



ARIZONA GAME AND FISH DEPARTMENT
HERITAGE DATA MANAGEMENT SYSTEM

Plant Abstract

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CLASSIFICATION, NOMENCLATURE, DESCRIPTION, RANGE

NAME: *Astragalus cremnophylax* var. *cremnophylax* Barneby

COMMON NAME: Sentry milk-vetch, Sentry milkvetch

SYNONYMS:

FAMILY: Leguminosae

AUTHOR, PLACE OF PUBLICATION: R. Barneby, Leaflets of Western Botany 5(5): 83-85. 1948.

TYPE LOCALITY: United State of America: Arizona: Coconino County: on South Rim of the Grand Canyon of the Colorado River, west of El Tovar, 3 June 1947.

TYPE SPECIMEN: HT: CAS-336060. H.D.D. Ripley 8473 and R.C. Barneby, 3 June 1947. Also cites Jones s.n. [in 1903] as paratype collection. IT: NY-5386, ARIZ.

TAXONOMIC UNIQUENESS: This genus contains 1,500 species occurring throughout the subtropical and temperate parts of the world; 350 occur in North America. *Astragalus* is the largest genus of flowering plants in Arizona. *Astragalus cremnophylax* and three other species are in the subsection *Humillimi* of *Astragalus* (Maschinski 1993). *A. cremnophylax* is divided into three varieties including *A. c.* var. *cremnophylax*, *A. c.* var. *myriorrhaphis* (cliff milkvetch) and *A. c.* var. *hevronii* (Hevron's milkvetch). Currently, a population on the North Rim of the Grand Canyon is considered a part of *A. c.* var. *cremnophylax*, however, this population may be a new variety (var. *nova*).

DESCRIPTION: A member of the pea family (Fabaceae), this dwarf, evergreen, perennial, mat-forming herb with a thick taproot, is usually less than 2.5 cm (1.0 in.) high and 2.5 to 25.0 cm (1.0 to 10 in.) in diameter. Short creeping stems have compound leaves 1.3 cm (0.5 in.) long, composed of 5-9 tiny leaflets 1-2 mm long. A large number of tiny, pea flowers are produced; 100-200 per plant is not uncommon. Flowers are whitish or pale pinkish-lilac in color, 5 mm long, and borne on a raceme of 1-3 flowers, held slightly above the mat. The fruit is unilocular, obliquely egg-shaped, and densely hairy, 3-4 mm long. Fruits vary in number from 1->700 per plant depending on size, amount of damage, and health of plant. Each fruit produces 1-6 orange seeds; the average number is 3. Seeds are 1 mm in length. Determination of age is difficult due to the mat-like growth form.

AIDS TO IDENTIFICATION: *A. c.* var. *cremnophylax* may easily be confused with *A. calycosus* (King's milkvetch), a species which is much more common in the surrounding habitat. *A. c.* var. *cremnophylax* is without a leafy stem above the ground and is a mat-former. *A. calycosus* is less prostrate, although it does not have a leafy stem above the ground and the inflorescence usually surpasses the leaves considerably. *A. c.* var. *cremnophylax* has pale pinkish-lilac flowers and one-celled pods. *A. calycosus* has blue flowers with wing petals deeply notched and two-celled pods. Care should be taken not to confuse *A. c.* var. *cremnophylax* with the other seemingly similar mat-formers at the site-locales, among them *Petrophytum caespitosum* (rock mat).

Per Falk and Jenkins et al. (2001), *A. c.* var. *cremnophylax* can be “distinguished from var. *myriorrhaphis* by lack of spinescent leaf bases; from var. *hevronii* by smaller flowers; and *A. calycosus* by unilocular fruits and teeny leaflets.”

According to the Draft Sentry Milk-vetch Recovery Plan (USFWS 2004), several characteristics distinguish *Astragalus cremnophylax* var. *cremnophylax* from the varieties *myriorrhaphis* and *hevronii*. Both of the varieties *myriorrhaphis* and *hevronii* are somewhat larger and coarser than variety *cremnophylax*. Variety *myriorrhaphis* has much longer leaves from 13-35 mm long, which are dimorphic within the growing season. Variety *hevronii* is similar to variety *myriorrhaphis* in foliage, but has larger flowers of brighter color. The three varieties are also distinguished by their geographic ranges. *A. cremnophylax* var. *myriorrhaphis* is known from several sites along the north Kaibab Plateau, *A. cremnophylax* var. *hevronii* is known from two sites on the rim of Marble Canyon, and the distribution of *A. c.* var. *cremnophylax* is as described below.

ILLUSTRATIONS: Line drawing (Rutman 1992:25)
 Color photos (Sue Rutman 1988, *in* http://ridgwaydb.mobot.org/cpcweb/CPC_ProfileImage.asp?FN=391a)
 Color photo (Peter Rowlands, NPS, accessed 2003 *in* <http://arizonaes.fws.gov/images/sentry%20Milkvetch%20Photo.jpg>).
 Line drawing of plant and parts (*in* Falk, Jenkins et al. 2001)
 Color photos of plant and habitat (Joyce Maschinski, *in* Falk, and Jenkins et al. 2001).
 Color photo of plant in flower (Sue Rutman, *in* Falk, Jenkins et al. 2001)
 Color photo of flowering plant and habitat (Karen Warren, *in* Brian 2000)
 Color photo (P. Rowlands, *in* Brian 2000)
 Color photos of plants and habitat (*in* Brian 1997)
 Line drawing (*in* USFWS 2004)

TOTAL RANGE: Two previously known populations occur on the South Rim of the Grand Canyon, including near El Tovar, Coconino County, Arizona. Recently discovered (1994) by park employees on the North Rim, west of Walhalla Plateau. Some botanists feel that the North Rim population is possibly a new variety (var. *nova*) (Brian 1998), however, unless and

until an alternative taxonomic treatment is published in a peer-reviewed journal and accepted, the North Rim population is recognized as sentry milk-vetch (USFWS 2004). In 2002, what may be an additional population was discovered on the South Rim of the Canyon at “Lollipop” Point, which is located between Maricopa and Grandview Points (USFWS 2004). Although not yet positively identified, the individuals in these populations appear to be the listed variety (var. *cremnophylax*). Potential range “includes open areas of the limestone pavement within the pinon-juniper-cliffrose plant community along the South Rim of the Grand Canyon or the east rim of Marble Gorge” (USFWS 2001).

RANGE WITHIN ARIZONA: See “Total Range.”

SPECIES BIOLOGY AND POPULATION TRENDS

GROWTH FORM: Perennial forb/herb.

PHENOLOGY: March-April (late April to early May) and September-November, spring more common; fruits from late May-June. According to Maschinski & Rutman (1993, in CPC 2003), “Plants flower in response to moisture in the spring and fall. There are two bouts of seed set.” Falk and Jenkins et al. (2001), report that flowering occurs from late April to May, with rarely a second flowering occurring following summer rains. Fruiting occurs from May to June. Fall flowering is not commonly observed in wild plants, but is common in greenhouse plants which receive supplemental watering (Brain 1997).

BIOLOGY: Grand Canyon population forms “lichen-like scabs of minute silvery foliage pressed against the rock pavement” (Barneby 1979). Soil types that retain great amount of water, such as limestone, are critical to the growth and development of seeds. Viability of different seed colors not significantly different. Under control conditions, it was observed that seeds germinated within five weeks after sowing (Maschinski 1990). After germination, branchlets spread in a densely-branched pattern over the surface of the rock. It does not root on rock surface, but rather traps wind-borne sand and silt, building own layer of “topsoil” from which it must extract some nutrition. Flowers are highly susceptible to low temperature conditions such as frost, freezing rain, or snow. These conditions often occur simultaneously with time of flowering. Ants may be primary pollinators. It should be noted that seeds are so small that they are not wind or rodent dispersed but instead fall in the mat of plant. Therefore, population does not spread and remains isolated (Phillips 1993).

HABITAT: Plants grow in the uppermost layer of a very peculiar white layer of limestone that is not grossly fractured, but rather weathers in small, shallow pockets and networks of small cracks. This kind of limestone (Kaibab limestone) is exposed for only a few hundred square yards, forms large flat platforms, has shallow soils (< 7 cm deep), is unshaded, and in the pinon-juniper-cliffrose plant community above 1219 m (4,000 ft). In these openings, sentry milk-vetch is co-dominant with rock mat (*Petrophytum caespitosum*).

ELEVATION: 7,000 - 7,960 ft. (2135 - 2428 m).

EXPOSURE: Full; slope of 0-5%.

SUBSTRATE: Kaibab Limestone. Soil is thin but “fluffy” due to frost heaving. At Maricopa Point, soils are shallow at less than 7 cm (2.8 in) deep. The textures range from very gravelly, very fine sandy loam to extremely gravelly loamy fine sand. Clay content range from 8 to 14 percent. Soils are mildly alkaline, with a pH value of 7.8.

PLANT COMMUNITY: Pinyon-juniper woodland. Sentry milk-vetch is co-dominant with rock mat (*Petrophytum caespitosum*). Associated species include: *Agropyron smithii* (wheatgrass), *Arenaria macradenia* (sandwort), *Astragalus calycosus* (King’s milkvetch), *Calyophus hartweggi* (Hartweg evening primrose), *Cercocarpus intricatus* (little-leaf mountain mahogany), *Hymenoxys acaulis* (nostem rubberweed), *Juniperus osteosperma* (Utah juniper), *Pinus edulis* (pinyon pine), *Poa pratensis* (bluegrass), *Purshia stansburiana* (cliffrose), and *Selaginella* sp. (spike-moss).

POPULATION TRENDS: The Maricopa Point population declined 38% between 1988 through 1992 (Maschinski 1993). The largest population of this variety is vulnerable to threats because fewer than 500 individuals occupy an area less than 0.4 ha (1 acre) (USFWS 2001). The Center for Plant Conservation (CPC, accessed 2003) reports that “Two known populations occur on the South Rim of the Grand Canyon, where one site has 2 living individuals and the other site has approximately 1000. On the North Rim on several Kaibab limestone fingers jutting into the canyon, there are approximately 1500 individuals. The North Rim populations are undergoing taxonomic scrutiny to determine if they are in fact the same variety. (Maschinski & Rutman 1993).” According to NatureServe (2003), the variety *cremnophylax* is “known with certainty only from 1 population on the South Rim of the Grand Canyon in Arizona. This population has been exhibiting severe reproductive problems (a large percentage of aborted embryos). Because the plants grow on the edge of the rim – where there are spectacular views – several subpopulations had been severely trampled by Park visitors, but the area has been fenced and these long-lived plants seem to be thriving, even though reproduction is sporadic.”

The 2004 U.S. Fish and Wildlife Service Draft Recovery Plan for the Sentry Milk-vetch, reports that in surveys completed in 2003-04, no plants were found at the Grandview Point locality, and that this population is thought to have died out. In 2001, the original population at Maricopa Point contained approximately 665 individuals, however, monitoring completed in 2004, shows a continuing decline in plants, with only 376 plants detected. Along with continued foot traffic in portions of this population, the drought that has plagued the state for the last several years (since about 1996) may be playing a role in their decline. Propagation studies conducted by Maschinski (1990 in USFWS 2004), indicates that water (retention higher in limestone substrates) is required for seedling growth and development. In 1994, a

third population of approximately 1,000 plants was discovered on the North Rim of the Canyon, and identified as var. *cremnophylax* based on morphological characteristics. However, recent preliminary research suggests that this population is worthy of varietal or other taxonomic distinction. As stated in "Total Range", in 2002, a new potential population was discovered on the South Rim of the Canyon at Lollipop Point. Specimens were collected in 2003 during the reproductive season, for identification and taxonomic purposes. There are approximately 250 individuals at Lollipop Point.

SPECIES PROTECTION AND CONSERVATION

ENDANGERED SPECIES ACT STATUS: LE, without critical habitat (USDI, FWS 1990)

STATE STATUS: Highly Safeguarded (ARS, ANPL 1999)
[Highly Safeguarded (ARS, ANPL 1993)]

OTHER STATUS: Not Forest Service Sensitive (USDA, FS Region 3 1999)
[Forest Service Sensitive (USDA, FS Region 3 1990)]

MANAGEMENT FACTORS: Compacting of soil and trampling by park visitors poses a major threat. Of the 410 plants observed in 1988, over half were dead or damaged from trampling. Very strict habitat requirements restrict this plant to highly specific locations. Other threats include low genetic variation, poor seed production, and extreme climatic conditions.

CONSERVATION MEASURES TAKEN:

Regulatory tools that aid in the conservation of sentry milk-vetch include: 1) Taking and Trade Prohibitions – The Endangered Species Act prohibits the malicious damage, destruction, or removal and reduction to possession of listed plants under Federal jurisdiction; 2) Endangered Species Act Section 7 Requirements – Section 7 of the Act prohibits actions authorized, funded, or carried out by Federal agencies that jeopardize the continued existence of any listed threatened or endangered species.

Status report was completed in 1982. A Draft Recovery Plan was prepared in June 1993 with Final Recovery Plan to be released in 1994, however, the Final was not completed and a new Draft Recovery Plan was released in 2004.

Other conservation measures and research efforts include: 1) In 1984, the National Park Service erected fences to help protect the South Rim population (Maricopa Point), which was extended in 1985. In 1990, the Park constructed a sturdy wooden fence, with wire fabric added to the fence in 1995. 2) Permanent demographic monitoring plots were established in the spring of 1988. Surveys were conducted annually for 8 years, but these plots are no

longer formally monitored. 3) Rim Road is closed to private vehicles during mid-May to October, aiding in protection.

SUGGESTED PROJECTS: Currently: 1) the genetic diversity of the live sentry milk-vetch plants in the National Collection is being compared to the genetic diversity of the wild population (Maschinski and Travis, in prep); 2) the Center for Research of Endangered Wildlife is investigating using tissue culture techniques to propagate sentry milk-vetch; 3) reproductive success and the possibility of inbreeding depression in the wild populations is being investigated by Allphin et al. (in prep).

Recovery strategy: 1) protection of all populations from old and new threats; 2) surveys of habitat to locate any other existing populations; 3) augmentation of existing populations; 4) research regarding the basic biology and ecology of the species; 5) establishment and maintenance of greenhouse/biological garden populations; 6) establishment of additional wild populations; and 7) close cooperative interaction among the entities involved in and responsible for recovery of the species (USFWS 2004).

Research needs (in addition to those in recovery strategy): 1) investigate ways to propagate large numbers of individuals if reintroduction is to be possible. Tissue culture is one of the areas being investigated; 2) Genetic studies are needed to determine if the population on the North Rim is a new variety (*var. nova*), or a variant of *A.c. var. cremnophylax*; 3) Seed dispersal seems to be extremely limited, thus studies should be implemented to investigate patterns of natural dispersal, consequences to seedlings, and natural dispersal agents; 4) Biotic factors may explain patterns of mortality and survival and should be investigated; 5) Intrinsic factors such as the timing of flowering, fruit set, and seed germination can guide the timing of recovery activities. Studies should be initiated to examine these factors; 6) Presently, little is known about the causes of death of plants of varying ages. To successfully augment known populations and establish new populations in natural settings, knowledge about when and which factors most seriously threaten the population is needed.

LAND MANAGEMENT/OWNERSHIP: National Park Service, Grand Canyon National Park, and possibly the Navajo Nation.

SOURCES OF FURTHER INFORMATION

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ADDITIONAL INFORMATION:

The Arboretum at Flagstaff is conducting ongoing germination studies. Final Recovery Plan from U.S. Fish and Wildlife Service will be released in 1994. (Statements made in general discussion at the South Kaibab Special Status Plant Workshop held at Williams Ranger District Office, October 27, 1993.) No new information as of 5/22/95 (DBI).

The genus *Astragalus* is either from a Greek word meaning ankle-borne or dice, perhaps in reference to the rattling of the seeds within the fruit, or it may be derived from *astro* meaning star and *gala* meaning milk in reference to the belief that its use in pasture land improves livestock milk yield. The specific epithet *cremnophylax* is from *cremno* meaning gorge and *phylax* meaning watchman.

Revised: 1992-12-04 (JSP)
1993-11-08 (DBI)
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1998-08-13 (DJG)
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