contained no plants. Fertig estimated the total population in Bighorn Canyon at approximately 7500 plants in 10-15 acres of habitat in 1998.

The Bighorn Canyon NRA population is one of only four occurrences rangewide found on lands managed specifically for natural values or wildlife. Colonies on the east bank of Yellowtail Reservoir (with the exception of the subpopulation near the US Highway Alt 14 causeway) are in isolated areas that receive minimal direct human impacts. Although these colonies are small and threatened by Saltcedar, they are the best-protected sites currently known for the species throughout its range. The long-term survival of this species may be strongly influenced by management actions in the NRA. Thus, it is recommended for consideration by the National Park Service as a rare species, emphasizing Saltcedar control and concerted water level management.

Stanleya tomentosa* Parry var. *tomentosa

Hairy prince's-plume
Brassicaceae (Mustard Family)

Status

Heritage Rank: Global – G4T3; Montana – S3 [watch; formerly listed as a species of special concern (Lesica and Shelly 1991) but downlisted to a watch species of limited distribution following the discovery of numerous small colonies in the Pryor Mountains by Lesica and Achuff (1992)]; Wyoming – S2. [Medium conservation priority] May be more abundant in Wyoming than currently recognized. Rank may be revised to S3 in the near future.

Legal Status: USF&WS – None. BLM - None. USFS – None.

Description

Description: Hairy prince's-plume is a perennial forb with an unbranched caudex covered by persistent leaf bases. Stems are erect, single or branched above, 5-15 dm tall, leafy, and densely pubescent with short, tangled, woolly hairs (Figures 26, 27). Basal leaves are 1-3 dm long, 2-6 cm wide, long-petioled, and have broadly lance-shaped, runcinate-pinnatifid blades (dissected like a dandelion leaf) covered with felt-like pubescence. Stem leaves are similar to the basal leaves, but become gradually smaller and entire or arrowhead-shaped farther up the stem. The elongate, densely-congested inflorescence is 2-6 dm long and has hirsute branches. Flowers consist of 4 pale yellowish-green, pubescent, sepals and 4 glabrous, lemon yellow petals that are wider at the base than the tip. Fruits are slender, erect, glabrous, distinctly com-

Figure 26. Illustration of *Stanleya tomentosa* var. *tomentosa*

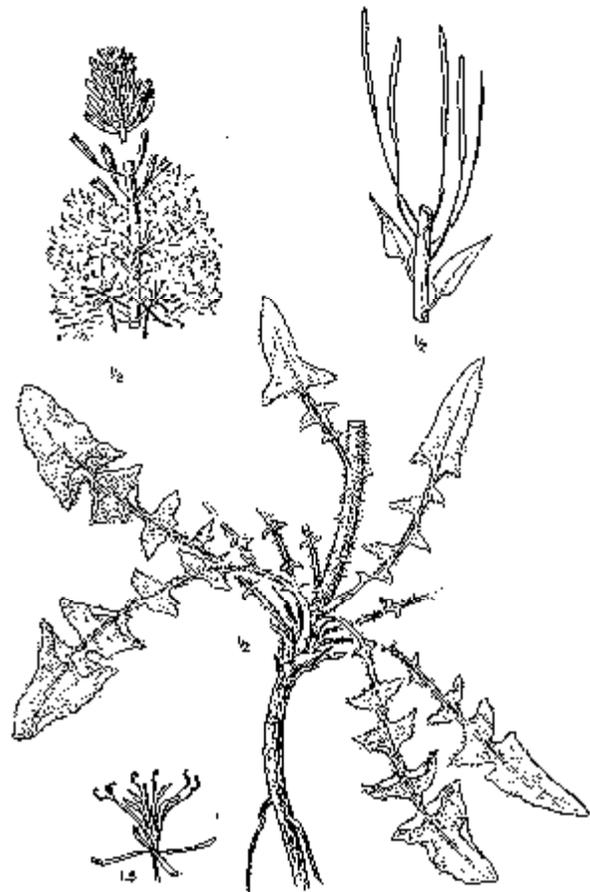


Illustration by Jeanne R. Janish
From "Vascular Plants of the Pacific Northwest"

Figure 27. Photo of *Stanleya tomentosa* var. *tomentosa*



Photo by Walter Fertig

pressed siliques 4-7 cm long and about 2 mm wide. The base of the fruit narrows to a slender stalk-like structure (gynophore) borne above the true fruit stalk (pedicel). Seeds are brown, oblong, and lack wings (Rollins 1939, 1993; Hitchcock and Cronquist 1964; Dorn 1992).

Similar Species: *Stanleya viridiflora* has sessile stem leaves and glabrous stems. *S. pinnata* has glabrous or sparsely short-hairy leaves and stems and pubescent petals.

Flowering/Fruiting Period: June-July. Note: Mature plants do not produce flowers every year, sometimes remaining as basal rosettes.

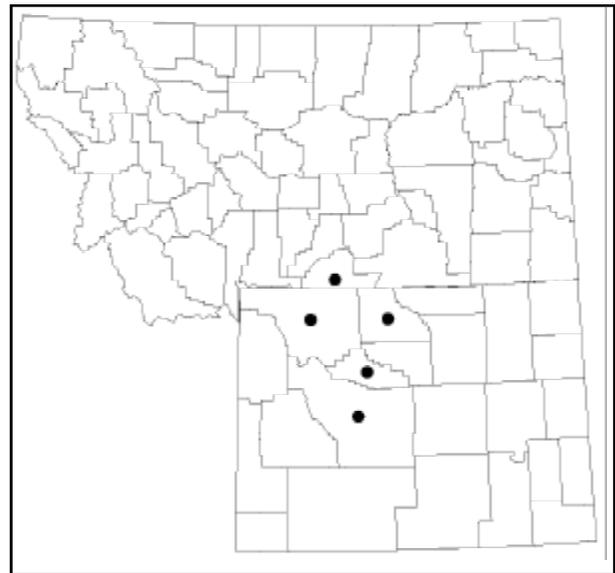
Range and Habitat

Range: Hairy prince's-plume is a regional endemic of south-central Montana and north-central Wyoming. Populations in Montana are restricted to the Pryor Mountain area in Carbon County. In Wyoming, this species is found in the Big Horn Basin and foothills of the Absaroka, Big Horn, Bridger, and Owl Creek

mountains in Big Horn, Fremont, Hot Springs, and Park counties.

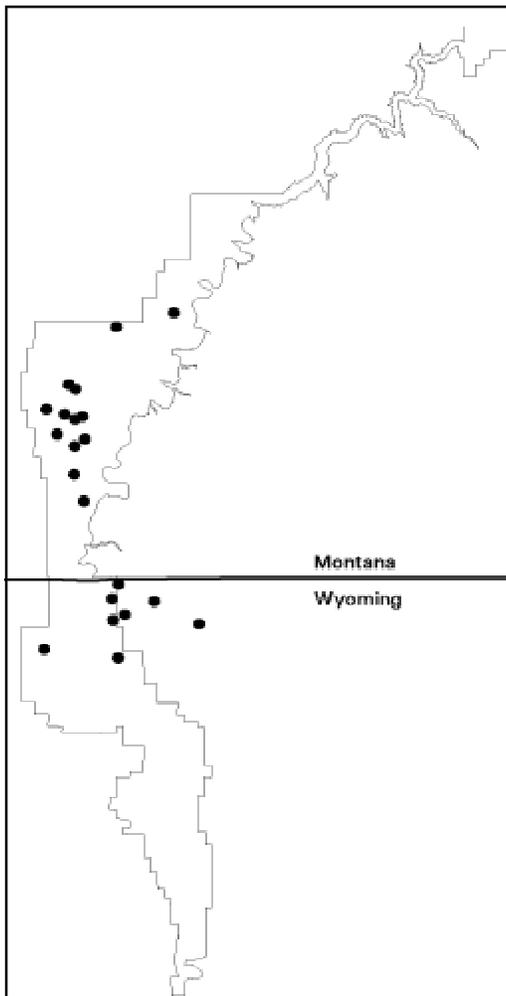
Habitat: Hairy prince's-plume occurs primarily in cushion plant communities, Black sagebrush-grasslands, Limber pine woodlands, and Utah juniper woodlands on limey-sandstone ridges, dry dolomite cliffs and talus, sandy canyons, or rocky clay slopes in the foothills of desert mountains (Lesica and Achuff 1992, Fertig and Jones 1997). Populations range in elevation from 3800-7300 feet.

Figure 28. Montana and Wyoming county distribution of *Stanleya tomentosa* var. *tomentosa*



In the Wyoming portion of Bighorn Canyon NRA, Hairy prince's-plume is found mostly on slopes of fissured, white, limey-sandstone boulders and bedrock outcrops of Tensleep Sandstone in openings within *Pinus flexilis*/*Juniperus* woodlands. The understory of these sites is usually dominated by cushion plants and bunchgrasses that provide a total cover of at least 50%. Common associated species include *Erigeron allocotus*, *Lesquerella alpina*, and *Stipa comata*. Populations of *S. tomentosa* can also be found in cushion plant communities dominated by *Phlox bryoides*, *Haplopappus armerioides*, *Paronychia sessiliflora*, and *Penstemon laricifolius* on slopes and low knolls of rocky-sandy calcareous soils with vegetative cover under 40%. Knight et al. (1987) describe this species from the Basin Grassland and Windswept Plateau vegetation types.

Figure 29. Distribution of *Stanleya tomentosa* var. *tomentosa* in Bighorn Canyon NRA



In the Montana portion of Bighorn Canyon NRA, Hairy prince's-plume is most often found on Juniper Woodland ridges on the Chugwater Formation. Common associated species making up the sparse vegetation include *Elymus spicatus*, *Phlox bryoides*, and *Hymenoxys acaulis* (Figure 20). It is also found on Great Basin grasslands that are at lower slope positions and toeslopes of the East Pryor Mountains and on isolated Quaternary gravel terraces. Common associated species include *Elymus spicatus*, *Bouteloua gracilis*, *Phlox hoodii*, and *Gutierrezia sarothrae*.

Abundance

Population Size: Rangewide, Hairy prince's-plume is known from approximately 50 localities. Lesica and Achuff (1992) documented 28 populations in the Pryor Mountains of Montana, most of which were "sparse but widespread". It was previously documented from Bridger and Bluewater Creek north of

the Pryor Mountains. In Wyoming, this taxon is currently known from 17 extant occurrences. Most populations have fewer than 50 individuals in an area of less than 3 acres.

Figure 30. Ridge habitat of *Stanleya tomentosa* var. *tomentosa*



Photo by Bonnie Heidel

Trends: Long-term trend data are not available for this species. Some populations in Wyoming may be declining due to habitat loss or herbivory.

Management

Threats: Hairy prince's-plume may be threatened by surface disturbances associated with mineral development at some sites in Wyoming. Overall, most of the habitat of this species is rugged enough that such threats are moderate. This species is readily grazed and browsed by stock and big game, but the impacts from herbivory are not fully known. Heidel observed that flowering stems had been eaten on a wild horse pasture of Bighorn Canyon NRA. It was also noted on both sides of a fenceline separating grazed from ungrazed areas of the study area, in lower numbers with no flowering stalks on the grazed side (Heidel pers. obs.) The species attracts a diverse insect fauna to its flowers, and its dependence on specific pollination vectors is not known.

Protection Status: Montana occurrences are found in Bighorn Canyon NRA and several more populations are protected on the adjoining East Pryor Mountains Area of Critical Environmental Concern. Two Wyoming occurrences are found in Bighorn Canyon NRA, one extending into the BLM Little Mountain Area of Critical Environmental Concern. An additional Wyoming population is found just outside the Shell Canyon Research Natural Area and potential Elephant

Head RNA on Bighorn National Forest. All other occurrences in Wyoming are on public, state, or private lands managed for multiple use.

Land Ownership: Populations occur on lands managed by Bighorn National Forest, Bighorn Canyon NRA, the BLM Billings, Cody, Lander, and Worland Field Offices, Montana Department of Fish, Wildlife & Parks lands (Bluewater Fish Hatchery), and private lands.

Management Comments: Additional information is needed on the population dynamics of this species and its response to herbivory. The small size of most subpopulations makes them potentially vulnerable to large-scale habitat disturbance, high grazing pressure, the loss of pollinators, and chance environmental mishaps. It should be surveyed in all Bighorn Canyon NRA exclosures, and the fence line contrast beside the Park road evaluated more completely. Pending review of these results, it may be appropriate to develop a demographic monitoring program to shed light on natural population fluctuations and on basic natural history of this plant. Additional information on species' response to fire may also warrant evaluation in any prescribed burn management actions.

Bighorn Canyon NRA Significance

At least 8 subpopulations of Hairy prince's-plume are found in Bighorn Canyon NRA and adjacent BLM lands on the east side of Yellowtail Reservoir in Wyoming, and over 10 subpopulations are scattered on the west side of Yellowtail Reservoir in Montana. In 1999 these subpopulations contained over 300 individuals in a total area of 20 acres (Wyoming), and over 60 individuals in a total area of less than 20 acres (Montana). Although small, most of these colonies are secure and have low threats. A second population on the west side of the reservoir in Wyoming discovered in 1983 could not be relocated in 1998 or 1999 and may be extirpated. Bighorn Canyon NRA is one of the few locations in Montana or Wyoming where Hairy Prince's-plume is afforded any protection, and maintenance of healthy populations in the NRA is important from a rangewide perspective.

Sullivantia hapemanii (Coult. & Fish.)
Coult. **var. *hapemanii***
Wyoming or Hapeman's Sullivantia
Saxifragaceae (Saxifrage Family)

Status

Heritage Rank: Global Rank - G3; Idaho - S2; Montana - S2; Wyoming - S3 [Medium conservation priority].

Legal Status: USF&WS – former C2 (dropped as a candidate with the elimination of the C2 program); BLM (MT) – Watch; USFS (WY) – Sensitive.

Figure 31. Illustration of *Sullivantia hapemanii* var. *hapemanii*



Illustration by Walter Fertig
From "Wyoming Rare Plant Field Guide"

Description

Description: Wyoming *Sullivantia* is a perennial with flowering stems 10-60 cm tall arising from fibrous roots (Figures 31, 32). Basal leaves are 1-10 cm broad, incised with 5-13 lobes for 1/3-1/2 of the blade length, and margins are toothed; stem leaves are reduced and 1-few. Foliage is glandular-pubescent. Flowers are borne in an open inflorescence with side branches at right angles to the main axis, with 5 white petals, 5 stamens, and a glandular calyx. The capsule is 2-celled, narrowly cylindrical at maturity, 4-8 mm long, and 1.5-2.7 mm wide (Soltis 1991, Fertig 1993, Dorn 1992).

Figure 32. Photo of *Sullivantia hapemanii* var. *hapemanii*



Photo by Bonnie Heidel

Similar Species: This is the only species of *Sullivantia* in our area, distinguished from species in the *Saxifraga* genus by 5 stamens rather than 10. The open inflorescence with its spreading branches distinguishes it from other genera in the Saxifrage Family. The one other variety of this species, *Sullivantia hapemanii* var. *purpusii*, is restricted to Colorado and is distinguished in having an elongate fruiting capsule over 2.5 times longer than broad at maturity (Soltis 1991).

Flowering/Fruiting Period: Flowering in late June – late July or August.

Range and Habitat

Range: Wyoming *Sullivantia* is a regional endemic of the Bighorn Mountains in north-central Wyoming and the contiguous Bighorn Canyon area of south-central Montana; with disjunct sites in Wind River Canyon and Casper Mountain in Wyoming and disjunct in the

Figure 33. Montana and Wyoming county distribution of *Sullivantia hapemanii* var. *hapemanii*

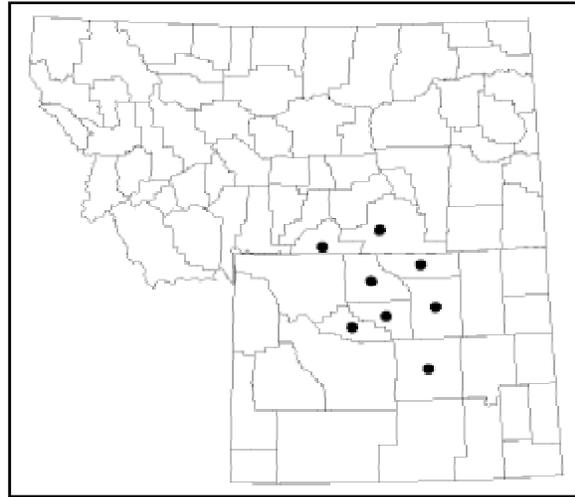
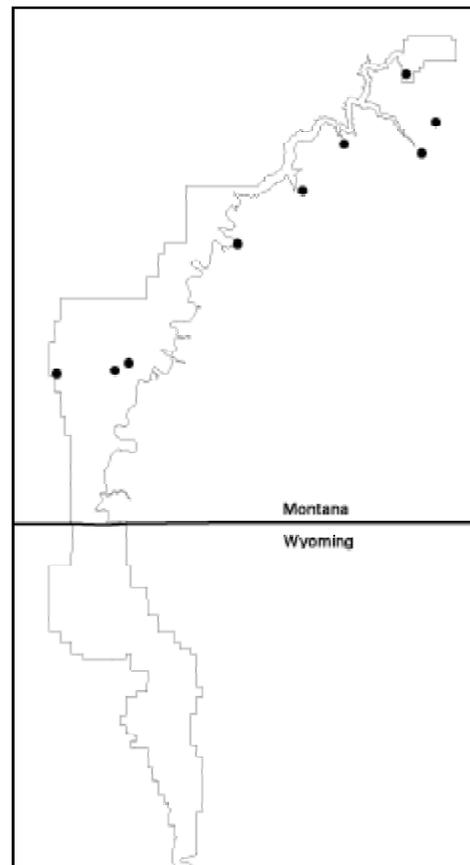


Figure 34. Distribution of *Sullivantia hapemanii* var. *hapemanii* in Bighorn Canyon NRA



Middle Fork of the Salmon River in central Idaho. Bighorn Canyon populations are widely scattered along the length of the canyon in Big Horn and Carbon counties, Montana. Populations at the north end are on or directly above the Reservoir and lower reaches of major tributaries, from Big Bull Elk Creek to Yellowtail Dam, while populations in Carbon County are set back over a mile from the Reservoir in association with small tributaries, from Layout Creek to Davis Creek. In this area, it is known from nine sites. All previous collection sites based on Lichvar et al. (1984) and specimens on file at the herbaria of the University of Montana and the University of Wyoming (MONTU and RM, respectively) were relocated and precisely mapped, with the exception of one that is apparently on tribal land off of the Ok-A-Beh Road. In addition, a database on spring locations is being developed by NPS staff and the nine sites that had been mapped to date were visited. Other NPS staff were consulted on additional spring locations. Finally, springs were sought in streamcourse traverses, by seeking out “amphitheater settings” and wetland vegetation that indicates spring habitat.

Habitat: The species grows at calcareous springs and seeps on canyon walls and streambanks, plus boulder-lined streamcourses and at waterfalls with waters rich in calcium bicarbonate (Figure 35). The springs and seeps represent contact zones between limestone or dolomite and underlying impervious layers, or else groundwater discharge along fault lines. Some of the most distinct settings are “amphitheaters,” grotto-like settings where *Sullivantia hapemanii* var. *hapemanii* covers cavernous interior walls. It occurs at foothills and montane zones from 3,650 ft to 7,400 ft in elevation.

Figure 35. Spring-fed habitat of *Sullivantia hapemanii* var. *hapemanii*



Photo by Bonnie Heidel

The settings are often on north-facing slopes, in the shade of rock overhangs, or under tree and shrub canopy; but include a few with partial or full sun. The thing that they all have in common is water percolation or surface flow that saturates the soil in most or all of the growing season. The species is characterized as a wetland obligate (USDI Fish and Wildlife Service 1993), variously growing as an emergent with the base of its stem submerged, on sheer wet slopes, or in mats of aquatic mosses that wick the moisture. The rooting materials include calcium carbonate-rich precipitate, and loose gravel. In any case, it is unconsolidated, and held together at least in part by the intertwined roots of *Sullivantia hapemanii* var. *hapemanii* and sometimes also mosses.

In its best-developed seep habitat, this species is the most abundant vascular plant, and can form 100% cover. Such habitats were called “*Sullivantia* seeps” by Lichvar et al. (1985), a rare habitat dominated by a rare plant. Common associated herbaceous species include: *Carex aurea*, *Aster foliaceus*, *Catabrosa aquatica*, and *Glyceria striata*. Mosses are abundant in most of the habitats where it is found.

In its best-developed riparian habitat, it grows at the edge of streams in wooded, shrub-lined riparian corridor with *Betula occidentalis*, *Acer negundo*, *Acer glabrum*, *Populus angustifolium*, and *Physocarpus monogynous*.

In Idaho, *Sullivantia hapemanii* var. *hapemanii* is found on wet granitic outcrops associated with waterfalls or dripping water (Robert Moseley personal communicated reported in Fertig 1993). It is found in a similar environment at Shell Falls in Wyoming, but all other populations in Wyoming are on limestone or dolomite substrates. One of the Bighorn Canyon occurrences was described from an anomalous “open grassy slope” habitat, and it was not surveyed because it is apparently on tribal land. But it is presumed that the habitat description on the collection label corresponds with the overall setting rather than the microhabitat, and that the species was probably occurring at a plateau spring or seep as was noted from road.

The seeps supporting *Sullivantia hapemanii* var. *hapemanii* are the largest, most stable, coldwater seeps present in the study area. There is a second kind of wetland seep community present that does not support this species and which dries out at the surface over the growing season.

Abundance

Population size: There are totals of 26 known occurrences and 1 historic occurrence of Wyoming *Sullivantia* in Wyoming, 9 in Montana, and 5 in Idaho. Population sizes are highly variable, ranging in magnitude from less than 10 to over 100,000, as documented in earlier studies (Marriott and Jones 1989, Fertig 1993), and in this study. Population size depends both on available habitat and its intactness. It is important to bear in mind that population densities also vary greatly between occurrences, and that some of the “larger” populations are restricted to one or few small areas that are less than 10 meters square.

Bighorn Canyon NRA includes some of the largest known populations. Its population numbers and distribution patterns are characterized as follows.

inundation, grazing practices prior to NRA establishment, and water developments (discussed in the following text).

Management

Threats: Wyoming *Sullivantia* is often in remote settings that have few direct threats. The primary threat to *Sullivantia hapemanii* var. *hapemanii* is change in water quality and flow. It has a narrow ecological amplitude and occupies a fragile habitat that is directly affected by any changes in the ground-water discharge and streamflow conditions, with unconsolidated substrate that is vulnerable to the slightest amount of trampling.

In Bighorn Canyon NRA, the effects of Yellowtail Dam construction are not known. The only springs that are mapped on the study area geology map

Table 3. Population sizes of *Sullivantia hapemanii* var. *hapemanii* in Bighorn Canyon NRA

Site	Population Magnitude	Extent
East Cabin Creek	10,000+	Common along two adjoining streamcourses; survey incomplete
Ok-A-Beh Road area	Not surveyed	Tribal land
Black Canyon	100+	Uncommon along Black Canyon Creek; survey incomplete
Trail Creek	1,000+	Abundant on very small, north-facing seep
Box Canyon	1,000+	Common among talus of seep above highwater mark, extensive but uncommon at springs above rim of canyon cliff, and associated small streams and fissures below
Layout Creek	100,000+	Common to abundant at large spring system at head of creek
Hillsboro	100+	Occasional to common in three small seep areas
Big Bull Elk Canyon	1,000+	Common at small spring system midslope on canyon
Black Canyon Creek	100+	Uncommon along small streamcourse

Trends: Population numbers tend to remain stable in such a stable wetland habitat barring disturbance or very long-term change in climate and hydrology. Most Wyoming populations are considered to be stable. The habitat, however, is easily disrupted and population numbers have probably declined where habitat disruption has occurred. Three forms of habitat alterations have occurred in Bighorn Canyon NRA where there are likely to have been declines and losses among some Bighorn Canyon populations due to

(Richards 1955) were along the river directly above Yellowtail Dam. This was perhaps the largest spring in the Bighorn Canyon and the species occurs at all of the large intact springs. Populations would have been flooded if entire spring and seep habitats were submerged, and populations along streamcourses were probably inundated in their lower reaches as at East Cabin Creek and Black Canyon Creek. Even the populations above highwater mark are potentially affected. For example, there had been a large, charac-

teristic “*Sullivantia seep*” described in an “amphitheater setting” in Box Canyon across from Yellowtail Dam by Lichvar based on his visit in 1983 (Lichvar et al. 1984). It lies directly above highwater mark. When it was revisited in 1999, there were still hundreds of plants present, but there were no “mounds of calcareous precipitate” much less a “floor” but instead a loose unconsolidated slope. Based on the original description, it is possible that parts of the amphitheater walls have deteriorated and collapsed. If there were any photos of the Box Canyon amphitheater that had been taken at least 10+ years ago, they would be useful to compare directly with current conditions.

It may also have been affected at least locally by some combination of water developments. The well that supplies water to the Ok-A-Beh Marina was installed at one end of an extensive seepage system along a bench near the Canyon rim. The system has several major springs spread out for over a mile, with streams and rivulets below the largest of these that cross the Om-ne-a Trail.

Not all springs and seeps are remote. Indirect trampling disturbance to the species was likely at its Hillsboro population when it was an active dude ranch before creation of Bighorn Canyon NRA. A complex of seven springs lie above Hillsboro. The three that are farthest away are in an “amphitheater,” representing a natural corral and watering hole for stock. While the nearly vertical walls of the amphitheater are not subject to trampling, they are half-buried in dirt that may have resulted from trampling at their base. Rank emergent vegetation grows below the springs in what may have been potential habitat. There are three small population remnants in the amphitheater but none at the other springs. In addition, a road was paved directly above the rim of the “amphitheater” springs, perhaps leading to destabilization if not also changing the groundwater flow.

Similarly, the Davis Ranch and Snell Ranch headquarters were logically located among springs. *Sullivantia hapemanii* var. *hapemanii* does not occur at the developed and impounded springs in these settings, sites where the species may have been extirpated.

Protection Status: Four populations of the species are protected in the Five Springs and Spanish Karst ACECs managed by the BLM, the Shell Canyon RNA

of Bighorn NF, and Amsden Creek Wildlife Habitat Management Area. It is also found in The Nature Conservancy’s Tensleep Preserve and seven TNC conservation easements in Wyoming. Idaho populations lie within the Salmon River Wilderness Area. Though it is relatively well-protected across its range, Bighorn Canyon NRA is important because it protects populations that are distant from others, including seep populations of large numbers, and stream populations of great extent.

Land Ownership: In Wyoming, populations have been documented on lands managed by Bighorn National Forest, the BLM Buffalo, Cody and Worland Field Offices, the Amsden Creek Wildlife Habitat Management Area, and on private lands. All Montana occurrences are on or contiguous with Bighorn Canyon NRA. One of the collection sites along Ok-a-Beh Road was not resurveyed because it lies on Crow Indian Reservation. The one running above Ok-A-Beh Marina and Yellowtail Dam is shared with Crow Indian Reservation. There are also populations on year-round streamcourses at Black Canyon Creek and Cabin Creek that are likely to extend onto Crow Indian Reservation.

Management Comments: The habitat of *Sullivantia hapemanii* var. *hapemanii* is susceptible to disturbance and was reduced prior to Bighorn Canyon NRA establishment. Its spring and seep habitat is most susceptible. Thus, it is a priority for recognizing as a special habitat management concern. Spring and seep habitats are currently being mapped within Bighorn Canyon NRA as reference in management planning. We recommend that intact spring habitats harboring this species be recognized as highly vulnerable for all management planning purposes.

New recreation developments should not lead visitors directly to the fragile habitat of this species. The Om-ne-a Trail at the north end skirts subpopulations at springs and seepage zones. Any trail work is to be conducted with wetland integrity in mind, and trail interpretive information should include general messages about leaving plants and other pieces of the landscape in place for others to enjoy.

One population of *Sullivantia hapemanii* var. *hapemanii* lies beside the Trail Creek Campgrounds. It is on the opposite (south) side of Trail Creek, across from a picnic table at a bend where the creek flows

over a plate of sandstone bedrock. It is surprisingly intact, and while the current recreational design does not signify a direct threat, any foot traffic on the steep seepage slope could destabilize it. One misplaced footstep at the base of it this past year nearly tore out a piece of the vegetation mat made up of this species, and the rest of the highly restricted population is just as vulnerable. Natural impediments to streamside foot access at that point might reduce accidental damage. It is on a nearly vertical slope where the population reaches down to the stream, so it is also affected by natural or accelerated stream erosion on Trail Creek, and the bottom fringe of the population was eroded out in the spring of 1999.

Stable groundwater and surface flow conditions are needed to maintain stable populations, and any water developments in the watershed should be evaluated in light of their potential impact. Groundwater and reservoir/stream management decisions at the north end of Bighorn Canyon NRA potentially affect this species. Pre-1990 photos of the Box Canyon “amphitheater” are to be sought to determine more accurately the extent of habitat change and to help identify if there are any restoration options. Similarly, an annual photo point monitoring or close visual inspection of the Trail Creek population across from a campground is needed to gauge whether recreation use is occurring. It may be desirable to locate shrub plantings or downed timber to shift the public access from the campground to the stream away from the small spring on the other side.

The species’ habitat is not currently used by cattle or horses. New levels of use or water developments for livestock are potential threats to the species. The only places where a population occurs in a livestock allotment is above Yellowtail Dam extending onto tribal land, where stock use is low or absent because there is better access to water elsewhere in the pasture. The potential for restoring habitat and populations numbers above Hillsboro warrants where there has been a long history of livestock use warrants consideration.

Bighorn Canyon NRA Significance

Wyoming *Sullivantia* was first documented on Bighorn Canyon by Robert Dorn at Trail Creek in 1976. The work of Lichvar et al. (1984) documented the species at the north end of Bighorn Canyon and included a revisit to Trail Creek site in the south end. The species was subsequently found on Layout Creek by Lesica and Winslow (EO #007). We surveyed all known populations, as well as all mapped and reported springs, to precisely locate and compare sites. Only two additional populations were found.

Big Horn Canyon NRA harbors less than a quarter of all known populations of the species rangewide. While many of its sites elsewhere are protected and remote, the Bighorn Canyon NRA populations are distant from all others and their protection lends to rangewide, long-term viability. Thus, it is recommended for consideration by the National Park Service as a rare species, emphasizing conservation of its spring and stream habitats.