

**Status of *Astragalus leptaleus* (Park milkvetch)
in south-central Wyoming**



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ABSTRACT

Astragalus leptaleus (Park milkvetch) was systematically surveyed in Albany and Carbon counties, Wyoming during 2015 and 2016. Results are presented in the first state status report for this species. It is a species of alkaline meadows, an uncommon habitat. Wyoming has the fewest occurrences of any state within its four-state distribution. It is now known from five extant occurrences and one historic collection area in the state.

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Cover photo: *Astragalus leptaleus* by Bonnie Heidel

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INTRODUCTION

Astragalus leptaleus (Park milkvetch) has been on the Wyoming Plant Species of Concern list since at least 1986, as only known from historic records. In 2009 it was collected on BLM lands administered by BLM Rawlins Field Office as part of graduate floristic inventory work (Lukas et al. 2012). It is on the watch list (Type 4) for the Idaho BLM and is currently designated as a sensitive plant species in U.S. Forest Service regions where it occurs (Region 2, Region 4). It is a regional endemic of the Rocky Mountains with sporadic distribution in central and north-central Colorado, southcentral Wyoming, and northcentral Idaho and directly adjoining southwestern Montana. Systematic survey was initiated for *A. leptaleus* in 2015 and continued in 2016. This report represents all survey work for *A. leptaleus* in Wyoming to date and results are compiled to produce the first state status report for the species.

METHODS

Study area

The study area is in southern Albany and Carbon counties, south of Wyoming Highway 130 and at elevations below national forest boundaries. All townships in or adjoining known occurrences were considered for surveys.

Prior to fieldwork

Early in the 2015 field season, photointerpretation was conducted using aerial imagery. A premium was placed on locating different expressions of alkaline meadow habitat, after conducting surveys at the 2009 Albany County collection site on BLM land. In August 2015, the riparian and wetland habitats in nine more areas were surveyed for *A. leptaleus* in Albany County, including drainages that surround the known location. It was absent from each of these sections.

Prior to the 2016 field season, the Carbon County collection records were examined more closely, additional photointerpretation was pursued, and additional survey targets were identified.

In the field

The full array of wetland habitats as present was sought in each of the site surveys. Digital orthophotograph images were carried into the field to target riparian and wetland features and zones. These images also had private land boundaries. An Oregon 600 Global Positioning System (GPS) unit was also loaded with the public land information available through GPS Maps landownership software for Wyoming, and used in the field to reference public and private land boundaries, and to record GPS coordinates for delimiting distribution. Occupied habitat was surveyed on foot to map local distribution, estimate numbers, document the full range of habitat conditions, and document the species and associates with vouchers and photographs. Wyoming Natural Diversity Database (WYNDD) plant species of concern survey forms were completed at each sites where the species was found, as recorded for each separate point and polygon. Field surveys were conducted on 1 and 13 Aug in 2015 and 25-26 July and 20 August

in 2016. There had also been pilot surveys conducted in August of earlier years. In total, 25 sites were surveyed in Albany and Carbon counties.

After fieldwork

GPS coordinates and digital images were downloaded, projected in ArcMap and used to demarcate discrete polygons where the species is present. Data on field forms were entered into the central WYNDD database.

RESULTS – SPECIES INFORMATION

Classification

Scientific name: *Astragalus leptaleus* Gray (1884. Proc. Am. Acad. 6:220.)

History of the species: *Astragalus leptaleus* (Park milkvetch) was first collected by Thomas Nuttall in 1838 from the "plains of the Rocky Mountains near streams" (probably XX).

The first four collections of *A. leptaleus* in Wyoming were made in July of 1896 and 1898 by George Osterhout. Label information was scant and they were all provisionally mapped in the database maintained by WYNDD as representing a single locale in the Big Creek Park area within the Sierra Madre. In September of 1951, another collection was made on Big Creek in an area downstream from earlier collections, below the Sierra Madre. Wyoming collection information and that from other states in its distribution is reported by Ladyman (2006) as part of a technical conservation assessment on *A. leptaleus* prepared for the U.S. Forest Service (Region 2).

In 2009, it was collected from an area of the BLM Rawlins Field Office south of Woods Landing, near the Laramie River in Albany County, Wyoming on 21 August 2009 by Laura Lukas (11042 RM) as part of a floristic inventory project. A collection from private land in the same township was made in the same year.

In 2013, unsuccessful efforts were made by the author to relocate the oldest historical record of *A. leptaleus* at Big Creek Park, an area of the Medicine Bow National Forest with a private inholding. It is possible that the specimens collected in the 1890's were from locations that are now private land, the species was collected on what is now national forest but the habitat is no longer suitable, or the extensive 2013 surveys were incomplete for relocating the historical collection site(s). Surveys spanned the length of Big Park to the state line, as conducted on public land.

In 2014, the author relocated and surveyed *A. leptaleus* at the 2009 collection site in order to get precise location, check phenology, determine what other milkvetches grow in the same place and how to distinguish them, document habitat, get a search image of habitat for remote sensing, and map the population. Three nearby springs and meadows were also surveyed though the species was not found.

Synonyms: *Phaca pauciflora* Nutt. ex T. & G.; *Astragalus pauciflora* (Nutt.) Gray

Common name: Park milkvetch

Family: Fabaceae (Bean family)

Size of genus: The *Astragalus* genus may be comprised of over 2000 species worldwide, making it the largest genus of flowering plants according to some authors (Polhill 1981, Mabberly 1987). There are estimated to be at least 375 species in North America, with 156 in the Intermountain Region (Barneby 1989).

Phylogenetic relationships: *Astragalus* is believed to be a mesophytic genus of the North Hemisphere, with a proliferation by adaptive radiation into arid harsh habitats (Barneby 1989). It is similar to a suite of other arctic-alpine species including *A. alpinus* (alpine milkvetch), which is present in moist mountain settings of Wyoming and beyond. Barneby (1949) also recognized its semblance to *A. bodinii* (Bodin's milkvetch), a boreal species present in alkaline meadows of Wyoming basins, and *A. shultziorum* (Shultz' milkvetch), a state endemic species (sometimes treated as *A. molybdenus*; *A. plumbeus* as the synonym he used for it) in alpine settings of western Wyoming.

Present legal or other formal status

U.S. Fish & Wildlife Service: None.

Agency status: *Astragalus leptaleus* is on the watch list (Type 4) for the Idaho BLM, meaning that it is a species of concern, included among a group of species that are generally rare in Idaho with small populations or localized distribution and currently have low threat levels. However, due to the small populations and habitat area, certain future land uses in close proximity could significantly jeopardize these species. It has been recognized for a long time by U.S. Forest Service and is currently designated as a sensitive plant species in U.S. Forest Service Regions 2 (USFS 2017, Von Ahlenbrant 1993) and 4 (Spahr et al. 1991). The Sensitive list includes those species identified by the Regional Forester with "significant current or predicted downward trends in populations, density, ...or habitat capability" which makes them vulnerable to extirpation (Forest Service Manual 2670.5). Sensitive species are typically managed so as to prevent them from experiencing further declines and becoming listed as Threatened or Endangered under the Endangered Species Act. *Astragalus leptaleus* is not protected under state law in any of the four states where it occurs.

Natural heritage rank: The network of Natural Heritage programs gives *A. leptaleus* a rank of G3G4 meaning that the species is on the threshold between "Globally vulnerable or potentially secure". It had previously been ranked G4, which may be warranted if threat levels are low for large populations in each of the other geographic areas. *Astragalus leptaleus* is ranked S1 in Wyoming but S2 in Colorado and S3 in both Idaho and Montana.

Description

General non-technical description: Park milkvetch is a perennial herb with delicate stems mostly 5-20 cm long, arising from a slender, branching caudex. Leaves consist of 15-23 leaflets that are mostly lanceolate and acute, and glabrous above. Stipules of at least the lower leaves are united on the side opposite of the petiole. Flowers are pea-like, white with a purple-tipped keel and arranged in a loose, 1-3 (6) flowered raceme. The calyx has short, straight, appressed hairs. Fruit are drooping, 8-14 mm long, oblong-ellipsoid and flattened, one-celled, sparsely hairy with a

subsessile or short stalk less than 1.5 mm long (Barneby 1964; Iseley 1998, Dorn 2001, Caicco and Henderson 1981, Heidel 2017).

Technical description: Weak, delicate, diffuse, with a slender taproot and widely branching subterranean caudex, thinly strigulose with fine, appressed hairs up to 0.2-0.5 mm long, the stems and herbage bright green, the leaflets glabrous above, the inflorescence commonly nigrescent; stems loosely tufted, in old plants very numerous and entangled, (3) 5-20 (30) cm long, arising singly or few together from buds on the slender, buried caudex-branches, branched at first emerged, usually congested nodes, floriferous upward from near or from well below the middle; stipules 2-5 mm long, thinly herbaceous or submembranous, usually several-nerved, the lowest becoming papery in age, all glabrous dorsally, fully amplexicaul and connate, the lowest into a short bidentate sheath, the upper ones longer, united through half their length or less, sometimes only at very base, with lanceolate free blades; leaves 2.5-10 cm long, petioled but the uppermost shortly so, with subfiliform rachis and (9) 15-23 (27) narrowly elliptic or lanceolate and subacute, or (in the lower leaves) often ovate and obtuse, thin-textured leaflets 3-15 mm long; peduncles filiform, ascending, 2-5.5 cm long, shorter than the leaf; racemes loosely 1-5 (commonly 2- or 3-) -flowered, the flowers ascending at anthesis, declined thereafter, the axis up to 1 cm long in fruit; bracts membranous, lanceolate or lance-ovate, 1.3-3.3 mm long; pedicels at anthesis straight, 1.2-2.1 mm long, in fruit arched outward, 1.4-2.5 mm long; bracteoles 0-2, minute when present; calyx 4-5.7 mm long, densely to quite thinly black- or rarely white-strigulose, the somewhat oblique disc 0.3-1 mm deep, the campanulate tube 2.7-3.4 mm long, 1.9-2.4 mm in diameter, the subulate or lance-subulate teeth 1.1-2.5 mm long; petals white, the keel-tip maculate with dull bluish-purple; banner recurved through 45°, ovate to cuneate, notched, 8.5-11.8 mm long, 4.8-7.2 mm wide; wings 7.2-9.5 mm long, the claws 2.7-3.8 mm, the obliquely obovate, oblong-oblancheolate or -elliptic, obtuse or emarginate blades 4.9-6.5 mm long, 1.8-2.9 mm wide; keel 6-7.3 mm long, the claws 2.8-3.9 mm, the obliquely half-obovate blades 3.2-3.9 mm long, 1.8-2.3 mm wide, incurved through 85-120° to the bluntly deltoid apex; anthers 0.3-0.5 mm long; pod pendulous, obscurely stipitate or subsessile, the stipe not over 1.5 mm long, often reduced to a narrow neck, the body oblong-, lance-, or subclavate-elliptic in dorsiventral view, 8-14 mm long, 2.5-4 mm in diameter, slightly decurved, shortly subulate- or cuspidate-beaked, obcompressed and bluntly trigonous, with obtuse lateral angles and low-convex lateral faces, keeled ventrally by the prominent, convexly arched suture, flattened or shallowly and openly sulcate dorsally, the thin, green, sparsely black- or white strigulose valves becoming stramineous and papery, not inflexed; ovules 6-10; seeds brown, smooth, lustrous, 1.8-2.1 mm long (Moseley 1991, based on Barneby 1964).

Local field characters: The weak stems arise from a slender forking subterranean root crown. The few tiny whitish flowers and purple keel are sometimes concealed by prolific foliage; both traits are helpful in distinguishing it from other *Astragalus* species of alkaline meadow habitat. Plant stature varies greatly between open settings and those in shade, with the former having short, decumbent, abundant stems, while the latter are elongate, may grow upright entwined with surrounding vegetation, and have lower stem density. The short, weak stems are often overtopped by other vegetation. It is easily overlooked, though may be locally plentiful (Barneby 1964).

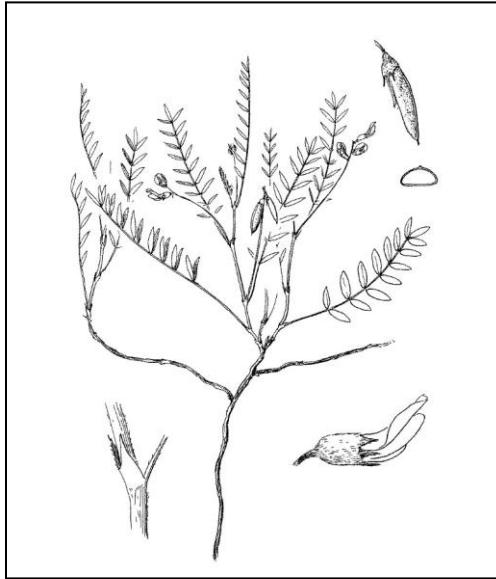


Figure 1. *Astragalus leptaleus* illustration by Jeanne R. Janish, from: Hitchcock, C. L. and A. Cronquist. 1961. *Vascular Plants of the Pacific Northwest, Part 3: Saxifragaceae to Ericaceae*. Pages 1-597. University of Washington Press, Seattle, WA.

Table 1. Comparison of the diagnostic characteristics of *Astragalus leptaleus* and similar species (Barneby 1949, Ladyman 2006, Lavin and Marriott 1997)

Species	Petals	Flower color	Stipe	Pod	Leaflets
<i>Astragalus alpinus</i>	Sub-equal in length	Pale bluish-purple; the petal bases usually whitish	Long as the calyx tube; 2/4-3.5 mm long	Deeply sulcate dorsally, the valves inflexed dorsally as a narrow scarious partition	Emarginate or retuse
<i>Astragalus bodinii</i>	Keel evidently shorter than wings and wings slightly shorter than banner	Pink-purple	None	Slightly depressed or flat dorsally, the valves subdiaphanous, obtusely trigonous	Acute
<i>Astragalus leptaleus</i>	Keel evidently shorter than both wings and banner	White or whitish except for purple keel	Very short or none; less than 1.5 mm long	Flattened dorsally, wholly unilocular, ventral suture convex	Obtuse or acute, not emarginate
<i>Astragalus shultziorum</i>	Keel and wings shorter than banner	Banner and wing cream, sometimes with purple tips and striations, keel with purple tip	Very short; sessile to less than 1.5 mm long	Deeply grooved dorsally, the valves triquetrously compressed	Acute

Similar species: *Astragalus alpinus* has flowers that are pale bluish purple, petals of equal length or nearly so, a fruit borne on a stipe as long as the calyx tube, and covered by black hairs. *A. bodinii* has a stouter root and vivid purple flowers. *A. molybdenus* (*A. shultziorum*) has flowers pink-purple, with keel petals 8-10 mm long, and the pod is ascending or spreading, and has a definite beak (Table 1) (Barneby 1949, Moseley 1991).

Figure 2. *Astragalus leptaleus* photographs: A. Close-up, B. Whole plant



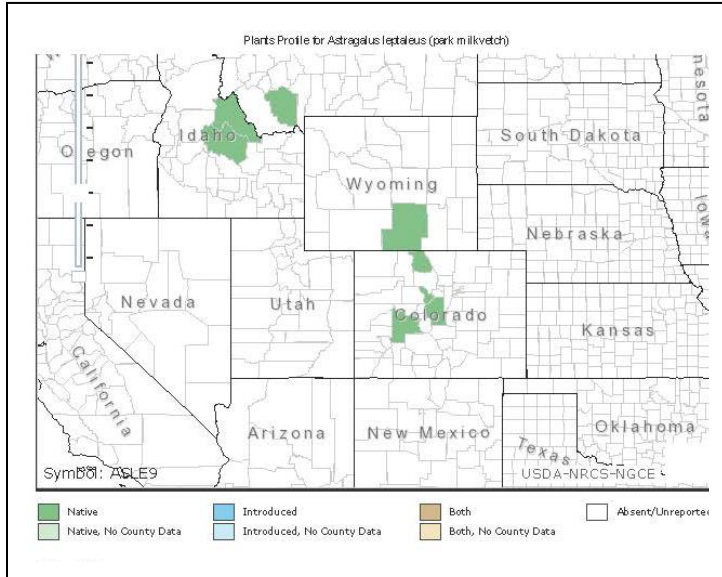


Figure 3. Rangewide distribution of *Astragalus leptaleus* (from USDA PLANTS database)

Geographic Distribution

Range: Regional endemic of the Rocky Mountains with sporadic distribution in central and north-central Colorado, southcentral Wyoming, and northcentral Idaho and directly adjoining southwestern Montana. The USDA PLANTS database shows its distribution as covering eight counties, though the addition of Albany Co., WY has yet to be added, it is present in two more counties of Colorado (Ackerfield 2015) and omitting Beaverhead Co. (Montana Natural Heritage Program 2016)(Figure X). It is reported from the Greater Yellowstone landscape by Evert (2010) based on Montana records.

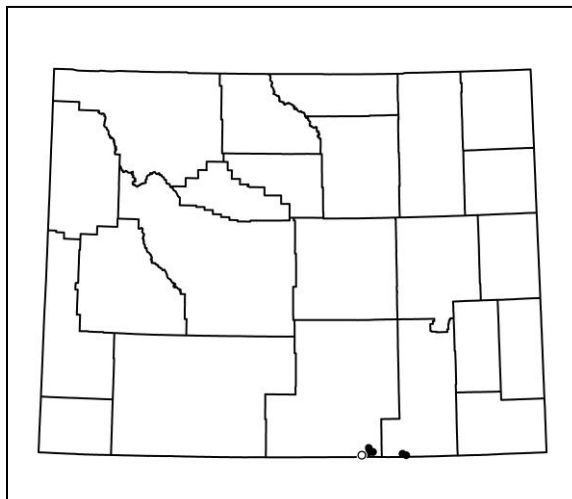


Figure 4. Wyoming distribution of *Astragalus leptaleus*

In Wyoming, *A. leptaleus* is known from the Sierra Madre and the Saratoga Valley below the Sierra Madre (Carbon County), and from the Laramie Valley in foothills of the Medicine Bow Mountains (Albany County). According to Barneby (1964) it is "... to be expected in western Wyoming." However, it is not known from contiguous counties of Idaho or Montana.

Extant sites: Known from five extant occurrences in Wyoming, most recently observed in 2016 (Table 2; Appendix A). The species was relocated in the area of the 1951 Carbon County collection, and in two new areas in the same township, information that is incorporated in this status report. The three extant occurrences in Carbon County are within five miles of one another and might be part of a single large population complex if there is habitat for the species on intervening private land. No new locations were found in Albany County but more detailed was data acquired.

Table 2. Location information for occurrences of *Astragalus leptaleus* in Wyoming

EO No.	County	Drainage	TRS	Directions	Agency
001	Carbon	Big Creek (N. Platte R.)	T12NR82W, T13NR82W	Big Creek Park vicinity, including "Hiltons" and "North Park at edge of WY/CO state line"	Med Bow NF? Pvt?
002	Carbon	Big Creek (N. Platte R.)	T13N R81W Sec 16	East and west of Hwy 230 bridge over Big Creek, ca XX miles southeast of Encampment	State
003	Albany	Laramie R.	T12N R77W	East side of Laramie River, ca 5.7 miles south of Woods Landing	Pvt
004	Albany	Maggie Creek (Laramie R.)	T12N R77W Sec 13	South side of Gyp Quarry Road, ca 7 miles south-southeast of Woods Landing	BLM
005	Carbon	Spring Creek (N. Platte R.)	T13NR81W Sec 36	West side of Wyoming Highway 230 along Spring Creek and tributaries, ca 19 miles southeast of Encampment	State
006	Carbon	Wetland above Big Creek (N. Platte R.)	T12NR81W Sec 4; T13NR81W Sec 33	Ca 4.5 mi west of Wyoming Highway 230 and ca. 19 air miles southeast of Encampment	BLM

Historical sites: Four collections of *A. leptaleus* were made in 1896 and 1898 (three different dates) by George Osterhout that might correspond with different locations, but they are all mapped as one occurrence in the WYNDD database. One of them is described as North Park, north of the state line. Big Creek Park marks the northern extension of the North Park area otherwise restricted to Colorado. The other is described as "Hiltons", a ranch headquartered in Big Creek Park. The set of Osterhout specimens represent plants of both short and tall stature, indicating different settings, but there is not enough location information to recognize separate locations.

Unverified/Undocumented reports: None

Sites where present status not known: None

Land ownership: Two occurrences are on lands managed by BLM and two are on State Trust lands (Table 2).

Areas surveyed but species not located: A total of 25 areas have been surveyed in Albany and Carbon counties where the species was not found (Table 3). They generally lacked alkaline meadow habitat.

Table 3. Areas surveyed for *Astragalus leptaleus* where it was not found

County	Year	Drainage	Township-Range Section	Habitat Notes
Carbon	2013	Big Creek Park	T12NR82W Sec 4, 9, 10, 14	Meadows, thickets
Carbon	2013	Quimby Park	T13NR82W Sec 33, 34	Meadows, thickets
Carbon	2013	Holroyd Park	T12NR81W Sec 16	Meadows
Albany	2014	Unnamed Laramie River tributary	T12N R77W Sec 1	Meadow
Albany	2014	Unnamed Laramie River tributary	T13N R77W Sec 36	Spring
Albany	2014	Unnamed Laramie River tributary	T13N R77W Sec 25	Spring
Albany	2015	Unnamed Maggie Creek tributary, also Maggie Creek (foothill)	T12N R77W Sec 13; T12N R76W Sec 17, 18	Downstream, side stream and main stream from collection on BLM land, and nearby Red Mtn
Albany	2015	Maggie Creek (Red Mountain headwaters)	T12N R76W Sec 17, 18	Wetland complex
Albany	2015	Lindsey Creek	T12N R76W Sec 7	Stream
Albany	2015	Laramie River	T12N R77 Sec 3, 4	Riverbank, on public lands nearest collection on pvt land
Albany	2015	Laramie River	T13N R77W Sec 23	Riverbank fishing access
Albany	2015	Laramie River	T13N R77W Sec 22	Riverbank fishing access
Albany	2015	Unnamed Laramie River tributary	T14N R77W Sec 23	Spring
Albany	2015	alkali wetlands above Laramie River	T15N R74W Sec 36	Meadow
Albany	2015	alkali lake above Laramie River	T15N R75W Sec 29	Lake fishing access
Albany	2015	Laramie River	T13N R77W Sec 23	Riverbank fishing access
Albany	2015	Laramie River	T13N R77W Sec 22	Riverbank fishing access
Albany	2015	Unnamed Laramie River tributary	T14N R77W Sec 23	Spring
Albany	2015	alkali wetlands above Laramie River	T15N R74W Sec 36	Meadow
Albany	2015	alkali lake above Laramie River	T15N R75W Sec 29	Lake fishing access
Carbon	2016	Deer Creek	T13N R81W Sec. 18	Alkaline wetland
Carbon	2016	N. Platte River	T13N R81W Sec. 4, 8	River bottom
Carbon	2016	Bull Creek	T12N R82W Sec 36	Side tributary
Carbon	2016	N. Platte River	T15N R82W Sec. 14, 15	Wet meadow, River bottom
Carbon	2016	Big Creek	T13N R81 Sec 33	Alkaline swale

Habitat

Rangewide, *Astragalus leptaleus* occupies "...moist sedgy meadows, along swales, or on turfy hummocks at the edge of meandering brooks, 2800-8700 ft" (Barneby 1964). In Colorado and Idaho, it is also present in fens. In Wyoming, *A. leptaleus* occupies alkaline meadow in montane parkland and foothill valleys, a mesic habitat at ecotone between saturated and upland conditions, often dominated by grasses such as *Muhlenbergia richardsonis* (mat muhly) and

occasionally at thicket borders, on subirrigated soils of both hummocks and flats. Elevation 7,600-8,400 feet (2316-2560 m).

Associated vegetation: Typical alkaline meadow habitat is dominated by grasses such as *Muhlenbergia richardsonis*. In particularly wet set settings, *Deschampsia caespitosa* (tufted hairgrass) dominates and in at least one seasonally dry setting, *Distichilis stricta* (inland saltgrass) dominates. *Carex praegracilis* (clustered fieldsedge) is sometimes co-dominant though grass cover usually exceeds sedge cover. Part of one population extends to willow thicket margins dominated by *Salix boothii* (Booth’s willow) and *S. geyeriana* (Geyer willow).

Frequently associated species: There is a relatively diverse flora associated with *A. leptaleus*, and there are overlaps and contrasts in this associated flora for Wyoming vs. other states (Table 4).

Table 4. Species associated with *Astragalus leptaleus*¹

Scientific name	Common name	Wyoming	Montana	Idaho	Colorado
<i>Achillea millefolium</i>			X	X	
<i>Agrostis stolonifera</i>		X		X	
<i>Agropyron repens</i>				X	
<i>Allium schoenoprasum</i>			X	X	
<i>Alnus incana</i>				X	
<i>Antennaria anaphaloides</i>		X		X	
<i>Antennaria microphylla</i>		X		X	
<i>Antennaria pulchella</i>			X	X	
<i>Astragalus agrestis</i>		X		X	X
<i>Astragalus bodinii</i>				X	
<i>Astragalus diversifolius</i>				X	
<i>Astragalus eucosmus</i>				X	
<i>Astragalus gracilis</i>		X			
<i>Astragalus tenellus</i>		X			
<i>Betula glandulosa</i>				X	
<i>Betula occidentalis</i>			X	X	
<i>Calamagrostis inexpansa</i>		X			
<i>Campanula parryi</i>		X			
<i>Cardaria draba</i>				X	
<i>Carex aquatilis</i>					X
<i>Carex aurea</i>		X			
<i>Carex capillaris</i>					X
<i>Carex livida</i>				X	
<i>Carex pellita</i>				X	
<i>Carex nebrascensis</i>		X		X	X
<i>Carex parryana</i> var. <i>unica</i>		X			X
<i>Carex praegracilis</i>	clustered fieldsedge	X		X	X
<i>Carex scirpoidea</i>					X
<i>Carex simulata</i>					X
<i>Carex scirpoidea</i>		X			X
<i>Carex utriculata</i>				X	X
<i>Cinna latifolia</i>					X
<i>Cirsium arvense</i>	Canada thistle			X	X

¹ The list of associated Idaho species is mainly from Moseley (1991), with additions recorded in Ladyman for both Idaho and Montana (2006). In Idaho it has also been documented from at least one fen location.

<i>Cirsium scariosum</i>		X		X	
<i>Deschampsia cespitosa</i>	tufted hairgrass	X		X	X
<i>Distichlis stricta</i>	inland saltgrass	X		X	
<i>Dodecatheon spp.</i>				X	X
<i>Eleocharis rostellata</i>				X	
<i>Elymus lanceolatum</i>				X	
<i>Elymus trachycaulis</i>		X			
<i>Equisetum laevigatum</i>		X			
<i>Erigeron lonchocarpus</i>				X	
<i>Erigeron lonchophyllus</i>		X		X	
<i>Erigeron peregrinus</i>				X	
<i>Gentiana affinis</i>		X			
<i>Gentiana aquatica</i>		X			
<i>Geranium richardsonii</i>		X			
<i>Geum macrophyllum</i>		X		X	
<i>Glaux maritima</i>				X	
<i>Hesperochiron pumilius</i>				X	
<i>Hordeum brachyantherum</i>		X		X	
<i>Hordeum jubatum</i>				X	
<i>Iris missouriensis</i>		X		X	
<i>Juncus balticus</i>		X		X	
<i>Kobresia myosuroides</i>					X
<i>Lomatogonium rotatum</i>	marsh felwort	X		X	X
<i>Maianthemum stellatum</i>		X		X	
<i>Muhlenbergia richardsonis</i>	mat muhly	X		X	
<i>Oxytropis deflexa</i>		X		X	
<i>Oxytropis viscida</i>				X	
<i>Packera debilis</i>		X		X	
<i>Parnassia palustris</i>		X			
<i>Pedicularis groenlandica</i>				X	
<i>Phleum pratense</i>	timothy	X			
<i>Phlox kelseyi</i>		X		X	
<i>Plantago eriopoda</i>		X			
<i>Poa pratensis</i>	Kentucky bluegrass			X	
<i>Polygonum vivipara</i>		X		X	
<i>Potentilla fruticosa</i>		X		X	X
<i>Primula alcalina</i>				X	
<i>Primula egalikensis</i>					X
<i>Primula incana</i>		X			
<i>Pyrrocoma lanceolata</i>		X			
<i>Pyrrocoma uniflora</i>				X	
<i>Ranunculus cardiophyllus</i>		X			
<i>Ranunculus cymbalarioides</i>				X	
<i>Ribes niveum</i>				X	
<i>Rosa woodsii</i>				X	
<i>Salix brachycarpa</i>				X	
<i>Salix boothii</i>		X		X	
<i>Salix candida</i>				X	
<i>Salix geyeriana</i>		X		X	
<i>Scirpus americanus</i>				X	
<i>Sidalcea neomexicana</i>		X			
<i>Sarcobatus vermiculatus</i>				X	
<i>Sisyrinchium idahoense</i>				X	

<i>Sisyrinchium montanum</i>		X			
<i>Sisyrinchium pallidum</i>					X
<i>Spartina gracilis</i>		X			X
<i>Thalictrum alpinum</i>		X		X	
<i>Thelypodium sagittatum</i>				X	
<i>Thermopsis montana</i>			X	X	
<i>Trifolium longipes</i>			X	X	
<i>Trifolium repens</i>				X	X
<i>Triglochin maritimum</i>		X		X	
<i>Triglochin palustris</i>		X			
<i>Valeriana edulis</i>		X			
<i>Zigaenus elegans</i>				X	
<i>Zizia aptera</i>		X		X	

The associated species are very similar between Albany and Carbon County locations despite differences in settings and extent.

Noxious weeds are not associated with *A. leptaleus* in Wyoming although *Cirsium arvense* (Canada thistle) and *Carduus nutans* (musk thistle) are present nearby in some of the same sections. Non-native species including *Phleum pratense* (timothy), *Poa pratensis* (Kentucky bluegrass) and *Trifolium repens* (white clover) are present in marginally-suitable occupied habitat.

In Wyoming, *A. leptaleus* is in the same locales, if not the same habitats, as two other rare species, *Carex parryana* var. *unica* (deer sedge) and *Lomatogonium rotatum* (marsh felwort). In Idaho, it occurs in the same locale(s) as *A. diversifolius* (meadow milkvetch) and *L. rotatum* as well as a Threatened species endemic to Idaho (*Primula alcalina* [bluedome primrose]), and to rare fen plants (*Carex livida* [livid sedge] and *Salix candida* [hoary willow]). In Colorado, it is also in the same locales as *L. rotatum* plus *Primula egaliksensis* (Greenland primrose) and *Sisyrinchium pallidum* (pale blue-eyed grass).

Topography: *A. leptaleus* occurs in low-lying settings at borders of both drainages and wetlands, spanning a range of stream order gradients from headwaters to perennial streams and rivers. The Albany County occurrence on BLM lands is in a headwater position and, as such, is the farthest removed from water. There was no standing water in the vicinity at the time of visits in recent years apart from rainstorm events.

Soil relationships: The subirrigated soils are loamy, mineral soils that are usually dry at the surface but moist below the surface when the plant is in flower in the latter half of summer. The soil surface sometimes has a whitish crust of alkaline salts accumulating on top, possibly associated with calcium carbonate.

All of the 2015-2016 sites surveyed for *A. leptaleus* where it was found had it growing on hummocks, though the species wasn't always restricted to the local hummocky microtopography. Studies done in Colorado have tried to determine whether or not hummocks form under natural conditions in the absence of grazing, but did not come to hard conclusions (Smith 2011). Regardless of their origin, the formation of hummocks creates a gamut of soil



Figure 5. *Astragalus leptaleus* habitat

- A. Productive alkaline meadow (EO#004; BLM)
- B. Terraces along spring-fed stream (EO#005; state)
- C. Outer margins of wetland (EO#006; BLM)
- D. Dried alkaline meadow (EO#005; state)
- E. Riverbottom by shrubs (EO#002; BLM)

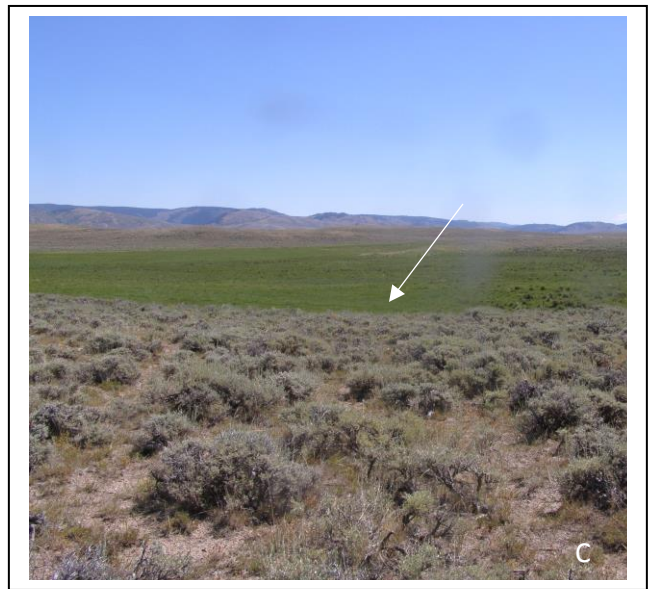
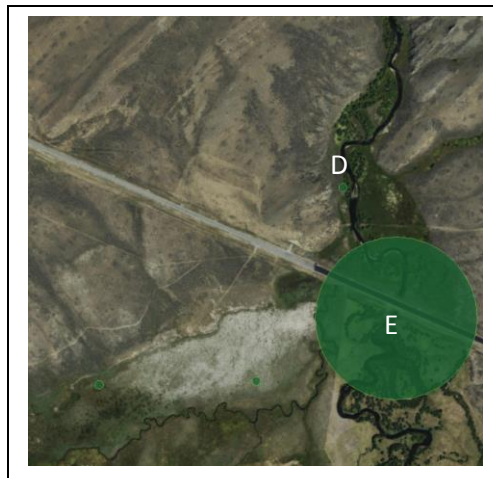


Figure 6. *Astragalus leptaleus* habitat settings on aerial imagery



- A. Productive alkaline meadow in headwaters; corresponds with 5.A.
- B. Terraces along spring-fed stream and dry alkaline meadow; corresponds with 5.B. and 5.D.
- C. Wetland margins; corresponds with 5.C.
- D. Riverbottom by shrubs; corresponds with 5.E.
- E. Historical collection area on Big Creek – precise location unknown.

Note: Occupied habitat is demarcated in green.



conditions, possibly reducing trampling and competition for those plants that grow on hummock tops such as *A. leptaleus*.

The extant distribution of *A. leptaleus* in Carbon County corresponds with Quaternary alluvium surface geology (Sutherland and Hausel 2005) whereas the riparian setting of species' habitat in Albany County is not differentiated from widespread upland bedrock geology.

Regional climate: Mean annual precipitation is 14.57 in (37.01 cm) and mean annual temperature is 41.2 °F (5.11 °C) based on values at the nearest station in Encampment (NOAA Station 483045 - ENCAMPMENT 11 ESE; <http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?wyenca>). The 2016 growing season in this area was dry, as evidenced by the Beaver Creek Fire that burned in the mountains south and west of the study area throughout much of the summer.

Population biology and demography

Phenology: July – September; flowering throughout much of summer in moist conditions.

Population size and condition: *Astragalus leptaleus* forms "... small scattered colonies or running together into extensively matted growths" (Barneby 1964) such that it can be difficult to distinguish individuals. It is often concentrated in hummocked microtopography so that the conservative approach used in this survey was to count or estimate the number of occupied mounds.

Population numbers vary by magnitudes. It is abundant at two locations, the largest population approaching 100,000 plants. It is common to uncommon at two locations (10's and 100's), and there is no data available for the other two records.

Ladyman (2006) states that there have been no demographic studies or analysis of population viability for *A. leptaleus* to know about longevity, mortality and recruitment. It is possible that the species is long-lived if the subterranean branches of the caudex emerge and die back separate from one another.

There are no data available on trend, but *A. leptaleus* was relocated in the vicinity of the 1951 collection in an altered landscape, where only ca 10 mounds of occupied habitat were found, which may reflect decline over the intervening decades. It is absent from a stream segment that was once impounded, and where the species is present above and below the former stock dam.

Type of reproduction: Reproducing sexually.

Pollination biology: The *Astragalus* genus is generally insect-pollinated (Geer and Tepedino 1993), with bilaterally symmetrical flowers visited by polylectic bees in the genera *Bombus*, *Osmia*, and *Anthophora* (Karron 1987a). Pollen grains are deposited on the anterior ventral surfaces of a bee when it lands on the keel and inserts its head under the banner. The exceptionally small size of *A. leptaleus* flowers may favor the smaller genera and species, or else the species may be self-fertile as has been reported for other rare *Astragalus* species (Karron 1987b, Karron 1991).

Seed dispersal and biology: It is not known if *A. leptaleus* has any specialized dispersal vectors. Fruit set was reportedly low in one grazed Idaho study site compared to a local ungrazed site for comparison (Moseley 1992). An alternative explanation is that fruit set depends on adequately moist conditions that may vary under different management and different habitat conditions, as well as between years. The species appears able to produce flowers throughout a long flowering period at least in suitably moist settings.

Population ecology

Competition: Associated vegetation varies greatly in extent of cover, ranging from very sparse to very densely-vegetated. It is only found in the latter where the topography is hummocked. Hummocks often have less vegetation on their sides than their tops, so the formation of hummocks may provide localized low-competition zones that benefit the species.

Hybridization: None known

The species information compiled on previous pages has been used to update and expand the state species account (Appendix B).

CONSERVATION CONSIDERATIONS

Potential threats to currently known populations

Water developments and agricultural developments are potential threats to *Astragalus leptaleus*, as are any activities that artificially raise or lower the water table. Roads and road maintenance are potential threats. The net effects of grazing have not been determined, but the species is often found on hummocky microtopography. *Astragalus leptaleus* appears to be most threatened by loss of habitat (Ladyman 2006). This may not be the case for the species in Wyoming, at least not on public lands.

Grazing: The public lands occupied by *A. leptaleus* are part of grazing allotments, and the species occupies habitat that often adjoins livestock water sources. Its habitat provides forage if not also water late in the growing season.

In Idaho, monitoring of *A. leptaleus* was recommended (Moseley 1991), particularly to answer questions of grazing response. Since that time, it has changed on the BLM list from a species of moderate endangerment (Type 3) in Idaho to a species of concern with currently low threat levels (Type 4). This change in BLM status provides more current context than the following information.

In the technical conservation assessment, Ladyman (2006) addressed the effects of grazing in stating:

“Livestock graze *Astragalus leptaleus* (Moseley 1992). Gray (1963a) and Barneby (1964) reported that it affords palatable forage. There are indications that livestock grazing can have detrimental effects: especially on the sexual reproduction of this species since fruit production appeared to be inhibited by livestock grazing (Moseley 1992). When compared with ungrazed sites, flower and fruits tended to be fewer at grazed sites (Moseley 1992). Three consecutive visits were made to occurrence ID-19 in Idaho

during the growing season of 1981, and those observations exemplify the likely impacts of grazing. On the first visit many plants had flowers, but on the return trip a month later very few fruits had been produced (Caicco and Henderson 1981). In the intervening time the site had been moderately trampled by cattle and also by the passage of a flock of sheep. No fruits were found during a third visit in the last week of August (Caicco and Henderson 1981). By this time, the site had been heavily trampled by livestock, which tend to congregate in moist areas late in the growing season (Caicco and Henderson 1981). Although significantly less flower and fruit production appears to be a result of recurrent livestock grazing, populations can otherwise appear dense and vigorous (Moseley 1992). However, this is not a universal situation. Among several populations within Birch Fen in Idaho, the small occurrences that was the most heavily grazed also had the lowest vigor of any occurrence known in the region (Moseley 1992). This occurrence was reported to be near a spring and thus may have received more trampling than most sites. Sheep may be particularly damaging herbivores, not only because they tend to graze a plant down to ground level but also because they can interact negatively with bee pollinators. ...”

Water developments: Water developments are potential threats, as are any activities that artificially raise or lower the water table or change the seasonality of moist conditions. There are small active and inactive ditches and diversions by the populations on State Trust lands. As already mentioned under “trend”, the species is absent from a stream reach segment that was once impounded, but is still present above and below the stock dam site.

Agricultural developments: Plowing and related agricultural developments are potential threats, as are any activities that artificially raise or lower the water table. Plowed, irrigated hayfield lies downstream from the largest population, on adjoining private land.

Roads: As already mentioned under “trend”, the species is in very low numbers in the Big Creek area where collected in 1951. The highway bridge that was present in 1951 has been replaced and the highway crossing realigned (building up the grade and moving the bridge crossing to the west), as determined on the Elkhorn Point USGS (7.5’) topographic map (1961 map with photo-revision of earlier map), field observation, and digital imagery. The upstream habitat seems to be typical alkaline meadow and comparable to habitat at most other occurrences except that the alkaline meadow soils were brick hard and moisture was absent below the surface at the time of survey. It is possible that the road work or related developments favored down-cutting of the stream channel to lower the water table.

Recreational use: The Big Creek area where *A. leptaleus* was collected in 1951 includes open valley west of the highway, and an incised topography that is more like a canyon west of the highway. Access is provided at the Big Creek Fishing Access. There were ample signs of foot traffic, but the species is set back from the shoreline and no direct effects of recreation were observed. There is some use by hunters in the area, but no direct effects were observed.

Weeds: *Cirsium arvense* is absent from occupied habitat but present in low numbers in the vicinity and might have the greatest potential for invading among noxious weeds. In addition, *Trifolium repens* is present in some occupied habitat on hummocks.

Other threats: Most of the populations are on isolated parcels of public land where the management activities on adjoining lands have potential effects.

Additional Notes and Summary

Notes regarding present or anticipated activities: There are no known present or anticipated large-scale activities that affect *A. leptaleus*. There are a number of other BLM sensitive species in Wyoming that occur in alkaline meadow in other field offices, and it might be appropriate to cross-reference alkaline meadow sensitive and rare species collectively with the Medicine Bow National Forest if not with other BLM field offices in the state so as to address the possibility of distribution extensions as part of project reviews.

Notification of BLM personnel of locations on BLM lands: *A. leptaleus* does not have standing as a BLM sensitive species but is included in WYNDD data exports conveyed to BLM for reference.

Status notes: It might be appropriate to consider *A. leptaleus* in the future on the BLM sensitive species list, ideally with more information and input from BLM personnel familiar with alkaline meadow habitat on BLM Rawlins FO and with input of researchers working in wetlands statewide. Photointerpretation search images and other information from this study might be applied in surveys for *A. leptaleus* on Medicine Bow National Forest lands to further evaluate potential habitat. Though the species may be vulnerable to heavy grazing, it appears as though *A. leptaleus* and its habitat have a measure of resiliency to lower levels of grazing.

Summary: The following summary statements were prepared for *A. leptaleus* in describing its primary conservation elements, management implications and considerations (Ladyman 2006):

“Although the total range of *Astragalus leptaleus* extends from central Colorado to southeastern Montana and south-central Idaho, occurrences are isolated from one another and it appears to be generally uncommon. The assumption that it has been “overlooked” has not been adequately validated. Support for this assumption would require documented negative surveys in areas where later surveys discover occurrences. Lack of historical information prevents a definitive determination of how this species’ abundance and range may have changed over the last century, but with the current understanding of its ecology and biology it is likely that it has suffered a loss of habitat. This mesophytic perennial may prove to be an indicator species of hydrologic changes to its habitat...”

Current Wyoming information about *A. leptaleus* supports the interpretation that its habitat has been overlooked, and the habitat clues identified in this report may warrant wider application in the Saratoga Valley and Sierra Madre, using photointerpretation and possibly any available collection records of closely-associated species. It is possible that this species may have more potential wetland habitat on private land than on public land.

The Wyoming occurrences are all within 10 km of the southern state boundary and may represent extensions of species' distributions in Colorado, so one other constructive measure might be the pooling of data from North Park, Colorado with that in Wyoming to provide a better picture of habitat vulnerability and species' conservation needs. Sometimes the proximal information on either side of state lines can refine status information and provide a more robust picture than treated separately (Heidel and Handley 2014).

Distribution of this report is proposed as a springboard for promoting surveys and botanical collaboration between agencies and across state lines.

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APPENDIX

Appendix A. *Astragalus leptaleus* element occurrence records and population maps

Appendix B. *Astragalus leptaleus* state species account