THE CONSERVATION STATUS OF PICABO MILKVETCH (ASTRAGALUS ONICIFORMIS BARNEBY)

by

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ABSTRACT

Astragalus oniciformis Barneby (Picabo milkvetch) is a narrowly-distributed endemic to the north-central portion of the eastern Snake River Plain. Habitat for nearly the entire known distribution of this species is managed by the BLM, mostly the Shoshone District, but also the Idaho Falls District. Due to its rarity, it is a federal category 3c candidate and a BLM sensitive species. Intensive searches, beginning in 1981, have resolved the distribution, abundance, and conservation status of the species. Thirty-six occurrences, consisting of numerous subpopulations, occur within a main range of about 42 x 13 miles, with several disjunct populations lying outside the core of its distribution. Short- and long-term threats have been identified. Any conservation strategy developed to assure the long-term persistence of Picabo milkvetch as a viable evolutionary unit must take into account the decline of the sagebrush-steppe ecosystem on the Snake River Plain.

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INTRODUCTION

Picabo milkvetch (Astragalus oniciformis Barneby) is a narrow endemic, restricted to sandy soils in the north-central portion of the eastern Snake River Plain, Idaho. It has been recognized to be of conservation concern since the early 1970's (Johnson and Steele 1974), and as BLM sensitive species for a number of years (e.g., Conservation Data Center 1994). It was once considered a candidate for listing under the Endangered Species Act, first as a category 1 species (U.S. Fish and Wildlife Service 1980), and later as a category 2 candidate (U.S. Fish and Wildlife Service 1983; 1985). It was later downgraded to a category 3c candidate (U.S. Fish and Wildlife Service 1990). Category 3c is used for those candidate species that are later found to be more common or under less threat than previously thought. This reconsideration by the U.S. Fish and Wildlife Service was largely a result of recommendations of Packard and Smithman (1984) who performed the first systematic field inventory for Picabo milkvetch in 1984. In the intervening decade since the last field survey, a large portion of Picabo milkvetch habitat has been altered by wildfire and range improvement seedings and the current status of its distribution and abundance are unknown.

Most Picabo milkvetch habitat occurs on public lands managed by the Shoshone District BLM. Because land management activities could have a major impact on the long-term viability of the species, the BLM felt a current status inventory should be undertaken. Aside from mapping populations they discovered and collecting numerous voucher specimens, Harrison (1981) and Packard and Smithman (1984) collected little population and habitat information. To rectify this paucity of information on the current conservation status of Picabo milkvetch, the Shoshone District BLM and the Idaho Department of Fish and Game's Conservation Data Center (CDC) entered into a cooperative project to conduct field inventories in 1994. The primary objectives of this investigation are as follows:

1) Survey and delineate known populations of Picabo milkvetch, and search for additional populations.

2) Characterize habitat conditions for the populations.

3) Assess population data and threats to the species and make management recommendations to the Shoshone District BLM based on these assessments.

RESULTS

During May and June 1994, Moseley conducted a field survey of nearly all suitable habitat west of the Craters of the Moon Lava Field and Wapi Lava Field. Popovich conducted a survey for the

species east of the Craters of the Moon Lava Field in June 1994 (Popovich 1994a), filling in much needed distribution data. Following is the status of our knowledge of the distribution, abundance, and conservation status of Picabo milkvetch, including information on taxonomy, habitat, distribution, conservation status, and management and conservation recommendations. Line drawings of Picabo milkvetch, distribution maps, and occurrence records are appended to the end of the report.

Astragalus oniciformis Barneby

TAXONOMY

Bibliographic citation: Barneby, R.C. 1957. Pugillus Astragalorum XX: Notes on A. mulfordae [sic] and some close relatives. Leaflets in Western Botany 8:120-125.

Type specimen: Idaho, Blaine County, elevation 4750 ft, east of Picabo, 21 June 1947.

Pertinent synonym(s): None.

Common name: Picabo milkvetch.

Size of genus: A vast genus of perhaps 2000 species, most highly developed in arid continental, desert, and Mediterranean climates, circumboreal in dispersal, most numerous in central Asia, Iran and Turkey, in western North America, and in the Andes of South America (Barneby 1964).

Family name: Fabaceae; Leguminosae

Common name for family: Pea.

History of knowledge of taxon in Idaho: Although previously collected by Nelson and Macbride, and possibly Ray Davis, Rupert Barneby collected this species near the town of Picabo in 1947. He did not describe it as a new species, however, until 1957 (Barneby 1957). For over two decades, Picabo milkvetch was known only from this locality (Barneby 1964; Steele 1975; Packard 1981), although other sources say that it was "plentiful" in the foothills of the Sawtooth Mountains, Blaine County (Hitchcock 1961; Hitchcock and Cronquist 1973). Early rare plant inventories of the Shoshone District failed to locate any populations (Eidemiller 1977a; 1977b). It was not until Harrison's (1981) survey for the BLM in 1981, that any new populations were located. Packard and Smithman (1984) were the first to conduct a systematic inventory for the species and, with a few slight modifications by Ann DeBolt and Steve Popovich, the distribution for Picabo milkvetch that they delimited stood until 1994.

Alternative taxonomic treatments: None.

LEGAL OR OTHER FORMAL STATUS

National:

U.S. Fish and Wildlife Service: Picabo milkvetch is a category 3c candidate for listing under the Endangered

Species Act (U.S. Fish and Wildlife Service 1990). Category 3c includes those taxa that have proven to be more abundant or widespread than previously believed and/or those that are not subject to any identifiable threat. If further research or changes in habitat indicate a significant decline in these taxa, they may be reevaluated for possible inclusion in categories 1 or 2 (U.S. Fish and Wildlife Service 1993). Bureau of Land Management: Picabo milkvetch is currently an Idaho BLM Sensitive Species (Conservation Data center 1994).

Other current formal status recommendations: Because it is rare and uncommon, but not currently imperiled, it is given a global (G) conservation rank of 3 (on a scale of 1 to 5) by the Association for Biodiversity Information (the International Association of Natural Heritage Programs and Conservation Data Centres) (Conservation Data Center 1994).

State: (Picabo milkvetch is endemic to Idaho.)

Idaho:

Idaho Native Plant Society: Picabo milkvetch is a Monitor species on the Idaho Native Plant Society list of the state's rare flora. The Monitor list includes species that are common within a limited range in Idaho, and/or are uncommon, but have no identifiable threats (Idaho Native Plant Society 1994).

Conservation Data Center: Because Picabo milkvetch is endemic to Idaho, the state (S) conservation rank assigned by the Conservation Data Center (the Idaho node of the Association for Biodiversity Information) equals the global (G) rank of 3, discussed above (Conservation Data Center 1994).

Review of past status: In her review of this taxon for the Rare and Endangered Plants Technical Committee of the Idaho Natural Areas Council, Packard (1981) recommended a federal status of Endangered, admitting, however, that further study was needed. Harrison (1981) also recommended Endangered status.

DESCRIPTION

General nontechnical description: Picabo milkvetch is a wiry, prostrate plant with numerous stems emanating from a loosely branching caudex at ground level. The caudex surmounts a rather long, slender taproot. The stems are from 1 to 2.5 dm long, sparsely leafy, and only the lowest leaf axils without an inflorescence. Leaves have a short petiole, or the upper ones nearly without a petiole, a stiff rachis, and 17 to 25 small,

scattered, oval leaflets. The herbage is covered with short, white hairs. A raceme of 6-12, cream-yellow, pea-like flowers comprises the inflorescence. The small fruit is pendulous, attached by a short stipe, light green-papery, and more or less triangular in cross section.

Technical description: Slender but wiry, diffuse, perennial, with a taproot and at length loosely forking, suffruticulose caudex, loosely strigulose or subvillosulous with incumbent or ascending, nearly straight or sinuous hairs up to 0.35-0.5 (0.6) mm long, the herbage greenish-cinereous, the leaflets glabrous or medially glabrescent above; stems several or numerous, decumbent or prostrate, (0.5) 1-2.5 dm long, commonly spurred at the lowest nodes and thence floriferous upward from all succeeding axils; stipules papery-membranous or early becoming so, 1.5-3.5 (4) mm long, triangular or triangular-acuminate, decurrent around half, or the lowest around the whole stem's circumference but not connate; leaves 2.5-7.5 cm long, shortly petioled or the upper ones subsessile, with stiff but slender rachis and (13) 17-25 (27) rather distant, scattered, narrowly to broadly elliptic, oval or oblong, obtuse to retuse, mostly folded leaflets 1-6.5 mm long; peduncles 0.5-2.5 cm long, much shorter that the leaves; racemes very loosely (4) 6-12-flowered, the flowers early nodding, the axis
becoming 1-7 cm long in fruit, usually produced beyond the last flower as a subulate appendage; bracts papery-membranous, ovate or lanceolate, 0.5-1.8 mm long; pedicels filiform, very early arched outward or ultimately recurved, at anthesis 1-1.4 mm, in fruit 1-1.6 mm long, tardily disjointed with the fruit; bracteoles 0; calyx 2.9-3.8 mm long, strigulose-villosulous like the herbage with white or some dark hairs, the subsymmetric disc 0.6 mm deep, the campanulate tube 2.1-2.3 mm long, 1.7-2 mm in diameter, the subulate teeth 0.8-1.5 mm long, the whole becoming papery, marcescent unruptured; petals ochroleucous, the banner veined with dull brownish-lilac; banner abruptly recurved through 90^{o} or sometimes further, broadly ovate cuneate, 5.3-6.8 mm long, 4-5 mm wide; wings (0.7 mm longer to 0.7 mm shorter that the banner) 5.7-6.8 mm long, the claws 2-2.5 mm, the oblong-obovate, obtuse blades 4-4.4 mm long, 1.9-2.9 mm wide, both incurved but the left one further and more abruptly that the right; keel 4-5 mm long, the claws 1.8-2.3 mm, the half-circular blades 2.4-3 mm long, 1.7-1.9 mm wide, abruptly incurved through $110\text{-}130^{o}$ to the deltoid, often obscurely porrect apex; anthers 0.35-0.5 mm long; pod pendulous, stipitate, the stipe (1.5) 2-4 mm long, the body lance- or oblong-ellipsoid, usually a trifle incurved, 7-12 mm long, (2) 2.5-3.5 (3.8) mm in diameter, cuneate at both ends or truncately contracted at the base into the stipe, cuspidate at apex, triquetrously compressed with nearly flat lateral and openly sulcate dorsal faces, keeled ventrally by the prominent suture, the thin, green but rather densely strigulose valves becoming papery, stramineous, delicately cross-reticulate, inflexed as a not quite complete septum 0.7-1.2 mm wide; dehiscence apical and

through the ventral suture; ovules 6-12; seeds brown or greenish-brown, sometimes purple-speckled, smooth but dull, 1.5-1.8 mm long (Barneby 1964).

Local field characters: The elegantly pretty Picabo milkvetch is easily picked out from among other species on the eastern Snake River Plain with small, whitish to yellowish flowers. It is recognized by its combination of wiry, prostrate stems, and its pod that is pendulous, stipitate, and almost exactly triquetrous, the three faces being of almost equal width. The pod is sometimes a trifle turgid, and the papery valves become straw-colored and shiny in ripening. Neither of the two other Astragali known to be sympatric with Picabo milkvetch, Astragalus purshii and A. lentigenosus, share these characteristics. Another microphyllous milkvetch, also largely endemic to the Shoshone District BLM, that may cause some confusion is Astragalus atratus var. inseptus (Eidemiller 1977a; 1977b). The main characteristic that differentiates it from Picabo milkvetch is the presence of a pod that is usually purplish or mottled when mature and is not conspicuously triquetrous. Other morphological and ecological differences also exist (Smithman 1989).

In many respects, Picabo milkvetch resembles Astragalus mulfordiae, with which it is not sympatric, being separated by at least 90 miles [Isely (1986) erroneously states that the two have contiguous distributions]. In fact, Barneby (1957; 1964) referred to this likeness in naming Picabo milkvetch. The specific epithet, oniciformis, notes the plant's resemblance to Astragalus mulfordiae, which was referred by Rydberg to the genus Onix. Care must be taken to distinguish specimens of the two species in the herbarium; there has been confusion in the past. The following key, adapted from Barneby (1964:459), can be used to distinguish the two species:

1. Stipules mostly free; vesture of sinuous or incurved hairs; petals ochroleucous, the banner veined with brownish-purple; leaflets oblong-elliptic, all jointed; body of the pod 6-12 mm long; ovules 6-12; seeds 1.5-1.8 mm long; Blaine, Lincoln, and Minidoka counties, between 3700 and 5200 feet in elevation .....Astragalus oniciformis

1. Stipules connate; vesture of appressed, straight hairs; petals whitish; leaflets mostly linear, the terminal one of some upper leaves nearly always continuous with the rachis; body of the pod (9) 10-16 mm long; ovules (11) 12-16; seeds 2-2.6 mm long; Ada, Owyhee, Payette, and Washington counties, Idaho, and adjacent Malheur County, Oregon; between 2100 and 3200 feet in elevation..... Astragalus mulfordiae

Photos and line drawings: Reproductions of a line drawing of Picabo milkvetch by Jeanne Janish appears in Hitchcock (1961), Hitchcock and Cronquist (1973), Barneby (1989), and Appendix 1.

Photographs of its habit and habitat are in the slide collection of the Conservation Data Center.

DISTRIBUTION

Global/Idaho distribution: Picabo milkvetch is endemic to the north-central portion of the eastern Snake River Plain (sensu Malde 1991) in Blaine, Lincoln, and Minidoka counties, Idaho (Appendix 2). Although first collected at Picabo, reflected by the common name, that population represents the extreme northwestern corner of its distribution. Using this population as their reference, Barneby (1964; 1989), Hitchcock (1961), and other sources described its range as occurring in the "foothills of the Pioneer Mountains." This has been found to be false; Picabo milkvetch is truly a species of the Snake River Plain.

The CDC data base contains 36 occurrence records for this species. An occurrence record is an information management convenience to track data regarding a population or several subpopulations in a localized area and is identified with the three-digit code (e.g., 012). The general distribution of Picabo milkvetch is mapped in Appendix 2. We also mapped the distribution on two sets of 1:100,000-scale Idaho Transportation Department maps, on file at the CDC and Shoshone District BLM office. Photocopies of these maps have been included in Appendix 2. In addition, the distribution is also mapped on 1:24,000-scale USGS quadrangles on file at the CDC. Picabo milkvetch populations on the latter two maps are referenced by CDC occurrence number. A general description of Picabo milkvetch distribution, defined by its distributional limits, is outlined below:

Northern Limit: The northwestern section of its northern limit follows the base of the foothills of the Pioneer Mountains and Picabo Hills. The foothills are largely underlain by Eocene Challis Volcanics (Rember and Bennett 1979a; Worl et al. 1991) and the soils derived by this bedrock have a clay texture, a habitat unsuitable for Picabo milkvetch (see Habitat section). Apparently little to no sandy loess was deposited in the upper Silver Creek valley, west of Picabo. To the east the northern limit runs across the Snake River Plain, and appears to be defined by increased effective precipitation and a general transformation to heavier soils, as evidenced by the increased presence of Artemisia tripartita and by the predominance of Festuca idahoensis as the understory dominant in the sagebrush-steppe, as opposed to the predominance of Agropyron spicatum and Stipa comata within its range. Superimposed on this precipitation and soil gradient are the recent lava flows between Carey and Laidlaw Park, which limit its distribution over large areas.

Western Limit: The western limit runs largely on a line between Picabo, Richfield and Shoshone, along lower Silver Creek and the Little Wood River. Most of the western edge of its distribution is defined by unsuitable soil types. To the west, no sandy loess occurs and the soils are high in clay. The result is the exclusive, but contiguous, distributions of two endemic milkvetch, Astragalus atratus var. inseptus and Picabo milkvetch. Astragalus atratus var. inseptus occurs on the clayey soils to the west and, with the exception of a small disjunct population of Picabo milkvetch (036), does not occur within the range of Picabo milkvetch (Smithman 1989; Prentice 1993). The disjunct population occurs on a small sandy deposit at the base of the Picabo Hills, approximately five miles east of the main portion of its range.

Extensive areas of sandy soil occur between Shoshone and Gooding, yet only two disjunct populations of Picabo milkvetch are known from this area. The distributional limit here, and to the south, may be defined by increased aridity, opposite of its northern limit.

Southern Limit: The southern limit runs northeast from Shoshone, across the Snake River Plain to just beyond the eastern edge of the Craters of the Moon Lava Field. Considerable suitable-appearing habitat occurs to the south, but only one disjunct population has been discovered southeast of Dietrich. As mentioned previously, increasing aridity to the south may limit its distribution here. Harrison (1981), Packard and Smithman (1984), and Popovich have searched extensively for Picabo milkvetch south of its known distribution.

Eastern Limit: The eastern limit of the main range of Picabo milkvetch is the Craters of the Moon Lava Field. Four disjunct occurrences, and a small area of suitable-appearing habitat, occur east of the lava field in the vicinity of Mule Butte. Beyond this small area, searches by Popovich (1994a) and, to a lesser extent, Moseley (1989) revealed little suitable habitat on the Big Desert, between the Craters of the Moon Lava Field and Big Southern Butte.

Extant occurrences: Appendix 3 contains the occurrence records for the 29 recently-visited occurrences of Picabo milkvetch (see below regarding 7 historical occurrences). These records contain detailed information on the location, population size, population area, habitat characteristics, occurrence documentation, and comments.

Extirpated occurrences: No populations of Picabo Milkvetch are known to be extirpated (but see discussion under historical occurrences, below).

Historical occurrences: Of the 36 documented occurrences in the CDC data base, 7 mentioned in Packard and Smithman's (1984) report have not been visited since 1984, and are considered historical.

These include occurrences 005, 011, 012, 025, 027, 028, and 031 (Appendix 3). No population and habitat data has been documented for these sites and their current status is unknown. Occurrences 028 and 031 are among the most southern locations known.

Unverified/undocumented reports: A population of Picabo milkvetch in T5S, R18E, S17, about four miles northeast of Shoshone, was reported by Packard and Smithman (1984) and is indicated on an undated, small-scale map on file at the Shoshone District BLM office. Authorship of the map is unknown. No other documentation exists for this population, and Moseley was unable to locate any Picabo milkvetch in section 17. A large depression surrounded by recent lava occurs in the center of the section, but no sandy soil was present. The only remotely potential habitat in this area is the small sand bars along the dry channel of the Big Wood River, a habitat that is probably too sandy to be optimum habitat. We believe this is an erroneous occurrence and have not included it in the distribution of Picabo milkvetch (Appendices 2 and 3).

Synopsis of past and needed inventories: The distribution of Picabo milkvetch has been fairly well determined by numerous documented and undocumented surveys. Regarding documented surveys, Eidemiller found no milkvetch in her surveys of the foothills of the Pioneer, Smoky, and Soldier mountains (Eidemiller 1977a) and the Bennett Hills (Eidemiller 1977b). Rare plant inventories in the early 1980's contributed the most to our knowledge of the distribution of Picabo milkvetch west of the Craters of the Moon Lava Fields (Harrison 1981; Packard and Smithman 1984; Smithman 1984; Rosentreter 1986). Steve Popovich resumed surveying in the 1990's, with numerous searches in 1992, 1993, and 1994. A survey of sandy habitats east of the Craters of the Moon Lava Field by Popovich (1994a), resulted for the first time in the discovery of several populations on that side of the recent lavas. Popovich's 1994 survey, and field work by (Moseley 1989), confirmed that the appropriate sandy habitat required by Picabo milkvetch is common west of, but limited east of, these recent lava flows. Nearly all roads within the known range have been driven at least once in search of Picabo milkvetch. Many areas to the west, south, and southeast of the species known distribution have also been searched.

Little remains to be done as far as determining the general range of Picabo milkvetch. The boundaries of existing populations will certainly be expanded and new populations or subpopulations will probably be discovered within the range described above. New disjunct populations may be discovered as well. Searches of the kipukas in the lava between Laidlaw Park and Mule Butte should be conducted to determine if Picabo milkvetch occurs in these protected areas. Visits to historic sites should be made to determine their current status.

HABITAT

General habitat description: Picabo milkvetch occurs almost exclusively on the Artemisia tridentata var. wyomingensis/Stipa comata habitat type (Hironaka et al. 1983). This is an edaphically controlled habitat type restricted to sandy loam soils [in our case] or uniformly, highly calcareous silt loam soils. The sandy loam texture largely precludes Agropyron spicatum or Stipa thurberiana establishment. Oryzopsis hymenoides is a consistent member of this community (Hironaka et al. 1983). Topographically, Picabo milkvetch occupies sandy basins, bowls, and flats within rolling basalt. Stipa comata and Oryzopsis hymenoides, plants indicative of sandy soils in this area, are the best indicators of Picabo milkvetch habitat within the sagebrush/steppe. Dominant shrubs are Artemisia tridentata var. wyomingensis, A. tridentata subsp. tridentata, and Chrysothamnus spp. The precipitation zone is mostly 8-12", but it grades into the 12-16" zone along the northern edge of its distribution (Hironaka et al. 1983; Johnson 1991; Popovich 1994a). Slopes vary from nearly level to gently rolling. At these declivities, aspect is not a factor.

Elevations of known Picabo milkvetch populations range from 3700 feet for the disjunct populations between Shoshone and Gooding (028 and 034) to nearly 5200 feet at the northeastern limit of its distribution (007). The habitat at this latter site is considerably different than the others, being an Artemisia tripartita/Agropyron spicatum habitat (Hironaka et al. 1983) with an unusual assortment of associated species, such as Carex filifolia, Koeleria cristata, and Phlox hoodii. Sites 006, 008, and parts of 002 are ecotonal to A. tripartita habitat types, but are still dominated or co-dominated by A. tridentata and are not truly "clayey" sites.

As suggested earlier, the northern limit of its distribution is probably influenced by increased precipitation and increased clay content of the soils. Artemisia tripartita and Festuca idahoensis become more prominent beyond the northern limit of Picabo milkvetch. The southern limit appears to be influenced by hotter, more draughty conditions, and increased level of historic and current habitat alteration. Alteration consists of numerous, frequent wildfires, extensive invasion of weedy annuals, especially Bromus tectorum, high grazing levels, and mechanical seeding of Agropyron cristatum. At both the northern and southern limits, unobserved attributes, such as soil temperature and frost-free growing season, may also be affecting distribution.

Much of the species' occupied habitat, containing a majority of the known plants, burned in a series of large wildfires in 1992, which consumed 210,000 acres (Popovich 1994a). Picabo milkvetch plants appear to be more commonly found in open grassy areas that have been recently burned, than in closed-canopy sagebrush stands.

Picabo milkvetch evolved with fire as part of the presettlement ecosystem processes and is able to survive burning. However, the fire regime has changed dramatically on the Snake River Plain within the last century, to the point where many native species are unable to withstand high fire frequencies and/or compete with cheatgrass (Pellant 1990; Whisenant 1990; Peters and Bunting 1994). Some sites containing very high densities (e.g., 017) are known to have burned at least 3-5 times since 1941. The impact of the this increased fire return interval on Picabo milkvetch is unknown. Fortunately, the sandy soils supporting Picabo milkvetch currently do not appear to be as prone to cheatgrass invasion as soils with siltier textures, although cheatgrass is very abundant in some localized sandy areas containing Picabo milkvetch.

Picabo milkvetch does not occupy unstable sands. Psoralea lanceolata characterizes these loose, shifting sands (Packard and Smithman 1984), and we never observed it to occur with Picabo milkvetch.

Geology and Soils: The bedrock underlying most of the range of Picabo milkvetch is basalt of the Snake River group, a common extrusive rock of Quaternary age that covers much of the eastern Snake River Plain. Undifferentiated Quaternary/Tertiary basalt underlies a few sites and Quaternary Wendell Grade basalt underlies the two occurrences (028 and 034) between Shoshone and Gooding (Rember and Bennett 1979a; 1979b; Worl et al. 1991). The few published K-Ar dates for the Snake River Group indicate that they were extruded less than 2 million years ago, although these dates have a large experimental error associated with them. Possibly a better indication is the normal polarity of exposed basalts, indicating that virtually all of them erupted in the last 750,000 years (Malde 1991). Following deposition of these basalts, sandy eolian loess was then deposited over much of the area, forming the parent material of the soils supporting Picabo milkvetch (Packard and Smithman 1984; Johnson 1991).

The western half of the range of Picabo milkvetch is interrupted by numerous Holocene lava flows of the Craters of the Moon Lava Field. Within the range of Picabo milkvetch, these flows range in age from approximately 12,000 years to less than 3600 years. Even younger flows occur to the north in Craters of the Moon National Monument. We speculate that these flows probably interrupted what was once a more continuous distribution of Picabo milkvetch. No loess was deposited on these recent flows and, therefore, they are unoccupied and unsuitable for Picabo milkvetch. The youngest flow within its range is the Minidoka Flow, which separates the eastern edge of the main distribution from the disjunct populations around Mule Butte. This flow, which separates these populations by nearly eight miles, is estimated to have been laid down 3590$\pm$70 years ago (Kuntz et al. 1988).

The soil survey done for the Blaine County area (Johnson 1991), is

the most recent soils mapping effort within the range of Picabo milkvetch. Although it does not cover the entire range, we will rely on this document to characterize the soils supporting the milkvetch. Three general groups of "well-drained soils on basalt plains" predominate:

1. McCarey-Justesen-Rock Outcrop - These occur in the northeastern portion of its distribution in the Little Wood River valley. They are moderately deep and very deep soils that formed in loess over basalt residuum. These soils contain extensive and dense populations of Picabo milkvetch.

2. Deerhorn-Rehfield-Rock Outcrop - This general soil group occurs in the southern portion of Laidlaw Park and to the south of the recent flows and contains many, high density populations. They are moderately deep and very deep soils that formed in eolian material over basalt.

3. McCarey-McBiggam-Bancroft - These soils occur in the Paddleford Flat, Little Park, and the northern portion of the Laidlaw Park kipukas. While these soils contain a few populations of Picabo milkvetch, they largely lie to the north of the core of its distribution. They are moderately deep and very deep soils that formed in loess over basalt residuum and in silty alluvium. Soil series in this group generally occur in higher precipitation zones than the previous two groups.

Refer to the soil survey (Johnson 1991) for a detailed description of each of the soil series.

Packard and Smithman (1984) noted that the species also occurs on clayey soils, as evidenced by the presence of Viola beckwithii and other clay-soil obligates. They didn't reference the location of this observation(s), but this situation has not been observed by other surveyors. In fact, Moseley observed that if there is enough clay in the soil to form polygonal cracks after drying, then Picabo milkvetch is always absent.

Associated species:

Shrubs - Artemisia tridentata var. wyomingensis, A. tridentata var. tridentata, A. tripartita, Chrysothamnus nauseosus, C. viscidiflorus, Purshia tridentata, Tetradymia canescens.

Graminoids - Stipa comata, Oryzopsis hymenoides, Agropyron smithii/dasytachyum(?), A. spicatum, A. cristatum, Poa secunda, Bromus tectorum, Carex douglasii, C. filifolia, Koeleria cristata.

Forbs - Chorizanthe sp., Astragalus purshii, A. lentigenosus,

Chaenactis douglasii, Sphaeralcea munroana, Gymnosteris nudicaulis, G. parvula, Cryptantha circumscissa, Alyssum desertorum, Eriogonum vimineum, Lomatium foeniculaceum, L. triternatum, Oenothera caespitosa, Lupinus sp., Phacelia heterophylla, Agoseris glauca, Phlox acaulis, P. longifolia, P. hoodii, Erigeron pumilus, Sisymbrium altissimum, Machaeranthera canescens, Leptodactylon pungens, Centaurea sp., Verbena sp., Penstemon acuminatum, Ranunculus glaberrimus, Opuntia polyacantha, Mimulus nanus, Collinsia parviflora.

Other rare plant species: As previously mentioned, another rare milkvetch, Astragalus atratus var. inseptus, has a contiguous, but not sympatric, range with Picabo milkvetch (Smithman 1989; Prentice 1993). As discussed earlier, differences in soil texture appear to be the primary factor driving the distribution of these two species.

Gymnosteris parvula, a state monitor species (Idaho Native Plant Society 1994) was found to co-occur with Picabo milkvetch at one site near Mule Butte (033). The Gymnosteris occupied the more silty/clayey edge of the site while the greatest concentration of milkvetch occurred in the sandiest areas.

Moseley found Mentzelia congesta, a state Review species (Idaho Native Plant Society 1994), in unstable sands between Shoshone and Gooding, in the vicinity of Picabo milkvetch occurrences 028 and 034.

Gymnosteris nudicaulis occurs nearly throughout the range of Picabo milkvetch. This species was found to be more common than previously thought, and was recently dropped from the rare plant list for the state (Idaho Native Plant Society 1994). Although 1994 was a relatively dry spring, we found this annual to be widely distributed throughout the survey area.

POPULATION BIOLOGY

Phenology: Seed germination probably occurs early in the spring (or possibly in late fall). Flowering begins in mid-May most years. Fruit maturation proceeds through June, with most probably dehiscing sometime in July. There is wide variation in all these dates, possibly by as much as four weeks, depending on the temperature pattern during the spring.

Population size and condition: Appendix 3 contains the CDC data base records for the 36 known occurrences of Picabo milkvetch. These occurrence records contain information on location, survey dates, occurrence rank, population and habitat data, population size, area occupied, and various comment fields related to protection, management, and occurrence documentation. Below is a

summary of selected occurrence record fields related to population size and condition. The Occurrence Rank is a relative ranking between A (highest) and D (lowest) based on population size, structure, and habitat quality. An Occurrence Rank of H refers to the seven historical collections that have not been revisited since they were discovered in 1984. Most of the population numbers and areas are estimates.

Occurrence Number	Occurrence Rank	Number Individuals	Area (acres)
001	C	100's	10+
002	B	1000's	500+
003	B	1000's	40+
004	C	100's	20
005	H	??	??
006	C	100's	5
007	B	1000's	10
008	C	10	10?
009	A	10,000's	200+
010	A	10,000's	200+
011	H	??	??
012	H	??	??
013	A	10,000's	500+
014	A	1000	40
015	A	10,000's	500+
016	C	<100	40
017	A	10,000's	hundreds
018	C	100	1
019	C	100's	40
020	C	100's	20?
021	D	100	3?
022	D	30	3?
023	A	1000's	40+
024	A	<10,000	40
025	H	??	??
026	B	1000's	10
027	H	??	??
028	H	??	??
029	D	<50	2
030	C	1000's	10
031	H	??	??
032	B	100	3
033	A	1100	11
034	D	200	100
035	D	200	100
036	C	100's	2

Steve Popovich, Shoshone BLM, and David Pyke, National Biological Service, began monitoring selected populations and habitats of Picabo milkvetch in 1993 and 1994, in response to wildfire and rehabilitation treatments, livestock grazing, and "range improvement plow and seed" treatment (Popovich 1994b). These monitoring sites are located at the following occurrences (see also Appendix 3 for site details):

1. Tikura plow and seed (occurrence 002)
2. Mile marker 186 on Hwy 26 (occurrence 017)
3. Pagari Bridge (occurrence 017)
4. Black Ridge Fire WSA site 2 (occurrence 014)
5. Black Ridge Fire WSA site 3 (occurrence 015)
6. Great Rift Fire 1 (occurrence 013)
7. Great Rift Fire 2 (occurrence 013)

Because the plots were only recently established, it is too early to discern population trends and all but tentative differences between treatments.

Reproductive Biology: Picabo milkvetch reproduces by seed. Nothing is known about seed dispersal, seed viability, or pollinators. Insects are assumed to be the pollination vector, therefore, it is possible that there is genetic interchange between all populations, even the disjunct ones. Genetic differentiation between populations has not been measured, however, to determine if this is the case. Popovich and Pyke have collected specimens of insects observed around plants at some monitoring sites, but they have not yet been identified.

Many Picabo milkvetch juveniles were observed in 1994. These plants probably germinated during 1993, which was an exceptionally wet spring and summer. We observed an enormous number of one-year old plants of many species of the sagebrush-steppe on the Snake River Plain.

The extent of the seed bank for this species is unknown, but it is widely known that many Astragali have seeds that remain viable for many years (Barneby 1964).

Biological Interactions: Harrison (1981) observed many plants to be chlorotic later in the growing season. He suspected that it was caused by insect predation, possibly a stem borer. He discounted other possibilities, such as mineral deficiency, because the symptoms would have been more widespread. Packard and Smithman (1984), however, suggested that drought is more likely the factor responsible. Popovich and Pyke observed that a small proportion of pods at their Tikura plow and seed study site had borers inside. One borer was captured, but they were unsuccessful in attempts to raise it to adult stage for identification.

Competition: It appears that Picabo milkvetch is not a good

competitor. As stated previously, the sandy habitat occupied by Picabo milkvetch is often, but no always, very open, with considerable bare ground between plants. Newly open or disturbed habitat, such as roads, appears to be readily invaded by the milkvetch if the frequency of disturbance and competition is not too severe.

Herbivory: At most sites we did not observe significant herbivory of Picabo milkvetch plants in 1994. However, Popovich observed rabbit or small rodent herbivory to be 65 and 35 percent, respectively, for juvenile and adult plants at the Mile 186 monitoring site (n = 20 for each age class), and 29 and 11 percent, respectively, at the Tikura study site (n = 35 for each age class). When herbivory occurred, it was almost always severe, removing most or all above-ground phytomass. Sometimes some uneaten fruiting stalks remained nearby. Herbivory was not mentioned by any other botanists who conducted surveys for it prior to 1994.

Land ownership: Below is a table summarizing the ownership information of known Picabo milkvetch sites (see also Appendix 3). The BLM manages all or a portion of 32 occurrences (89%). The BLM shares management of these populations with the Idaho Department of Lands, and to a much lesser extent with the Idaho Department of Fish and Game and private owners. The Monument Resource Area, Shoshone District, has the greatest management responsibility with 26 occurrences. The Bennett Hills Resource Area manages the two occurrences between Shoshone and Gooding, and the Idaho Falls District manages the four occurrences east of the Craters of the Moon Lava Field.

Occurrence Number	Ownership
001	Railroad and highway right-of way
002	BLM - Monument Resource Area
003	BLM - Monument Resource Area, State Lands
004	BLM - Monument Resource Area
005	BLM - Monument Resource Area
006	BLM - Monument Resource Area, Private
007	BLM - Monument Resource Area
008	BLM - Monument Resource Area
009	BLM - Monument Resource Area
010	BLM - Monument Resource Area, State Lands
011	State Lands
012	BLM - Monument Resource Area
013	BLM - Monument Resource Area, State Lands
014	BLM - Monument Resource Area
015	BLM - Monument Resource Area, State Lands
016	BLM - Monument Resource Area
017	BLM - Monument Resource Area, State Lands, Idaho Fish and Game, Private
018	State Lands
019	BLM - Monument Resource Area, State Lands
020	BLM - Monument Resource Area
021	BLM - Monument Resource Area
022	BLM - Monument Resource Area
023	BLM - Monument Resource Area, State Lands
024	BLM - Idaho Falls District
025	State Lands
026	BLM - Monument Resource Area, State Lands
027	BLM - Monument Resource Area
028	BLM - Bennett Hills Resource Area
029	BLM - Idaho Falls District
030	BLM - Monument Resource Area
031	BLM - Monument Resource Area
032	BLM - Idaho Falls District
033	BLM - Idaho Falls District
034	BLM - Bennett Hills Resource Area
035	BLM - Monument Resource Area
036	BLM - Monument Resource Area

Land use: The primary land use of virtually all habitat occupied by Picabo milkvetch is livestock grazing, both cattle and sheep. Portions of two occurrences do occur in areas that are ungrazed. These include a few plants in the fenced road right-of-way along lower Silver Creek (002) and a small portion of the population along the Little Wood River (017) that occurs in Bear Track Williams Wildlife Management Area, managed by the Idaho Department of Fish and Game.

ASSESSMENT AND MANAGEMENT RECOMMENDATIONS

Threats to currently known populations: The impacts to this plant from management activities are little understood. Observations have shown that populations may be present in areas receiving disturbance from light to moderate livestock grazing, invasion of annual exotics, increased fire frequency, and mechanical application of crested wheatgrass. However, we know nothing of the disturbance thresholds, long-term stability of the populations, and response to fire rehabilitation.

Given these uncertainties and the limited geographic range of Picabo milkvetch, a conservative approach to threat assessment and conservation planning is in order. Both short- and long-term threats to population and species viability of Picabo milkvetch exist. First a discussion of the short-term threats. There has already been considerable habitat lost to paved highways, gravel and dirt roads, powerline rights-of-way, canals, railroad rights-of-way, agricultural conversion, and livestock sacrifice areas (water developments, salting, bedding grounds, etc.). All of these could potentially be threats to populations or portions of populations in the future. These threats tend to be more localized in nature than the long-term ones, and more easily accounted for in land management planning. Also in need of consideration is the use of herbicides, especially in road rights-of-way, and noxious weed control programs.

Of greater concern is the 130-year decline of the sagebrush-steppe ecosystem on the Snake River Plain (Ertter and Moseley 1993; Noss et al. 1993) and its long-term effect on the persistence of rare plants, such as Lepidium papilliferum (Moseley 1994) and Picabo milkvetch. Although livestock grazing <u>appears</u> to have no immediate direct effect on population viability, in general past and possibly current grazing tends to cause detrimental changes in the composition, structure, and function in arid ecosystems (Tisdale et al. 1969; Yensen 1980; Tisdale and Hironaka 1981; Pellant 1990; Fleischner 1994; Young 1994). Picabo milkvetch habitat occupies areas conducive to habitat alteration and desirable for land treatment practices. It has had and is currently being converted to crested wheatgrass and other non-native perennials, invaded by noxious weeds, and invaded by exotic annuals that increase the fire return frequency to the point at

which natives may be unable to persist. These problems are not as acute within the range of Picabo milkvetch as on the western Snake River Plain, but they are a cause for concern. The ecosystem- and population-level monitoring being conducted by the National Biological Service and Shoshone District BLM needs to be sensitive to habitat change due to the effects of management practices within the range of Picabo milkvetch.

Although Picabo milkvetch is sometimes found in crested wheatgrass seedings, the introduction of this perennial grass may be harmful in two ways: increased competition and the disturbance associated with the mechanical application of seed. As has been found with other rare plants in Idaho (Moseley 1994), plowing is probably more destructive to the habitat than broadcasting or drilling the seed. Packard and Smithman (1984) observed that the most continuous and highest density populations of Picabo milkvetch were indeed in crested wheatgrass seedings. Other surveyors, including both authors of this report, have observed the opposite. For example, near Brokie Lake (015) a sandy area was partially plowed and there are noticeably fewer Picabo milkvetch plants on the disked area than in the adjacent undisturbed soil. Based on ocular estimates by Popovich in 1994, the one study site at Pagari that underwent a seeding contains less milkvetch that the three less-disturbed sites. Also, Popovich (unpublished data on file at the Shoshone District BLM office) found in 1994 that Picabo milkvetch was 6.5 times more abundant in an untreated sagebrush island as compared to an adjacent area that had been plowed and seeded in 1993. There was also a significant ($p < 0.05$) reduction in the proportion of seedlings and juveniles to adults in the treatment as compared to the untreated control plots Unfortunately, pre-disturbance data is not available for any of these observations, limiting confidence in their interpretation.

Seeding exotic genotypes as part of a fire rehabilitation program should be critically evaluated. Following the Great Rift and Potter Butte fires in 1992, the natural sagebrush community in Laidlaw Park responded beautifully, with little mortality of forbs and grasses. The rehabilitation seeding that took place in this community was largely unnecessary to control erosion or prevent invasion of exotic annuals. If the pre-fire ecological status of the community is good, then little rehabilitation needs to be done (Peters and Bunting 1994). If, on the other hand, the ecological condition is poor and exotic annuals comprise a large part of the community, then seeding may be appropriate to prevent total conversion to annuals.

Diffuse knapweed (Centaurea diffusa) occurs in localized, but dense stands in disturbed areas around Picabo and Richfield. While not yet widespread in the area, it could pose a potential threat in the future if it increases in area and density.

Recommendations:

- It is clear that the greatest threat to the viability of Picabo milkvetch is the continued decline of the native sagebrush-steppe on the Snake River Plain. The Shoshone District BLM should concentrate on this aspect of biodiversity conservation first and foremost. Picabo milkvetch is a narrowly-distributed endemic to this region, yet is locally abundant and not in such dire status that its immediate viability is in question. Any conservation strategy developed to assure the long-term persistence of Picabo milkvetch as a viable evolutionary unit must take into account the decline of the ecosystem.

- In this ecosystem conservation context, we offer these general recommendations that should be considered when developing a conservation plan. While the largest populations, those ranked "A" and "B", are often thought to make the largest contribution to evolutionary viability, the importance of all extant populations to maintaining acceptable metapopulation structure and dynamics should not be discounted. A metapopulation is defined as a collection of "interdependent populations affected by recurrent extinctions and linked by recolonizations" (Murphy et al. 1990). In other words, while the loss of a few individuals may be deemed insignificant, it will generally be very important to maintain the overall geographic structure of the populations and their component subpopulations. The maintenance of the "distribution viability" of populations and subpopulations will serve as a good stand-in for maintaining less easily observed features that affect population and species viability, including genetic variation patterns, pollinator relationships, seed dispersal patterns, and gene flow within and among populations (Shelly 1994). Maintaining metapopulation structure and dynamics becomes critical in the case of a narrow endemic like Picabo milkvetch, where many of the populations are isolated. Maintaining multiple populations over a wide range of geography and habitats will serve as a source for colonists as a hedge against a shifting mosaic of habitats and environmental stochasticity, and will buffer the effects of land management-induced alterations and future natural habitat changes (Shelly 1994).

- Recommendation to the U.S. Fish and Wildlife Service: continue to maintain Picabo milkvetch as a category 3c candidate. If monitoring detects serious negative changes in ecosystem or population health, then it can be moved to the C1 category and possibly to listing, if appropriate.

- Recommendation to the Idaho Native Plant Society: Continue to include Picabo milkvetch as a Monitor species, indicating that it is common within a limited range, but that it must

continue to be monitored to detect possible upward or downward population trends.

- Recommendation to the Idaho BLM: Continue to maintain Picabo milkvetch as a sensitive special status species.

- Recommendations to the Shoshone and Idaho Falls Districts, BLM:

  > Conduct a search of kipukas on the Minidoka Flow, between Mule Butte and Laidlaw Park, to determine if Picabo milkvetch occurs in these protected areas. Presence in the kipukas would be an important factor in developing conservation strategies.

  > Relocate the seven historical sightings on the Shoshone District and assess their current status.

  > Conduct intensive clearances of all proposed land development or land exchange projects that occur within the range outlined on the 1:100,000-scale maps. We know a considerable amount regarding the general distribution and habitat of Picabo milkvetch, but more intensive, local inventories will certainly extend the boundaries of known occurrences and possibly discover additional sites within the known range. There is also the possibility of new disjunct populations being discovered outside of this range.

  > In order to maintain the "distribution viability" of Picabo milkvetch metapopulations, populations, and subpopulations, all habitat containing this narrow endemic should be given some form of special management consideration. A planning strategy that incorporates long-term species and habitat viability objectives in the BLM's broader land management planning process is highly recommended. This would include specific objectives whose achievement or failure would be measured by a monitoring program. A monitoring program would also ensure early detection of a downward trend. This would also include time-lines and clearly defined accountability. Above and beyond this, however, four areas deserve special recognition as ACEC/RNAs for their high-quality habitat and excellent populations of Picabo milkvetch:

    Mule Butte - This site on the Idaho Falls District contains occurrence 024 (Appendix 2), a large dense population in high quality stands of the Artemisia tridentata var. wyomingensis/Stipa comata habitat type. The Mule Butte population is also important because it is the largest population on the eastern edge of its range, possibly having been isolated from the nearest

populations for at least 3600 years by the Minidoka Flow. The area is relatively isolated and no permanent water sources have been developed nearby. The size of the special management area should encompass more than the known occupied area, perhaps a buffer of several miles on each side or incorporating the other sites nearby. An area of approximately 7500 acres will sufficiently encompass all known populations east of the lava flows and appropriate suitable habitat to maintain long-term metapopulation viability.

Bear Den Basin - Located in the eastern thumb of Laidlaw Park, in the basin between Bear Den Butte and Lava Butte, this site contains occurrence 009 (Appendix 2). Like the Mule Butte site, this isolated area has a large, high density population of Picabo milkvetch in a stand of Artemisia tridentata var. wyomingensis/Stipa comata in high ecological condition. The basin is traversed by a dirt road, but is isolated from most other developments. An area approximately 4500 acres in size will provide sufficient protection to this population and habitat.

Southeast of Pagari Bridge - The large sandy depression bisected by a two-track road in Section 6 (T4S R21E) of occurrence 017 (Appendix 2), about four miles southeast of Pagari Bridge, contains excellent habitat and high Picabo milkvetch densities in the northwestern portion of its range. There is also a permanent study plot there and several nearby along the road to Pagari Bridge. The entire area, from the bridge to Section 6, is being used to monitor long-term changes in plant populations and habitat attributes due to various land treatment practices.

Squaw Butte - The northern half of occurrence 015 (Appendix 2), from one mile south of Squaw Butte, along both sides of the road, several miles northwest toward The Blowout. This area is probably the best representation, in terms of habitat quality and plant numbers, of all known populations in the Wagon Butte to Black Ridge Crater area. This area encompasses the east-central portion of the species geographic range. Only the roadside has been surveyed; the full extent of the population is not known and may be considerably larger.

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Appendix 1

Line drawings of Astragalus oniciformis (from Barneby 1989).

Appendix 2

Maps of the distribution of Astragalus oniciformis.

Appendix 3

Occurrence records from the Conservation Data Center for Astragalus oniciformis.