

State Rare Plants

***Agrimonia gryposepala* Wallr.**
Common agrimony
Rosaceae (Rose Family)

Status

Heritage Rank: Global Rank - G5; Montana - SU (watch); Wyoming - S1 [Low Conservation Priority]
Note: The species was added to the watch list for Montana based on this and other studies.

Legal status: USF&WS - None. BLM - None. USFS - None.

Description

Description: Common agrimony is a perennial 30-150 cm tall with 1-several stems in small clumps arising from short, stout rhizomes and long fibrous roots. Leaves are alternate, divided, coarsely-toothed, and glabrous above, with glands and hairs along the veins below. The yellow flowers are borne in a simple, elongated inflorescence with stalked flowers; they have 5 petals that are 3-5.5 mm long, and usually 15 stamens. The fruit is furrowed and shaped like a top or half-sphere, with rows of blunt, hooked bristles in rings on top; the outer ring usually reflexed. The achene is globose and 2.8-3.3 mm in diameter (Great Plains Flora Association 1986).

Similar Species: It resembles the more widespread *Agrimonia striata* from which it is distinguished by the absence of hairs in the furrows, and the presence of glands along the axis of the inflorescence. The latter species was documented in Bighorn Canyon as part of this study.

Flowering/Fruiting Period: Flowering in July, fruiting in August. Fruits are needed for positive identification.

Range and Habitat

Common agrimony is widespread in eastern North American from Maine to Ontario and North Dakota, south to Kansas and North Carolina. It is reported for California and New Mexico (Great Plains Flora Association 1986). The collections of this species at East Cabin Creek in the north end of Bighorn Canyon

Figure 36. Montana and Wyoming county distribution of *Agrimonia gryposepala*

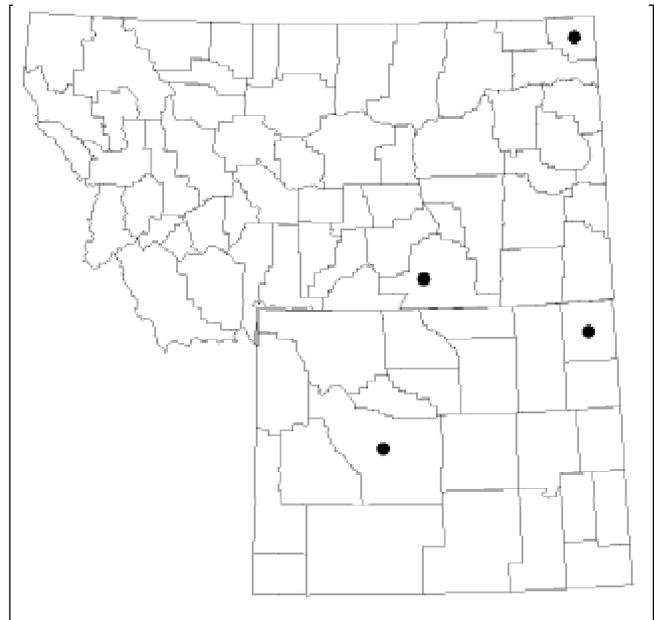
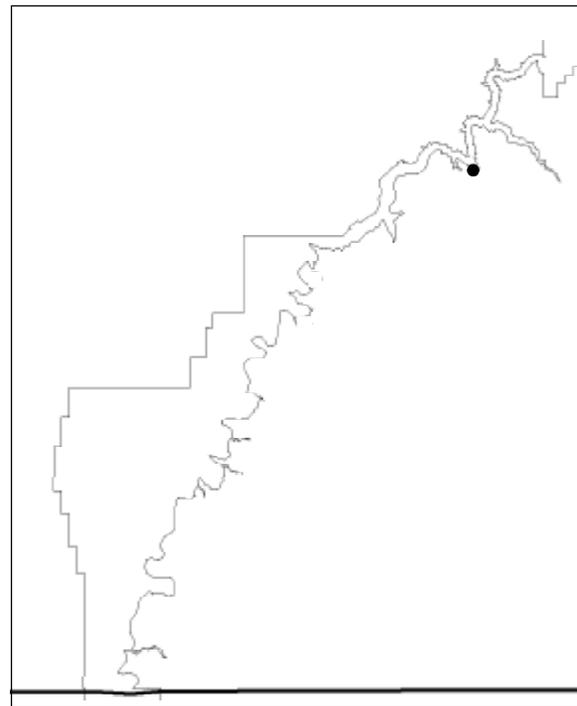


Figure 37. Distribution of *Agrimonia gryposepala* in the Montana portion of Bighorn Canyon NRA



NRA by Lichvar (#6385) and Collins (#871) were not recognized as new additions to the Montana flora until this study. It has since been collected in northeastern Montana (Sheridan Co.; Heidel et al. in progress.) In Wyoming, it is known from the Black Hills and the east slope of the Wind River Range.

Abundance

No information on abundance is available from the collection record. Species of *Agrimonia* are often found in low numbers.

Management Recommendations

Study area data are needed before making management recommendations. It may be a riparian corridor species of perennial spring-fed streams, with limited potential habitat inside NRA boundaries.

Arabis demissa* Greene var. *languida
Rollins
Daggett rock cress
Brassicaceae or Cruciferae (Mustard Family)

Status

Heritage Rank: Global Rank - G4T4; Montana - S1; Wyoming - S2 (not tracked)

Note: This species was dropped as a species of concern in Wyoming in 1999 because it is more widespread in the state than previously recognized (Fertig and Beauvais 1999).

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

Description

Description: Daggett rock cress is a perennial with multiple flowering stems 10-30 cm tall, arising from clusters of basal leaves surmounting a simple or branched rootcrown. Stems are usually unbranched, and often decumbent. Basal leaves are lance or narrowly spoon-shaped, with entire margins and pointed tips, and are about 1.5 cm long. The scattered stem leaves are 5-10 mm long, sessile, and have small lobes at their bases. The basal leaves, lower stem, and lower stem leaves are usually sparsely hairy with large simple and forked hairs, though in rare cases, they may be almost hairless. Flowers have 4 erect, greenish or purple-tinged sepals, 4 spreading, white to purplish, spatula-shaped petals that are 4.5-6.5 mm long and 1.5-2 mm wide, 6 stamens, and a single pistil. The siliques are 2-4 cm long and are descending or pendulous, arising from 4-7 mm long stalks that arch downward from the stem. The flattened, round,

wingless seeds are in one row in each of the 2 chambers of the capsule (Rollins 1993).

Similar species: This species is distinguished from most other *Arabis* in Montana by its coarse hairs and siliques that are pendulous or arch downwards with wingless or narrowly-winged seeds in one row within each cell of the capsule. It differs from *A. holboellii* in having basal leaves with loose, spreading hairs that are unbranched or merely forked (Dorn 1992). In Wyoming, it cannot be reliably distinguished from *A. fendleri* without fully-ripe fruit. Additional study is needed to confirm that these two taxa are truly distinct in the state.

Flowering/Fruiting Period: Flowering in May, fruit maturing in June.

Figure 38. Montana and Wyoming county distribution of *Arabis demissa* var. *languida*

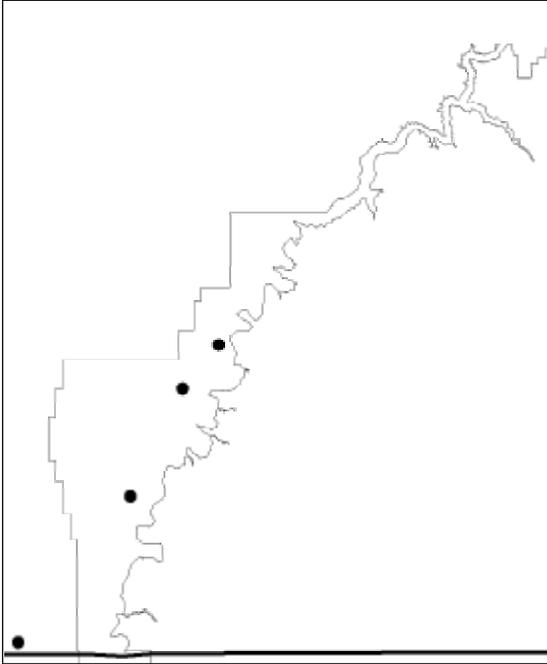


Range and Habitat

Daggett rock cress is known from Wyoming, Colorado, and eastern Nevada (Rollins 1993). It was only more recently recognized as part of the Montana flora, documented in the foothills of the Pryor Mountains area (Lesica et al. 1998). It grows in canyon bottoms and outwash plains with dry, stony soils derived from limestone, often in juniper woodland. Its earlier documentation in the Bighorn Canyon NRA (Lichvar et al. 1985) included Montana stations, and it was also

reported from the juniper woodland, limber pine, and sagebrush steppe vegetation types in the study area by Knight et al. (1985).

Figure 39. Distribution of *Arabis demissa* var. *languida* in the Montana portion of Bighorn Canyon NRA



Abundance

There are 3 known occurrences in Bighorn Canyon based on vegetation sampling data of Knight et al. (1985), in addition to two elsewhere in the Pryor Mountains desert. The species made up 0.1-0.2% of total vegetation cover, indicating that it was not common.

Management Recommendations

Study area data is needed before making management recommendations.

***Aster glaucodes* Blake**
Gray aster
Asteraceae (Aster Family)

Status

Heritage Rank: Global Rank - G4G5; Montana - S2S3 (no longer tracked); Wyoming - S3 (not tracked) Note: This species was reranked in Montana from S1 based on results of this study.

Legal Status: USF&WS Status - none; BLM Status - none; USFS Status - none.

Description

Description: Gray aster is a perennial with simple or branched, mostly hairless stems that are 20-70 cm tall, and arise from rhizomes with many stems forming colonies. There are numerous alternate, stalkless, entire-margined leaves that are 4-12 cm long by 0.5-2.5 cm wide and are hairless and glaucous. The lowermost leaves are smaller and scale-like. The flowers are borne in several to many composite heads of ray and disk flowers surrounded by an involucre of bracts borne on spreading branches. The involucre is 6-9 mm high and is composed of several series of overlapping bracts; the outer bracts are broad and firm, and the inner bracts are narrower and longer and often have purplish tinged midribs. The 8-19 strap-shaped rays are pale lavender and 8-18 mm long by 1-2 mm wide. The disk is 7-12 mm in diameter and consists of numerous flowers with tubular corollas that are shorter than the rays. The bases of both ray and disk corollas are encircled by a pappus of slender white bristles. Achenes are hairless or sparsely short-hairy near their tip (Cronquist 1994).

Similar Species: It is distinguished from other *Aster* species in Montana and Wyoming by the combination of the rhizomatous perennial habit, glabrous stems and glaucous leaves, and an involucre of broad stiff bracts that are green only on the midrib and tip.

Flowering/Fruiting Period: Flowering in early August.

Range and Habitat

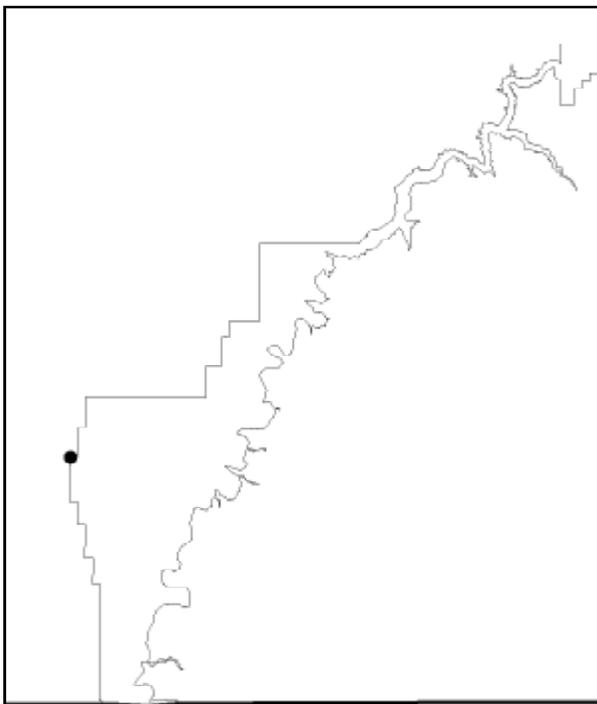
Gray aster has its center of distribution in the Central Rockies, extending from south-eastern Idaho and south-central Montana to northern Arizona. In Montana, it is known only from the Pryor Mountains

where it was first discovered in 1995 (Lesica et al. 1998). There have not been Pryor Mountains species surveys late in the growing season when this species is in flower, and its distribution is likely to be incompletely documented.

Figure 40. Montana and Wyoming county distribution of *Aster glaucodes*



Figure 41. Distribution of *Aster glaucodes* in the Montana portion of Bighorn Canyon NRA



It is a montane woodland species restricted to limestone outcrops and shallow soils with limestone parent material. It grows in shade, as well as in partial sun around small outcrops, margins of roads, and in the open canopy found along ridge tops, where it is found in higher density than in shade. On the south side of the Pryor Mountains, it seems to be associated with the prevalent forest types dominated by *Pseudotsuga menziesii* as reported in DeVelice and Lesica (1993). Other common associated species include *Leucopoa kingii*, *Juniperus compressa*, and *Poa rupicola*.

Abundance

The species presence in the study area represents the fringes of an extensive population on Sykes Ridge, where it was found recurrently on six sections of adjoining land in a nearby study.

Management Recommendations

No management needs were identified for Gray aster. The species has been shown to be more widespread than previously known and lacking threats, thus it has been moved to the watch list in Montana. It showed no signs of being browsed or grazed.

Astragalus aretioides (M.E. Jones)

Barneby

Sweetwater milkvetch

Fabaceae (Bean Family)

Synonym: *Astragalus serioleucus* Gray var. *aretioides* Jones

Status

Heritage Rank: Global Rank - G4; Montana - S2; Wyoming - S3 (not tracked)

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

Description

Description: Sweetwater milkvetch is a long-lived perennial with short, profusely branching stems that form mounded cushions that are 10-30 cm in diameter. Leaves are pinnately compound, 6-15 mm long and have 3 narrowly lance-shaped leaflets and a prominent papery sheath around the petiole where it meets the stem. Foliage is densely covered with silky hairs.

Figure 42. Illustration of *Astragalus aretioides*



Illustration by Bobbi Angell
From "Intermountain Flora"

Figure 43. Montana and Wyoming county distribution of *Astragalus aretioides*

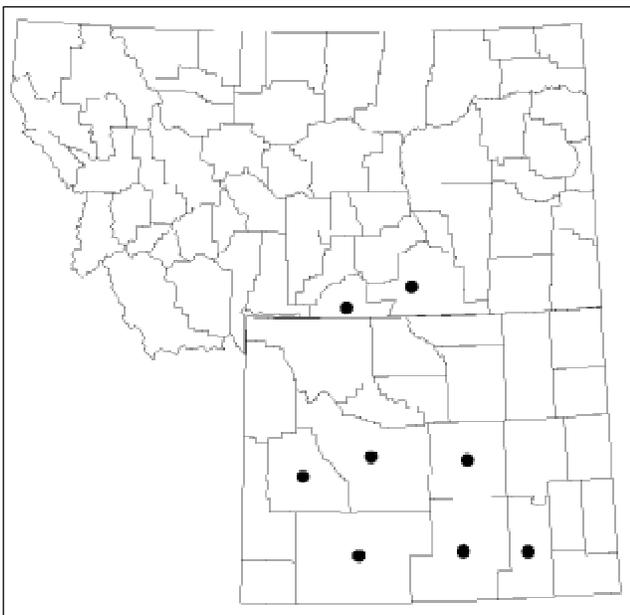
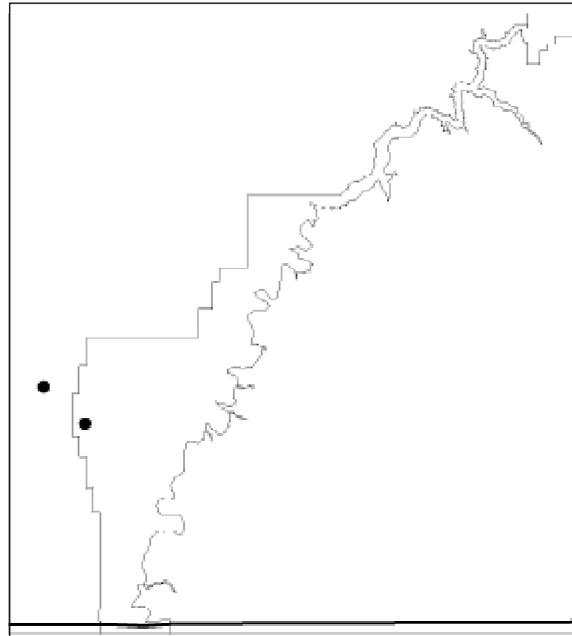


Figure 44. Distribution of *Astragalus aretioides* in the Montana portion of Bighorn Canyon NRA



Pea-like, magenta flowers are paired on short stems among the leaves. The upper petal is 6-8 mm long and partly reflexed upwardly. The calyx is 3-4 mm long. Fruit pods are narrowly egg-shaped, 4-5 mm long, densely silky and hairy, and are usually hidden among the leaves (Barneby 1989).

Similar Species: The combination of purple flowers and a calyx less than 5 mm long separate *Astragalus aretioides* from other cushion-forming 3-leaflet species in our area including *A. barrii*, *A. gilviflorus*, and *A. hyalinus*. The latter is widespread in Bighorn Canyon.

Flowering/Fruiting Period: Flowering mid June-mid July; prolonged into August under some conditions.

Range and Habitat

Sweetwater milkvetch is a regional endemic of central, southwestern and south-central Wyoming, and south-central Montana. In Montana, it is known mainly from the Pryor Mountains area, Carbon County. In Bighorn Canyon NRA, it grows on a steep-sided spine-like ridge above Layout Creek as an outlier of a larger ridgetop population. In addition, two 1953 collections were made on the same day in Big Horn County, at "Grapevine Dome" and on the north side of the canyon, at the rim. After survey in the NRA, it is believed that these collection sites were outside of NRA boundaries.

It grows on thin, usually limestone-derived soil of exposed ridges and slopes from app. 4400 –7800 ft, in the foothills and montane zone. The Pryor Mountains occurrences are in openings among *Pseudotsuga menziesii* associated with *Eritrichium howardii*, *Shoshonea pulvinata*, *Petrophyton caespitosum*, and *Hymenoxys acaulis*. The steep habitat where it occurs in Bighorn Canyon has limited cushion plant community development. The only low elevation occurrences (below 6,000 ft) are those from Grapevine Dome where its habitat in open terrain would be expected to have differences in composition if not structure.

Abundance

There are seven records of Sweetwater milkvetch in Montana. The smallest are populations of about 50 plants. Population sizes were not estimated at the two sites where it was described as common, including the Grapevine Dome record. The presence of *Astragalus aretioides* at the head of Layout Creek represents the fringes of a more extensive population on Sykes Ridge. Less than 20 plants were found on the spine of a finger ridge.

Management Recommendations

Sweetwater milkvetch is a species confined to remote habitat in the study area. It is among a set of higher priority species for coordination with BLM in management affecting Sykes Ridge and the escarpment face of the Pryor Mountains. Its earlier documentation in Big Horn County may have been outside of the Bighorn NRA boundaries.

Astragalus geyeri* Gray var. *geyeri
 Geyer's milkvetch
 Fabaceae (Bean Family)

Status

Heritage Rank: Global Rank - G4?T4?; Montana - S2; Wyoming - S3 (not tracked)

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

Description

Description: Geyer's milkvetch is an annual with spreading to erect stems 5-20 cm tall. Leaves are 2-10

cm long, with 5-13 linear to oblanceolate leaflets covered with short hairs (Figure 44). The 2-8 flowered inflorescences arise in the leaf axils and are overtopped by the leaves. Flowers are 6-8 mm long, and whitish with pink or violet veins or hues. The pod is sessile, ca. 2 cm long, membranous, glabrous, and inflated in a half-ellipsoid shape to form a single chamber (Barneby 1964, Barneby 1989, Hitchcock and Cronquist 1961.)

Figure 45. Illustration of *Astragalus geyeri* var. *geyeri*



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

Similar Species: *Astragalus lotiflorus* and *A. ceramicus* resemble *A. geyeri* in growth form and affinity to sandy habitat, but are perennial. *Astragalus lotiflorus* also differs in having dolabriform hairs on the foliage, and a hairy pod. *Astragalus ceramicus* differs in having linear leaves, and a pronounced mottling pattern on the pod. The one other variety of this species, *Astragalus geyeri* var. *triquetrus*, is restricted to Arizona and Nevada.

Flowering/Fruiting Period: Flowering in June; fruiting in late June-July.

Figure 46. Montana and Wyoming county distribution of *Astragalus geyeri* var. *geyeri*

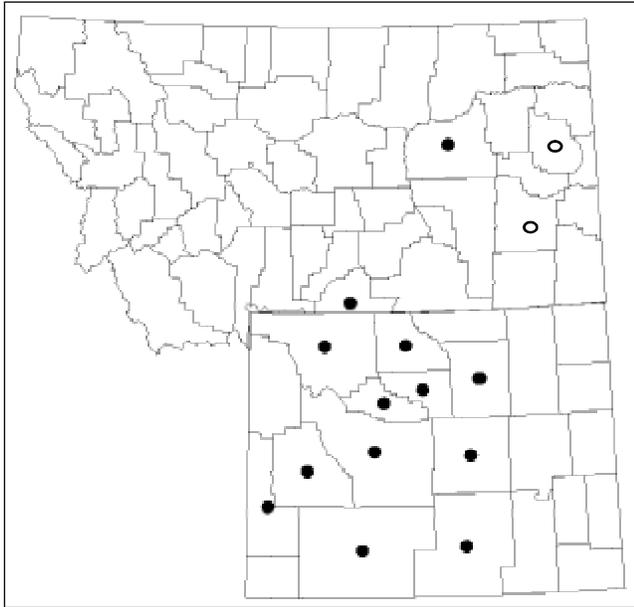
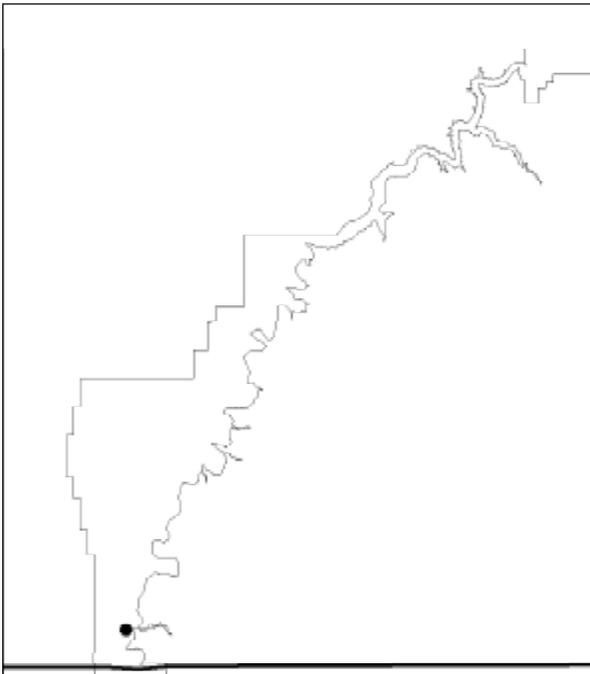


Figure 47. Distribution of *Astragalus geyeri* var. *geyeri* in the Montana portion of Bighorn Canyon NRA



Range and Habitat

Geyer’s milkvetch is a Great Basin species known from southeastern Oregon to California, and east to Montana, Wyoming, and Utah. In Montana, it is

known from Carbon County, an outlying occurrence in Garfield County, and historical collections in Custer and Dawson counties that have not been relocated.

This species is restricted to well-drained sandy settings. In the Pryor Mountains desert it occupies sandy soils of alluvial plains and terraces, frequently found on the Chugwater Formation. The habitat is typically dominated by *Artemisia tridentata*/*Stipa comata*; but the species is also present in *Juniperus osteosperma*/*Artemisia tridentata*, *Artemisia tridentata*-*Atriplex gardneri*, and *Sporobolus cryptandrus* – *Boutleoua gracilis* plant associations (Lesica and Achuff 1992). In Garfield County it grows on loose sand eroded out of sandstone caprock. In Bighorn Canyon NRA, it occurs in an isolated pocket of sand blowout within dense cover of *Artemisia tridentata*, associated with *Oryzopsis hymenoides*, *Oenothera alba*, *Eriogonum cernuum*, and *Opuntia polyacantha*.

Abundance

Population numbers range from fewer than 10-1000+. As an annual, numbers fluctuate from year to year by at least an order of magnitude. The study area population has the lowest reported population numbers of the species in Montana and is highly restricted.

Management Recommendations

It appears that the study area blowout conditions are maintained by wild horse use. The surrounding setting of *Artemisia tridentata* lacks understory vegetation and is among the few areas that appear to be distinctly overgrown among Bighorn Canyon NRA shrub/steppe communities. It is possible that *Astragalus geyeri* var. *geyeri* was present throughout a much more open landscape under natural conditions, or that the blowout habitat for it is an “unnatural” setting created by wild horse use. Information is needed on the land use history of this area to further evaluation whether it occupies “natural” habitat.

***Astragalus oreganus* (Nutt.)**
Wind River milkvetch
Fabaceae (Bean Family)

Status

Heritage Rank: Global Rank - G4?; Montana - S1; Wyoming - S3 (not tracked)

Note: The global rank is under review and may be changed to “G3?” reflecting known abundance in the two states making up its entire range.

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

Description

Description: Wind River milkvetch is a perennial with lax stems 6-20 cm long that arise from deep, cord-like rhizomes (Figure 47 SID 1362). Spreading, alternate, pinnately compound leaves are 5-15 cm long with 9-15 broadly elliptical leaflets. Foliage is thinly to densely covered with long, ashen T-shaped (dolabriform) hairs. Spike-like inflorescences, 3-7 cm long, are densely 20-35-flowered and arise from the axils of the upper leaves. Off-white or yellowish, pea-like flowers have a reflexed upper petal that is notched

Figure 48. Illustration of *Astragalus oreganus*



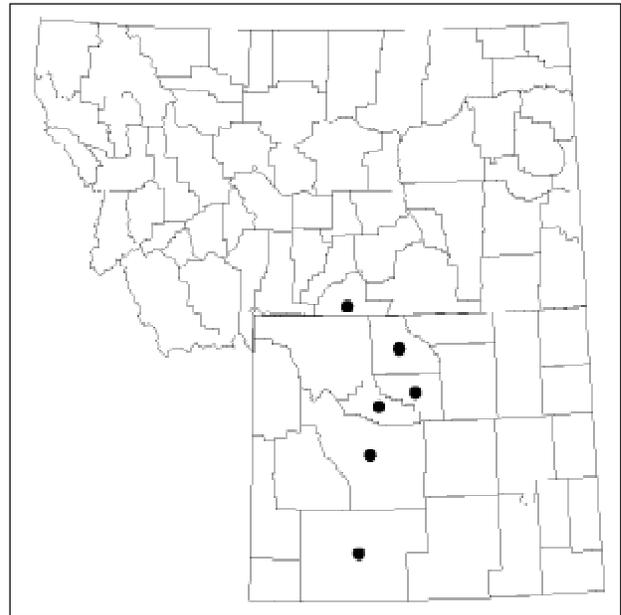
Illustration by Debbie McNiel

at the tip and a calyx that is 6-10 mm long and thinly covered with light-colored hairs. The fleshy, green, oblong pods are 10-15 mm long, round in cross section, and held nearly erect (Barneby 1964).

Similar Species: Distinguished from other species of *Astragalus* in our area by the combination of the broadly elliptic to nearly round leaflets, the dolabriform foliage hairs, and the papery sheaths at the base of the petioles that completely surround the stems (Dorn 1984, 1992).

Flowering/Fruiting Period: Flowering and fruiting in June-July.

Figure 49. Montana and Wyoming county distribution of *Astragalus oreganus*



Range and Habitat

Wind River milkvetch is a regional endemic of south-central Montana and western Wyoming. In Montana, it is only known from the Pryor Mountain desert area, while it is widely scattered over western Wyoming. It occupies sandy or clayey soil in desert shrublands and sagebrush grasslands, occurring on both Chugwater Formation and Madison Group Formations, most often in *Artemisia tridentata*/*Stipa comata*, but also present in *Juniperus osteosperma*/*Artemisia tridentata* and *Juniperus osteosperma* - *Cercocarpus ledifolius* (Lesica and Achuff 1992). In the study area, it is

Figure 50. Distribution of *Astragalus oreganus* in the Montana portion of Bighorn Canyon NRA



restricted to sparsely-vegetated “red beds” of the Chugwater Formation.

Abundance

Wind River milkvetch is known from six occurrences in Montana. They range in size from rough estimates of 100-3000 plants. The Bighorn Canyon population in Montana consists of over 100 plants; over half were vegetative in 1999. They are clustered in small patches that together total less than an acre. A much larger and more extensive population (numbering in the low thousands) occurs in the Sykes Mountain area and on the east shore of Yellowtail Reservoir on the Wyoming side of the NRA.

Management Recommendations

Wind River milkvetch is located close to a gravel road on the border of the NRA. There were no ORV incursions noted, but it is vulnerable. *Halogeton glomeratus* is present in low numbers along the road and could pose a competition threat. Separate species management needs were not identified.

Carex gravida Bailey var. *gravida*

Pregnant sedge

Cyperaceae (Sedge Family)

Status

Heritage Rank: Global Rank - G5T?; Montana - S1; Wyoming - S2 (not tracked)

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

Description

Description: Pregnant sedge is a grass-like perennial that forms clumps of stems which reach up to 60 cm high and arise from short root stocks (Figure 50). Leaves are 4-8 mm wide and clustered near the base of the plant. Flowers are clustered in spikes that are ca. 1 cm long; the perigynia occupy most of the spike, but there are a few male flowers at the tip. Spikes are aggregated at the top of the stem and subtended by 2-3 leaf-like bracts that are shorter than the inflorescence. Scales subtending each perigynia are oval, awned, and as long or longer than the perigynia. Perigynia are 4-5

Figure 51. Illustration of *Carex gravida* var. *gravida*



From “New Britton and Brown Illustrated Flora of the Northeastern United States and Canada”

mm long and egg-shaped; they gradually taper into a beak that is serrate on the edges and notched at the tip. There are few or no nerves visible on the outer face of the perigynia. Each perigynium has 2 stigmas, and a lens-shaped achene (Great Plains Flora Association 1986).

Similar Species: Distinguished from *C. hoodii* in having a loose sheath that easily breaks ventrally, and is also prominently septate-nodulose or mottled on the dorsal surface. The awn-tipped scales of the perigynia are also distinctive. A hand lens or microscope and technical key are needed for positive identification. The one other variety of this species, *C. graviora* var. *lunelliana*, does not occur in the northern Rocky Mountain states.

Flowering/Fruiting Period: Fruit mature in July.

Range and Habitat

Carex graviora var. *graviora* is an eastern species extending from Pennsylvania to Virginia, and west from Saskatchewan and Montana to New Mexico. In Montana, it is known only from Big Horn and Rosebud counties. All Wyoming populations of this species are from the Black Hills.

It occurs among deciduous woody vegetation in

Figure 52. Montana and Wyoming county distribution of *Carex graviora* var. *graviora*

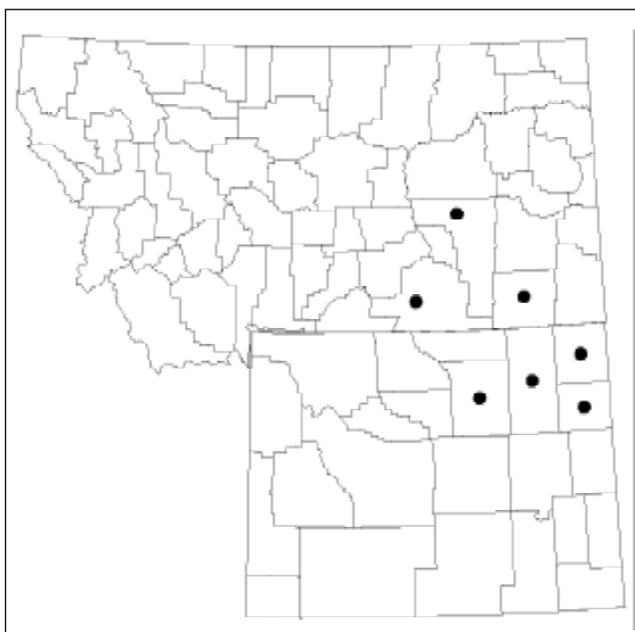
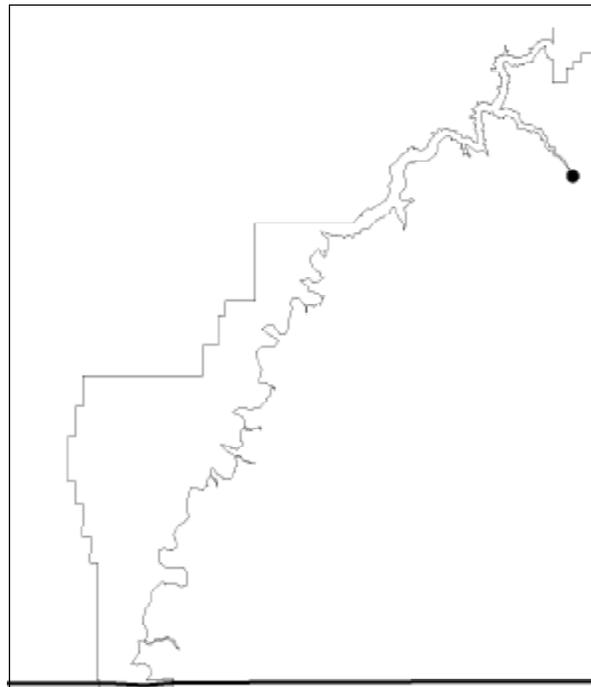


Figure 53. Distribution of *Carex graviora* var. *graviora* in the Montana portion of Bighorn Canyon NRA



riparian corridor and moist ravines. Most Montana occurrences are in isolated green ash ravines and wooded draws lacking surface water surrounded by pine uplands. The Bighorn Canyon occurrence is along Black Canyon Creek, a perennial coldwater stream where *Pinus ponderosa* has a *Prunus virginiana* understory in the valley bottom, and the species was associated with *Agrimonia striata* and *Toxicodendron rydbergii*.

Abundance

There are five occurrences of this species in Montana, and each of them has low numbers of less than 50 plants. In Black Canyon, the species is present in low numbers and density but with vigorous, multi-stemmed clumps. Less than ten clumps were found but survey did not extend upstream.

Management Recommendations

The riparian corridor habitat of Pregnant sedge is laced with fishing access trails, but no immediate management needs were identified. It has limited potential habitat within NRA boundaries and the riparian corridor habitat may extend onto Crow Reservation.

***Cleome lutea* Hook.**
Yellow bee plant
Capparaceae (Caper Family)

Status

Heritage Rank - Global Rank - G5; Montana - S1; Wyoming - S3 (not tracked)

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

Description

Description: Yellow bee plant is an annual with simple to branched stems that are 10-30 cm high (Figure 53). The leaves are palmately compound with long, 2-6 cm petioles and 3-5 narrowly lance-shaped, 2-6 cm long leaflets. Foliage is glabrous to sparsely hairy with a thin, pale, waxy coating. The yellow flowers are borne on 10-20 mm long, ascending stalks, and are densely clustered in a globular inflorescence that greatly expands as the fruit matures. Each flower is subtended by a green bract; the lowest ones resemble leaves, while the uppermost are short and narrow. Flowers have a 4-lobed calyx and 4 separate petals that are 5-8 mm long. There are 6 stamens, which are greatly exerted beyond the petals. The pod-like capsules are 1-3 mm long and borne on arching stalks that are as long as the fruit (Hitchcock and Cronquist 1964).

Figure 54. Illustration of *Cleome lutea*



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

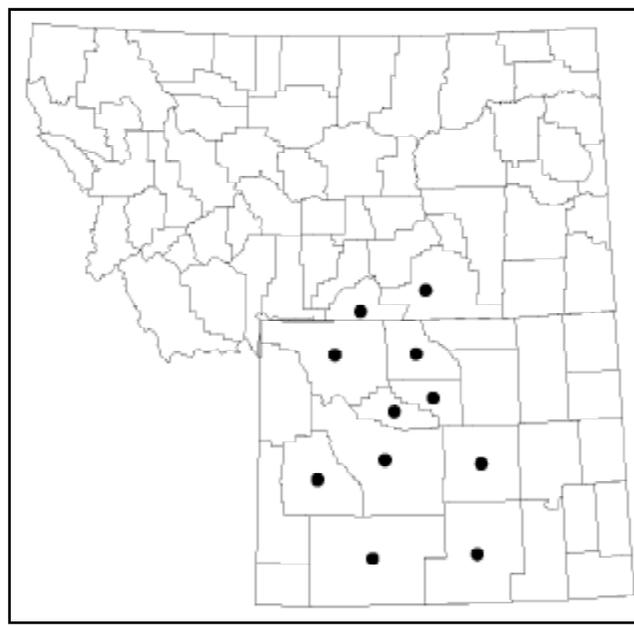
Similar Species: The palmately compound leaves and the bright yellow flowers distinguish this species from the common *Cleome serrulata* that has pinkish flowers.

Flowering/Fruiting Period: It flowers in June to early July; and sets fruit in July.

Range and Habitat

Yellow bee plant is a western species known from eastern Washington to southcentral Montana, and south to California and Texas. In Montana it has been confirmed only from Carbon County. A 1967 collection south of the Dryhead area may have been collected in either Carbon or Big Horn County. It is not known whether the latter is inside or outside of Bighorn Canyon NRA boundaries, but it was later collected in 1976 at the foot of Sykes Ridge. It could not be relocated there in 1998. Fertig observed *Cleome lutea* along a weedy inlet on the eastern shore of Yellowtail Reservoir on the Wyoming side of the NRA in 1998 growing near a colony of *Rorippa calycina*.

Figure 55. Montana and Wyoming county distribution of *Cleome lutea*



It occupies open, often sandy soil of sagebrush steppe in valleys and plains. In this landscape, its natural habitat is moist places around valleys and springs, and is considered a facultative upland plant in the Great Plains (USDI Fish and Wildlife Service 1994). The

two occurrences in or near Bighorn Canyon are from disturbed places including a roadside (Dryhead), and a spot characterized as a “disturbed area” (base of Sykes Ridge) that may also have been associated with the nearby roadbed or transmission corridor. Note: if the species is viable in man-made disturbance settings, then it will no longer be tracked as a Montana species of special concern. Chance establishment of native species in roadside settings usually does not represent a viable population, but the information is retained insofar as it may reflect species’ presence elsewhere in the landscape.

Abundance

The species is known from six occurrences. The largest known population in Montana had numbers fluctuating from 1-1000 plants in consecutive years. It may persist under adverse conditions by its seedbank. The other collection sites for this species did not have number estimates or had numbers less than 50 plants.

Figure 56. Distribution of *Cleome lutea* in the Montana portion of Bighorn Canyon NRA



Management Comments

Current population data are needed from the study area before making management recommendations. This species is likely to be affected by competition from weedy annuals, including halogeton.

***Delphinium geyeri* Greene** Geyer’s larkspur Ranunculaceae (Buttercup Family)

Status

Heritage Rank: Global Rank G5; Montana - SU; Wyoming - S4 (not tracked).

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

Description

Description: Geyer’s larkspur is a perennial 30-60 cm tall arising from deep, branched, fibrous roots. Leaves are basal and cauline, with dense, minute pubescence, and palmately divided with more rounded, wider lobes on basal leaves than stem leaves. Sepals are bright blue and flared, with spurs that are straight to slightly down-curved. Upper petals are whitish with blue tips, lacking prominent blue-purple lines (Warnock 1997).

Similar Species: Distinguished from *Delphinium bicolor* by the presence of dense, minute pubescence; also distinguished from *D. bicolor* ssp. *calcicola* by the cleft in the lower petal being 2 mm or less.

Flowering/Fruiting Period: The 1967 specimen from the Dryhead area was collected on 24 June; presumably in late flower or fruit.

Figure 57. Montana and Wyoming county distribution of *Delphinium geyeri*

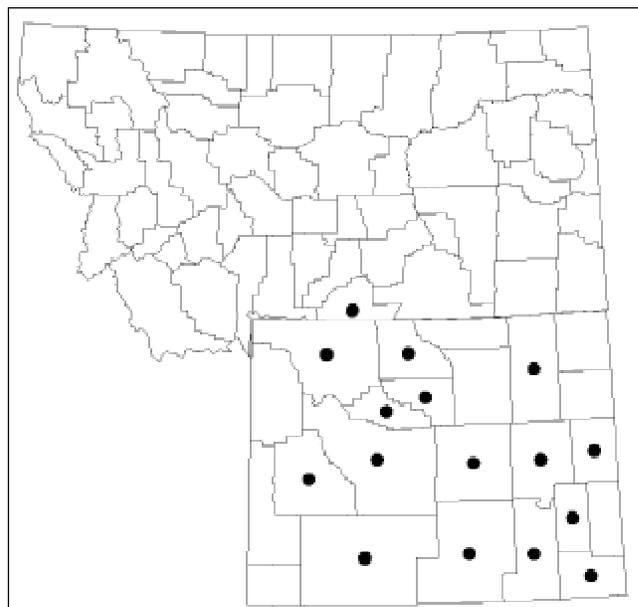
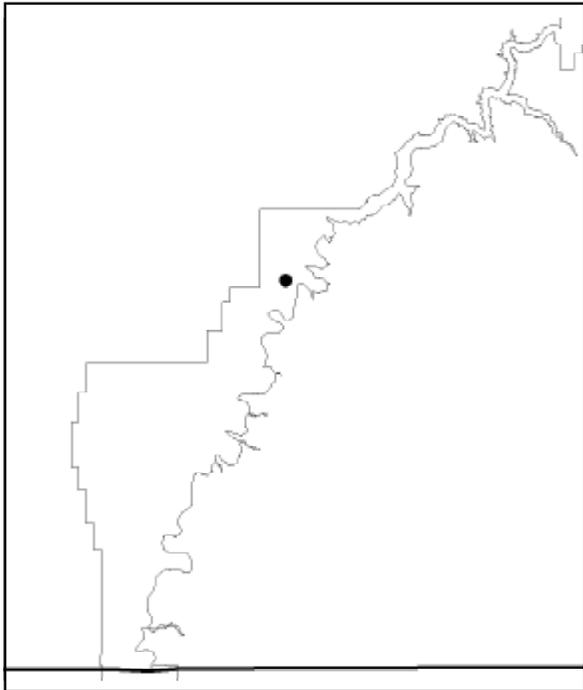


Figure 58. Distribution of *Delphinium geyeri* in the Montana portion of Bighorn Canyon NRA



Range and Habitat

Delphinium geyeri is a regional endemic species that has its center of distribution in Wyoming, extending into Colorado and Utah (Warnock 1997). Verification of specimens is needed to confirm that this species is in Montana. It is also possible that the specimens correspond with a newly-described variety of larkspur, *D. bicolor* ssp. *calcicola*. The state rank of *Delphinium geyeri* is undetermined until such time as specimens are verified. The only collection in or near the study area was “5 miles southeast of Dryhead near Bighorn River”.

Abundance

Unknown.

Management Recommendations

Study area data are needed before making management recommendations. The species is poisonous to livestock and is often an increaser under grazing. This species may be in a portion of the study area that is in grazing allotment.

Eupatorium maculatum var *bruneri*

(Gray) Breitung

Joe-pye weed

Asteraceae (Aster Family)

Status

Heritage Rank: Global Rank - G5TU; Montana - S2; Wyoming - S2 (not tracked)

Note: This species has been reranked in Montana from S1 based on results of this study.

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

Description

Description: Joe-pye weed is a stout, fibrous-rooted perennial 60-150 cm tall. The lance-shaped leaves are 6-20 cm long, have serrated edges, and occur in whorls of 3-4 on the stem (Figure 58). Foliage is covered with short, curled hairs. Flowerheads are

Figure 59. Illustration of *Eupatorium maculatum* var. *bruneri*



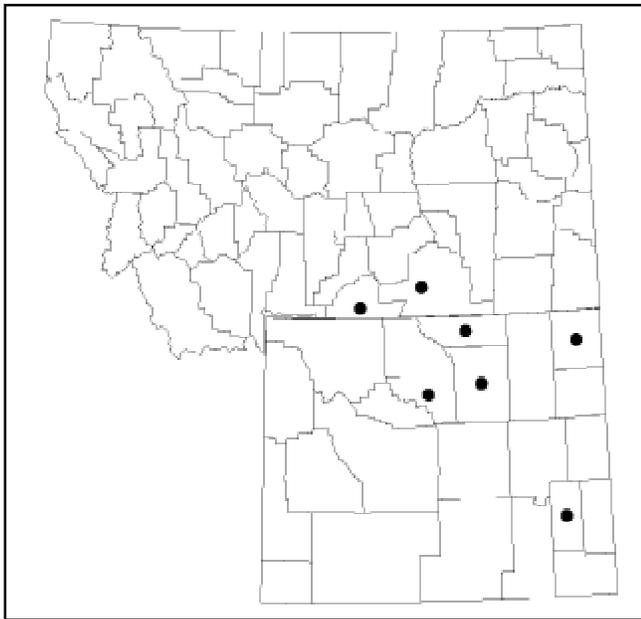
Illustration by John H. Rumely from “Vascular Plants of the Pacific Northwest”

arranged in a flat-topped, umbrella-like inflorescence at the top of the stem. Each head has 2-3 series of a few overlapping, purplish involucre bracts and 9-22 purple disk flowers. Ray flowers are lacking. The seeds have numerous, thin, stiff pappus bristles (Great Plains Flora Association 1986, Cronquist 1955.)

Similar Species: The combination of large size, whorled leaves, and purple, discoid flower heads distinguish this species from all other composites. *Eupatorium occidentale* (syn. *Ageratina occidentalis*) is put in the same genus by some authors, but has alternate leaves. The two other varieties of this species do not occur in the northern Rocky Mountain states.

Flowering/Fruiting Period: Flowering in August.

Figure 60. Montana and Wyoming county distribution of *Eupatorium maculatum* var. *bruneri*

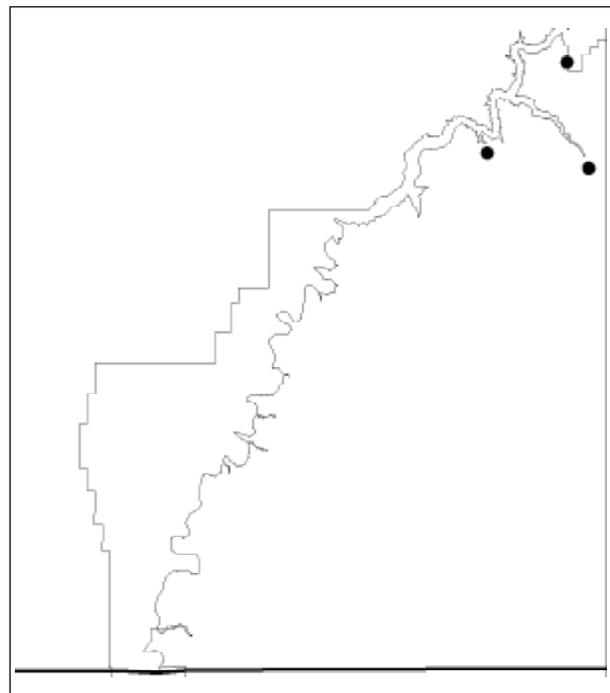


Range and Habitat

Joe-pye weed is common in eastern North America, extending from Newfoundland to North Carolina, and sporadically west from British Columbia and Montana south to Kansas and New Mexico. In Montana, it is restricted to the Bighorn and Tongue River drainages where it grows in moist meadows, springs, margins of spring-fed streams, and swamp thickets. In the Great Plains, it is considered a facultative upland species (USDI Fish and Wildlife Service 1994). It is not an

invasive “weed” but does become established in ditches and fencerows elsewhere in parts of its range. The three Bighorn Canyon populations are along the extensive seep and stream complex above Box Canyon directly along the Om-ne-a Trail; and along the two largest coldwater creeks, Black Canyon Creek and East Cabin Creek. It is in partial shade to full sun, associated with *Populus acuminata*, *Acer negundo*, *Betula occidentalis*, and *Rudbeckia laciniata* on streams; and *Salix bebbiana*, *S. melanopsis*, and *Carex lanuginosa* on seeps.

Figure 61. Distribution of *Eupatorium maculatum* var. *bruneri* in the Montana portion of Bighorn Canyon NRA



Abundance

There are six occurrences of Joe-pye weed in Montana. Population numbers are higher in Bighorn Canyon than in other Montana populations, with at least two populations numbering 100+ individuals above Box Canyon and along East Cabin Creek. This tall, multi-stemmed plant is very conspicuous, with multiple flowering stems from a single base that might give an impression of a profusion of plants when only one is present.

Management Recommendations

Joe-pye weed is potentially affected by water develop-

ments, recreation developments, livestock grazing, and herbicide treatment. The well drilled to supply water to the Ok-a-Beh Marina may have reduced habitat available at one end of the Box Canyon population. It has limited potential habitat within NRA boundaries, and occurs in the vicinity of other rare riparian corridor species like *Sullivantia hapemanii* var. *hapemanii*.

***Grayia spinosa* (Hook.) Moq.**
Spiny hopsage
 Chenopodiaceae (Goosefoot Family)

Status

Heritage Rank: Global Rank - G5; Montana - S2; Wyoming - S4 (not tracked)

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

Figure 62. Illustration of *Grayia spinosa*



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

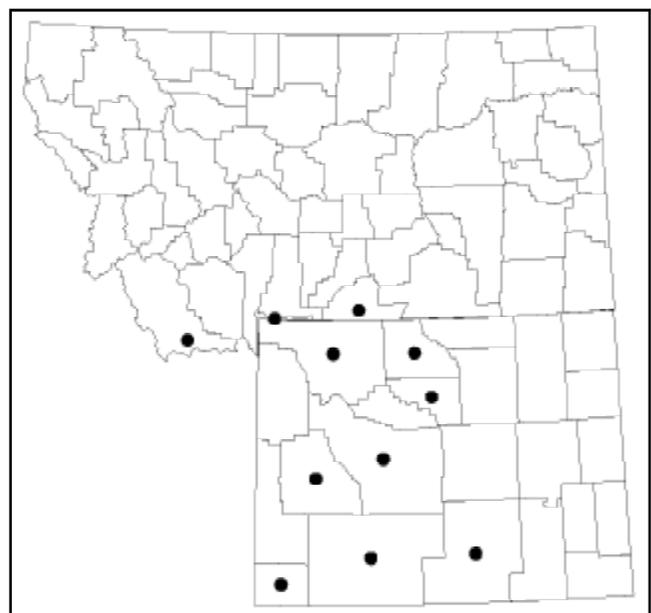
Description

Description: Spiny hopsage is a rounded, profusely branched shrub that is up to 1.5 m high and has erect or spreading, gray-barked, spine-tipped stems (Figure 61). The fleshy, broadly lance-shaped leaves are 10-25 mm long and have entire margins and a short stalk. Foliage is covered with small, star-shaped hairs that easily rub off. Male flowers are on different plants than female flowers. There are 2-5 small, green, sessile male flowers that are 1-2 mm long with a 4-lobed calyx, 4 stamens, and no petals; they occur in the axils of the smaller upper leaves, or bracts. Female flowers are arranged in small spikes in the upper leaf axils. Each flower has an ovary surrounded by 2 green, nearly circular bracts. When mature, the bracts enlarge to be 8-15 mm wide, and are whitish-green to red with thin margins (Hitchcock and Cronquist 1964).

Similar Species: The combination of fleshy leaves with circular, entire-margined, female fruiting bracts distinguishes this shrub from woody species of *Atriplex*. It superficially resembles the common *Atriplex confertifolia*, with which it is often associated.

Flowering/Fruiting Period: Flowering and fruiting in May-June.

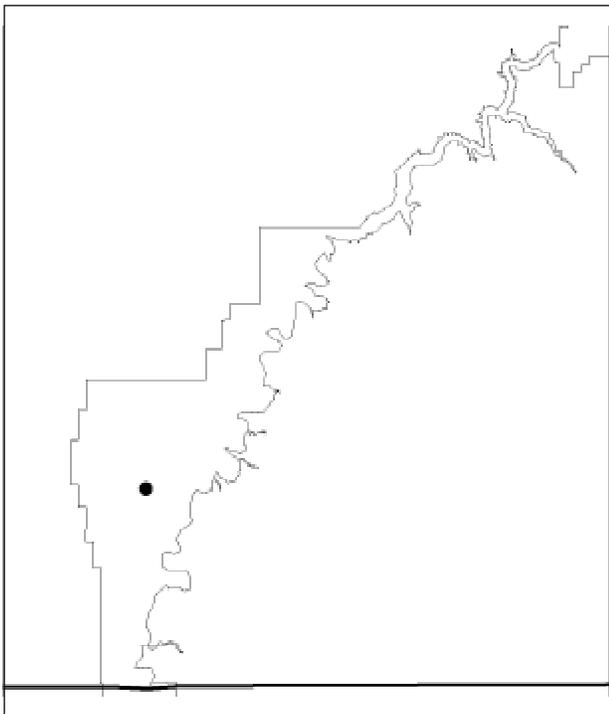
Figure 63. Montana and Wyoming county distribution of *Grayia spinosa*



Range and Habitat

Spiny hopsage is a Great Basin species distributed from eastern Washington to California, and eastward from Montana to Colorado. In Montana, it is known mainly from the Pryor Mountains desert, in addition to a historical record in Beaverhead County and a Park County occurrence outside of Gardiner in Yellowstone National Park. It occupies dry, alkaline, often sandy soils in desert shrubland of valleys dominated by *Artemisia tridentata* and variously codominated by *Stipa comata*, *Elymus spicatus*, *Bouteloua gracilis*, and *Atriplex confertifolia* (Lesica and Achuff 1992). It was collected in 1967 by W. E. Booth (#6740) and the location was characterized as “south of Dryhead community about 10 miles on flat overlooking the river.” This would seem to put it between Layout Creek and Devils Canyon overlook. It was not relocated in this study.

Figure 63. Distribution of *Grayia spinosa* in the Montana portion of Bighorn Canyon NRA



Abundance

Unknown.

Management Recommendations

Study area data is needed before making management recommendations.

Leptodactylon caespitosum Nutt.

Leptodactylon

Polemoniaceae (Phlox Family)

Status

Heritage Rank: Global Rank - G3G4; Montana - S2; Wyoming - S3 (not tracked).

Note: This species has been reranked in Montana from S1 based on results of this study.

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

Description

Description: *Leptodactylon* is a mat-forming perennial with a highly branched woody rootcrown that gives rise to numerous mat-forming stems that are up to 2 cm high (Figure 64). Each stem is closely covered by opposite, deeply 2-3 equally-lobed, spine-tipped leaves that are 3-6 mm long. Foliage is glabrous to glandular. Solitary flowers are borne on the stem tips.

Figure 65. Illustration of *Leptodactylon caespitosum*

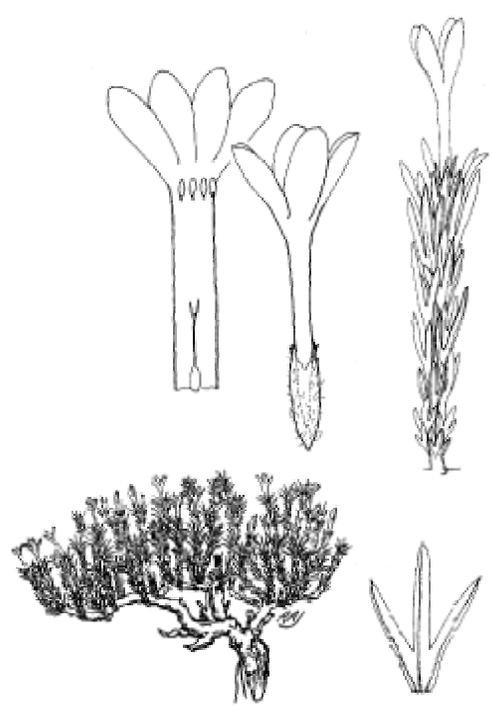


Illustration by Robin A. Jess
From "Intermountain Flora"

The pinkish-white, tubular corolla is 12-20 mm long and flares into 4 spreading lobes. 4 anthers are borne near the top of the tube, and the calyx is 5-8 mm long, with 4 shallow, pointed lobes. The fruit is a round capsule (Cronquist et al. 1984)

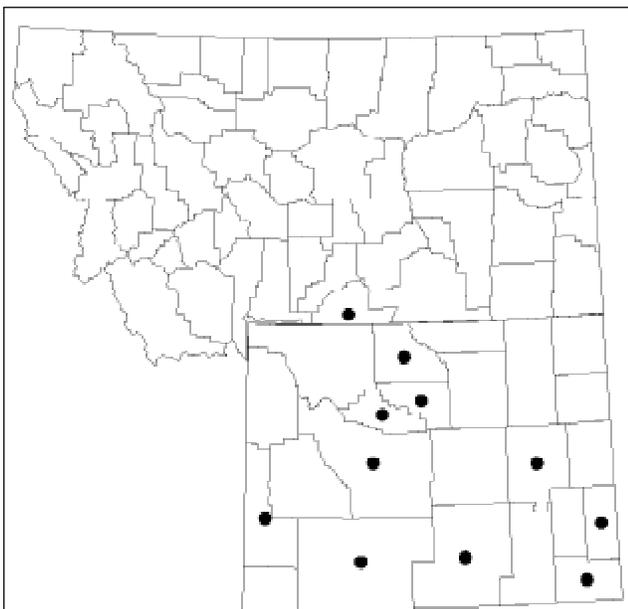
Similar species: *Leptodactylon pungens* is a taller subshrub and not forming tight mats or mounds. Both it and mat-forming species of *Phlox* have flowers with a 5-lobed calyx and corolla.

Flowering/Fruiting Period: Flowering in late May-early June.

Range and Habitat

Leptodactylon caespitosum is a Great Basin species of Utah, Nevada, Colorado and Wyoming that reaches as far east as western Nebraska and as far north as south-central Montana. It is restricted in Montana to the Pryor Mountains desert area of Carbon County. It is known from four Montana populations in the Bighorn Canyon NRA, but is more widespread in the Wyoming segment of the study area.

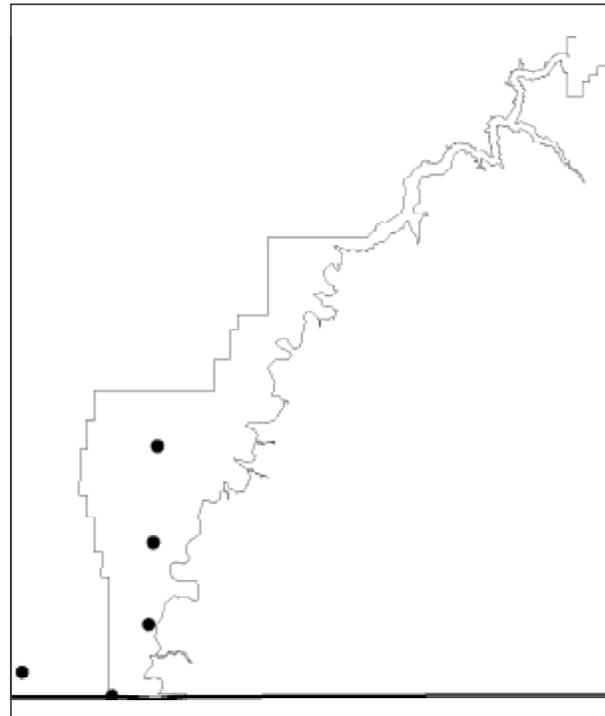
Figure 66. Montana and Wyoming county distribution of *Leptodactylon caespitosum*



This species occupies dry, rocky, windswept ridges mainly on the Chugwater Formation. It is most consistently found in association with sparsely-vegetated plant associations dominated by *Phlox*

bryoides, often co-dominated by *Chrysothamnus nauseosus*, but also with *Elymus spicatus* and *Juniperus osteosperma* (Lesica and Achuff 1992). In Bighorn Canyon, it is restricted to Chugwater Formation on barren slopes of deep red slate formed into knolls and ridges.

Figure 67. Distribution of *Leptodactylon caespitosum* within Bighorn Canyon NRA



Abundance

Populations are often locally abundant though highly restricted. There are two populations documented in Montana with over 1000 plants. Total estimated number of plants in Montana is over 5000 individuals. Of these, about 25% are in Bighorn Canyon NRA, where the two largest populations have over 500 individuals.

Management Recommendations

Road construction may have reduced some populations in the past, and right-of-way maintenance activities potentially affect the fringes of the largest population in Bighorn Canyon NRA. The harsh environment of this species is a deterrent to most exotic species invasion, but *Halogeton glomeratus* was observed invading roadside habitat close to one population. Livestock trail through part of the largest population in Bighorn Canyon NRA, bighorn sheep

and tourists congregate at the scenic overlook point of the other large population, and horse use is heavy at a third population. Despite these concentrated uses, there were no obvious signs of impact in the absence of any mechanical surface-disturbance.

Mentzelia pumila Nutt. ex Torr. & Gray
var. *pumila*
Dwarf mentzelia
Loasaceae (Blazing-star Family)

Status

Heritage Rank: Global Rank - G4; Montana - S2; Wyoming - S3 (not tracked)

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

Description

Description: Dwarf mentzelia is a biennial or short-lived perennial with branched, white stems that arise from a stout taproot and that are 20-60 cm tall. The lance-shaped basal leaves are 8-10 cm long and have short petioles and broadly-toothed margins. The alternate leaves become sessile, smaller, and more deeply lobed higher on the stem. Foliage is covered with short, barbed hairs that cause it to stick to clothing like velcro. 1-3 flowers are borne on short stalks arising from the axils of the reduced upper leaves, or bracts. Flowers have 10 yellow petals that are 9-15 mm long and numerous stamens, the outer of which are petal-like. The calyx forms a deep bowl with 5 narrow, pointed lobes that are 4-10 mm long; it also contains the ovary and bears the stamens. The cylindrical seed capsules are 15-20 mm long.

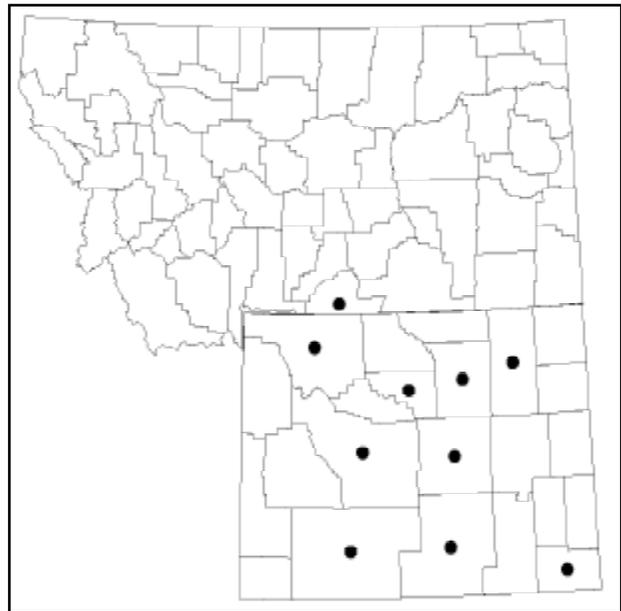
Similar Species: This is our only *Mentzelia* with 10 yellow petals and our only perennial member of the genus with calyx lobes less than 15 mm long (Dorn 1984, 1992).

Flowering/Fruiting Period: Flowering in June-early July.

Range and Habitat

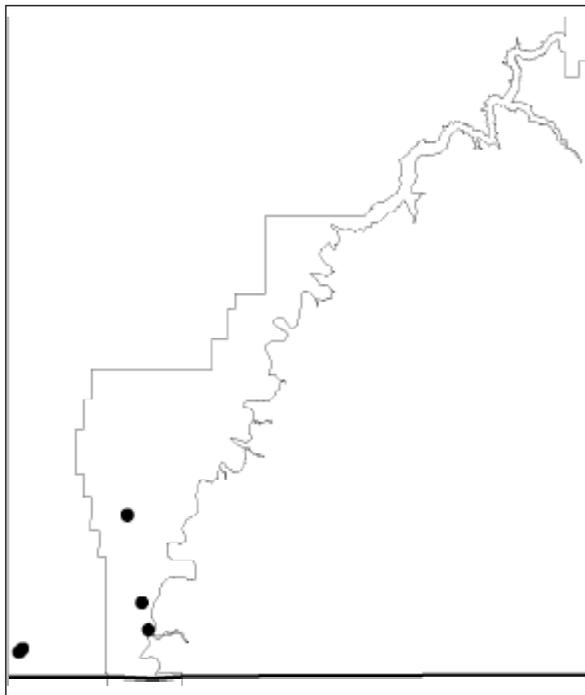
Dwarf mentzelia is a Great Basin species distributed from Colorado, Utah and Nevada as far north as

Figure 68. Montana and Wyoming county distribution of *Mentzelia pumila*



south-central Montana, where it is known only from the Pryor Mountains area in Carbon County. In the study area, it occurs on platy shale of the Chugwater Formation. It occupies open, usually sandy soil in sparse juniper woodlands and cushion plant communities dominated by *Elymus spicatus*, *Krascheninnikovia lanata* and *Phlox bryoides* (Lesica

Figure 69. Distribution of *Mentzelia pumila* in the Montana portion of Bighorn Canyon NRA



and Achuff 1992). In Montana, it was found at two sites and attempts to relocate a third were unsuccessful. There are at least three small populations on the Wyoming side on Sykes Mountain and the east shore of Yellowtail Reservoir.

Abundance

There are 16 occurrences in Montana, ranging in size from 1 plant to estimated numbers of 100-1000. Population numbers for this species are typically low, and it is subject to fluctuations in numbers. All populations found in the study area had fewer than 10 flowering plants. Immature basal rosettes were present but these could not be identified to species with certainty.

Management Recommendations

Most populations of Dwarf mentzelia are small and any surface disturbances that diminish or degrade suitable habitat are potential impacts. It was collected in 1982 near Devils Canyon Overlook by Larry Thompson and could not be relocated; precise location was not given and more extensive survey in June is needed before coming to the conclusion that this population is extirpated. One small Bighorn Canyon occurrence is reduced to an island of habitat surrounded by parking lot and park road. Despite the extremely harsh setting, exotic species such as *Halogeton glomeratus* are present in low numbers here and pose potential management concerns.

Musineon vaginatum Rydb.

Sheathed musineon

Apiaceae (Parsley Family)

Status

Heritage Rank: Global Rank - G3G4; Montana - S3 (not tracked); Wyoming - S2 [Medium conservation priority]

Note: Global rank was changed from G3?, and Montana rank was assigned as S3 as a result of this study.

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

Description

Description: Sheathed musineon is a perennial from a

stout taproot surmounting a short branched rootcrown, with 1-several slender stems that are 15-30 cm tall at maturity. The conspicuously sheathed leaves are basal and alternate on the stem, thrice-divided into linear segments. The inflorescence is a compound umbel of white or yellowish flowers, well-developed calyx teeth, and involucre bracts. The fruit is laterally compressed, with distinct ribs, 3-4 mm long (Hitchcock and Cronquist 1961).

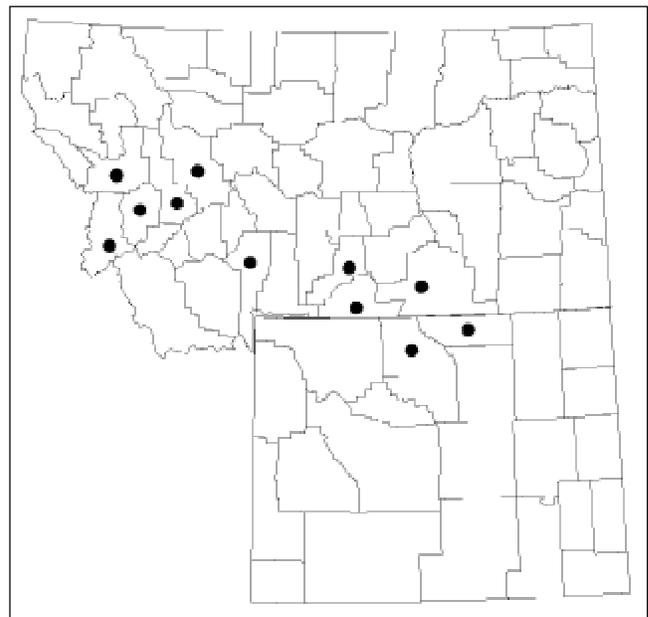
Similar Species: *Musineon divaricatum* has leaves subopposite and twice-divided, and none of the leaves have distinct stalks between the sheath and the base of the blade. Species of *Lomatium* differ in having the fruit dorsally compressed.

Flowering/Fruiting Period: Flowers from June-July; fruits produced from July-August.

Range and Habitat

Sheathed musineon is a regional endemic ranging from west-central Montana to north-central Wyoming, including Big Horn and Sheridan counties. While Montana represents the center of its limited range, it has never been considered a rare species in the state. It was only known from a total of about 20 collection stations in Montana in Big Horn, Carbon, Gallatin, Granite, Lewis & Clark, Missoula, Powell, and Stillwater counties. They include 18 collections representing about 15 different sites at MONTU and

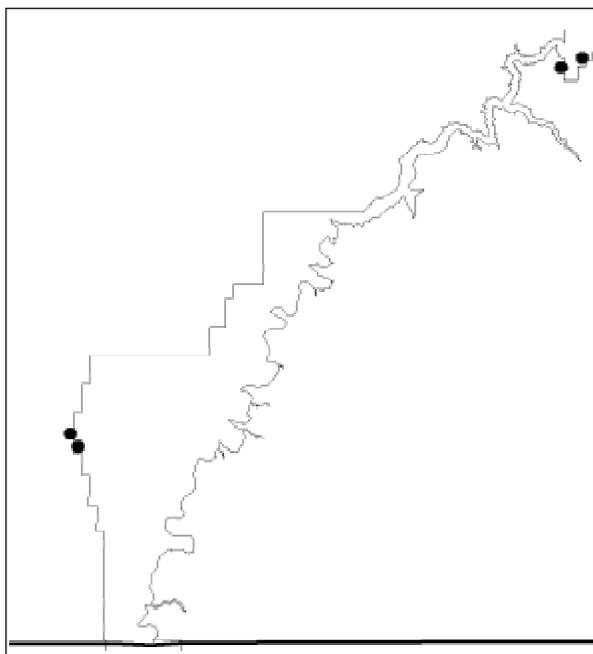
Figure 70. Montana and Wyoming county distribution of *Musineon vaginatum*



seven collection sites at Montana State University (MONT) representing six additional different sites.

In the study area, it was consistently found in

Figure 71. Distribution of *Musineon vaginatum* in the Montana portion of Bighorn Canyon NRA



Pseudotsuga menziesii stands, which are of limited extent in the NRA. It has not been found from the Wyoming part of the NRA. Vegetation plot data was examined for the adjoining Pryor Mountains, where it had been recorded in vegetation plots for most conifer woodland and forest plant associations (DeVelice and Lesica 1993) including:

- Juniperus osteosperma* – *Cercocarpus ledifolius*
- Pinus flexilis*/*Festuca idahoensis*
- Pinus flexilis*/*Juniperus communis*
- Pseudotsuga menziesii*/*Cercocarpus ledifolius*
- Pseudotsuga menziesii*/*Elymus spicatus*
- Pseudotsuga menziesii*/*Symphoricarpos oreophilus*

Substrates are derived from Madison Group limestones sometimes with loose rubble or fractured bedrock exposed at the surface, but more often with deep duff of undecayed needles.

Abundance

Sheathed musineon is not only widespread, it is very common throughout the more heavily forested types above. This ubiquity and abundance across the Pryor

Mountains-area landscape has not been documented elsewhere for the species.

Management Recommendations

No management needs were identified for Sheathed musineon. Populations in Montana are relatively secure and this species does not occur on the Wyoming side of the Bighorn Canyon NRA.

Oxytropis besseyi* (Rydb.) Blank. var. *fallax
 Barneby
 Bighorn locoweed
 Fabaceae or Leguminosae (Pea Family)

Synonym: *Oxytropis nana* Nutt. var. *fallax* (Barneby) Isely

Status

Heritage Rank: Global Rank - G5T3; Montana - SU (watch); Wyoming - S3 (not tracked).

Note: Added to the watch list in Montana as having unresolved status, based on its recent documentation as an addition to the state flora.

Legal Status: USF&WS Status -None; BLM Status - none; USFS Status - None.

Description

Description: Bighorn locoweed is a stemless perennial forb from a stout rootstalk. Stems and leaves are densely silky-pubescent to nearly tomentose throughout with basally-attached hairs. The leaves are once-pinnately compound with 7-15 leaflets and are shorter than the flowering stalks. Flowers are pinkish-purple, 16-25 mm long, and are arranged in a loose, elongate inflorescence 2.5-5 cm long. The calyx tube is 6.5-8 mm long with linear or triangular teeth 2-2.5 mm long. Pubescence of the calyx is comprised of appressed or loosely ascending white hairs less than 1.5 mm long and does not obscure the calyx surface. Fruits are short-stalked, long-beaked, and woolly-pubescent and split the calyx at maturity (Barneby 1952; Dorn 1992; Isley 1998).

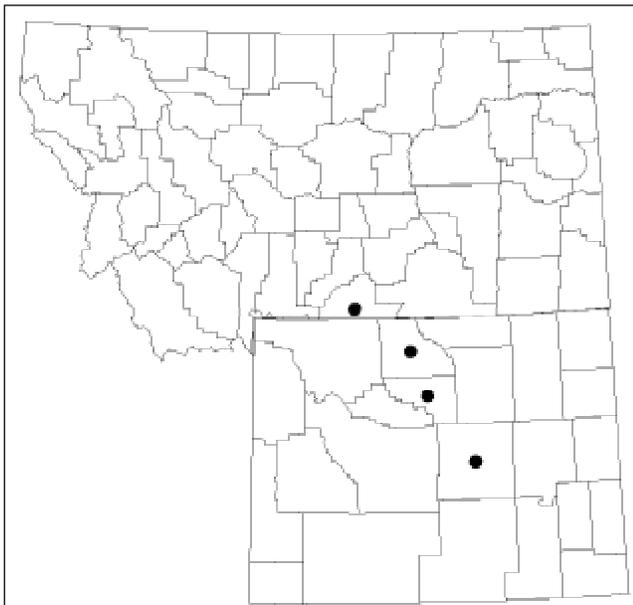
Similar Species: *Oxytropis besseyi* var. *obnapiformis* has sessile fruits, basal leaves that equal the inflorescence in length, and calyces with densely white-woolly hairs that obscure its surface. *O. besseyi* var. *ventosa* has a congested, head-like inflorescence and calyces with spreading or ascending hairs ca 2 mm long. *O. besseyi* var. *besseyi* has 9-21 leaflets per leaf and spreading to ascending hairs ca 2 mm long on the calyx. *O. nana* has a densely white-woolly calyx that is inflated (and not split) at maturity. *O. lagopus* has a mix of black and white hairs on the calyx. *O. lambertii* has herbage with t-shaped (dolabriform) hairs.

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

Range and Habitat

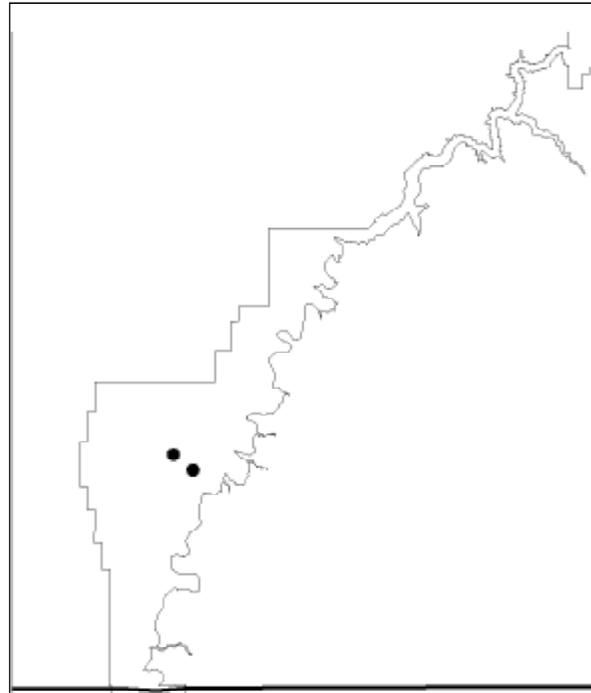
Bighorn locoweed is a regional endemic of the Bighorn and possibly Pryor Mountains and their foothills in Carbon County, Montana, and Big Horn, Fremont, Hot Springs, Natrona, and Washakie counties, Wyoming. It has only recently been recognized as present in Montana (Isely 1998) based on its documentation in Bighorn Canyon by Wyoming botanists in 1991 (Struttman and Fertig #54). It has not been systematically searched on the Montana side of the NRA, and may warrant further documentation.

Figure 72. Montana and Wyoming county distribution of *Oxytropis besseyi* var. *fallax*



O. besseyi var. *fallax* occurs on rocky sandy slopes, alluvial fans, gravelly sandstones, and eroded badlands from 3660-6600 feet. Populations may occur in sparsely vegetated cushion plant communities, *Artemisia tridentata*-*Stipa comata* grasslands, or *Juniperus osteosperma*-*Artemisia tridentata* shrublands.

Figure 73. Distribution of *Oxytropis besseyi* var. *fallax* in the Montana portion of Bighorn Canyon NRA



In Bighorn Canyon NRA, *O. besseyi* var. *fallax* is commonly found on terraces of red clay covered by dolomite rubble in cushion plant or sparse sagebrush grasslands with *Eriogonum brevicaulis* var. *canum*, *Haplopappus nuttallii*, *Arenaria hookeri*, *Hymenoxys acaulis*, *Cryptantha cana*, *Astragalus hyalinus*, *Lesquerella arenosa*, *Elymus spicatus*, *Stipa comata*, *Gutierrezia sarothrae*, and *Artemisia tridentata* var. *wyomingensis*. It is most commonly found on outcrops of Chugwater redbeds and Goose Egg sand and siltstones.

Abundance

This taxon is widely distributed at low population densities throughout much of the Bighorn Canyon NRA in Wyoming, and is locally abundant (although typically scattered) along much of the west slope of the Bighorn Range in north-central Wyoming.

Management Recommendations

No immediate management needs have been identified for Bighorn locoweed. Populations in Wyoming appear sufficiently secure so that this species is not a high priority target for conservation attention in that state, and status information in Montana is preliminary. Nature Conservancy's Tensleep Preserve and additional populations are likely to occur in BLM ACECs, potential Forest Service Research Natural Areas and Wilderness Study Areas along the western foothills of the Bighorn Range.

Oxytropis besseyi (Rydb.) Blank. var. *ventosa* (Greene) Barneby Wind River locoweed Fabaceae or Leguminosae (Pea Family)

Synonym: *Oxytropis nana* Nutt. var. *ventosa* (Greene) Isely

Status

Heritage Rank: Global Rank - G5T3; Montana - SU (watch); Wyoming - S3 (not tracked).

Note: Added to the watch list in Montana as having unresolved status, based on its recent documentation as an addition to the state flora.

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

Description

Description: Wind River locoweed is a stemless perennial forb from a stout rootstalk. Herbage is densely silky-pubescent to nearly tomentose throughout with basally-attached hairs. The leaves are 3-7 cm long and once-pinnately compound with 5-9 (11) crowded leaflets 10-21 mm long. Flowering stalks are 3-9 (13) cm long and exceed the basal leaves. Flowers are pinkish-purple with banners 15-20 mm long and are arranged in a dense, head-like inflorescence 0.5-2 (3) cm long. The calyx is 9-10.5 mm long with linear teeth 3-4 mm long and is thinly to densely covered by white, loosely spreading hairs about 2 mm long. Fruits are short-stalked, long-beaked, and woolly-pubescent and split the calyx at maturity (Barneby 1952, 1989; Dorn 1992; Isley 1998).

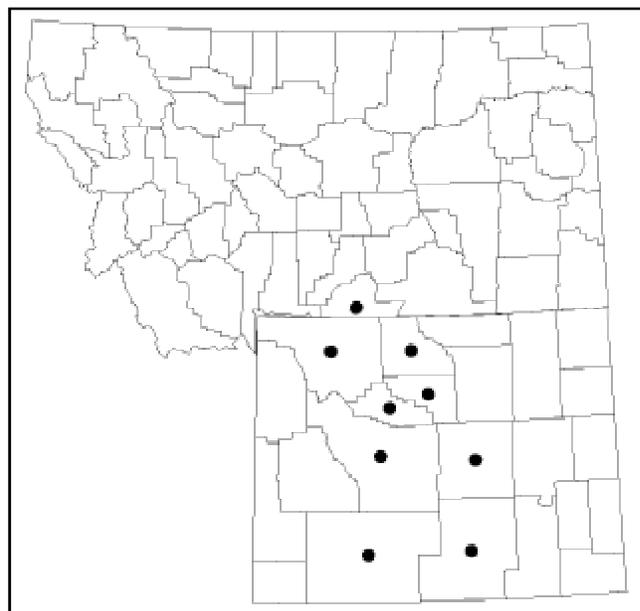
Similar Species: *Oxytropis besseyi* var. *besseyi* has a loose inflorescence that is 2-8 cm long at maturity and borne on a stalk 9-16 cm long and 9-21 leaflets per leaf. *O. besseyi* var. *fallax* has appressed hairs that are 1.5 mm long or less on the calyx. *O. lambertii* has herbage with t-shaped (dolabriform) hairs.

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

Range and Habitat

Wind River locoweed is a regional endemic of central

Figure 74. Montana and Wyoming county distribution of *Oxytropis besseyi* var. *ventosa*

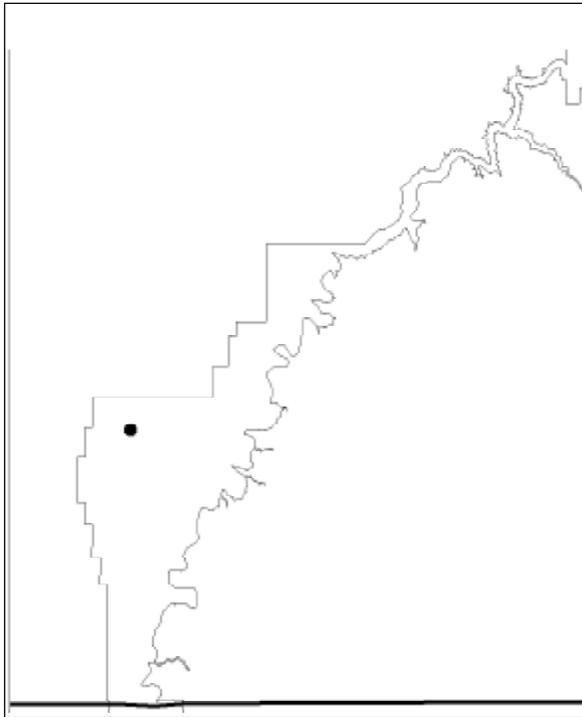


Wyoming (Big Horn, Carbon, Fremont, Hot Springs, Natrona, Park, Sweetwater, and Washakie counties), southcentral Montana (Carbon County), and northeastern Utah (Daggett County). Populations in Wyoming occur in the Bighorn, Wind River, Green River, and North Platte river basins and the foothills of the Absaroka Range. It has only recently been reported for Montana (Welsh 1998), and previous collection records of this taxon in the state are being secured to evaluate its status. It has not been systematically searched on the Montana side of the NRA, and may warrant further documentation.

Wind River locoweed is found primarily on arid sandstone and siltstone ridges in cushion plant or sparsely vegetated sagebrush grasslands. Populations are also occasionally found on sandy beaches, badlands, and dry volcanic slopes. In Wyoming, it ranges in elevation from 4600-8300 feet.

Abundance

Figure 75. Distribution of *Oxytropis besseyi* var. *ventosa* in the Montana portion of Bighorn Canyon NRA



O. besseyi var. *ventosa* is known from over 50 locations in central Wyoming. No formal surveys have been conducted to determine its abundance in the state.

Management Recommendations

No immediate management needs have been identified for Wind River locoweed. Populations in Wyoming appear sufficiently secure so that this species is not a high priority target for conservation attention in that state, and status information in Montana is preliminary.

Senecio eremophilus* Richardson var. *eremophilus
Cut-leaved groundsel
Asteraceae or Compositae (Aster Family)

Status

Heritage Rank: Global Rank - G5T5; Montana - S1; Wyoming - S3 (not tracked)

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

Description

Description: Cut-leaved groundsel is a short-lived, glabrous perennial with a solitary stem that is 30-120 cm high and arising from a short taproot (Figure 74). The lowest leaves are inconspicuous, while the others are alternate and little reduced upwards. Each leaf has

Figure 76. Illustration of *Senecio eremophilus* var. *eremophilus*



Illustration by John H. Rumely
From "Vascular Plants of the Pacific Northwest"

a short petiole and a lance-shaped blade that is 4-15 cm long with deeply lobed and coarsely-toothed margins. Numerous flower heads are borne in an open, flat-topped, terminal inflorescence. The heads have a single series of ca. 13 non-overlapping, narrow, pointed, minutely black-tipped involucral bracts that are 7-9 mm long. The ca. 40 disk flowers are yellow, and the ca. 8 yellow rays are 6-10 mm long. The achene has a pappus of white bristles at its summit (Cronquist 1955).

Similar Species: Distinguished from other tall, leafy-stemmed *Senecio* by having lobed, coarsely toothed leaves, and a taproot rather than fibrous roots. The two other varieties of this species do not occur in the northern Rocky Mountain States.

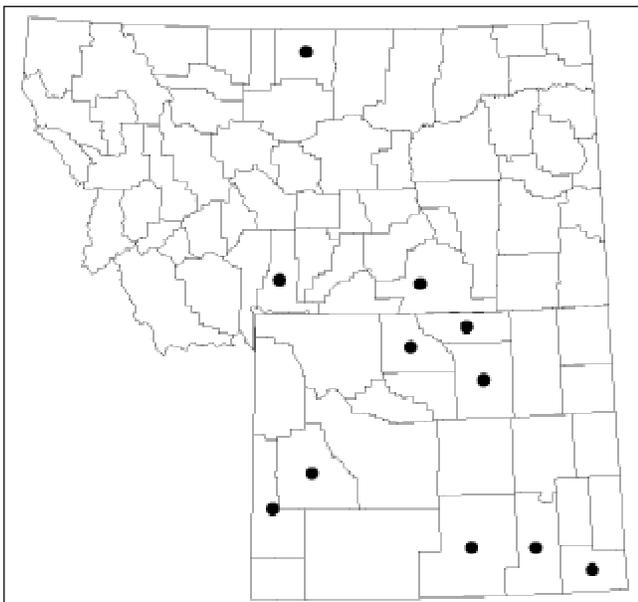
Flowering/Fruiting Period: Flowering in late June.

Range and Habitat

Cut-leaved groundsel is a western species distributed from British Columbia to Ontario, and south from Arizona and New Mexico to Nebraska. In Montana, it is known from the Bear's Paw Mountains, Bighorn Canyon, and historically from the Yellowstone Valley.

It is considered to be a facultative wetland species in the Great Plains (USDI Fish and Wildlife Service 1994). Its habitat includes moist streambanks and riparian forests in the valley and montane zones. It

Figure 77. Montana and Wyoming county distribution of *Senecio eremophilus* var. *erimophilus*

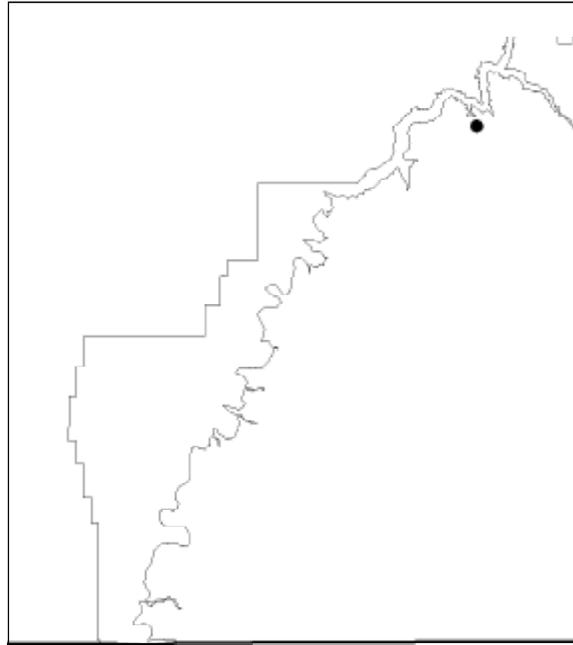


was originally collected in Bighorn Canyon from a streambank setting along East Cabin Creek by Lichvar (#6383) and was not relocated in this study.

Abundance

Unknown.

Figure 78. Distribution of *Senecio eremophilus* var. *eremophilus* in the Montana portion of Bighorn Canyon NRA



Management Recommendations

Study area data are needed before making management recommendations. Cut-leaved groundsel appears to be a riparian corridor species of perennial spring-fed streams, with limited potential habitat inside NRA boundaries.

***Sphenopholis intermedia* (Rydb.) Rydb.**
Slender wedgrass
Poaceae (Grass Family)

Synonym: *Sphenopholis obtusata* var. *major*

Status

Heritage Rank: Global Rank - G5; Montana - S1; Wyoming - S2 (not tracked).

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

Description

Description: Slender wedgrass is an annual or short-lived perennial grass with stems 20-100 cm tall in small clusters and arising from fibrous roots (Figure 77). Leaves are flat, 2-5 mm wide, and minutely roughened. The slender spike is made up of loosely clustered spikelets that are on erect branches that are plainly distinct. Spikelets are two-flowered, and the seeds drop with the glumes. The shape and difference

Figure 79. Illustration of *Sphenopholis intermedia*

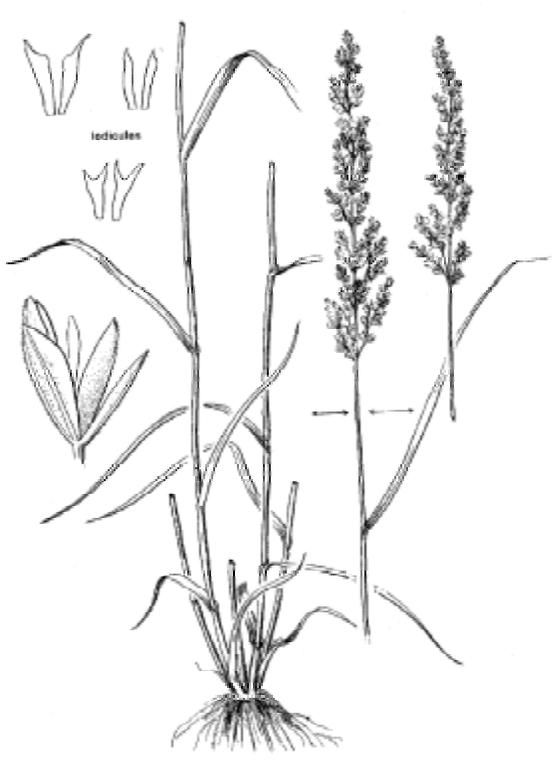


Illustration by Jeanne R. Janish
From "Vascular Plants of the Pacific Northwest"

in width of the two glumes is distinctive, with the large second glume being very broad at its upper end, giving it the appearance of a wedge. Lemmas are 2.5-3 mm (Great Plains Flora Association 1986).

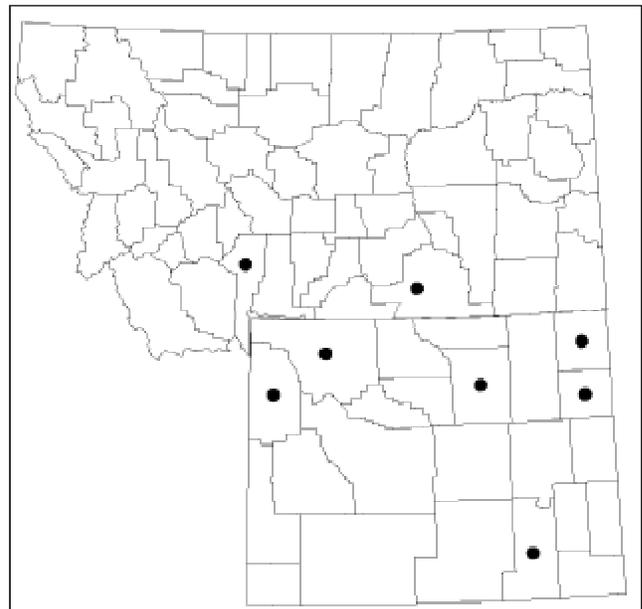
Similar Species: Distinguished from the more common *Sphenopholis obtusata* by the relatively open inflorescence, second glume almost 3 times as long as wide, and pointed glume tips (Dorn 1992).

Flowering/Fruiting Period: Producing seed in late June-July.

Range and Habitat

Sphenopholis intermedia is a widespread northern plant extending from Alaska to Newfoundland and scattered southward as far as New Mexico. It is a facultative wetland species (USDI Fish & Wildlife Service 1993). In Montana, it is known from Big Horn County and a historic collection in Park County. The Big Horn collection information indicated that the material was collected in riparian habitat of East Cabin Creek.

Figure 80. Montana and Wyoming county distribution of *Sphenopholis intermedia*



Abundance

Unknown.

Figure 81. Distribution of *Sphenopholis intermedia* in the Montana portion of Bighorn Canyon NRA



Management Recommendations

Study area data are needed before considering management of Slender wedgegrass. If it is a riparian species, then there is limited potential habitat inside NRA boundaries.

Stipa lettermanii Vasey
 Letterman's needlegrass
 Poaceae (Grass Family)

Status

Heritage Rank: Global Rank - G5; Montana - S1; Wyoming - S3S4 (not tracked)

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

Description

Description: Letterman's needlegrass is a bunch-forming perennial with mostly glabrous stems that are 20-60 cm tall (Figure 80). The leaf blades are 1-1.5

Figure 82. Illustration of *Stipa lettermanii*

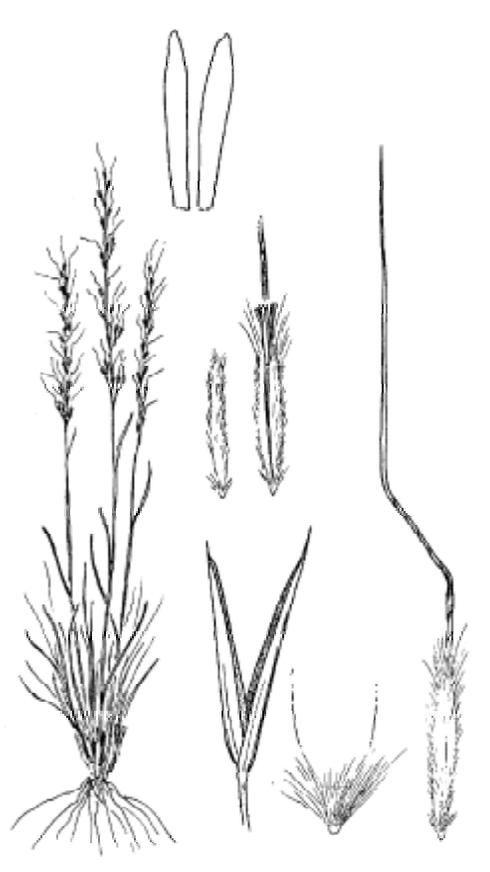


Illustration by Jeanne R. Janish
 From "Vascular Plants of the Pacific Northwest"

mm wide and are threadlike or inrolled. Ligules are membranous, mostly 0.3 to 0.8 mm long, and with a straight margin. The narrow inflorescence is 10-15 cm long with erect branches. The spikelets consist of two glumes that are longer than and enclose a single floret. The glumes are 6-9 mm long with 3 nerves and pointed tips. The lemma is hardened in comparison to the glumes, is hairy with longer hairs towards the tip, and has a twisted, bent, glabrous awn from its tip that is about 1.5 cm long; the body of the lemma, excluding the awn, is 4-5.5 mm long. The palea is hairy, about 3.5 mm long, and usually at least 2/3 the length of the body of the lemma (Hitchcock et al. 1969).

Similar Species: Distinguished from other species of *Stipa* in Montana by having short, glabrous awns and paleas that are hairy and about 2/3 the length of the lemmas. A hand lens and technical key may be needed for positive identification (Dorn 1984).

Flowering/Fruiting Period: Fruiting in late June-July.

Range and Habitat

Stipa lettermanii is a western Basin species distributed from Oregon and California east to Montana and New Mexico. In Montana, it is known only from Bighorn Canyon, the upper Madison River drainage, and a recent addition in the Centennial Valley. In these settings it was reported on limestone talus and dry fescue grassland in the valley and foothill zones.

Figure 83. Montana and Wyoming county distribution of *Stipa lettermanii*

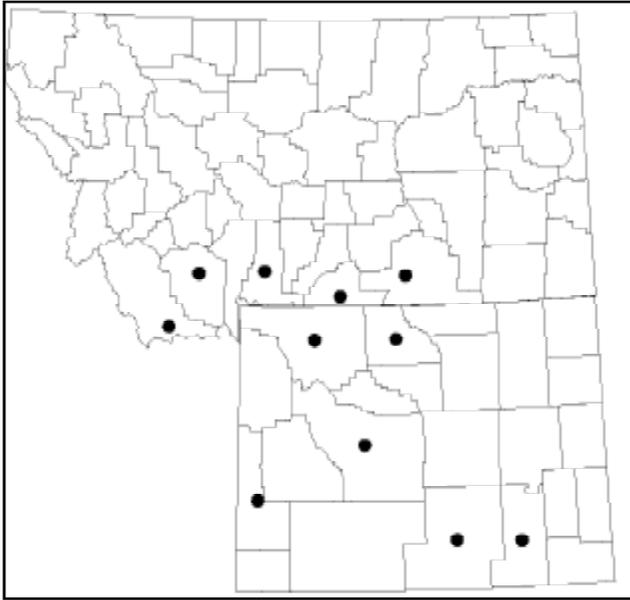
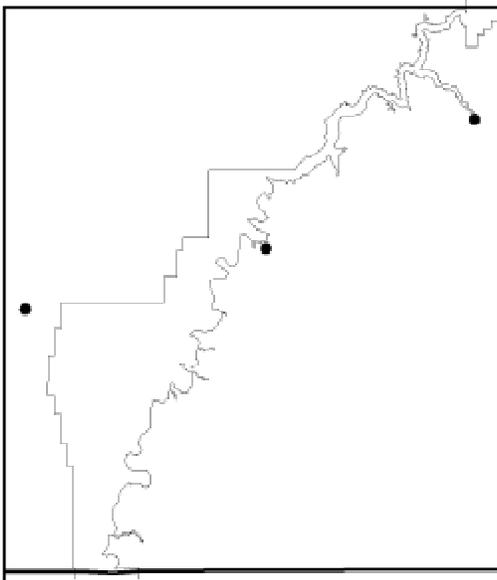


Figure 84. Distribution of *Stipa lettermanii* in the Montana portion of Bighorn Canyon NRA



Abundance

Unknown. Its local distribution spans the range of elevation in the NRA from canyon bottom to the Pryor Mountains rim, suggesting that documentation is incomplete.

Management Recommendations

Study area data are needed before making management recommendations. It is not known whether the two collections made in 1983 were at or near reservoir level.

Discussion and Management Recommendations

Bighorn Canyon NRA provides significant habitat for 25 globally rare or state rare plant species. More importantly, the NRA is one of the few areas within the Bighorn Basin or the west foothills of the Bighorn Range that is managed specifically for the enhancement of natural processes and biological diversity. Under current management, most species appear to be secure and have stable population sizes. Exotic species encroachment, recreational activities, water management, fire management, and wild horse use may affect three globally rare species. Effects of other management actions on these and other species are unresolved or small-scale.

Monitoring is needed to answer questions about population trends and to assess changes in species abundance or distribution in response to current practices or management change. This is most important for the globally restricted plants found in the Bighorn Canyon NRA potentially affected by management actions. We recommend implementing the following monitoring programs, described in greater detail in the preceding species summaries:

1. Combine monitoring of *Rorippa calycina* with *Tamarisk chinensis* control efforts on the east side of Yellowtail Reservoir in Wyoming. Record results in combination with water level data for further evaluation of water level management effects on *Rorippa calycina*.
2. Take photo points of two vulnerable *Sullivantia hapemanii* var. *hapemanii* populations (Box Canyon, Trail Creek), and determine if there are earlier photos, to detect major changes in species' cover as indication of trend as affected by water levels and recreation, respectively.
3. Monitor wild horse grazing effects on demography of *Stanleya tomentosa* var. *tomentosa*. Also monitor fire effects if occurrences are within prescribed burn plans.

In addition, we recommend the following general actions:

1. Control noxious weeds
2. Evaluate the effects of management actions on the five globally rare species
3. Identify the most vulnerable habitats of globally rare species as places of special management concern
4. Pursue remaining plant and plant community inventory needs

Each of these four general actions is discussed in greater detail under the headings that follow.

1. Control noxious weeds

One of the most widespread threats to rare species conservation and native species in much of Montana and Wyoming is invasion by exotic species (Sheley and Petroff 1999, Schassberger and Achuff 1991). With the exception of Saltcedar (*Tamarisk chinensis*) and its effects on *Rorippa calycina*, noxious weeds are not well-established in the Bighorn Canyon NRA and are not yet significantly impacting rare plants. The opportunity to curtail or curb noxious weed encroachment is important to long-term rare species conservation in the NRA. The following discussion highlights the exotic species that were mentioned in Knight et al. (1987) and that are recognized as noxious species in one or both states, plus other exotic species that pose potential management problems or management questions.

Saltcedar (*Tamarisk chinensis*) is widespread along the drawdown zones and mudflats at the south end of the Reservoir, becoming established throughout the growing season in bands, and building up seedbanks that greatly confound control. Hudson's (1999) baseline research on Saltcedar would ideally be meshed with *Rorippa calycina* species' monitoring at the south end of the NRA to contribute to Reservoir water level management reviews and guidelines. Saltcedar is abundant upstream on the Bighorn and Shoshone Rivers and is at early stages of becoming established upstream on side tributaries along Davis Creek, East Cabin Creek area, and Trail Creek where there are no other immediate threats to these coldwater stream systems and their rare species.

Russian and Spotted knapweed (*Centaurea repens* and *Centaurea maculosa*, respectively) and Leafy spurge (*Euphorbia esula*) are among the most serious threats in Bighorn Canyon NRA and have the potential to invade the habitats of nearly all Bighorn Canyon rare species if left unchecked. They become established in a wide range of moisture conditions. They are most likely to initially invade at sites of heaviest traffic including campgrounds, fishing accesses, and roadsides. They could spread most readily into habitats of globally rare species from road right-of-ways that cross creeks or cushion plant communities. They can also spread readily, with much greater difficulty of control, along reservoir margins. While the options for shoreline control of these species may be more limited, they are all the more critical in the impoundment landscape.

Halogeton (*Halogeton glomeratus*) is a salt-accumulating species that is present in arid areas at the south end of the NRA. It thrives under heavy grazing but is most common in roadside settings of the study area. It is present in low numbers on barren habitat of two state rare plant species, *Leptodactylon caespitosum* and *Mentzelia pumila*, and is close to several other state rare species occurrences.

Canada thistle (*Cirsium arvense*), Hoary cress (*Cardaria draba*), and Field bindweed (*Convolvulus arvensis*) are mainly restricted to disturbed settings with limited potential to expand into intact vegetation. Canada Thistle, however, is abundant at the mouth of some spring-fed stream inlets in the Canyon, and is part of the competing vegetation crowding out native vegetation along stream margins that support Wyoming *Sullivantia* at the lowermost ends of streams. It was not otherwise noted as a threat to rare species.

Red fescue (*Festuca rubra*) and Northern reedgrass (*Phalaris arundinacea*), sometimes with other introduced haymeadow grasses including Smooth brome (*Bromus inermis*), Timothy (*Phleum pratense*) and Quackgrass (*Agropyron repens*), are present around most springs and seeps including most *Sullivantia hapemanii* var. *hapemanii* populations. It appears that only the springs and seeps that have had heavy disturbance also have these species in abundance, but this does not preclude the possibilities of invasion and expansion under current management.

Annual bromes, particularly Cheatgrass (*Bromus tectorum*) are widespread (Knight et al. 1987) and have been reported to have allelopathic effects on germination of native species. It is also reported to foster increased fire frequency. There are related questions whether fire fosters the invasion of Cheatgrass. Heidel observed a lightning strike in July 1998, and the site was visited on the ground in 1999. The fire killed *Pinus flexilis* and *Elymus spicatus*, resulting in a solid *Bromus tectorum* stand. This is consistent with studies that report explosive numbers of annual bromes in burned grassland habitat of northeastern Wyoming (Williams 1961, 1963).

In a few of our inventory sites, native species that increase under disturbance are locally common. Purple threeawn (*Aristida purpurea*) is native but its relative abundance may indicate grazing pressure. One of the “windswept plateau” plots of Knight et al. (1987) showed relatively high frequency for this species.

2. Evaluate the effects of management actions on the five globally rare species

Riparian zone management on the Yellowtail Reservoir includes both “confined” and “unconfined” reservoir segments, and competition between a rare plant species (*Rorippa calycina*) vs. an exotic species (*Tamarix chinensis*) for shoreline habitat. Water levels reached maximum-allowed pool elevations of 3,650 ft. in late July of 1999. The mid-summer peak, at least in years of high water conditions, may interfere with *Rorippa calycina* flowering and seed establishment if not competitive ability and survival. Reservoir water levels may still be affecting the *Sullivantia hapemanii* var. *hapemanii* population in Box Canyon, or all of the alteration may already have taken place.

Wildfire policy and prescribed burn planning are important in rare species conservation. Wildfire policy potentially affects the Layout Creek headwaters and Sykes Ridge rare species, considering the high numbers of standing dead trees among the Douglas fir stands in this area. Species potentially involved include *Lesquerella lesicii* and *Astragalus aretioides*, plus adjoining populations of *Shoshonea pulvinata* that are outside the study area. These settings are on the western NRA boundary and management will require coordination with BLM.

Wildlife and wild horse management planning are similarly important to rare plant populations. The viability of *Stanleya tomentosa* var. *tomentosa* under wild horse grazing may warrant monitoring. The “natural state” of *Astragalus geyeri* var. *geyeri* habitat is an unresolved question for this species that is present in one small area with heavy wild horse use. Three of the six globally rare species are present in low numbers in Dyyhead livestock allotments where habitat is limited for them. Trailing and yarding elsewhere in the NRA may have localized affects, or provide opportunity to evaluate grazing responses on a small scale.

3. Identify the most vulnerable habitats of globally rare species as places of special management concern

Within existing management zones and subzones, it may be desirable to identify the most vulnerable plant communities that are critical to associated globally rare species, and document/map them further. Spring-seep systems are very restricted on the landscape, and very fragile and vulnerable to any foot traffic or altered hydrology. In such an arid landscape, the waters of springs and spring-fed streamcourses have historically been centers of use and development, as with the fish hatchery development at Sykes Spring immediately west of Bighorn Canyon NRA. The most fragile habitats in the study area are the intact springs that are dominated by *Sullivantia hapemanii* var. *hapemani*. These are found in “amphitheater” settings and other major spring-seep systems, where an emergent wetland association is fed by groundwater high in calcium carbonate, on both bedrock and colluvial substrate.

This species is also present along streams at the northern end of the study area but does not form a discrete community in these settings, nor are the streamside settings as vulnerable. Graminoid seeps form another type of seep wetland, with varying abundance of *Carex lanuginosa*, *Juncus torreyi*, *Carex praegracilis*, *Carex aquatilis*, *Dichanthelium acuminatum* var. *lanuginosa*, *Muhlenbergia richardsonis*, *Scirpus pungens* and *Eleocharis pauciflora*. They adjoin *Eupatorium maculatum* var. *bruneri* habitat in the Box Canyon area, and are potential habitat for other state rare plants but are not known to harbor globally rare plants. At the other ecological extreme are the cushion plant

communities, called windswept plateaus in Knight et al. (1987), and *Elymus spicatus*/Cushion Plant Herbaceous Vegetation in DeVelice and Lesica (1993). The cushion plant community occurs on windswept plateaus, ridges, and upper slopes of foothills and outwash plains around the Pryor Mountains and Bighorn Mountains. In the Pryor Mountains Desert, the soils have been characterized as deep soils from limestone or calcareous sandstone (DeVelice and Lesica 1993), but in the study area they also include thin-soil sites with gravel pavement over bedrock. *Elymus spicatus* is consistently present with the highest cover among grass species. Total vegetation cover is low and most of the rest of vegetation canopy cover is made up of cushion-forming perennial forbs with 1-7% species cover, including *Arenaria hookeri*, *Hymenoxys acaulis*, *Phlox bryoides*, and *P. hoodii* (Knight et al. 1987, DeVelice and Lesica 1993). These may be found in different combinations and patterns. One distinct form has *Sphaeromeria capitata* as the dominant cushion plant species, as found in the most exposed settings between Crooked Creek and Booz Hill. *Erigeron allocotus* is consistently found in or adjoining these settings in relatively high numbers, and is most vulnerable here. A number of other locally common regional endemics are restricted to the cushion plant community or reach their peak numbers here, including *Townsendia spathulata* and *Penstemon laricifolius*. Despite the harshness of the setting and the ruggedness of the community, it has some of the most restricted flora and may be vulnerable to concentrated trampling and degradation.

4. Pursue remaining plant species and plant community inventory needs

We recommend inventorying concentrations of state rare species, and species groups that were not inventoried such as nonvascular plants. We also recommend expanded survey and documentation of vulnerable habitats, and possible floristic work in select areas. These are encapsulated in the following:

1. Riparian corridors of coldwater streams at the far north end
2. Cushion plant communities
3. Marsh and forest riparian habitat at the far south end of Yellowtail Reservoir
4. Cliff habitat and large segments of dryland canyon habitats
5. Vernal flora in outwash settings
6. Graminoid seep wetland habitats.

Conclusions

Bighorn Canyon NRA is important to the long-term viability of four globally rare plant species that are endemic to the Bighorn Basin or Bighorn and Pryor Mountains areas. We documented and analyzed the distribution, relative abundance, and habitat of these species in the study area and reviewed rangewide information to determine that they are vulnerable but not imperiled. They include:

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

Bighorn Canyon NRA is among the few areas for the first three of these species that is managed for natural processes and biological diversity. Monitoring of species' population trend or species' management response is needed for the latter three species to provide a management framework.

Bighorn Canyon NRA has secondary importance for Lesica's bladderpod (*Lesquerella lesicii*; global rank: G1) among a suite of globally and state rare plants requiring interagency coordination along part of the western border of the NRA. In general, it appears to have high importance in providing habitat for state species of special concern as indicated by the numbers of tracked and watch species in the Montana segment of the study area, warranting further evaluation.

These data are conveyed to help resource managers develop and prioritize management and monitoring plans to ensure the long-term viability of globally rare plant species, and protect the most important concentrations and habitats of both globally and state rare plant species.

Literature Cited

- Alt, D. and D. W. Hyndman. 1986. Roadside geology of Montana. Mountain Press Publishing Company, Missoula, MT.
- Bailey, R. G., P. E. Avers, T. King, and W. H. McNab. 1994. Ecoregions and subregions of the United States. USDA Forest Service. 1:7,500,000 map.
- Barneby, R. C. 1952. A revision of the North American species of *Oxytropis* DC. Proceedings of the California Academy of Sciences IV. 27:177-312.
- Barneby, R. C. 1964. Atlas of North American *Astragalus*. Memoirs of the New York Botanical Garden, 13:1-1188.
- Barneby, R. C. 1989. Volume 3, Part B, Fabales. In: A. Cronquist, A. H. Holmgren, N. H. Holmgren, J. L. Reveal, and P. K. Holmgren, eds. Intermountain Flora, Vascular Plants of the Intermountain West, USA. New York Botanical Garden, Bronx, NY.
- Blake, S. F. 1937. New Asteraceae. Journal Washington Acad. Sciences. 27:379-380.
- Clark, T. W. and R. D. Dorn, eds. 1979. Rare and Endangered Vascular Plants and Vertebrates of Wyoming. Publ. by the editors, Jackson, WY.
- Cronquist, A. 1947. Revision of the North American species of *Erigeron*, north of Mexico. Brittonia 6(2):121-300.
- Cronquist, A. 1955. Pt. 5. Compositae. In: C. L. Hitchcock, A. Cronquist, M. Ownbey and J. W. Thompson, eds. Vascular Plants of the Pacific Northwest. University of Washington Press, Seattle.
- Cronquist, A., A. H. Holmgren, N. H. Holmgren, J. L. Reveal and P.K. Holmgren, eds. 1984. Vol. 4, Subclass Asteridae (Except Asteraceae). In: Intermountain Flora, Vascular Plants of the Intermountain West, USA. New York Botanical Garden, Bronx, NY.
- Cronquist, A. 1994. Vol.5, Asteraceae. In: A. Cronquist, N. H. Holmgren, J. Holmgren, J. Reveal, and P. K. Holmgren, eds. Intermountain Flora, Vascular Plants of the Intermountain West, USA. New York Botanical Garden, Bronx, NY.
- DeVelice, R. and P. Lesica. 1993. Plant community classification for vegetation on BLM lands, Pryor Mountains, Carbon County, Montana. Unpublished report to the Bureau of Land Management. Montana Natural Heritage Program, Helena.
- Dorn, R. D. 1984. Vascular Plants of Montana. Mountain West Publ., Cheyenne, WY.
- Dorn, R. D. 1992. Vascular Plants of Wyoming, second edition. Mountain West Publ., Cheyenne.
- Fertig, W. 1993. Field survey for *Cleome multicaulis*, *Cymopterus williamsii*, and *Sullivantia hapemanii* in north-central Wyoming. Unpublished report prepared for the Casper District of the Bureau of Land Management by the Wyoming Natural Diversity Database, Laramie.
- Fertig, W. 1999. The status of rare plants in the Bighorn Landscape. Report prepared for The Nature Conservancy Wyoming State Office by the Wyoming Natural Diversity Database, Laramie, WY.
- Fertig, W. and G. Beauvais. 1999. Wyoming plant and animal species of special concern. Unpublished list of Wyoming Natural Diversity Database, Laramie.
- Fertig, W. and G. Jones. 1997. Plant species of special concern and plant associations of the Copper Mountain ecosystem, Fremont County, Wyoming. Report prepared for the BLM Wyoming State Office by the Wyoming Natural Diversity Database, Laramie, WY.
- Fertig, W., C. Refsdal, and J. Whipple. 1994. Wyoming Rare Plant Field Guide. Wyoming Rare Plant Technical Committee, Cheyenne, WY.
- Fertig, W. and L. Welp. 1998. Status report on Persistent-sepal yellowcress (*Rorippa calycina*) in Wyoming. Report prepared for the Bureau of Land Management Wyoming State Office by the Wyoming Natural Diversity Database, Laramie, WY.

- Great Plains Flora Association. 1977. Atlas of the Flora of the Great Plains. Iowa State University, Ames.
- Great Plains Flora Association. 1986. Flora of the Great Plains. Univ. Kansas Press, Lawrence.
- Greenlee, J. T. and R. M. Callaway. 1996. Abiotic stress and the relative importance of interference and facilitation in montane bunchgrass communities in western Montana. *Am. Nat.* 148:386-396.
- Heidel, B. L. 1994. Sensitive plant species survey – Garfield and McCone counties, Montana. Unpublished report to the Bureau of Land Management. Montana Natural Heritage Program, Helena.
- Heidel, B. L. 1999. Montana plant species of special concern. Unpublished list of Montana Natural Heritage Program, Helena.
- Heidel, B. L., S. V. Cooper and C. Jean. Plant species of special concern and plant associations of Sheridan County, Montana. Report to the U.S. Fish and Wildlife Service. Montana Natural Heritage Program, Helena.
- Heidel, B. L. and H. Marriott. 1996. Sensitive plant species survey in the Ashland District, Custer National Forest, Powder River and Rosebud counties. Unpublished report to the U.S. Forest Service. Montana Natural Heritage Program, Helena.
- Hitchcock, C. L. and A. Cronquist. 1961. Pt. 3. Saxifragaceae to Ericaceae. *In*: C.L. Hitchcock, A. Cronquist, M. Ownbey, and J.W. Thompson. Vascular Plants of the Pacific Northwest. University of Washington Press, Seattle.
- Hitchcock, C. L. and A. Cronquist. 1964. Pt. 2. Salicaceae to Saxifragaceae. *In*: C. L. Hitchcock, A. Cronquist, M. Ownbey, and J.W. Thompson. Vascular Plants of the Pacific Northwest. Univ. of Washington Publ. Biol. 17(2):1-597.
- Hitchcock, C. L., A. Cronquist, and M. Ownbey. 1969. Pt. 1. Vascular cryptogams, gymnosperms and monocotyledons. *In*: C.L. Hitchcock, A. Cronquist, M. Ownbey, and J.W. Thompson. Vascular Plants of the Pacific Northwest. Univ. of Washington Publ. Biol. 17(1):1-914.
- Hitchcock, C. L. and A. Cronquist. 1973. Flora of the Pacific Northwest. University of Washington Press, Seattle.
- Hudson, L. E. 1999. Climatic and hydrologic effects on the establishment of *Tamarix chinensis* in the cold desert of northern Wyoming (Bighorn Lake). Masters Thesis. University of Montana, Missoula.
- Isley, D. 1998. Native and Naturalized Leguminosae (Fabaceae) of the United States (exclusive of Alaska and Hawaii). Monte L. Bean Life Science Museum, Brigham Young Univ., Provo, UT.
- Knight, D. H., G. P. Jones, Y. Akashi, and R. W. Myers. 1987. Vegetation ecology in the Bighorn Canyon National Recreation Area, Wyoming and Montana. Report prepared for the US National Park Service and University of Wyoming-National Park Service Research Center.
- Lesica, P. 1995. Conservation status of *Lesquerella lesicii* in Montana. Unpublished report to the U.S. Forest Service and Bureau of Land Management. Montana Natural Heritage Program, Helena.
- Lesica, P. and P. L. Achuff. 1992. Distribution of vascular plant species of special concern and limited distribution in the Pryor Mountain desert, Carbon County, Montana. Unpublished report to the Bureau of Land Management. Montana Natural Heritage Program, Helena.
- Lesica, P., P. Husby and S. V. Cooper. 1998. New records for Montana. *Madrono* 45: 328-330.
- Lesica, P. and J. S. Shelly. 1991. Sensitive, Threatened and Endangered Vascular Plants of Montana. Montana Natural Heritage Program, Helena.
- Lichvar, Robert W. 1981. Field survey for *Rorippa calycina* (Engelm.) Rydb. Report prepared for the Bureau of Land Management by the Wyoming Natural Heritage Program, Cheyenne.
- Lichvar, R. W., E. I. Collins, and D. H. Knight. 1984. Checklist of vascular plants for the Bighorn Canyon National Recreation Area. Unpublished report for the Wyoming National Park Service Research Center and the Bighorn Canyon National Recreation Area.

- Lichvar, R. W., E. I. Collins, and D. H. Knight. 1985. Checklist of vascular plants for the Bighorn Canyon National Recreation Area, Wyoming and Montana. *Great Basin Naturalist* 45(4): 734-746.
- Marriott, H. and G. P. Jones. 1989. Special status plant surveys and plant community surveys in the Trapper Creek and Medicine Lodge Wilderness Study Areas and the Spanish Point Karst ACEC. Report prepared for the Worland District Office of the Bureau of Land Management by the Wyoming Natural Diversity Database, Laramie, WY.
- Marriott, H. and G. P. Jones. 1993. Special status plant surveys and plant community surveys in the Trapper Creek and Medicine Lodge Wilderness Study Areas and the Spanish Point Karst ACEC. Unpublished report prepared for the BLM Worland District by the Wyoming Natural Diversity Database, Laramie.
- Montana Natural Heritage Program. 1999. Montana Rare Plant Guide. Posted at: (<http://nris.state.mt.us/mtnhp/plants/>). Helena.
- Mulligan, G. A. and A. E. Porsild. 1966. *Rorippa calycina* in the Northwest Territories. *Canadian Journal of Botany* 44:1105-1106.
- Myers, R. W., D. H. Knight, G. P. Jones, and L. Frey. 1986. Vegetation map for the Bighorn Canyon National Recreation Area, Wyoming and Montana. Department of Botany, University of Wyoming, Laramie.
- Reveal, J. L. 1967. Notes on *Eriogonum* – III On the status of *Eriogonum pauciflorum* Pursh. *Great Basin Naturalist* 27:102-116.
- Reveal, J. L. 1969. A revision of the genus *Eriogonum* (Polygonaceae). Doctoral Dissertation, Brigham Young University, Provo, UT.
- Richards, P. W. 1955. Geology of the Bighorn Canyon – Hardin area, Wyoming and Montana. U.S. Geological Survey Bulletin 1026.
- Rollins, R. C. 1939. The cruciferous genus *Stanleya*. *Lloydia* 2:113-121.
- Rollins, R. C. 1993. The Cruciferae of Continental North America, Systematics of the Mustard Family from the Arctic to Panama. Stanford University Press, Stanford, CA.
- Rollins, R. C. 1995. Two *Lesquerellas* (Cruciferae) of south central and western Montana. *Novon* 5:71-75.
- Rydberg, P. A. 1917. Flora of the Rocky Mountains and Adjacent Plains, Colorado, Utah, Idaho, Saskatchewan, Alberta, and neighboring parts of Nebraska, South Dakota, North Dakota, and British Columbia. New York Botanical Garden, New York.
- Schassberger, L. A. and P. L. Achuff. 1991. Weeds and rare native plants in Montana. *Weed Symposium, Proc. Montana Acad. Sci.* 18-26.
- Sheley, R. L. and J. K. Petroff, eds. 1999. Biology and management of noxious rangeland weeds. Oregon State University Press, Corvallis.
- Soltis, D. E. 1991. A revision of *Sullivantia* (Saxifragaceae). *Brittonia* 43 (1) 27-53.
- Stokes, S. G. 1936. The genus *Eriogonum*. San Francisco: J.H. Neblett Pressroom, San Francisco, CA.
- Stuckey, R. L. 1972. Taxonomy and distribution of the genus *Rorippa* (Cruciferae) in North America. *Sida* 4:279-430.
- USDI Fish and Wildlife Service. 1993. National list of plant species that occur in wetlands. Region 9 – northwest (includes WA, OR, ID, w. MT, w. WY). Prepared by Resource Management Group, Inc. Grand Haven, MI.
- USDI Fish and Wildlife Service. 1994. National list of plant species that occur in wetlands. Regions 4, 5, and 8 – North Plains, Central Plains, and Intermountain. Prepared by Resource Management Group, Inc. Grand Haven, MI.
- USDI National Park Service. 1981. Final general management plan and environmental impact statement for Bighorn Canyon National Recreation Area, Montana - Wyoming. Denver, CO.

USDI National Park Service. 1988. Management Policies. "Endangered, threatened and rare species management", in: Chapter 4. Biological Resources. Washington, DC.

USDI National Park Service. 1998. Species in Parks: Flora and Fauna Databases. Posted at: (<http://ice.ucdavis.edu/nps/>)

Walter, H. 1973. Vegetation of the Earth. Springer-Verlag, New York.

Warnock, M. J. 1997. Ranunculaceae. *In*: Flora of North America, Vol. 3. Magnoliophyta. Oxford University Press, New York.

Welsh, S. 1998. Review of North American species of *Oxytropis* De Candolle (Leguminosae). Department of Botany and Range Science and Life Science Museum. Brigham Young University, Provo. Unpublished manuscript.

Williams, C. S. 1961. Distribution of vegetation in the Wind River Canyon, Wyoming. M.S. thesis, University of Wyoming, Laramie.

Williams, C. S. 1963. Ecology of bluebunch wheatgrass in northwestern Wyoming. PhD. Dissertation, University of Wyoming, Laramie.