

Monitoring Update on Four Listed Plants on the Arizona Strip

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Abstract: Four listed plants on the Arizona Strip are being monitored for various population characteristics. *Pediocactus sileri* Engelm. L. Benson and *P. bradyi* L. Benson have been monitored since 1985-86, *Asclepias welshii* N & P Holmgren since 1989, and *Cycladenia humilis* Benth. var. *jonesii* Welsh & Atwood since 1993. The two *Pediocactus* species were monitored in plots where each cactus was tagged, measured for height or width, and mapped; how many cactus fruited and the mortality rate were also noted. *Asclepias welshii* plants were counted and mapped, and each stem was checked for follicles. Seedlings were also noted. The *Cycladenia humilis* var. *jonesii* were counted and checked for follicles in two plots. The size structure of *Pediocactus sileri* has shown a strong shift to the smaller size class from the mid-size class. *Pediocactus bradyi* has also shifted to the smaller individuals. The counts on the *Cycladenia humilis* var. *jonesii* and *Asclepias welshii* populations through the years have demonstrated ups and downs in population numbers, probably in line with precipitation amounts. Management plans have been implemented for the two *Pediocactus* species to deal with the threats listed for the species: livestock trampling, off-road vehicle activity, mineral activity, and collection. There is a recovery plan for the *Asclepias welshii* (Welsh's milkweed), but not for the cyclad.

The Arizona Strip District of the Bureau of Land Management (BLM) has four federally listed plants. Two of the plants have management plans, one has a recovery plan, and one has no plan to prescribe management. All four have established plots that are monitored every year.

The Siler pincushion cactus *Pediocactus sileri* (Engelm.) L. Benson has been protected under an implemented Habitat Management Plan (HMP) since 1987 (BLM 1987). The Siler pincushion grows in the broad Moenkopi soil formation that ranges from St. George, Utah to the Kaibab Plateau in northern Arizona. It grows specifically on the Red and Shnabkaib members of that formation. There are 330,000 acres of habitat and potential habitat. HMP actions completed by 1990 were monitoring, placing off-road vehicle closure signs around Warner Ridge in the Utah portion of the habitat, constructing a 200 acre enclosure in the Fort Pearce part of Arizona, and placing four raptor poles in the Atkin Well allotment. The HMP for Siler pincushion cactus, which is classed by height, set a healthy near-term objective of increasing by 20 percent the size classes of 0-4 cm, 4-8 cm, 8-12 cm, 12-16 cm, and 16+ cm.

Brady pincushion cactus, *Pediocactus bradyi* L. Benson, has been managed under an HMP since 1986, and under the Marble Canyon Area of Critical Environmental Concern (ACEC) Management Plan since 1994. It grows along the Marble Canyon

rim and its tributary canyon rims of the Colorado River. This plan has been aggressively implemented especially with emphasis towards off-road activity and livestock watering facilities. Due to accessible terrain along the Marble Canyon rim, signs, rock barriers, and fences have been put in place to define where not to drive and why. Inter-agency law enforcement has helped achieve compliance with vehicle activity restrictions. Livestock water has been relocated to prevent heavy livestock activity on the rim. Brady pincushion cactus is classed by width, rather than height. The objective for a healthy width size for all four plots of cactus is an average of 70 percent in the 0-15 mm size class and 30 percent in the 15-30+ mm size class. One plot, since establishment, has not had livestock influences on it. The other three are subject to livestock use (BLM 1994).

Welsh's milkweed, *Asclepias welshii* N & P Holmgren, is managed under a recovery plan implemented in 1992 (U.S. Fish and Wildlife Service 1992). This plant occurs in a widespread manner throughout the Paria Canyon-Vermilion Cliffs Wilderness, which contributes to the physical protection of the plant by not allowing off-road vehicle access. The Jones cyclad (*Cycladenia humilis* Benth. var. *jonesii* Welsh & Atwood) in Arizona is currently under neither a recovery nor a management plan. The Jones cyclad grows in the Chinle Formation (BLM 1999). This plant occurs on steep

slopes and it appears little threatened by livestock and off-road vehicles. The area is remote and it draws little attention from the public. However, efforts are underway to amend the Resource Management Plan for the public lands of the Arizona Strip to develop protective actions for this plant (BLM 1999).

Methods

The Brady and Siler pincushion cacti are monitored in square or rectangular plots. The plot sizes for each cactus are shown in Tables 1 and 2. Plot locations were selected using the following criteria: cactus, or other plants to be studied, are present in reasonable quantities, access is easy, and the location is in an area that shows the effects of land uses and man-induced mortality causes. All Brady and Siler pincushions are mapped and tagged at each plot. The Siler pincushion height is measured from the base of the plant to the tip of the spines at the top of the cactus; for the Brady pincushion only the width is recorded. One plot at Atkin Well is in a livestock enclosure and an adjacent plot is under the influence of livestock. The cacti are also evaluated for fruit production and mortalities and causes thereof (BLM 1987, 1994). The comparison of size classes for Brady pincushion cactus is made with a little difficulty because size classes were lumped differently in the 1980s than after 1994. The change was made because it was determined that at about the 15 mm size, the cactus begins to flower.

Welsh's milkweed is monitored by charting the plants on a map of the sand dune plot. The clump of milkweed is counted at each location, and then marked on the map with the number of plant stems, the number of stems with seed pods, and the number of seedlings. Plants are widely scattered and are easy to count (BLM 1999).

Jones cyclad is monitored in two 10 m x 10 m plots. All plants are counted, and those with follicles are counted separately. These plots occur on very steep slopes with fragile soils, so observers are prevented from marking each ramet, as working in the plot would destroy the plants. Counts are done until two consecutive counts come within a small difference of each other (BLM 1999).

Results

The size structure information given in Table 1 demonstrates that Siler pincushion cactus shifted to a large proportion of small cactus (young) from a predominantly larger size class in the 1980s. All

Table 1. *Pediocactus sileri* size structure.

Year	Height class (cm)	Number in height class	Percent in height class
Location: Yellowstone (size 30 x 45.5 m)			
1985	0-4.9	11	11%
	5-8.9	42	42%
	9-12.9	36	36%
	13-16.9	9	9%
	17+	2	2%
	Total cactus	100	
1998	0-4.9	79	60%
	5-8.9	44	34%
	9-12.9	8	6%
	13-16.9	0	0
	17+	0	0
	Total cactus	131	
Location: Atkin Well (Size of enclosure plot 444 x 360 x 330 x 468 ft; subplot 12 x 16 m. Outside plot 234 x 426 x 294 x 390 ft; subplot 17 x 17 m.) Numbers in parentheses are for enclosure cactus.			
1988	0-4.9	16 (6)	15% (8%)
	5-8.9	31 (17)	32% (22%)
	9-12.9	31 (23)	32% (29%)
	13-16.9	15 (20)	15% (29%)
	17+	4 (12)	5% (26%)
	Total cactus	96 (78)	
1997	0-4.9	42 (19)	57% (63%)
	5-8.9	8 (0)	11% (0)
	9-12.9	18 (11)	25% (37%)
	13-16.9	3 (0)	4% (0)
	17+	2 (0)	3% (0)
	Total cactus	73 (30)	
Location: Johnson Spring (Size subplot 1, 150 x 66 ft; subplot 2, 66 x 66 ft.)			
1989	0-4.9	39	71%
	5-8.9	15	27%
	9-12.9	1	2%
	13-16.9	0	0
	17+	0	0
	Total cactus	55	
1998	0-4.9	63	90%
	5-8.9	7	10%
	9-12.9	0	0
	13-16.9	0	0
	17+	0	0
	Total cactus	70	

Table 2. *Pediocactus bradyi* population structure.

Year	Width class (mm)	Number in size class	Percentage in size class
Location: Soap Creek Plot (Road closed in 1994; grazed by livestock.)			
1986	0-4.9	0	0%
	5-19.9	4	11%
	20-30.9	19	54%
	31+	12	35%
	Total cactus	35	
1998	0-15	25	19%
	15-30	91	70%
	31+	15	11%
	Total cactus	129	
Location: Badger Creek Plot (Road open to traffic; no grazing since 1980.)			
1988	0-4.9	0	0%
	5-10.9	11	15%
	11-20.9	18	26%
	21-30.9	32	46%
	31+	9	13%
Total cactus	70		
1998	0-15	119	78%
	15-30	33	22%
	31+	1	0
	Total cactus	153	
Location: North Canyon west and east plots (Remote from roads; grazing.)			
1988	0-4.9	0, 0	0%, 0%
	5-10.9	3, 0	9%, 0%
	11-20.9	3, 19	9%, 22%
	21-30.9	22, 50	66%, 58%
	31+	5, 17	16%, 20%
Total cactus	33, 86		
1998	0-15	19, 17	39%, 28%
	15-30	29, 41	59%, 69%
	31+	1, 1	2%, 2%
	Total cactus	49, 59	

plots for *Siler pincushion* have met their HMP objective for the 0-4.9 cm height class, which is to be at least 20 percent of the plot population. This is thought to be enough small and young plants to sustain the population. *Siler pincushion* plots now range from 60 to 90 percent for that size class. In the 1980s, only one of the three plot areas was above 20 percent for the 0-4.9 cm height class. Mortality data (not shown in the tables) reveal that the overwhelming majority of deaths of this cactus are from natural causes, mostly rabbits, old age,

and insects. This continues a pattern reported by the BLM (1991) and Hughes (1992). *Siler pincushion* was downlisted to threatened in 1994 as a result, in part, of the above data.

The Brady pincushion data (Table 2) are encouraging in that the Badger Creek plot has met the team-generated objective in the ACEC Management Plan of 70 percent in the 0-15 mm width class and 30 percent in the 15-30+ mm width class (BLM 1994). The Soap Creek and North Canyon plots have not met that objective, but have shown significant increases in the 0-15 mm class from what the 1984-1991 readings show. The 15-30 mm class continues to predominate in these two plots. This increase in young or small plants at Badger Creek may be a 1 year in 20 type of episode. The big increase occurred in 1995.

The Jones cyclad (Table 3) has been monitored since 1993. Little change occurs with this population except for the number of ramets. The higher number of ramets probably results from well-timed precipitation. The plant generally develops only a few follicles in any one year and observations by Sipes and Tepedino (1995) and Spence (1994) have shown that no sexual reproduction occurs in this plant. The plant population occupies similar acreage year to year and reproduces vegetatively.

The Welsh's milkweed plot (Table 4) in the Coyote Buttes area of the Paria Canyon-Vermilion Cliffs Wilderness is on a large dune. The milkweed, like all plants, has higher and lower numbers in accordance with precipitation. This plant does sexually reproduce and by monitoring later in the fall, seedlings can be observed. When monitoring began, it was done in the summer after flowering. Later, fall monitoring was found to produce more fruit and reproduction data.

Discussion

Do some of the above results indicate success for the planned actions prescribed in the management plans? Have actions such as closing roads on the Marble Canyon rim, convincing the public not to drive on the rim of Marble Canyon, or putting up the raptor poles in the *Siler pincushion* habitat, where rabbits and others harvest the cactus, had any visible or documentable effect yet?

Road Closures

The road adjacent to the Soap Creek plot has been closed to traffic since 1994; the Badger Creek plot continues to have an authorized, open to traffic road adjacent to it and the plot was vandalized

Table 3. *Cycladenia humilis* var. *Jonesii*.

Year	Plot no.	Ramets without follicles	Ramets with follicles	No. of follicles
1993	1	180	5	9
1993	2	206	21	32
1994	1	107	10	22
1994	2	220	0	0
1995	1	101	67	0
1995	2	99	146	0
1996	1	201	NC	3
1996	2	268	NC	0
1997	1	226	FNF	
1997	2	309	FNF	
1998	1	128	1	NC
1998	2	295	4	NC

NC = not counted
FNF = follicles not formed

Table 4. *Asclepias welshii*.

Year	Number of stems	Stems with pods	seedlings
1989	240	NO	NO
1990	566	NO	NO
1993	152	NO	NO
1995	143	32 Pods	NO
1996	68	96 Pods	NO
1997	121	45	4
1998	169	55	7

NO = not observed

in 1993; and the two North Canyon plots are remote from any road since the road to them was closed in 1994. The Soap Creek Brady pincushion data in Table 2 show that the 15–30 mm size cactus continues to dominate. Badger Creek plot data show more small cactus in the Badger Creek plot than the Soap Creek plot. The North Canyon plots are remote from any road and have data similar to the Soap Creek plot. In all probability, it is too early to detect the effects of the road closures on the biological reproduction of Brady pincushion cactus. The reduction or absence of off-road tracks has been observed in the closed areas since placement of educational signs to close the areas to off-road driving. No Brady pincushions have been driven over in the plots in the late 1990s. However, four new road starts into Brady habitat were closed by signs, fences, and rock barriers in cactus habitat in the late 1990s. Educational signs explaining the need to protect the Brady pincushion, as opposed to just closure signs, appear to have had a positive effect.

Welsh's milkweed occurs totally in designated wilderness and is therefore not vulnerable to off-road vehicles. The Jones cyclad occurs on very steep slopes in an area physically inaccessible to off-road vehicles.

Raptor Poles

Four raptor poles were placed in the Atkin Well allotment as part of the Siler pincushion cactus HMP to allow raptors more opportunity to prey on rabbits, which were consuming the Siler pincushion cactus. The poles were placed near a dense population of cacti at Atkin Well, which is where the high rabbit depredation took place. Table 5 shows cacti mortality from rabbit depredation before pole placement and after the 1989 pole placement. The enclosure had the highest mortalities by rabbits of all the Siler pincushion plots. The depredation of cactus by rabbits dropped in 1989 and remained low until 1997. That year, 16 Siler pincushions in the enclosure were eaten, which was about the same depredation level as prior to the raptor pole installation; however, the level dropped in the following years. The drop in cactus depredation thus could have been facilitated by the pole placement and the subsequent raptor use of the poles.

Livestock Trampling

Two livestock exclusion areas and corresponding livestock use areas have been established for Siler and Brady pincushion cactus. The Siler pincushion Atkin Well plots, where one plot is in an enclosure and one is outside the enclosure, have been followed since 1985. To date, there is small difference between cactus size structure in the enclosure and out of the enclosure (see Table 1).

Table 5. Rabbit-caused mortality at Atkin Well enclosure pole set-up in 1989.

Year	Mortality
1985	16
1987	22
1988	15
1989	1
1990	1
1991	1
1992	NO
1993	0
1994	0
1995	0
1996	0
1997	16
1998	0

NO = not observed

The Badger Creek plot for Brady pincushion occurs in an allotment pasture that for various reasons has not been grazed since the plot was established in 1984. The plot shows a dominant presence of small cactus (0–15 mm) as compared to the Soap Creek and North Canyon plots. This is the only time in the 15 years of monitoring that the small size cactus have shown such domination in any of the plots. This, however, may be a result of an episodic reproductive event and the structure may revert to a 15–30 mm size dominance after a few years. Spence (1993) did a 2-year study on Brady pincushion in 1992–93. His size data for both years showed a population dominated by larger cacti (mean size of almost 30 mm). This size structure has continued through 1997, the last year of data collection (John R. Spence, personal communication 1999). This part of Lees Ferry has not been grazed for an unknown number of years. I have worked in the area since 1977 and have never observed livestock there; it is not designated for grazing. If livestock were the factor in trampling young, small cactus, a small sized younger population would theoretically be predominant at the Lees Ferry plots. More than likely this might indicate that young cactus predominate after an episodic reproductive event, independent of livestock absence or presence.

Welsh's milkweed occurs in an area lightly used by livestock on the Paria Plateau; however, milkweed is not a palatable forage and is not used by cattle. Its habitat is a sand dune, which often is hard for cattle to traverse, so livestock use is very light where the milkweed occurs. No damage by livestock has been observed in this population.

Jones cyclad grows on the side slopes of two canyons just west of the Kaibab Piate Indian Reservation. The area is inaccessible in most places to livestock. In the years of doing monitoring, no cattle have been observed in the habitat.

Conclusion

The objectives and planned actions of the two management plans for the listed plants were generally to assure that enough reproduction was occurring to sustain a healthy population level. The Brady pincushion cactus has shifted slightly to the smaller, younger cactus (0–15 mm) from the 15–31+ mm size classes since the 1980s. This is a result of an apparently good germination year in 1996, when many small young cactus appeared. But the 15–31+ mm size class remains predominant in three of the four plots.

The Siler pincushion cactus populations have also shifted to the smaller, younger cactus in two of the three plot areas. Two of those plots were dominated in the 1980s and early 90s by the 5–16.9 cm size class. However, the Johnson Spring plot has always been dominated by younger and smaller cacti (the 0–4.9 cm class). This cactus has met the size class objectives for the 0–4.9 mm class of the 1987 HMP.

Welsh's milkweed had high numbers in 1990 with 566 plants counted, then dropped to 68 plants in 1996 and has since started to climb upward in number again. This population needs to be monitored for a few more years to better determine the trend and cycles of the plant.

Jones Cyclad seems not to reproduce sexually, and monitoring the number of ramets emerging seems the only indicator of trend. Judging from the numbers shown in Table 3, the number of ramets remains at strong levels during wet years, with fewer showing in dry years.

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