

**REPORT ON THE CONSERVATION STATUS OF
ASTRAGALUS YODER-WILLAMSII IN IDAHO**

by

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Taxon Name: *Astragalus yoder-williamsii* Barneby

Common Names: Mud Flat Milkvetch, Osgood Mountains Milkvetch

Family: Fabaceae

States Where Taxon Occurs: U.S.A.; Idaho, Nevada

Current Federal Status: Category 2 Candidate

Recommended Federal Status: Category 1 Candidate

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ABSTRACT

Astragalus yoder-williamsii (Mud Flat milkvetch) is a low growing, easily overlooked perennial forb. It was first collected in 1977 and subsequently described in 1980 when it was known from only two sites. As a result of recent surveys conducted by the Conservation Data Center, Science Application International Corporation, and the Boise District Bureau of Land Management, our knowledge of the distribution and conservation status of Mud Flat milkvetch is now relatively well known.

To date, 23 occurrences of Mud Flat milkvetch have been documented for Idaho, all from a portion of the Owyhee Upland in west-central Owyhee County. At least 15 of these occur fully or in part on BLM land, the remainder on private or State lands. One disjunct population is also known from the Osgood Mountains in Humboldt County, Nevada. Population numbers and extent vary greatly, ranging in size from less than an acre to being scattered over approximately two sq. miles (1280 acres), and supporting from over 10,000 to less than ten individuals. The Idaho populations are estimated to contain a minimum of 50,000 individuals, total.

Mud Flat milkvetch most commonly occurs within *Artemisia tridentata* ssp. *vaseyana*-dominated communities in flat to gently sloping, often swale positions. Elevations range from 5100 to 6200 feet.

To varying degrees, all Mud Flat milkvetch populations are subject to threats, the most widespread being those associated with livestock grazing.

Mud Flat milkvetch is presently a category 2 candidate. A status change to category 1 is recommended. In coordination with the Boise District BLM, the U.S. Fish and Wildlife Service should develop and implement a Conservation Agreement for Mud Flat milkvetch. Basically, nothing is known concerning the species life history, its population trends, or its response to anthropogenic influences such as grazing. Any conservation strategy must address these shortcomings in our understanding of this species. More specific recommendations are contained in the report.

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I. Species Information.

1. Classification and nomenclature.

A. Species.

1. Scientific name.

a. Binomial: *Astragalus yoder-williamsii* Barneby

b. Full bibliographic citation: Barneby, Rupert C. 1980. *Dragma Hippomanicum* VI: A new tragacanthoid *Astragalus* from Nevada and Idaho. *Brittonia* 32(1):30-32.

c. Type specimen: United States, Nevada, Humboldt Co.: decomposed granite gravel flats in sage-rabbitbrush association, 2170 m, northern Osgood Mountains, off the N side of Burma Road at the summit, NE corner of Section 6, T38N, R42E, 11 August 1979 (fruit and late flowers), M.P. Yoder-Williams 1232. HOLOTYPE: NY.

2. Pertinent synonym(s): None.

3. Common name(s): Common names used in the past include Osgood Mountains milkvetch, Osgood milkvetch and Yoder-William's milkvetch. To more accurately reflect its center of distribution and abundance, the common name Mud Flat milkvetch is proposed here and is the name used throughout this report.

4. Taxon codes: PDFAB0F9W0 (Idaho Conservation Data Center).

5. Size of genus: A very large genus of perhaps 1600 species worldwide, dispersed primarily around the Northern Hemisphere and most highly diversified in arid continental, desert and Mediterranean climates. Approximately 375 species in North America, including 156 (plus 122 varieties) in the Intermountain West region (Barneby 1989). It is the largest genus of flowering plants in the Intermountain region.

B. Family classification.

1. Family name: Fabaceae

2. Pertinent family synonyms: Leguminosae; Papilionaceae

3. Common name(s) for family: Bean; Pea; Legume

C. Major plant group: Dicotyledonea (Class Magnoliopsida)

D. History of knowledge of taxon: This taxon is relatively new to science, first collected in 1977, and formally described in 1980 (Barneby 1980). In August, 1980, *Astragalus yoder-williamsii* became the first plant species granted Endangered species status under the emergency listing provisions of the Endangered Species Act (U.S. Fish and Wildlife Service 1980). At that

time, it was known from only two populations, one each in Idaho and Nevada, and both were potentially threatened by mining claims. In 1981 the Idaho Rare and Endangered Plants Technical Committee recommended *Astragalus yoder-williamsii* be listed as endangered citing its disjunct nature in Idaho, and its overall rarity (Packard 1981).

E. Comments on current alternative taxonomic treatment(s): None.

2. Present legal or other formal status.

A. International: None.

B. National.

1. Present designation of proposed legal protection or regulation: Mud Flat milkvetch is a Category 2 candidate species for federal listing (U.S. Fish and Wildlife Service 1990).

2. Other current formal status recommendation: Mud Flat milkvetch is ranked as "imperiled because of rarity or because of other factors demonstrably making it vulnerable to extinction" (global rank = G2) by the Natural Heritage Network of The Nature Conservancy.

Mud Flat milkvetch is a sensitive species for the Bureau of Land Management in Idaho (Bureau of Land Management 1991). It is also a sensitive species for the Humboldt National Forest in Region 4 of the Forest Service (Spahr *et al.* 1991).

3. Review of past status: In August, 1980, *Astragalus yoder-williamsii* became the first plant species granted Endangered species status under the emergency listing provisions of the Endangered Species Act (U.S. Fish and Wildlife Service 1980). This special protection expired after 240 days and the species was downgraded on the federal list to a category 2 Candidate because steps were taken by the BLM to protect it. In particular, an Area of Critical Environmental Concern (ACEC) was designated covering the critical habitat of the type locality. Prior to this emergency listing, it had no federal or state protection. It has subsequently been added to the Nevada State List (NRS 527.260-.300) as Critically Endangered (Knight 1991), and is presently a Category 2 federal candidate species (U.S. Fish and Wildlife Service 1990).

C. Idaho.

1. Present designation or proposed legal protection or regulation: None.

2. Other current formal status recommendation: Mud Flat milkvetch is currently listed as "imperiled in Idaho because of rarity or because of some other factors demonstrably making it very vulnerable to extinction" (state rank = S2) by the Idaho Conservation Data Center (Moseley and Groves 1992).

Since it is a federal candidate species, no Idaho Native Plant Society category applies to Mud Flat milkvetch (Idaho Native Plant Society 1992).

3. Review of Past status: None.

D. Nevada

1. Present designated or proposed legal protection or regulation: Mud Flat milkvetch is currently listed as Critically Endangered in Nevada. This designation includes "taxa threatened with extinction, whose survival requires assistance because of over exploitation, disease or other factors or because their habitat is threatened with destruction, drastic modification or severs curtailment" (Morefield and Knight 1991).

2. Other current formal status recommendation: Mud Flat milkvetch is currently listed as "critically imperiled due to extreme rarity, imminent threats, or biological factors" (state rank = S1) by the Nevada Natural Heritage Program (Morefield and Knight 1991).

The Northern Nevada Native Plant Society has placed Mud Flat milkvetch on its 'Watch' list. This category is reserved for "potentially vulnerable taxa in need of monitoring or further data to determine status" (Morefield and Knight 1991).

3. Description.

A. General nontechnical description: Mud Flat milkvetch is a dwarf, densely tufted, short-stemmed perennial herb from a taproot. Large plants can be up to about 7 cm tall and 15 cm wide, most plants are considerably smaller, however. The caudex is armed with stiff, straight persistent leaf-stalks. Leaves are 2.5 to about 5.5 cm long, with 9-17 minute leaflets on the stiff, tapering leaf-stalks. The lateral leaflets are 1-3 mm long while the terminal one is less than 1 mm long. Stipules are 1.2-2.2 mm long and at least the lowest are connate and fully clasp the petiole. Racemes of 2-8 flowers are typically immersed in the foliage. The tiny, pea-like flowers are whitish, with the banner faintly pink-veined. The pod is stipitate, the stipe 1-3 mm long. The pale green, papery textured fruit pod is pendulous except when confined by the crowded leaf-stalks and is elliptic in profile. See Appendix II for a line drawing of Mud Flat milkvetch and Appendix V for color slides.

B. Technical Description: Dwarf, densely tufted, shortly caulescent suffruticose herb with multicipital taproot and closely branched caudex armed with stiff straight, weakly pungent anastomosing and older leaf-stalks, the horizontal stems 1-3 cm, internodes 2-7 mm, the foliage of stiff tapering leaf-stalks and minute leaflets green but sparsely strigulose with subappressed basifixed hairs up to 0.25-0.4 mm, the filiform, remotely few flowered racemes shorter than or barely equalling the leaves; stipules membranous pallid 1.2-2.2 mm, adnate to petiole through 1-1.5 mm, fully amplexicaul, at least the lowest shortly, sometimes obscurely connate opposite the petiole, the free blades deltate 0.6-1.7 mm; leaves 2.5-4.5 cm; leaflets 9-17, opposite or scattered, decrescent distally, obovate, elliptic or linear-elliptic obtuse conduplicate, the lateral ones minutely petiolate 0.7-3 mm, the terminal one 0.3-0.8 mm remote from the distal pair, either petiolate or decurrent into the rachis; racemes distantly 2-8 flowered, the peduncle 2-9 mm, often shorter than the distance between flowers; bracts membranous ovate-triangular 0.5-0.9 mm persistent; pedicels 1.4-2.7 mm, early arcuate, disjoining with the ripe pod; calyx 2.3-3 mm, strigulose with white or sometimes a few fuscous hairs, the symmetrical disc 0.5-0.6 mm deep, the campanulate tube 1.4-2.2 x 1.3-1.6 mm the subulate or deltate teeth 0.5-1.1 mm,

the whole marcescent unruptured about the pod's stipe; petals whitish, the banner faintly pink-striate internally; banner reflexed through 50-85 degrees, rhombic-elliptic emarginate 4.8-6.2 x 4-4.6 mm; wings nearly as long as banner, the claw 1.6-2.4 mm, the elliptic obtuse blade 4.1-4.5 x 1.4-2 mm; keel 3.8-4.4 mm, the claws 1.7-2 mm, the nearly semicircular blades 2.2-2.4 x 1.6-1.8 mm, incurved through 120 degrees to the obtusely deltate apex; anthers 0.3-0.4 mm; ovary strigulose; ovules 7-8; pod naturally pendulous but often in fact confined among the petioles and ascending, stipitate, the stipe 1.2-3 mm, the body in profile elliptic 4-7 x 2-2.8 mm, abruptly contracted at the base of the stipe and apex into a subulate style-base, trigonously compressed, keeled ventrally by the gently convex suture, the equally wide faces all flat or slightly concave, the lateral angles narrow but obtuse, the pale green strigulose valves becoming papery stramineous, inflexed as a complete septum 1.1-1.8 mm wide; seeds 1.7-1.9 mm, the smooth testa ochraceous or pale greenish, not speckled (Barneby 1980).

C. Local field characters: At least five other astragali were encountered during our 1992 field survey for Mud Flat milkvetch, including *Astragalus conjunctus* (basalt milkvetch), *Astragalus lentiginosus* (freckled milkvetch), *Astragalus obscurus* (arcane milkvetch), *Astragalus purshii* (Pursh's milkvetch), and *Astragalus salmonis* (Trout Creek milkvetch). Once observed in the field, Mud Flat milkvetch is distinctive and should not be confused with any other sympatric astragali. Prominent field characters include its dwarfed, densely tufted habit, persistent, spiny leaf-stalks, minute leaflets and tiny flowers typically hidden within the foliage.

The following summary of characteristics for the other astragali noted above will help distinguish them from Mud Flat milkvetch.

Pursh's milkvetch - is the only one of these other astragali with a densely tufted habit similar to Mud Flat milkvetch. It is easily differentiated by its densely villous or tomentulose foliage, much larger flowers, and larger fruits fully concealed by a dense coat of hairs.

Arcane milkvetch - has a diffusely tufted habit; leaflets are small, but still considerably larger than Mud Flat milkvetch; flowers are raised on a peduncle above the foliage; mature pods are stiffly chartaceous or nearly leathery.

Basalt milkvetch - has a loosely tufted, typically taller habit; long, erect peduncles surpassing the true stems; leathery to subliguous pods.

Freckled milkvetch - has larger, conspicuous leaves, leaflets, flowers and fruits, as well as a more upright habit and typically taller stature.

Trout Creek milkvetch - has a tufted, but more diffuse habit; flowers not hidden by foliage; stipules not connate; pod red-mottled.

Barneby (1989) notes that Mud Flat milkvetch looks like a diminished and condensed *Astragalus mulfordiae* (Mulford's milkvetch), which is another rare astragali endemic to southwestern Idaho and adjacent parts of Oregon, but predominantly north of the range of Mud Flat milkvetch. The prominent field characters already noted for Mud Flat milkvetch will differentiate it from Mulford's milkvetch too. In addition, the habitats for the two species are different.

D. Identifying characteristics of material which is in interstate or international

commerce or trade: No interstate or international trade is known. See above section for differences with related species.

E. Photographs and/or line drawings: Line drawings of Mud Flat milkvetch appear in Barneby (1980) and Barneby (1989). Reproductions of the latter drawing can be found in the Humboldt National Forest sensitive plant field guide (Anderson *et al.* 1991), and in Threatened, Endangered, and Sensitive Species of the Intermountain Region (Spahr *et al.* 1991). See Appendix II for a reproduction of the line drawing from Barneby (1980). Photographs (35 mm slides) of Mud Flat milkvetch and its habitat in Idaho are in the slide collection of the Idaho Conservation Data Center. Several have been reproduced in Appendix V.

4. Significance.

A. Natural: None known.

B. Human: Many astragali are poisonous to livestock. At least one species is edible. No medicinal information is available concerning Mud Flat milkvetch.

5. Geographical distribution.

A. Geographical range: Except for one disjunct population (the type locale) in the Osgood Mountains in Humboldt County, Nevada, Mud Flat milkvetch is restricted to the Owyhee Uplands of west-central Owyhee County, Idaho. In the Uplands it occurs south of the main Owyhee Range, from near Triangle to the upper Deep Creek drainage, mostly west of Battle Creek, to the Pleasant Valley area, within about six miles of the Oregon state line.

B. Precise occurrences in Idaho.

1. Populations currently or recently known extant: 23 extant populations of Mud Flat milkvetch have been documented for Idaho, eleven of these discovered in 1992. The site of the original, 1977, Idaho collection near Clover Spring (population 009) has never been relocated despite searches by BLM and other botanists. Note that the number in parentheses following the site name refers to the occurrence number of *Astragalus yoder-williamsii* in the Conservation Data Center's data base.

1. Stoneman Creek (001)

- a. USA: Idaho, Owyhee County
- d. Slack Mountain 7.5' U.S.G.S. topographic map quadrangle, 1973.
- e. First observed in 1984.
- f. Most recently observed in 1992.

2. Meadow Creek (002)

- a. USA: Idaho, Owyhee County
- d. Triangle 15' U.S.G.S. topographic map quadrangle, 1965.
- e. First observed in 1992.

- f. Most recently observed in 1992.
- 3. Grassy Flat (003)
 - a. USA: Idaho, Owyhee County
 - d. Clover Mtn. 7.5' U.S.G.S. topographic map quadrangle, 1972.
 - e. First observed in 1983.
 - f. Most recently observed in 1992.
- 4. Lower Cougar Canyon (004)
 - a. USA: Idaho, Owyhee County
 - d. Slack Mountain 7.5' U.S.G.S. topographic map quadrangle, 1973.
 - e. First observed in 1980's.
 - f. Most recently observed in 1992.
- 5. Rays Reservoir North (005)
 - a. USA: Idaho, Owyhee County
 - d. Pleasant Valley 7.5' U.S.G.S. topographic map quadrangle, 1973.
 - e. First observed in 1980's.
 - f. Most recently observed in 1991.
- 6. Wilson Pasture West (006)
 - a. USA: Idaho, Owyhee County
 - d. Pleasant Valley 7.5' U.S.G.S. topographic map quadrangle, 1973.
 - e. First observed in 1991.
 - f. Most recently observed in 1992.
- 7. Southeast of Peppermint Spring (007)
 - a. USA: Idaho, Owyhee County
 - d. Fairylawn 7.5' U.S.G.S. topographic map quadrangle, 1973.
 - e. First observed in 1984.
 - f. Most recently observed in 1984.
- 8. Star Ranch (008)
 - a. USA: Idaho, Owyhee County
 - d. Smith Creek 7.5' U.S.G.S. topographic map quadrangle, 1973.
 - e. First observed in 1987.
 - f. Most recently observed in 1992.
- 9. Clover Spring (009)
 - a. USA: Idaho, Owyhee County
 - d. Pixley Basin 7.5' U.S.G.S. topographic map quadrangle, 1972.
 - e. First observed in 1977.
 - f. Most recently observed in 1977.
- 10. Ant Hill South (010)
 - a. USA: Idaho, Owyhee County
 - d. Clover Mtn. 7.5' U.S.G.S. topographic map quadrangle, 1972.

- e. First observed in 1989.
 - f. Most recently observed in 1992.
11. Ant Hill Southwest (011)
- a. USA: Idaho, Owyhee County
 - d. Clover Mtn. 7.5' U.S.G.S. topographic map quadrangle, 1973.
 - e. First observed in 1989.
 - f. Most recently observed in 1989.
12. Hurry Back Creek (012)
- a. USA: Idaho, Owyhee County
 - d. Slack Mountain 7.5' U.S.G.S. topographic map quadrangle, 1973.
 - e. First observed in 1984.
 - f. Most recently in 1992.
13. Nickel Creek Crossing (013)
- a. USA: Idaho, Owyhee County
 - d. Pleasant Valley 7.5' U.S.G.S. topographic map quadrangle, 1973.
 - e. First observed in 1983.
 - f. Most recently observed in 1992.
14. Antelope Flat - East (014)
- a. USA: Idaho, Owyhee County
 - d. Snow Creek, Clover Mtn., Crab Spring Butte, and Big Springs Ranch - all are 7.5' U.S.G.S. topographic map quadrangles, 1972.
 - e. First observed in 1992.
 - f. Most recently observed in 1992.
15. Grassy Flat Southeast (015)
- a. USA: Idaho, Owyhee County
 - d. Snow Creek 7.5' U.S.G.S. topographic map quadrangle, 1972; and Clover Mtn. 7.5' U.S.G.S. topographic quadrangle, 1972.
 - e. First observed in 1992.
 - f. Most recently observed in 1992.
16. Big Sagehen Reservoir (016)
- a. USA: Idaho, Owyhee County
 - d. Snow Creek 7.5' U.S.G.S. topographic map quadrangle, 1972.
 - e. First observed in 1992.
 - f. Most recently observed in 1992.
17. Battle Creek (017)
- a. USA: Idaho, Owyhee County
 - d. Snow Creek 7.5' U.S.G.S. topographic map quadrangle, 1972.
 - e. First observed in 1992.
 - f. Most recently observed in 1992.

18. Juniper Station Road (018)
- a. USA: Idaho, Owyhee County
 - d. Slack Mountain 7.5' U.S.G.S. topographic map quadrangle, 1973.
 - e. First observed in 1992.
 - f. Most recently observed in 1992.
19. Antelope Flat - West (019)
- a. USA: Idaho, Owyhee County
 - d. Clover Mtn. 7.5' U.S.G.S. topographic map quadrangle, 1972.
 - e. First observed in 1992.
 - f. Most recently in 1992.
20. Dry Creek - South (020)
- a. USA: Idaho, Owyhee County
 - d. Clover Mtn. 7.5' U.S.G.S. topographic map quadrangle, 1973; and Big Springs Ranch 7.5' U.S.G.S. topographic map quadrangle, 1972.
 - e. First observed in 1992.
 - f. Most recently observed in 1992.
21. Mud Flat Road/Grasshopper Trail (021)
- a. USA: Idaho, Owyhee County
 - d. Pleasant Valley 7.5' U.S.G.S. topographic map quadrangle, 1973.
 - e. First observed in 1992.
 - f. Most recently observed in 1992.
22. Ant Hill Well (022)
- a. USA: Idaho, Owyhee County
 - d. Clover Mtn. 7.5' U.S.G.S. topographic map quadrangle, 1972.
 - e. First observed in 1992.
 - f. Most recently observed in 1992.
23. Slack Mountain (023)
- a. USA: Idaho, Owyhee County
 - d. Slack Mountain 7.5' U.S.G.S. topographic map quadrangle, 1973.
 - e. First observed in 1992.
 - f. Most recently observed in 1992.
- 2. Populations known or assumed extirpated:** The location of the Clover Spring population (009) has never been clear. This population has never been relocated despite searching by BLM and other botanists. It is unclear if this population has been extirpated or just never relocated due to vague and conflicting location data.
- 3. Historically known populations where current status not known:** Documented by a collection in 1977, the Clover Spring population (009) has never been relocated (see section (I.5.B.2.)), and its current status is not known.
- 4. Locations not yet investigated believed likely to support additional natural**

populations: For the most part, recent survey work has delineated the range of Mud Flat milkvetch in Idaho. The portion of the Owyhee Uplands where Mud Flat milkvetch occurs is mostly surrounded by more mountainous country, dominated by western juniper, or by extensive areas characterized by low sagebrush (*Artemisia arbuscula*) or Wyoming sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) communities. This lack of much contiguous suitable habitat, makes it unlikely its range extends much further than presently known.

The west side of the South Fork Owyhee River drainage has not been systematically surveyed for this species, however, this vicinity is somewhat disjunct from all other Idaho occurrences to the north. Portions of the Duck Valley Indian Reservation contains suitable habitat for Mud Flat milkvetch, but none of this area has been systematically searched. Closer to its known range, Bull Basin and the area north of the confluence of Pole Creek and Nickel Creek, near Indian Crossing, are two areas worthy of additional survey work. Within the known range of Mud Flat milkvetch, it is likely additional populations exist in some of the more remote, inaccessible areas not surveyed.

5. Reports having ambiguous or incomplete locality information: The location information for the Clover Spring population (009) is ambiguous and somewhat conflicting (see comments under section (I.5.B.2)).

6. Locations known or suspected to be erroneous reports: None.

C. Biogeographical and phylogenetic history: Mud Flat milkvetch is just one of the many Intermountain astragali with a restricted distribution. Barneby (1980) places it in the small section *Neonix*, a group characterized by connate stipules and small, trigonous, bilocular, emmenoloboid (the pod persistent on the raceme) pods. In his assessment of Mud Flat milkvetch Barneby (1980) notes it fits neatly, where one might have foreseen the necessity for connecting links into the "empty triangle" described by the ranges of its three most closely related species. These three relatives are all rare, or uncommon xeromorphs localized in the intermontane western United States. It is apparently most closely related to *Astragalus peckii*, a species restricted to the east foot of the Cascade Range in Crook, Deschutes and northern Klamath counties, Oregon.

6. General environment and habitat description.

A. Concise statement of general environment: In Idaho, Mud Flat milkvetch occurs on flat to very gentle slopes predominately in swale positions supporting *Artemisia tridentata* ssp. *vaseyana* (Vasey sagebrush; also known as mountain big sagebrush) dominated communities. Plants are most abundant in the open spaces naturally occurring between shrubs, rather than in close association to the sagebrush. The Vasey sagebrush communities often contain lesser amounts of *Artemisia arbuscula* (low sagebrush) and are typically confluent with areas dominated by low sagebrush. Mud Flat milkvetch is generally absent or much less abundant on these adjacent low sagebrush sites. Small clusters of plants occasionally also occur on cindery lithic sites supporting very little if any other vegetation. Elevations range from about 5100 to 6200 feet.

Soils in the areas supporting Vasey sage are usually dark, fine to courser textured loamy sands

with a relatively thick mollic surface horizon, and are derived from igneous parent material.

The single known Nevada population for this species, in the Osgood Mountains, occurs on decomposed granitic gravels on exposed ridgecrests between 5300 and 5900 feet.

B. Physical characteristics.

1. Climate.

a. Koppen climate classification: Habitat for Mud Flat milkvetch is classified as Koppen's unit BSk: middle latitude steppe, with average annual temperature under 64.4° F (Trewartha 1968).

b. Regional macroclimate: Climatic records are available for Grasmere (Station No. 10-3809), for the years 1962 -1972 (Johnson 1978). Grasmere is located in south-central Owyhee County at T12S, R5E, at 5130 feet elevation. It is located a little south and east of the Idaho populations of Mud Flat milkvetch, but climatic patterns are expected to be similar. Mean annual temperature for Grasmere is 49.03°F (8.46°C) and the mean annual precipitation is 8.24 inches (209.3 mm). The annual temperature range for Grasmere averages between 27.98°F (-2.23°C) to 68.26°F (20.14°C), with highest temperatures occurring in July and the lowest in December. Mean annual precipitation peaks in late spring (May and June) with approximately 40% of the total annual precipitation. The rest of the year is considerably drier with all mean monthly precipitation averages less than 0.75 inch (190 mm).

c. Local microclimate: Vasey sagebrush sites are well drained compared to low sagebrush sites, which generally are shallower and have a strongly developed claypan. This results in a saturated mantle during the spring. How the different draining, as well as other soil properties characterizing low sagebrush sites interact to limit Mud Flat milkvetch is not known. Mud Flat milkvetch is often found in swale positions (slight topographic concavities), that are slightly more mesic and with deeper soils than adjacent areas.

2. Air and water quality requirements: Unknown.

3. Physiographic provinces: In Idaho, Mud Flat milkvetch occurs in the Owyhee Uplands section of the Columbia Intermontane Province (Ross and Savage 1967).

4. Physiographic and topographic characteristics: Mud Flat milkvetch occurs on flat to gently rolling slopes of all aspects. It commonly occurs and is most abundant in swales. Its elevational range is from about 5100 to 6200 feet and is absent from nearby higher elevations in the Owyhee Mountains.

5. Edaphic factors: The Owyhee Upland area consists of a series of undifferentiated silicic volcanic rocks overlying granitic rocks of Cretaceous age. These volcanic rocks were first extruded in the Lower to Middle Miocene. The last stage of volcanism occurred in Pliocene time. Rhyolite, latite and silicic welded ash-flow tuffs comprise most of the upland, with

patches of younger basalt distributed irregularly over the surface. The relatively flat surface of the lava plateau, has a number of deeply incised canyons, and is locally interrupted by isolated mountainous ridges such as South Mountain (Asher 1968; Bennett and Galbraith 1975).

The Nevada population of Mud Flat milkvetch occurs on decomposed granite gravels derived from granodiorite parent material. This sharply contrasts with the volcanic substrates for the Idaho populations.

Nine of the 23 known Mud Flat milkvetch populations are located in areas with available preliminary soil map and description information. From this information, it appears that Mud Flat milkvetch occurs on at least three soils: Hat Soil (part of the Hat-Avtable-Montasterio complex), Paynecreek Soil (part of the Paynecreek-Northcastle-Blackwell association), and Mulshoe Soil (part of the Mulshoe-Squawcreek-Gaib association). These soils are characterized as deep to moderately deep, well drained, with moderate to moderately slow permeability, and very low to high available water capacity. They occupy several topographic positions including terraces and sideslopes, and are dominated by Vasey sagebrush-bunchgrass vegetation (U.S.D.A. Soil Conservation Service 1992). Two populations mapped in soil associations that are characterized by shallow soils and low sagebrush vegetation very likely occur within inclusions of other, deeper soil types that must have been too small or local to map.

6. Dependence of this taxon on natural disturbance: Like many astragali, Mud Flat milkvetch seems tolerant of some disturbance. Portions of some populations occur in areas disturbed by heavily grazing livestock, along road tracks, and in association with ant hills. Plants are most abundant within openings in the vegetation, but it is the interaction of several ecological factors, not just disturbance that maintains these openings under natural conditions.

7. Other unusual physical features: None known.

C. Biological characteristics.

1. Vegetation physiognomy and community structure: Most populations occur in Vasey sagebrush-dominated vegetations, generally with a minor component of low sagebrush. Bunchgrasses, principally *Festuca idahoensis* (Idaho fescue) are always present. Occasional Mud Flat milkvetch plants may be found in nearby low sagebrush communities, but this is the exception more than the rule. These are the same as the *Artemisia vaseyana*/*Festuca idahoensis* and *Artemisia arbuscula*/*Festuca idahoensis* habitat types of Hironaka *et al.* (1983). A few populations are located near western juniper (*Juniperus occidentalis*) woodlands, and in some cases junipers are encroaching into the Vasey sagebrush communities.

Overall community diversity is generally low, with other shrub species, especially rabbitbrush (*Chrysothamnus* spp.), one or more sedges (*Carex* spp.), and several forbs being common associates of Mud Flat milkvetch.

2. Regional vegetation type: Kuchler (1964) places the Owyhee Uplands in the Sagebrush-steppe potential vegetation type.

3. Frequently associated species: Common associates include *Artemisia tridentata* ssp. *vaseyana*, *Artemisia arbuscula*, *Chrysothamnus viscidiflorus*, *Chrysothamnus nauseosus*, *Purshia tridentata*, *Lupinus* sp., *Astragalus purshii*, *Trifolium longipes*, *Lomatium macrocarpum*, *Phlox hoodii*, *Phlox longifolia*, *Mertensia longiflora*, *Festuca idahoensis*, *Agropyron spicatum*, *Poa secunda*, *Sitanion hystrix*, *Carex douglasii*, *Carex filifolia*, and *Carex rossii*.

4. Dominance and frequency: Mud Flat milkvetch can be locally abundant, but is not a dominant species because of its overall scattered distribution and low cover. The frequency of its occurrence in a community is generally variable, from small, dense clusters to very widely separated and scattered individuals.

5. Successional phenomena: Mud Flat milkvetch is present, but not restricted to 'climax' communities. It is tolerant of some disturbance and was encountered in a few places that recently burned. Its long taproot likely enables it to survive most fires that occur in its sagebrush habitat. It is most common in the interspace between sagebrush plants, less so beneath their direct canopy. Whether this indicates a relative shade intolerance or a sensitivity to allelopathic processes, or other factors, is unknown. It commonly occurs on cinder soil that is largely devoid of other plants or on other sites supporting relatively little vegetation, and may indicate it is a poor competitor.

6. Dependence on dynamic biotic features: None known.

7. Other endangered species: In Idaho, no other federally listed plants occur in the range of Mud Flat milkvetch. Several other candidate species are known from Owyhee County, but only one, *Erigeron latus*, has a range overlapping that of Mud Flat milkvetch.

A number of state rare species occur within the range of Mud Flat milkvetch and include, *Artemisia packardiae*, *Astragalus conjunctus*, *A. salmonis*, *Dimeresia howellii*, *Gymnosteris nudicaulis*, *G. parvula*, *Haplopappus uniflorus* var. *linearis*, and *Lupinus lepidus* var. *sellulus*. Several of these species may occur proximate to Mud Flat milkvetch, but none were ever observed directly sympatric with it.

7. Population biology.

A. General summary: 23 occurrences of Mud Flat milkvetch have been documented for Idaho. A single disjunct occurrence in Humboldt County, Nevada is also known. The Idaho populations vary from being small and localized, to groups discontinuous over several miles that can be viewed as a metapopulation (= a system of multiple separate populations, interconnected by a small amount of dispersal; see Murphy *et al.* 1990). Of the 23 Idaho occurrences, eight were revisited and 11 were discovered in 1992. The Idaho populations are estimated to contain a minimum of 50,000 individuals. The full extent of many populations is not known, and it is expected that many of these contain additional plants in nearby areas not surveyed. Four populations are estimated to contain less than 100 individuals, six populations are estimated to contain between 100 and 1000 individuals, another six between 1000 and 5000 individuals, three between 5000 and 10,000 individuals, and two populations with over 10,000 individuals. No population estimates exist for two populations.

The one Nevada population was estimated to contain between 500 and 1000 plants in 1990 (Knight 1991).

B. Demography.

1. Known populations: Individual plants can be widely scattered or, more often, they occur in clusters. Plants are generally well-spaced within clusters, but occasionally can be quite dense. Distribution patterns are generally more even in large compared to small populations. Most populations contain various sized plants that may be presumed to indicate a diverse age structure. Plants presumed to be seedlings were only rarely encountered. However, the ability to identify seedlings is problematic due to their small size.

2. Demographic details: For additional information see the Occurrence Records in Appendix IV. Note - in many cases, the "Area" amount given for a particular population includes habitat unsuitable for Mud Flat milkvetch, but which connects separate clusters or subpopulations.

1. Stoneman Creek (001)

- a. Location:
- b. Area: ca 25 acres
- c. Number and size of plants: 1992: minimum of 500-1000 genets
- d. Density: Low
- e. Presence of dispersed seeds: Unknown
- f. Evidence of reproduction: No evidence
- g. Evidence of expansion/contraction: No evidence

2. Meadow Creek (002)

- a. Location:
- b. Area: Minimum of 5 acres
- c. Number and size of plants: 1992: >5000 genets; all sizes represented
- d. Density: Low to medium
- e. Presence of dispersed seeds: Unknown
- f. Evidence of reproduction: 1992: Some plants in flower
- g. Evidence of expansion/contraction: No evidence

3. Grassy Flat (003)

- a. Location:
- b. Area: Many acres, not all potential habitat surveyed
- c. Number and size of plants: 1992: 3 subpopulations supporting 1000+ genets; all size classes represented
- d. Density: Low
- e. Presence of dispersed seeds: Unknown
- f. Evidence of reproduction: 1992: Some plants in early fruit stage, others flowering
- g. Evidence of expansion/contraction: No evidence

4. Lower Cougar Canyon (004)

- a. Location:
- b. Area: ca 10 acres

- c. Number and size of plants: 1992: 2000+ genets; all age classes represented
 - d. Density: High
 - e. Presence of dispersed seeds: Unknown
 - f. Evidence of reproduction: 1992: Some plants in flower
 - g. Evidence of expansion/contraction: No evidence
5. Rays Reservoir North (005)
- a. Location:
 - b. Area: 40 acres
 - c. Number and size of plants: 1991: 1000-3000
 - d. Density: Unknown
 - e. Presence of dispersed seeds: Unknown
 - f. Evidence of reproduction: 1991: Some plants with fruits
 - g. Evidence of expansion/contraction: No evidence
6. Wilson Pasture West (006)
- a. Location:
 - b. Area: 10+ acres
 - c. Number and size of plants: 1992: >5000 genets
 - d. Density: Moderate
 - e. Presence of dispersed seeds: Unknown
 - f. Evidence of reproduction: 1992: Some plants in flower
 - g. Evidence of expansion/contraction: In area north of Mud Flat Road that was broadcast burned, no Mud Flat milkvetch found; but it does occur south of road where individual junipers were piled and burned. This suggest that part of the population has contracted due to broadcast burning regime.
7. Southeast of Peppermint Spring (007)
- a. Location:
 - b. Area: Unknown
 - c. Number and size of plants: No data
 - d. Density: Unknown
 - e. Presence of dispersed seeds: Unknown
 - f. Evidence of reproduction: Unknown
 - g. Evidence of expansion/contraction: Unknown
8. Star Ranch (008)
- a. Location:
 - b. Area: Unknown
 - c. Number and size of plants: 1987: No data; 1992: only 2 genets observed
 - d. Density: Low
 - e. Presence of dispersed seeds: Unknown
 - f. Evidence of reproduction: No evidence
 - g. Evidence of expansion/contraction: No evidence
9. Clover Spring (009)
- a. Location:

- b. Area: Unknown
 - c. Number and size of plants: 1977: No data
 - d. Density: Low
 - e. Presence of dispersed seeds: Unknown
 - f. Evidence of reproduction: Unknown
 - g. Evidence of expansion/contraction: Unknown
10. Ant Hill South (010)
- a. Location:
 - b. Area: >50 acres, not all potential habitat surveyed
 - c. Number and size of plants: 1992: >5000 individuals
 - d. Density: Low to moderate
 - e. Presence of dispersed seeds: Unknown
 - f. Evidence of reproduction: 1992: Some plants in flower
 - g. Evidence of expansion/contraction: No evidence
11. Ant Hill Southwest (011)
- a. Location:
 - b. Area: ca. 2 acres
 - c. Number and size of plants: 1989: ca 500 genets
 - d. Density: Unknown
 - e. Presence of dispersed seeds: Unknown
 - f. Evidence of reproduction: 1989: Plants in fruit and flower
 - g. Evidence of expansion/contraction: Unknown
12. Hurry Back Creek (012)
- a. Location:
 - b. Area: ca 4 acres
 - c. Number and size of plants: 1992: ca 1000 genets; all age classes represented
 - d. Density: Moderate
 - e. Presence of dispersed seeds: Unknown
 - f. Evidence of reproduction: 1992: Plants in flower
 - g. Evidence of expansion/contraction: No evidence
13. Nickel Creek Crossing (013)
- a. Location:
 - b. Area: 10+ acres
 - c. Number and size of plants: 1992: >2000 genets; all age classes represented
 - d. Density: Low to moderate
 - e. Presence of dispersed seeds: Unknown
 - f. Evidence of reproduction: 1992: Plants in flower
 - g. Evidence of expansion/contraction: No evidence
14. Antelope Flat - East (014)
- a. Location:
 - b. Area: >200 acres; scattered over ca 1 sq. mile (640 acres); full extent of population is unknown

- c. Number and size of plants: 1992: >10,000 genets
 - d. Density: Low to high
 - e. Presence of dispersed seeds: Unknown
 - f. Evidence of reproduction: 1992: 10% of plants in fruit in September
 - g. Evidence of expansion/contraction: No evidence
15. Grassy Flat Southeast (015)
- a. Location:
 - b. Area: ca 5; full extent of population is unknown
 - c. Number and size of plants: 1992: ca 100 genets observed in three scattered subpopulations
 - d. Density: Very low
 - e. Presence of dispersed seeds: Unknown
 - f. Evidence of reproduction: 1992: Some plants in flower
 - g. Evidence of expansion/contraction: No evidence
16. Big Sagehen Reservoir (016)
- a. Location:
 - b. Area: Minimum of 25 acres; not all potential habitat surveyed
 - c. Number and size of plants: 1992: ca 1000 genets in six subpopulations
 - d. Density: Low
 - e. Presence of dispersed seeds: Unknown
 - f. Evidence of reproduction: 1992: Some plants with flowers and fruits
 - g. Evidence of expansion/contraction: No evidence
17. Battle Creek (017)
- a. Location:
 - b. Area: ca 0.5 acre
 - c. Number and size of plants: 1992: ca 15 genets
 - d. Density: Low
 - e. Presence of dispersed seeds: Unknown
 - f. Evidence of reproduction: 1992: Some plants in flower
 - g. Evidence of expansion/contraction: No evidence
18. Juniper Station Road (018)
- a. Location:
 - b. Area: ca 1 acre
 - c. Number and size of plants: 1992: Only four plants observed
 - d. Density: Very low
 - e. Presence of dispersed seeds: Unknown
 - f. Evidence of reproduction: 1992: One plant in flower
 - g. Evidence of expansion/contraction: Unknown
19. Antelope Flat - West (019)
- a. Location:
 - b. Area: Minimum of 25 acres scattered over ca 2 sq. miles (1280 acres); full extent of population is unknown

- c. Number and size of plants: 1992: ca 2000 genets in at least 14 subpopulations; all sizes represented
- d. Density: Low
- e. Presence of dispersed seeds: Unknown
- f. Evidence of reproduction: 1992: Some plants with flowers and immature fruits
- g. Evidence of expansion/contraction: Unknown

20. Dry Creek - South (020)

- a. Location:
- b. Area: ca 10 acres; population limits not fully known and may extend eastward and westward of points searched for southern subpopulations
- c. Number and size of plants: 1992: ca 500 genets in several subpopulations
- d. Density: Low
- e. Presence of dispersed seeds: Unknown
- f. Evidence of reproduction: 1992: Some plants in flower and fruit
- g. Evidence of expansion/contraction: Unknown

21. Mud Flat Road/Grasshopper Trail (021)

- a. Location:
- b. Area: ca 50 acres
- c. Number and size of plants: 1992: >500 genets
- d. Density: Low
- e. Presence of dispersed seeds: Unknown
- f. Evidence of reproduction: 1992: ca 15% of plants in flower and 20% with fruits
- g. Evidence of expansion/contraction: Unknown

22. Ant Hill Well (022)

- a. Location:
- b. Area: ca. 1 acre
- c. Number and size of plants: 1992: 20 genets
- d. Density: Unknown
- e. Presence of dispersed seeds: Unknown
- f. Evidence of reproduction: Unknown
- g. Evidence of expansion/contraction: No evidence

23. Slack Creek (023)

- a. Location:
- b. Area: Unknown
- c. Number and size of plants: 1992: >10,000 genets
- d. Density: Unknown
- e. Presence of dispersed seeds: Unknown
- f. Evidence of reproduction: 1992: ca 80% of plants in flower and fruit
- g. Evidence of expansion/contraction: No evidence

C. Phenology.

- 1. Patterns:** Flowering occurs from May into early July with most pods mature by mid-July.

2. Relation to climate and microclimate: Specific details are unknown.

D. Reproductive ecology.

1. Type of reproduction: Apparently by seed only, as no evidence of asexual reproduction has been documented.

2. Pollination.

a. Mechanisms: Unknown, but probably flying insects, especially small bees.

b. Specific known pollinators: Unknown. However, various bee species are known to be the principal pollinator for other astragali in the Great Basin region (e.g. see Green and Bohart 1975; Karron 1987; Sugden 1985).

c. Other suspected pollinators: Unknown.

d. Vulnerability of pollinators: Unknown.

3. Seed dispersal.

a. General mechanisms: The pod of Mud Flat milkvetch is persistent on the raceme. Seeds are small and have no special adaptations to long distance dispersal. Seeds are most likely dispersed in the fall after the pods fully ripen and crack open. Specific details are unknown, however.

b. Specific agents: Gravity, and in addition, wind may play some role. It is unknown if insect, small mammal, and bird agents are important.

c. Vulnerability of dispersal agents and mechanisms: Unknown.

d. Dispersal patterns: Specific details are unknown. It seems likely that gravity is the primary dispersing agent, with wind close to the ground in sagebrush stands a relatively minor contributor. With either of these agents, it seems likely that most dispersed seeds would be located relatively close to parent plants.

4. Seed biology.

a. Amount and variation of seed production: Barneby (1989) states that the pods contain 6-8 ovules. It is unknown if more recently discovered populations vary from this range.

b. Seed viability and longevity: Unknown.

c. Dormancy requirements: Unknown.

d. Germination requirements: Unknown.

e. Percent germination: Unknown.

5. Seedling ecology: Unknown.

6. Survival and mortality: Unknown.

7. Overall assessment of reproductive success: Specific details are unknown. The number of plants estimated at the Nevada and several Idaho populations show evidence of fluctuating. Whether this is due to reproductive or other factors is unknown.

8. Population ecology of the taxon.

A. General summary: In Idaho, the majority of *Astragalus yoder-williamsii* populations occur in Vasey sagebrush/Idaho fescue habitats. Within these habitats it occurs in very low to high densities, with scattered clusters of plants a common pattern. Populations range in size from less than an acre to scattered over a few sq. miles, and support from less than ten to over 10,000 individuals. The larger populations were generally comprised of various sized individuals, indicating variability in age classes present. In many cases, populations observed in 1992 contained a large proportion of non-flowering individuals, especially the smaller plants.

Most populations have been disturbed to some degree by livestock grazing and to a lesser extent by other activities such as roads and wood cutting operations. It is unknown if these disturbances have caused any populations to be reduced to critical levels. A limited amount of demographic information exists for the one Nevada population, but the overall demographics and ecology of this species is virtually unknown.

B. Positive and neutral interactions: None known.

C. Negative interactions.

1. Herbivores, predators, pests, parasites and diseases: No quantified information is available, and for the most part these affects are unknown for Mud Flat milkvetch.

Many astragali are subject to seed predation (see Center and Johnson 1976; Clement 1982; Green and Palmbald 1975; Platt *et al.* 1974). And in some cases this is believed to have an important effect on population dynamics. Green and Palmbald (1975) speculate that selection pressure by seed eating insects may account for much of the chemical and morphological diversity seen in the genus *Astragalus*.

Grazing livestock trample or uproot Mud Flat milkvetch plants at several sites. Areas of concentrated use, such as near water or salt blocks are especially prone to trampling. There is evidence that Mud Flat milkvetch has been removed from or its abundance reduced in areas of concentrated livestock use. Livestock also pose several indirect threats. Habitat degradation due to overgrazing is apparent at several populations, and certain livestock management activities such as road, water pipeline, and fence construction have impacted at least portions of several other populations. Studies in California have shown that sheep grazing practices may adversely affect pollinators of *Astragalus monoensis*, a rare milkvetch (Sugden 1985). If

pollination becomes limiting for a plant, seed set may decline. It is unknown if similar factors are operating in Mud Flat milkvetch populations. The low density and scattered distribution patterns exhibited by many populations may make consistent pollination problematic. Any adverse affects to pollinators would only serve to compound this problem. Livestock herbivory of Mud Flat milkvetch is apparently uncommon and poses little if any threat.

2. Competition.

a. Intraspecific: Unknown. Plants are generally well spaced, but small, fairly dense clusters of plants also occur. This hints that intraspecific competition may or may not be limiting, depending on the site.

b. Interspecific: The majority of astragali do not tolerate direct competition with other herbs or the shade of trees and large shrubs (Barneby 1964). Mud Flat milkvetch seems to fit this generalization well. It occurs most commonly in open portions of the surrounding vegetation or on microsites sparsely covered or devoid of other vegetation. It therefore appears that interspecific competition may be an important ecological factor for Mud Flat milkvetch.

3. Toxic and allelopathic interactions with other organisms: None known.

D. Hybridization.

1. Naturally occurring: Unknown. A number of other astragali occur sympatrically with Mud Flat milkvetch, but no evidence of hybridization was observed.

2. Artificially induced: Unknown.

3. Potential in cultivation: Unknown.

E. Other factors of population ecology: None known.

9. Current land ownership and management responsibility:

A. General nature of ownership: Populations of Mud Flat milkvetch, in Idaho, occur on Bureau of Land Management (BLM), State and private land. It occurs on both the Owyhee and Bruneau Resource Areas of the BLM. Six populations occur on land of mixed ownership. The location and land ownership of one population (009) is uncertain.

The one known population in Nevada occurs on land owned by the BLM, Winnemucca District, Paradise-Denio Resource Area.

B. Specific landowners: The full extent of several populations in Idaho has not been determined (see Appendix IV). Presently, ten populations are known to occur solely on BLM land, five each on the Owyhee (007, 008, 010, 011, 021) and Bruneau (013, 014, 018, 019,

022) Resource Areas of the Boise District. Five populations occur solely on private land (004, 006, 015, 017, 023), and one solely on State land (012). Two populations (001, 002) occur on both Owyhee Resource Area, BLM, and private land, and one (005) occurs on both Owyhee Resource Area and State land. One population (016) occurs on both Bruneau Resource Area, BLM, and private land, and one (020) occurs on both Bruneau Resource Area and State land. One population (003) occurs on a mix of Bruneau Resource Area, State and private land. Finally, the location and associated ownership of one population (009) is uncertain, it is either State or BLM land.

C. Management responsibility: Same as above.

D. Easements, conservation restrictions, etc.: Mud Flat milkvetch is presently listed as "Sensitive" for the BLM in Idaho (Bureau of Land Management 1991). Land administered by the BLM supporting this species would be managed according to the agencies regulations for sensitive species. In Idaho, no conservation regulations exist for plant species present on State or privately owned lands.

Part of the area supporting the Nevada population has been designated an Area of Critical Environmental Concern by the BLM.

10. Management practices and experience.

A. Habitat management.

1. Review of past management and land-use experiences.

a. This taxon: Livestock grazing has been the dominant land-use practice both past and present for sites supporting Mud Flat milkvetch in Idaho.

b. Related taxa: Unknown

c. Other ecologically similar taxa: All taxa commonly associated with Mud Flat milkvetch are much more widespread and abundant.

2. Performance under changed conditions: Mud Flat milkvetch would likely decrease or be eliminated if any management practices were to alter the relatively open structure of its sagebrush habitat. An example would be seeding to crested wheatgrass.

3. Current management policies and actions: Livestock grazing occurs throughout the range of Mud Flat milkvetch in Idaho, including associated activities such as water development projects, fencing and roads. Mining, wood cutting and recreational activities also occur within or near several populations.

4. Future land use: All of the present land uses of areas supporting Mud Flat milkvetch are expected to continue. In addition, the species range includes an area proposed for an U.S. Air Force bombing range. The ultimate outcome of this proposal is currently uncertain.

B. Cultivation.

- 1. Controlled propagation techniques:** None known.
- 2. Ease of transplanting:** Unknown.
- 3. Pertinent horticultural knowledge:** None known.
- 4. Status and location of presently cultivated material:** None known to be in cultivation.

11. Evidence of threats to survival.

A. Present or threatened destruction, modification, or curtailment of habitat or range.

1. Past threats: Livestock grazing has occurred throughout the range of Mud Flat milkvetch. Trampling is the most serious direct affect of grazing. This affect is serious only around areas of concentrated use such as near water. Indirect affects of grazing have also disturbed nearly all population to some degree. Indirect affects include habitat degradation due to overgrazing, affects on pollinators, and associated management activities such as roads, fencing, and water development projects. It is the cumulative impacts of these activities that pose the most threat. The affects of grazing on the population dynamics and long term viability of Mud Flat milkvetch remains unstudied and unknown.

Road construction has resulted in the destruction of plants at several populations. Roads typically affect only a portion of a population, but cumulatively may be important.

Mining operations were a past threat at the one known Nevada population until the ACEC designation gave protection to much of this population in 1980. Nearly all of the area where Mud Flat milkvetch occurs in Idaho is subject to potential mining activity, but presently no mining occurs in habitats supporting Mud Flat milkvetch.

2. Existing threats: Threats associated with livestock grazing noted above, continue to exist. Several populations have, or may be impacted by current management actions associated with livestock grazing. For example, some plants were destroyed during the completion of a recent water development and improvement project at the Big Sagehen Reservoir (016) population (Mancuso, personal observation). A proposed water pipeline project is expected to destroy some plants at the Antelope Flat - East site (014) despite moving most of the project away from the population. A similar situation exist at the Ant Hill Well population (022), although it is unclear if any plants will be lost if this proposed pipeline is constructed.

At least two populations (005, 006) have been recently disturbed by juniper cutting. Removing juniper from Vasey sagebrush habitats it is invading probably enhances the site for Mud Flat milkvetch. Contrastingly, associated activities such as roading, skidding, and general vehicle damage will destroy plants. The choice of site preparation and subsequent slash treatment will also effect impacts to Mud Flat milkvetch. An interesting observation was made at the Wilson Pasture West population (006) in 1992. An area on the north side of Mud Flat Road was broadcast burned while on the south side of the road junipers were piled and burned singly.

No Mud Flat milkvetch was observed on the north side of the road, but it was quite common on the south side. The method of burning was the only observable difference between the two sides of the road. The area was burned as either part of juniper wood cutting prescription or to curtail invasion of the juniper into the adjacent sagebrush/bunchgrass habitat. This suggests Mud Flat milkvetch will respond differently to different management strategies. More study is needed in this regard.

Road construction, improvements and maintenance continue to threaten portions of a majority of populations too.

3. Potential threats: It is anticipated that livestock grazing and its associated activities will continue as the dominant land use throughout the range of Mud Flat milkvetch. The threats posed by such activities will, therefore, also remain. Part of the range of Mud Flat milkvetch includes the U.S. Air Force's proposed Big Springs Bombing Range area. The ultimate outcome of the bombing range proposal is presently unknown. The effects of this bombing range on Mud Flat milkvetch are also unknown, but could potentially be serious for select populations.

B. Overutilization for commercial, sporting, scientific, or educational use.

1. Past threats: Minimal to no past threats.

2. Existing threats: Minimal to no existing threats.

3. Potential threats: Several populations contain too few individuals to justify collecting even for scientific purposes.

C. Disease, predation, or grazing.

1. Past threats: No past disease or predation threats are known. Past threats posed by grazing have been discussed in previous sections.

2. Existing threats: No disease or predation problems have been documented for Mud Flat milkvetch, but are known for many better studied astragali (see I.8.C.1.). Threats posed by grazing have been discussed in several previous sections.

3. Potential threats: Disease and predation pressures do occur in other species of astragali, but are unknown concerning Mud Flat milkvetch. The potential threats of grazing have been discussed in previous sections.

D. Inadequacy of existing regulatory mechanisms.

1. Past threats: At the time of its emergency listing in 1980, a monthly monitoring program was part of the ACEC management guidelines for the Nevada population, yet no monitoring has occurred. Population trends are still unknown after a decade and should be pursued (Knight 1991).

2. Existing threats: At least nine populations of Mud Flat milkvetch occur fully or in part on private land, and another four fully, or in part on State land. At present, no regulatory mechanisms exist to extend protection to populations occurring on either private or State lands.

3. Potential threats: Same as above.

E. Other natural or manmade factors.

1. Past threats: None known.

2. Existing threats: None known.

3. Potential threats: None known.

II. Assessment and Recommendations.

12. General assessment of vigor, trends, and status: In Idaho, 23 occurrences of Mud Flat milkvetch are known from an area of less than 1000 square miles in west-central Owyhee County. Mud Flat milkvetch occupies only a fraction of this area, however. One additional population is known from the Osgood Mountains in Nevada, where it is disjunct by approximately 150 miles from the Idaho populations. The size of Idaho populations range from less than 10 to well over 10,000 individuals, and may occupy less than one acre to several sq. miles in extent. Most of the area occupied by large populations does not support Mud Flat milkvetch, instead they are comprised of separated clusters or subpopulations. It is often absent from suitable appearing habitat, and appears to be sensitive to differences in its local environment. For instance, it is typically most abundant in relatively open portions of its Vasey sagebrush habitat, and is usually absent from adjacent low sagebrush sites. Density is generally low, but there are exceptions to this pattern. Except those supporting low numbers of plants, populations generally appear vigorous, with several different size (age?) classes represented and some plants reproducing as evidenced by flowers or fruits.

The long-term viability of the four populations supporting less than 100 individuals is questionable. The low numbers and small areal extent of these population makes them inherently prone to extirpation. This is perhaps what happened to the Clover Spring population (009), first discovered in 1977, but never relocated despite repeated efforts by several Idaho botanists. Many populations have only recently been discovered, making inferences about trend difficult. Furthermore, the full extent of several populations, such as 013, 015, 016, 019, 020 are unknown. No demographic or other population studies have ever been established for this species. Differences in the number of estimated plants at the Nevada and several Idaho populations which have been visited more than once, suggests that population numbers may fluctuate. Such fluctuations have never been quantified, however.

To varying degrees, all populations have incurred some level of livestock or human caused disturbance. Plants have undoubtedly been destroyed at several populations. The small size (ca <1000 individuals) of about half of the known populations, combined with its limited distribution to an area where grazing and related activities are the dominant land use, suggests that Mud Flat

milkvetch remain a conservation concern.

13. Recommendations for listing or status change.

A. Recommendations to the U.S. Fish and Wildlife Service: Mud Flat milkvetch is presently a Category 2 species with the U.S. Fish and Wildlife Service (1990). Based on recent field surveys conducted by the Conservation Data Center for the U.S. Fish and Wildlife Service, by the consulting firm Science Application International Corporation (SAIC) as part of their biological inventory of the proposed Big Springs Bombing Range, and the Boise District BLM's previous and ongoing survey work, our knowledge of the distribution and conservation status of Mud Flat milkvetch is relatively well known.

Mud Flat milkvetch is a relatively rare species with a limited distribution. Several large populations have been documented, but about half of the 23 known occurrences are estimated to support less than 1000 individuals. Four populations (008, 017, 018, 022) support less than 100 individuals and their long-term viability is questionable. All populations have incurred some level of disturbance, mostly related to grazing and/or roading activities, and all populations remain vulnerable to additional disturbance in the future. One of the largest populations (023) occurs within the proposed Big Springs Bombing Range area. The conservation consequences of this proposed action are unknown at this time. It is also unknown if the proposed Range will affect other outlying populations via increased road construction or other associated developments. One population (009), originally discovered in 1977 has never been relocated and may be extirpated.

Based on the population, distribution and threat-related information presented in this report, it is our assessment that Mud Flat milkvetch requires special conservation recognition. Towards this end, we recommend the U.S. Fish and Wildlife Service coordinate with the BLM to develop a Conservation Agreement for Mud Flat milkvetch. This Agreement should address the maintenance of all populations on public land, in this case, BLM land. The plan should include the Nevada population and will necessitate coordination and cooperation between the two states. The original, 1980, MOU between the BLM and U.S. Fish and Wildlife Service for the Nevada population can be a foundation to design the Conservation Agreement.

The conservation of Mud Flat milkvetch should be integrated into all management activities that have the potential to adversely effect Mud Flat milkvetch and its associated habitat. These activities include, but are not limited to livestock grazing, roads, the treatment or harvest of juniper, and land exchanges. Investigation of the population dynamics of the species and the long-term monitoring of selected populations should be part of this plan. These investigations should include the study of the response of Mud Flat milkvetch to various types of disturbance, especially different grazing regimes, and juniper woodcutting prescriptions. Private landowners with Mud Flat milkvetch should be contacted and assistance offered to confer conservation options to these populations as well.

Until a Conservation Agreement is developed and implemented, we recommend that *Astragalus yoder-williamsii* be placed in Federal Category 1, and that a listing priority of 8 be assigned. This recommendation for federal listing can be reevaluated upon completion of the Conservation Agreement Plan.

B. Recommendations to other U.S. Federal Agencies.

1. U.S. Forest Service: No populations of Mud Flat milkvetch are known from Forest Service land. There is essentially no possibility of it occurring on Forest Service lands in Idaho, but apparently potential habitat is present on the Santa Rosa Ranger District of the Humboldt National Forest. Spahr *et al.* (1991) recommend surveys be completed to determine any locations and population trends on the Forest. Until it is determined whether Mud Flat milkvetch occurs there, it should remain on the Region 4 Sensitive Species list for the Humboldt National Forest.

2. Bureau of Land Management: 16 of the 23 known occurrences of Mud Flat milkvetch in Idaho are located, at least in part, on BLM land (see section I.9.B., and Appendix IV of this report for more detailed ownership information). The BLM land is managed by the Boise District's Owyhee and Bruneau Resource Areas. The one Nevada population also occurs on BLM land, on the Winnemucca District. Based on information contained in this report, Mud Flat milkvetch still meets sensitive species criteria and should remain on the BLM Sensitive Species list. It is recommended the BLM cooperate with the U.S. Fish and Wildlife Service in the development of a Conservation Agreement to maintain and/or enhance existing populations on land they administer. Basic population and ecological investigation as well as monitoring should be part of any Conservation Agreement. It is likely the BLM will have primary responsibility for these studies. The Wilson Pasture West population (006) offers the chance to monitor the effects of juniper woodcutting. A number of populations (e.g. 010, 011, 012, 013, 020, 023) are good candidates to study the effects of grazing on Mud Flat milkvetch.

The BLM should continue sensitive plant clearance work in project areas known or suspected to support Mud Flat milkvetch populations. Two recent BLM surveys in areas scheduled for water pipeline projects has resulted in movement of the project to minimize impacts to Mud Flat milkvetch populations. We encourage more of this proactive kind of conservation.

The location of a salt block at the Hurry Back Creek (012) population should be moved to decrease the amount of concentrated livestock use adversely effecting a portion of the population. Concentrated livestock use occurs at a water trough in the vicinity of the Juniper Station Road population (018). The trough should not be moved any closer to this small and vulnerable population.

C. Other status recommendations.

1. Counties and local areas: No recommendations.

2. State: Currently, Mud Flat milkvetch is ranked S2 by the Idaho Conservation Data Center. Based on data presented here, it should remain at this rank.

3. Other Nations: No recommendations.

4. International: No recommendations.

14. Recommended critical habitat:

A. Concise statement of recommended critical habitat. Recommendations for critical habitat should be developed as part of an overall Conservation Agreement for *Astragalus yoder-williamsii*. It is recommended that several populations occurring on public lands that support relatively large numbers of plants, and offer potential monitoring and research opportunities, be considered for areas of critical habitat. Areas that should be considered for critical habitat include, but are not limited to the following:

1) Meadow Creek (002) - especially all of the public land in section of T7S, R2W. Portions of this population extend onto adjacent private land. It is the northernmost occurrence of *Astragalus yoder-williamsii* known.

2) Ant Hill South (010) - especially section in T9S, R1W.

3) Antelope Flat - East (014) - especially section in T9S, R1E.

4) Mud Flat Road/Grasshopper Trail (021) - especially sections in T10S, R4W.

Critical habitat has been recommended for the Nevada population (see Knight 1991).

B. Legal Description of boundaries: Legal description of boundaries have not been developed. See Appendix IV and "Precise Occurrences", Section I. 5. B. of this report for legal description of the occurrence records listed above.

C. Latitude and longitude: See Appendix IV and "Precise Occurrences", Section I. 5. B. of this report for latitude and longitude of the occurrence records listed above.

D. Publicity/sensitivity of critical habitat area: In Idaho, all Mud Flat milkvetch populations occur in areas where livestock grazing is a major land use. The understanding and cooperation of permittees will be important to the success of any Conservation Agreement and the integrity of any critical habitat areas, particularly monitoring and research plots.

15. Conservation/recovery recommendations.

A. General conservation recommendations.

1. Recommendations regarding present or anticipated activities: As part of a Conservation Agreement, the BLM should investigate the effects of current grazing management on existing populations on lands they administer. Basic population and ecology studies are also needed for this species. The BLM should continue to perform sensitive plant clearances in areas with potential habitat for Mud Flat milkvetch. Survey work for Idaho should be completed (see Section I. 5. B. 4. for a list of areas requiring additional survey work) to document the total distribution and abundance in the state. Funding should also be provided for survey work to be completed in Nevada.

2. Areas recommended for protection: Not developed, but see comments under "Critical

Habitat", Section II.14.A.

3. Habitat management recommendations: Presently, no direct habitat manipulation is recommended. Such management should be developed as part of the recommended Conservation Agreement.

4. Publicity sensitivity: Moderate, as noted in Section II.14.D.

5. Other recommendations: None.

B. Monitoring activities and further studies recommended: Very little is presently known about the life history of Mud Flat milkvetch. Collecting basic biological and ecological information will be necessary to fully assess its conservation status and to ensure its long-term viability. Monitoring is most needed to document the effects, if any, of the various grazing intensities populations are subject to. Monitoring will help document the current status of existing populations and allow a population dynamics model to be developed. The development and implementation of monitoring and research studies is essential to the success of the Conservation Agreement proposed in this report.

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III. Information Sources.

17. Sources of information.

A. Publications.

1. **References cited in report:** See Appendix I.

2. **Other pertinent publications.**

a. **Technical:** Yoder-Williams, M.P. 1980. Status report - *Astragalus yoder-williamsii*. Bureau of Land Management, Winnemucca District, Paradise-Denio Resource Area, Nevada.

b. **Popular:** None.

B. Herbaria consulted: Specimens of *Astragalus yoder-williamsii* from Idaho are known to be deposited at Brigham Young University Herbarium, Provo (BRY), Harold M. Tucker Herbarium at Albertson College, Caldwell (CIC), University of Idaho Herbarium, Moscow (ID), Idaho Department of Fish and Game Herbarium, Boise (IFGH), the Snake River Plains Herbarium at Boise State University, Boise (SRP), and the Boise District Bureau of Land Management herbarium, Boise (Boise BLM). The following is a list of known herbarium specimens, indexed by population:

001 - Roger Rosentreter 3444 (BRY, ID)
003 - Roger Rosentreter 3236 (CIC)
005 - Ann DeBolt 1529 (CIC, Boise BLM)
006 - Roger Rosentreter 3230 (CIC)
007 - Roger Rosentreter 3451 (CIC)
008 - Ann DeBolt 695 (CIC, NY) and 808 (CIC, NY)
009 - Sarah Richards 77-281 (CIC)

010 - Ann DeBolt 1212 (Boise BLM)
012 - Roger Rosentreter 3447 (CIC)
013 - Roger Rosentreter 3195 (CIC, ID, IFGH)
014 - Michael Mancuso 635 (ID)
020 - Michael Mancuso 636 (SRP)
023 - Carol Prentice 058 (CIC)

C. Fieldwork: BLM botanists have periodically searched for *Astragalus yoder-williamsii* in Owyhee County since the early 1980's (Rosentreter 1980). They have also looked for and found several populations while conducting sensitive plant clearance work. In 1992, and also scheduled for part of 1993, botanists for Science Application International Corporation have conducted extensive surveys for this species as part of their biological inventory in the Air Force's proposed Big Springs Bombing Range. During May and June, 1992, botanists from the Idaho Conservation Data Center conducted an extensive field investigation as part of this Section 6 Status Survey.

Comments on field work performed in Nevada can be found in Knight (1991).

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E. Other information sources: None known.

18. Summary of material on file: Color slides, field forms, maps, and all published and unpublished references pertaining to Mud Flat milkvetch in Idaho are on file at the Idaho Conservation Data Center office in Boise, Idaho.

IV. Authorship.

19. Initial authorship:

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20. Maintenance of status report: The Idaho Conservation Data Center and Nevada Natural Heritage Program will maintain current information for their respective states. The Idaho Conservation Data Center will update the status report as needed. Should Mud Flat milkvetch be listed as a threatened or endangered species by the U.S. Fish and Wildlife Service, the Boise Field Office of the Service should maintain the primary file on information, encourage others to provide new information, and distribute new findings to the interested parties (see Section II.16.).

V. New information.

21. Record of revisions: Not applicable.

APPENDIX I

Literature Cited.

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Appendix II

Line drawing of *Astragalus yoder-williamsii*
(From Barneby 1980)

Appendix III

Map locations of *Astragalus yoder-williamsii*
populations in Idaho.

Note: The number in parentheses refers to the occurrence number of *Astragalus yoder-williamsii* in the Conservation Data Center's data base.

Maps with the location of *Astragalus yoder-williamsii* in Nevada can be found in Knight (1991)

Map 1. Overall distribution of known *Astragalus yoder-williamsii* populations in Idaho. Part of Owyhee County, from a portion of the U.S. Department of Interior Geologic Survey's State of Idaho Hydrologic Unit Map - 1974.

Map 2. Meadow Creek (002) population. Portion of Triangle 15' USGS quadrangle.

Map 3. Clover Spring (009) population. Portion of Pixley Basin 7.5' USGS quadrangle.

Map 4. Antelope Flat - West (019), part of Antelope Flat - East (014), and part of Grassy Flat Southeast (015) populations. Portion of Clover Mtn. 7.5' USGS quadrangle.

Map 4A. Ant Hill South (010), Ant Hill Southwest (011), and part of Dry Creek South (020) populations. Portion of Clover Mtn. 7.5' USGS quadrangle.

Map 4B. Grassy Flat (003), Juniper Station Road (018), and Ant Hill Well (022) populations. Portion of Clover Mtn. 7.5' USGS quadrangle.

Map 5. Battle Creek (017), part of Antelope Flat - East (014), and part of Grassy Flat Southeast (015) populations. Portion of Snow Creek 7.5' USGS quadrangle.

Map 5A. Big Sagehen Reservoir (016) population. Portion of Snow Creek 7.5' USGS quadrangle.

Map 6. Part of Antelope Flat - East (014) population. Portion of Crab Springs Butte 7.5' USGS quadrangle.

Map 7. Part of Dry Creek South (020) population. Portion of Big Springs Ranch 7.5' USGS quadrangle.

Map 7A. Part of Antelope Flat - East (014) population. Portion of Big Springs Ranch 7.5' USGS quadrangle.

Map 8. Stoneman Creek (001) population. Portion of Slack Mountain 7.5' USGS quadrangle.

Map 8A. Lower Cougar Canyon (004), and Hurry Back Creek (012) populations. Portion of Slack Mountain 7.5' USGS quadrangle.

Map 8B. Slack Creek (023) population. Portion of Slack Mountain 7.5' USGS quadrangle.

Map 9. Rays Reservoir North (005), Nickel Creek Crossing (013), and Mud Flat Road/Grasshopper Trail (021) populations. Portion of Pleasant Valley 7.5' USGS quadrangle.

Map 9A. Wilson Pasture West (006) population. Portion of Pleasant Valley 7.5' USGS quadrangle.

Map 10. Star Ranch (008) population. Portion of Smith Creek 7.5' USGS quadrangle.

Map 11. Southeast of Peppermint Spring (007) population. Portion of Fairylawn 7.5' USGS quadrangle.

Appendix IV

Occurrence records for *Astragalus yoder-williamsii*
populations in Idaho.

***OCCURRENCE RECORDS ARE NOT INCLUDED IN THE HOME PAGE VERSION OF THIS
REPORT***

Appendix V

Slides of *Astragalus yoder-williamsii* and its habitat.

Slide 1. Close-up of plant; note overall small aspect of plant, its tufted habit, spreading to ascending stiff branches, minute leaflets, and tiny white flowers not raised above the foliage.

Slide 2. Close-up of single leaf and leaflets, flower and immature fruit pod. Knife is provided for scale.

Slide 3. *Artemisia tridentata* ssp. *vaseyana*/*Festuca idahoensis* habitat type; *Astragalus yoder-williamsii* scattered throughout the area.

Slide 4. Habitat degraded by livestock grazing. An *Astragalus yoder-williamsii* plant can be seen in the foreground next to the blue pen.