

Determining Habitat Potential and Surveying for Nine Rare Plant Species in South-Central Utah

DEBORAH J. CLARK and CHRISTINE M. GROEBNER

Bureau of Land Management, Richfield, Utah
Capitol Reef National Park, Torrey, Utah

Abstract: In south-central Utah, lands within and adjacent to Capitol Reef National Park contain populations of nine rare plant species. In an effort to enhance the combined knowledge about these species, the Bureau of Land Management, the USDA Forest Service, and the National Park Service signed an Interagency Agreement and hired an interagency biologist and field crew to conduct field surveys for each of these species. Eight of these species are federally listed and one is a candidate for listing. Survey efforts, beginning in 2000 and continuing through 2002, will satisfy the inventory requirements of the recovery plans and conservation agreement for the nine species. The geology of this area has created conditions that have allowed unique plant species to evolve. The nine target species tend to be restricted to specific geologic formations. Prior to the field season, habitat modeling using geologic formations, elevation, slope, aspect, and plant community associates will be done to predict potential habitat for each species. This information is overlain with known populations, and areas are selected for field surveys. This inventory information will be used to develop monitoring and habitat management protocols. Monitoring will also be an interagency effort with locations throughout the range and in places appropriate to answer the specific questions for each species.

In 2000, Capitol Reef National Park (CARE) received funding for a 3-year (through 2002) rare plant species inventory through the National Park Service (NPS). This funding enables CARE staff and an interagency biologist to collect critical data on several of the rarest plants occurring in and around the park.

The Bureau of Land Management (BLM), USDA Forest Service, Dixie National Forest (DNF), Fishlake National Forest (FNF), and CARE share management responsibilities for many of the same threatened, endangered and sensitive plant species (TE & S). To enable each of them to better manage their shared TE & S species, these agencies decided to create an interagency botany position and hire an employee to survey and monitor for these species throughout their ranges, regardless of agency boundaries. A BLM employee was hired for this position and was stationed at CARE to act as project leader. Through the interagency agreement, the agencies are able to pool funding in order to extend surveys onto federal lands adjacent to CARE. This has expanded the scope of the NPS project to include FNF, DNF, and BLM land around CARE.

Eight federally listed species and one candidate for federal listing were selected as the primary focus for this study: *Cycladenia humilis* var. *jonesii* (Jones cycladenia), *Erigeron maguirei* (Maguire's daisy), *Pediocactus despainii* (San Rafael

cactus), *Pediocactus winkleri* (Winklers cactus), *Sclerocactus wrightiae* (Wright's fishhook cactus), *Spiranthes diluvialis* (Ute ladies-tresses), *Townsendia aprica* (Last Chance townsendia), *Schoenocrambe barnebyi* (Barneby's reed-mustard), and *Gilia caespitosa* (Rabbit Valley gilia). An additional 18 sensitive species occur within the study area and are recorded when found during surveys. The Utah State Natural Heritage Division ranks these 18 species as global 1 or 2/state 1 or 2. This ranking is defined as both critically endangered throughout its range, with five or fewer occurrences known; and endangered throughout its range, imperiled globally or statewide because of rarity with only 6–20 known occurrences.

CARE is located in south-central Utah, in the Colorado Plateau region, 72 km (45 mi) west of Hanksville on U.S. Highway 24. It was established to protect the longest exposed monocline in North America and is approximately 97,000 ha (241,903 acres) in size. This wrinkle in the earth's crust runs about 160 km (100 mi) north to south and is named the Waterpocket Fold. Unique geological conditions in combination with the arid climate within the fold have created microhabitats that support more than 40 rare and endemic plant species. BLM and Forest Service lands border CARE, so these agencies also contain unique geology and the corresponding endemic plant species.

The park is primarily a backcountry park that receives about three-quarters of a million visitors each year. Many of these visitors hike the trails and backcountry, and many of these areas have rare plant populations within or adjacent to them. Therefore, information on the whereabouts of rare plants in these high-use areas and whether they are being affected by visitation is essential for park management. Three of the listed plant species occur in the northern portion of the park and on adjacent BLM lands, and are in active cattle grazing allotments. For these three species it is also essential for park and BLM management to know the whereabouts of these species and whether cattle grazing may affect them.

Species Backgrounds

Cycladenia humilis var. *jonesii* Welsh & Atwood (Apocynaceae) was listed as a federally threatened species by the U.S. Fish and Wildlife Service (FWS) on May 5, 1986. It is a herbaceous perennial 11–36 cm tall. The oval leaves are thick and fleshy, and are covered with a whitish waxy coating. Flowers are rose pink in color and have two forms depending on the population site; they may be large and broadly opening or smaller and narrowly opening. Flowering occurs from early May to early June. In flower this species cannot be confused with any other species; however, when only leaves are present, it is easily mistaken for *Asclepias cryptoceras* or *Astragalus asclepiadoides* (Heil 1987).

Erigeron maguirei Cronq. (Asteraceae) was listed by the FWS as endangered in 1985. This status was later revised to threatened on June 19, 1996. Maguire's daisy is a herbaceous perennial with sprawling to slightly erect stems. Basal leaves are 2–5 cm long and 3–8 mm wide and oblanceolate to spatulate with a rounded tip. Flowers are white with 12–20 rays. Flowering occurs from early June through late July.

Gilia caespitosa Gray (Polemoniaceae) is currently a candidate for federal listing under the FWS Endangered Species Act (ESA). The BLM, USDA Forest Service, FWS, and NPS wrote a conservation agreement and strategy for Rabbit Valley gilia (USDA Forest Service et al. 1996) that addresses protection measures designed to achieve long-term conservation of the species so that listing under the ESA would not be warranted. Rabbit Valley gilia is a long-lived perennial that grows in a cushion-like mound. Leaves and stems are covered with glandular hairs that become covered with grains of sand. Flowering stems are 3–8.5 cm tall. The bright red flowers are usually

solitary but there may be a few per cyme. Flowering occurs from May to July.

Pediocactus winkleri Heil and *Pediocactus despainii* Welsh & Goodrich (Cactaceae) are two very similar endemic cacti that occur only in Wayne and Emery counties in Utah. *Pediocactus despainii* Welsh & Goodrich was listed by the FWS as an endangered species on September 16, 1987 and *Pediocactus winkleri* Heil was listed as threatened on August 19, 1998. Both species are small, usually solitary cacti ranging from 3.8–6.8 cm tall and 2.7–9.5 cm wide. Tubercles lack central spines; radial spines are 1.5–4 mm long for *P. despainii* and 1.7–6 mm long for *P. winkleri*. Areoles are persistently white woolly, and elliptic for *P. winkleri* and wool is yellowish and typically caducous on *P. despainii*. Flowers are peach to yellowish pink. Slightly longer radial spines and caducous areole wool on *P. despainii* are the only distinguishing characters between these two species. They bloom between March and May.

These two closely related species of *Pediocactus* share the unusual habit of shrinking into the ground after blooming every year and remaining underground until the following spring. When temperatures rise in mid February or early March, and given adequate rainfall, the cacti emerge from just below the surface to flower. At this time they may reach about 2.5 cm in height. After flowering and before the summer heat (mid May to June), the cacti set seed and shrink back under the surface of the ground for another year. Field observations have noted that the plants shrink into the ground, forming a small depression that then fills in with windblown debris, making the cacti invisible until they emerge the following spring.

Schoenocrambe barnebyi Welsh & Atwood was listed as endangered by the FWS on January 14, 1992. Barneby's reed-mustard is a herbaceous perennial. Flower racemes have 2–28 flowers. Sepals are green to violet, with papery margins. Flowers are white to lavender with conspicuous purplish veins. Siliques are ascending to spreading. Flowering occurs from late April to mid June.

Sclerocactus wrightiae L. Benson was listed as endangered by the FWS on October 11, 1979. Wright's fishhook cactus is an obovoid to short-cylindrical shaped cacti. It typically grows as a single plant, but if damaged it will form clumps of stems. Tubercles are well developed with the areoles circular to elliptic. Juveniles have glabrous spines and 1–4 central spines; the lower one is hooked and usually 1–2 cm long. Adults have only one central hooked spine. There are 8–11 radial

spines spreading out from the aerole. Flowers are yellowish to white or pinkish. Short spine length, early flowering time, and small flower size help distinguish this species. The critical differentiating feature between *S. wrightiae* and *S. whipplei* (a closely related common species) is the number of leaf scales on the fruits. *S. wrightiae* has zero to two scales, and *S. whipplei* has five or more. Flowering occurs between March and May.

Spiranthes diluvialis Sheviak (*Spiranthes romanzoffiana* var. *diluvialis* (Sheviak) Welsh) was listed as threatened by the FWS on January 17, 1992. Ute ladies-tresses is an erect, slender plant ranging from 0.8 to 6 cm tall. Cauline leaves are 2–6 in number and greatly reduced above. Floral bracts are ovate to lance-attenuate and flowers are creamy white. Flowering occurs from June to September, depending on elevation. Ute ladies-tresses is similar to *S. romanzoffiana* var. *romanzoffiana*, but it differs in having short flowers that are broad at the base and strongly ascending.

Townsendia aprica Welsh & Reveal was listed as threatened by the FWS on August 21, 1985. Last Chance townsendia is a pulvinate-caespitose acaulescent perennial herb. Leaves are spatulate to oblanceolate, and strigose. Flower heads are sessile, usually submerged in the leaves. There are 13–21 yellow rays, 4–7 mm long, that are purplish dorsally. Flowering occurs in April and May.

Methods

The primary purposes of this project are to conduct intensive surveys for the target species on potential habitat within and adjacent to CARE; and to determine the potential for impact by visitor, recreational, or livestock use if possible.

Prior to beginning field surveys available information and location data on the nine target species was compiled. The study began during the 2000 field season when the interagency biologist mapped as many known locations of the target species as possible using a global positioning system (GPS). All known location data were then entered into the geographic information system (GIS) and overlaid with geologic formations, slope, aspect, and elevation to create a profile of potential habitat by species. In addition to accurately depicting known and potential habitats, this refined the range of the target species and helped resource managers plan how many people would be needed to accomplish the tasks. A field guide booklet containing detailed information and photographs or line drawings for the nine target species and 18 sensitive species was written to

assist the staff in learning each of the species.

After completing this initial work, field crews conducted surveys in potential habitat for the target species. By surveying from April through July when the majority of plants were in full bloom, crews ensured proper plant identification and increased survey accuracy. Surveys began in the early spring at lower elevations and as the season progressed the crew moved to higher elevations, thus ensuring proper search times for each species. Each area was surveyed both by walking wandering transects through all accessible areas and by using binoculars to search cliffs. The crews hiked established trails and other off-trail routes in CARE during the appropriate blooming time for each species. If a trail or route passed through potential habitat for two or more species and those species bloomed at different times, then those trails and routes were hiked multiple times to ensure that surveys were as thorough as possible for each species. For future reference, crews noted on maps all areas surveyed. Areas selected outside CARE for inventories this year were surveyed when the target species were expected to be in full bloom.

For each new occurrence of a species, crew members completed a modified version of the Utah Natural Heritage Division Site Visit Account Survey Form, took photographs, and mapped its location on 7.5' quadrangle maps. Wherever possible, a GPS was used to map the precise location of each new occurrence. All new localities will be entered into each agency's GIS along with a summary of data about the locality. This ensures long-term retrieval capabilities for future resource managers.

Results

Surveys were conducted by the interagency biologist employed by the BLM, a seasonal crew leader, and three seasonal crew members hired by CARE. If additional people were needed to survey specific areas, additional CARE Resources Division and Forest Service staff assisted. Surveys began on April 10 and continued through August 4, 2000. The field crew surveyed approximately 9,760 acres, and recorded 109 new site locations for 11 TE & S species. New locations for four of the primary targeted species were found and recorded. The remaining seven species recorded are sensitive species.

Calendar year 2000 was a very difficult year to survey for plants because it was extremely dry, following a dry year in 1999. Many of the plants

targeted for surveys either didn't bloom or if they did bloom it was for a short time period. To compensate for this, the crew moved to higher elevations sooner than originally planned and adjusted the list of species to look for the species that still came up and bloomed.

A preliminary review of the data showed that aspect and slope were not critical to selecting potential habitat areas to survey for most species. However, they are essential for selecting potential habitat for *Schoenrambe barnebyi*, which occurs only on steep, north-facing slopes in the Moenkopi Formation. Elevation or geologic formations were valuable in selecting survey areas for the target species. Tables 1 and 2 show the numbers of individuals (by species) by elevation and geology.

Erigeron maguirei most commonly occurs between 6,000 and 7,000 feet in elevation and only on Navajo Sandstone (see Table 2). *Gilia caespitosa* is another Navajo Sandstone endemic, with only one large population on Kayenta Sandstone. It is most numerous between 7,000 and 8,000 feet. The two species of *Pediocactus* were combined because they are so similar and occur in overlapping ranges.

They occur primarily in the Morrison Formation between 5,500 and 6,500 feet. Elevation and geological data compiled on *Sclerocactus wrightiae* and *Townsendia aprica* show that they are more uniformly scattered over a wide range of formations, *Sclerocactus* below 7,500 feet and *Townsendia* all above 6,000 feet in elevation. As mentioned above, *Schoenrambe barnebyi* is restricted to the Moenkopi Formation, primarily between 5,500 and 6,500 feet. Geologic formation data were not useful for *Spiranthes diluvialis* because it is restricted to riparian or wetland areas, regardless of formation. It was not found this year at any of the survey locations, but it was a very dry year with low water tables and this orchid is known to remain dormant for years. Additional surveys for it will be conducted next year. No data were gathered on *Cycladenia humilis* var. *jonesii* because its habitat will be surveyed in the next 2 years.

The habitat modeling information was very useful in selecting potential habitat areas to survey. Approximately 90 percent of areas selected for surveys in 2000 using the above information on elevation range and geologic formation contained

Table 1. Approximate number of individuals for each species by elevation (in feet).

Elevation	Erigeron	Gilia	Pedio-Cactus	Sclero-Cactus	Schoenrambe	Townsendia
4000-4500	0	0	0	110	0	0
4500-5000	0	0	160	450	0	0
5000-5500	100	25	350	440	30	0
5500-6000	400	45	1560	40	1200	0
6000-6500	1580	180	1650	75	710	140
6500-7000	3400	55	110	0	150	340
7000-7500	50	5470	0	250	0	260
7500-8000	170	3150	0	0	0	75
8000-8500	250	0	0	0	0	300

Table 2. Approximate number of individuals for each species by geologic formation.

Elevation	Erigeron	Gilia	Pedio-Cactus	Sclero-Cactus	Schoenrambe	Townsendia
Moenkopi			250		2090	75
Kayenta		3000				
Navajo	6900	5250				
Carmel			35	40		1270
Entrada			200	30		200
Curtis				380		20
Summerville			60	90		80
Morrison			2340	195		850
Dakota			420	125		
Mancos				135		280
Alluvium				110		145

sites with one or more of the target species. Associate plant species lists will be analyzed in conjunction with elevation and geologic formations to determine if this three-way combination increases accuracy in predicting potential habitat.

Findings by Species

Cycladenia humilis var. *jonesii* is restricted to gypsiferous clay or saline soils in the Summerville, Cutler, and Chinle formations. It is known from only a few scattered populations in south-central Utah and one near Pipe Springs, Arizona. Areas where Jones cycladenia persists tend to be sparsely vegetated to barren slopes between 1,340 and 2,000 m (4,400–6,600 ft) in elevation. This is a strongly rhizomatous species, so counting the number of above-ground stems doesn't give an accurate picture of individuals. The FWS (1985a) has recognized this feature and states that there are approximately 3,000 known "above-ground plants." This probably far outnumbers the actual number of individual plants. No work was done on this species in 2000, but surveys are planned for Jones cycladenia in 2001 and 2002.

Erigeron maguirei is restricted to decaying talus slopes or in cracks and crevices in Navajo Sandstone within Emery and Wayne counties, Utah. Surveys were focused in this formation in pinyon-juniper, ponderosa pine, and desert scrub communities on CARE, DNF and on FNF land. Prior to these surveys it was known to occur between 1,615 and 2,160 m (5,400–7,100 ft) in elevation (Van Buren and Harper 2000). As a result of this project, the elevation range has been extended to 2,650 m (8,680 ft) onto the FNF. These are the first recorded locations of Maguire's daisy on there. The recovery plan (U.S. Fish and Wildlife Service 1995a) for Maguire's daisy estimates 5,000 individual plants known from 33 locations, representing seven separate populations. To date, the field crew has located 17 new sites on CARE and FNF land containing approximately 4,400 individual plants.

Gilia caespitosa occurs primarily on the Navajo Formation although one large population has been found in the Kayenta Formation. It grows in cracks and crevices in sandstone cliffs or on talus slopes below these cliffs in pinyon-juniper woodland or mountain mahogany scrub between 1,740 and 2,740 m (5,700–9,000 ft). Rabbit Valley *gilia* occurs only in Wayne County, Utah on FNF, DNF, BLM, and CARE land. Prior to this survey there were 34 known locations containing approximately 8,200 individual plants. The largest known site is on the FNF in the Kayenta Formation, containing about

3,000 individuals. Surveys this year located two new sites in CARE containing approximately 50 individuals.

Pediocactus winkleri and *Pediocactus despainii* occur in Wayne and Emery counties in south-central Utah. Approximately two-thirds of the known populations of both species are located on lands administered by the BLM, and the rest occur within CARE or on state lands. Both species occur in desert scrub or open pinyon-juniper woodland communities, between 1,370 and 2,088 m (4,500 ft–6,850 ft). The BLM and CARE conducted an intensive 2-year study on these two species in 1998 and 1999 (Clark 1998, 1999). This project will focus on specific sites not completed during the earlier study; however, no sites were recorded on these species this year.

Sclerocactus wrightiae is found in Emery and Wayne counties, Utah in desert scrub or open pinyon-juniper woodland communities, between 1,460 and 1,860 m (4,800–6,100 ft) in elevation. This species occurs on numerous geologic formations and has a much wider distribution than other target species. The recovery plan (U.S. Fish and Wildlife Service 1985b) for Wright's fishhook cactus states that there are 13 locations in Emery and Wayne counties in Utah, without an estimate of the total number of individuals. One new site of *Sclerocactus wrightiae* was found in CARE.

Spiranthes diluvialis is found in moist soils along streambeds, in bogs, and in open seep areas in cottonwood, tamarisk, willow, and pinyon-juniper communities where vegetation is fairly open. Its distribution is much wider than any of the other targeted species, as it occurs in Utah, Colorado, Wyoming, Montana, Washington, and Nebraska. Ute ladies-tresses has a wide elevation range, from 1,340 to 2,130 m (4,400–7,000 ft). Extensive surveys were conducted this year on BLM, DNF, and CARE land, but no plants were found.

Schoenocrambe barnebyi is restricted to cool, north-facing, steep talus slopes in the Moenkopi Formation. It is associated with low desert scrub and pinyon-juniper communities between 1,705 and 1,985 m (5,590–6,510 ft). The recovery plan for Barneby reed-mustard (U.S. Fish and Wildlife Service 1994) estimates 2,000 total plants known from two locations, one in CARE and one on BLM land in the San Rafael Swell. No surveys were done for this species in 2000; however, select BLM areas will be targeted for surveys in 2001 and 2002.

Townsendia aprica occurs on a wider range of geologic formations than most of the other targeted species. It is found on fine-textured shale

soils in pinyon-juniper woodland between 1,860 and 2,440 m (6,100–8,000 ft). Its range consists of a long narrow band stretching north-south through Wayne, Sevier, and Emery counties in Utah. There are a few scattered locations east of this main cluster. The FWS (1993) stated in the recovery plan that there were 15 populations containing about 6,000 plants. Most populations occur on BLM, CARE, and FNF land. Surveys this year resulted in the discovery of 11 new Last Chance townsendia sites containing a total of approximately 650 individuals. Eight of these new locations are in CARE, one is on BLM land, one is on Utah state land, and one is on DNF land. The site recorded on the DNF is the first known record of this species there.

Discussion

Work accomplished during this field season resulted in the discovery and documentation of several new localities for most of the target species. Some of the target species were recorded for the first time on CARE and DNF land, confirming that more work needs to be done before these species' ranges and niches are completely understood. Individual species reports summarizing findings this year will be submitted to each agency (if the species is located on that agency's land), the Utah Natural Heritage Division, and the FWS. Preliminary habitat data modeling was extremely useful in selecting survey areas for seven of the nine target species. As more data are added to these models, the habitat niches and ranges of each of these species can be further refined.

The creation of an interagency crew for this project has proven beneficial to all participating agencies. There are numerous TE & S plant species whose distributions overlap agency jurisdictions, so it is to the mutual scientific and economic benefit of the agencies to manage these TE & S plant species cooperatively on an ecosystem basis. Field work is conducted throughout the range of each target species regardless of agency boundaries so a more accurate picture of the species is gained. Agencies can pool scarce funding for TE & S plant

species, so each agency gets more comprehensive information about each species, as well as increased services for each individual agency dollar spent.

Information gathered during this 3-year study enables the participating agencies to meet the legal requirements of the Endangered Species Act, comply with NPS, BLM, and USFS management policies, and address Government Performance and Results Act goals. Knowledge gained about these species and their specific habitat requirements will enable federal officials to ensure that these plants are protected and will assist in predicting which areas may contain additional occurrences. Results from this study will also help in determining which species should have monitoring plots to determine impacts.

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