

The Marble Canyon milk-vetch

Astragalus cremnophylax var. *hevronii*

A 10-year Monitoring Update

Redwall Site, Coconino County, AZ



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INTRODUCTION

The Marble Canyon milk-vetch (*Astragalus cremnophylax* var. *hevronii*) is one of three varieties of *Astragalus cremnophylax*, all three of which are extremely rare local endemics to the Grand Canyon area of northern Arizona. The Sentry milk-vetch, *Astragalus cremnophylax* var. *cremnophylax*, was Listed Endangered in 1990, primarily due to severe threats to known populations through trampling by park visitors of plants and habitat along the south rim of the Grand Canyon. The Cliff milk-vetch, *A. cremnophylax* var. *myriorrhapis*, is only known from the Buckskin Mountains, on the Arizona/Utah border, where it is managed both by the U.S. Forest Service and the BLM. A population of *A. cremnophylax* var. *cremnophylax* from the north rim of the Grand Canyon has shown to be genetically different from the south rim populations as well as the other varieties and may be described as a new species (Allphin et al. 2005). All three varieties are narrow endemics and are vulnerable to extinction due to their habitat specificity, limited habitat availability, low fecundity levels and the overall small number of plants in existence.

The Redwall population of *A. cremnophylax* var. *hevronii* was first discovered by Bill Hevron, former botanist with the Navajo Natural Heritage Program, in 1991 and described by Rupert Barneby of the New York Botanical Garden in 1992. In 1997 the Grand Canyon National Park received a grant from the National Fish and Wildlife Foundation to set up monitoring plots for all three varieties of *A. cremnophylax*, located on NPS, USFS, BLM and Navajo Nation lands. Four permanent transects were established within the Redwall population in June of 1997. No further data collection occurred at this site until 10 years later, in 2007.

The Marble Canyon milk-vetch is a dwarf, evergreen, perennial herb, forming a mat less than 1.5 cm high, 2.5-16 cm in diameter. The leaf bases produced in the fall disjoint readily when dry, leaving the rachis as a stiff, upright spinescent structure, making it easily distinguishable from other *Astragali*. The flowers are purplish-lilac and are usually held slightly above the mat. The Marble Canyon milk-vetch flowers from mid April to May, fruiting May to June. It is primarily known from seven sites along the east rim of Marble Canyon, north and south of Twentyninemile Canyon on the Navajo Nation. It is restricted to crevices and depressions with shallow soils between Kaibab Limestone slabs on rim-rock benches along the canyon edge in Great Basin Desertscrub communities, from ca. 5000 to 5500ft elevation. Associated species include *Agave utahensis* var. *utahensis*, *Bromus rubens*, *Gutierrezia sarothrae*, *Abronia nana*, *Chaetopappa ericoides*, *Hedeoma drummondii*, *Ephedra torreyana*, *Arenaria eastwoodiae* and *Astragalus calycosus*.

Astragalus cremnophylax var. *hevronii* is protected through the remoteness of the known population sites. It is listed as "Threatened" (G3) on the Navajo Endangered Species List (NESL 2005). The primary threat is considered climatic variability, especially long periods of drought and the potential effects of global climate change. Other observed threats are trampling by livestock and humans (especially near scenic overlooks), illegal collecting and natural erosional processes.

METHODS

Four permanent transects were established from June 11 through 13, 1997 at the Redwall *Astragalus cremnophylax* var. *hevronii* site on the east rim of Marble Canyon. All plants along the transects were measured and tagged with individually numbered plastic or metal tags. Transect one is 10.20m long, located on the lowest bench at the northern end of the point, oriented 76 degrees west to north. Along Transect 2, plants are oriented from the center of the northernmost *Rhus trilobata* bush, using “clock “ directions, with N being the 12:00 and south being 6:00. Transect 3 is located on the second tier up, running south to north, 19 m long, 50 degrees east of north. Transect 4 is 12.5 m long and is located on the upper tier. It runs south to north, 62 degrees east of north. Measured was the distance of each plant from the transects, each plant was assigned an age class (small, medium, large, seedling). The percent loss or dead growth on each plant was estimated visually. No indication of reproductive status was given in 1997, probably because monitoring took place well outside the flowering season. In 2007 we relocated the 4 transects in the field. Plants without tags were tagged and their distance and direction from the transect line was measured. Age class, percent dead growth or decline were visually estimated. Reproductive status (sterile, flowering, seed-set) was noted. Dead plants were also recorded and, if they still had tags from 1997, their tags were removed.

RESULTS

In 2007 there were just over 10% more plants located along the 4 transects than in 1997 (Figure 1). Of the 164 plants found in 2007, 43 still had original tags from 1997, 19 of which were dead (44%). It was difficult to determine which of the 2007 plants were left from 1997 and had lost their tags. Also, which of the plants that still had tags were actually from the 1997 cohort and which ones had died but reestablished from seed in the same location. The most noticeable change in population dynamics was the size class distribution differences between 1997 and 2007. In 1997 plant sizes were almost equally distributed between small, medium and large plants as well as seedlings. In 2007 the majority (> 80%) of all plants were in the small to medium category (Figure 3). This observation was also supported by the fact that 87% of all plants measured in 2007 had not incurred any loss, typical for younger, healthier plants (Figure 2). Dead growth or loss is commonly observed in large, older plants. In 1997 only 56% of all plants measured were found without any loss. In 1997, 24% of all plants tagged were considered to be seedlings. In 2007, 7 % of the plants tagged were considered seedlings. In 2007, 77% of all plants were found reproductive, mostly in full flower or early seed set. No reproductive data was taken in 1997.

DISCUSSION

Astragalus cremnophylax var. *hevronii* is an extremely rare *Astragalus*, known from only 7 locations of less than 1000 plants along a thin strip of habitat along the eastern rim of Marble Canyon. Despite losses in the 10 years since the monitoring transects were established in 1997, the population at the Redwall site remains constant with a slight increase in population numbers since 1997. Likely most of the original cohort was replaced in the 10 years. It is unclear whether most plants died during the drought of 2001 & 2002, which impacted most plant communities on the Navajo Nation and the desert southwest, including many rare plants. A Sentry milk-vetch (*A. cremnophylax* var. *cremnophylax*) population monitored along the south rim of the Grand Canyon experienced a similar decline, when that population lost almost 50% of plants originally recorded in 2000 over a 6 year period (USFWS 2006). Many of the 2007 Marble Canyon milk-vetch plants were seedlings or small to medium in size, indicating recovery following a potential bottleneck event. Among the three varieties of *A. cremnophylax* the variety *hevronii* exhibited the highest seed/ovule ratios, indicating the highest fecundity level within the three varieties (Allphin et al. 2005). Perhaps this aided in the recovery of the Redwall population following the drought. The closely related *Astragalus humillimus* from New Mexico also declined severely following the drought of 2001/2002. Seed/ovule ratios for this endangered plant are less than half of *A. cremnophylax* var. *hevronii* and consequently recovery is slow and population levels are at a fraction of the numbers observed during a 1997 survey (Roth, field observation 2007).

The botanical staff of the Navajo Natural Heritage Program has extensively surveyed the rims of Marble Canyon from Navajo Bridge to the Little Colorado River, yet populations remain few and small in numbers. Habitat is limited and only a small fraction is occupied. Despite extensive survey efforts the total range of *Astragalus cremnophylax* var. *hevronii* remains very limited and extends less than 10 miles north to south along the eastern rim of Marble Canyon with the total number of plants being estimated at less than 1,000 total.

In summary, it is difficult to determine changes in the dynamics of the Redwall population through the 10-year period since the original monitoring took place. No reproductive data was taken in 1997 and size class determination is highly subjective. Considering the rarity of this taxon and its potential susceptibility to environmental fluctuations due to drought conditions, further, more consistent monitoring of populations is essential to get a better understanding of this taxons' response to climatic variability, especially considering the potential effects of global climate change on the entire species.

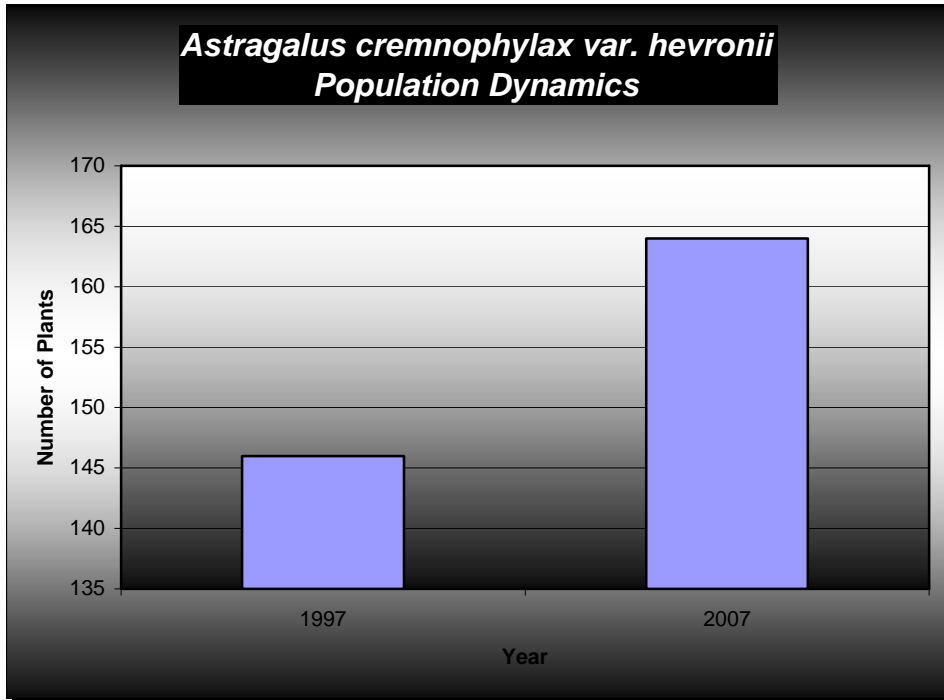


Figure 1. Number of *Astragalus cremnophylax* var. *hevronii* plants along 4 transects at the Redwall Site at Marble Canyon, AZ, in 1997 and 2007.

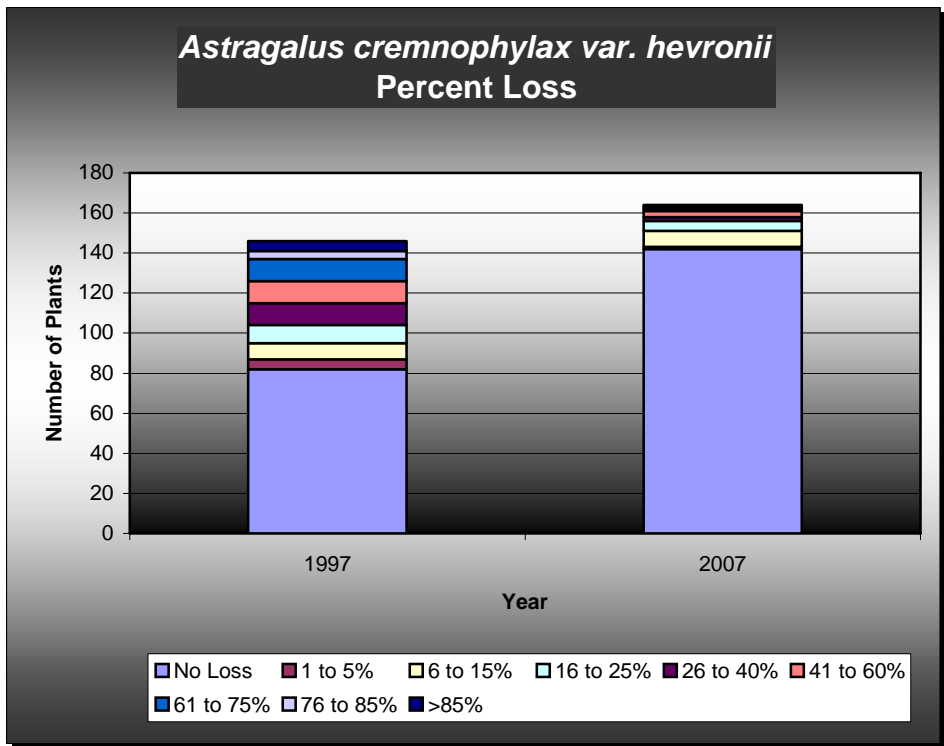


Figure 2. Dead growth of loss on *Astragalus cremnophylax* var. *hevronii* plants at the Redwall Site at Marble Canyon, AZ, in 1997 and 2007.

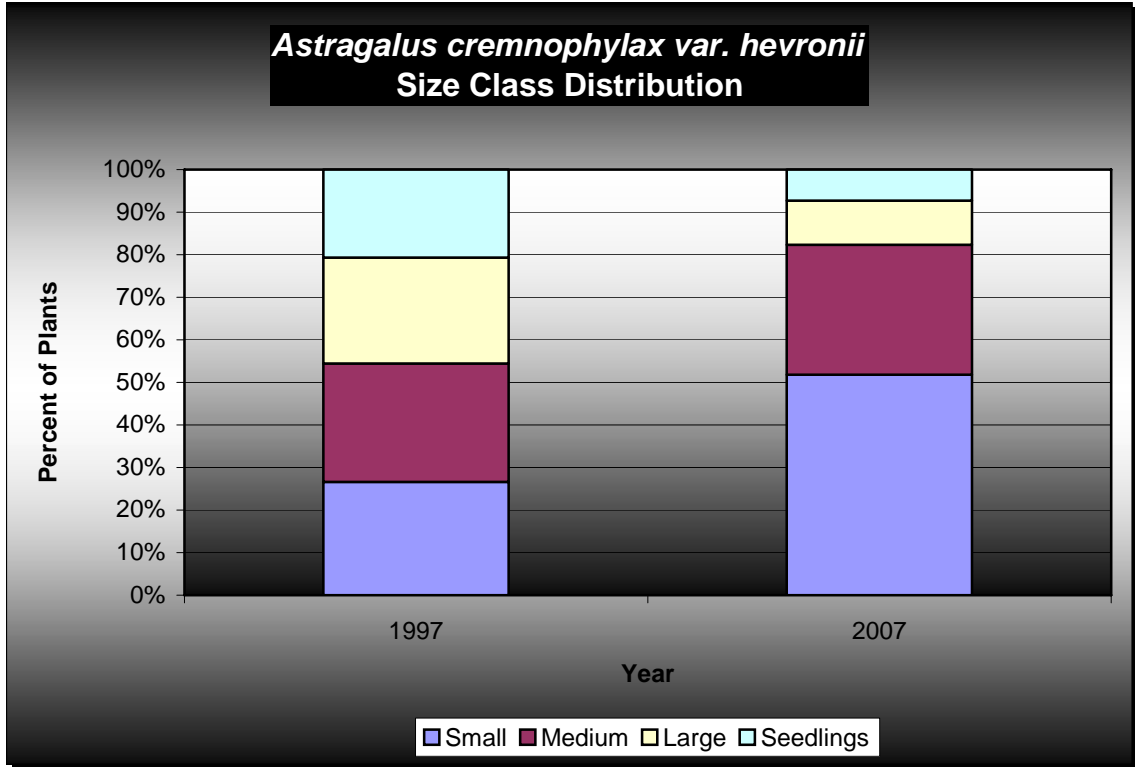


Figure 3. Size class distribution of *Astragalus cremnophylax* var. *hevronii* plants along 4 transects at the Redwall Site in Marble Canyon, AZ, between 1997 and 2007.

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