

Reseeding Four Sensitive Plant Species in California and Nevada

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Abstract—The Kern River Gas Transmission pipeline was constructed in 1991 to supply natural gas to be used in the thermally enhanced recovery of crude oil in Kern County, California, as well as to distribute natural gas in Utah, Nevada, and southern California. Populations of nine sensitive plant species were observed during surveys conducted prior to construction of the pipeline. Mitigation measures for this project included avoidance of identified populations, and reseeded of Rusby's desert mallow (*Sphaeralcea rusbyi* ssp. *eremicola*), Parish's phacelia (*Phacelia parishii*), rosy twotone beardtongue (*Penstemon bicolor* ssp. *roseus*) and yellow twotone beardtongue (*Penstemon bicolor* ssp. *bicolor*). Revegetation success varied within species. The number of Parish's phacelia plants in 1992 that germinated in adjacent seeded and unseeded plots was 706 and 10, respectively. In 1993, the number of plants increased to 2,702 in the seeded plot and 245 plants in the non-seeded plot. During an inventory in 1992, 216 Rusby's desert mallow plants were observed in 73 of 128 standard seeded plots (57 percent), and 300 rosy twotone beardtongue plants were found in the 11 seeded plots.

The Kern River Gas Transmission pipeline (KRG T) was constructed in 1991 to deliver new supplies of natural gas to be used in the thermally enhanced recovery of heavy crude oil in Kern County, California, and also to distribute natural gas in Utah, Nevada, and southern California. The pipeline route extended from a point near Opal, Wyoming, through Utah and Nevada to Daggett, California. Total pipeline length was 596 miles, which included 119 miles in Nevada and 95 miles in California.

The Final Environmental Impact Report/Environmental Impact Statement (Chambers Group 1987) identified potential habitat for several rare plant species along the proposed pipeline route. Additional information regarding rare plants in Nevada and California was acquired during 1989 and 1990 field surveys (Dames & Moore 1990a, b). Those surveys followed a mitigation plan developed by Dames & Moore (1990c). Potential species of special concern included federal candidate species, state-listed species and species on the Northern Nevada Native Plant

Society (NNNPS) and California Native Plant Society (CNPS) lists of rare plants (United States Fish and Wildlife Service 1990; NNNPS 1989; Smith and Berg 1988). One sensitive plant species was found in April 1991, after construction began, and further mitigation measures were developed.

The objective of this paper is to document implementation of mitigation measures regarding reseeded of four taxa of sensitive plants along the Nevada and California portions of the Kern River pipeline route and the subsequent reestablishment of these sensitive populations.

Sensitive Plant Surveys and Mitigation Measures

During sensitive plant surveys conducted in 1989 and 1990 along the Kern River pipeline route in Nevada and California, populations of nine sensitive species were observed within the 200-foot wide survey corridor (Table 1). The pipeline was generally constructed in a 75-foot wide disturbance zone located within the survey corridor. These populations were described and mapped (Dames & Moore 1990a, b). Additional surveys were conducted in May 1991 to locate *Phacelia parishii*.

Mitigation measures for this project to facilitate reestablishment of sensitive plants included avoidance, minimization of disturbance to the extent practicable, salvage of topsoil, use of an imprinter during reclamation, and reseeded. Seedbank material, including seeds of sensitive plants saved along with the topsoil, assisted in reestablishment of rare plants. Similarly, the use of an imprinter aided in the retention of precipitation, which assisted the revegetation of both common and sensitive plants.

Active revegetation measures were evaluated for their appropriateness in reestablishing sensitive plants. The methods evaluated for potential use included reseeded of sensitive species, and transplanting bearclaw poppy (*Arcotomecon californica*). Mormon needle grass (*Stipa arida*) and scaly cloak fern (*Cheilanthes cochisensis*) plants were located at or adjacent to the 200-foot wide corridor, and avoidance of plants was considered more appropriate than reseeded. The same consideration applied for the annual species three corner milk vetch (*Astragalus geyeri* var. *triquetrus*) and sticky buckwheat (*Eriogonum viscidulum*) which were observed outside of the standard 75-foot-wide disturbance zone and work spaces. In anticipation of possible transplantation efforts, a permit to collect 50 bearclaw poppy plants was obtained from the Nevada Division of Forestry. However, because reseeded and transplanting

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Table 1—Sensitive plant species observed along the Kern River pipeline route, Nevada and California, 1989 to 1991.

Taxon name	Common name	Protection status
<i>Sphaeralcea rusbyi</i> ssp. <i>eremicola</i>	Rusby's desert mallow	C2, CNPS 1B
<i>Phacelia parishii</i>	Parish's phacelia	C2, CNPS 1B*
<i>Penstemon bicolor</i> ssp. <i>roseus</i>	Rosy twotone beardtongue	C2
<i>Penstemon bicolor</i> ssp. <i>bicolor</i>	Yellow twotone beardtongue	C2
<i>Stipa arida</i>	Mormon needle grass	CNPS 2
<i>Cheilanthes cochisensis</i>	Scaly cloak fern	CNPS 2
<i>Astragalus geyeri</i> var. <i>triquetrus</i>	Three corner milkvetch	C2, Nevada CE, NNNPS T
<i>Eriogonum viscidulum</i>	Sticky buckwheat	C2, Nevada CE, NNNPS T
<i>Arctomecon californica</i>	Bearclaw poppy	C2, Nevada CE, NNNPS T

*Currently reclassified to CNPS 2; CNPS = California Native Plant Society; NNNPS = Northern Nevada Native Plant Society.

of this species has not been successful in the past (Knight 1990), those methods were not implemented. The remaining four sensitive plant taxa were located within the pipeline zone and could not be avoided during construction of the pipeline. These species were Rusby's desert mallow (*Sphaeralcea rusbyi* sp. *eremicola*), Parish's phacelia (*Phacelia parishii*), rosy twotone beardtongue (*Penstemon bicolor* ssp. *roseus*) and yellow twotone beardtongue (*Penstemon bicolor* ssp. *bicolor*). Reseeding of these species appeared to be appropriate and the methods are described below.

Reseeding Methodology

Seed Collection and Storage

Reseeding efforts were accomplished for Rusby's desert mallow, Parish's phacelia, rosy twotone beardtongue, and yellow twotone beardtongue. Ripe seeds of Rusby's desert mallow were collected on 20-21 June, 1991. This species is located near Keany Pass on the east and west sides of the Clark Mountains, San Bernardino County, California, approximately 10 miles west of the Nevada/California border and Interstate 15. Seed collections for this species were segregated as east and west side samples to maintain local gene pools. Seed material for Parish's phacelia was collected on 21 May, 1991. Seeds were gathered from a larger population located less than one mile north of the population that intercepted the pipeline near the Manix Trail, approximately 12 miles northeast of Yermo, California. Collections of seeds of the two subspecies of twotone beardtongue were accomplished during July 1990, within and adjacent to locations along the proposed pipeline construction zone in which the subspecies were observed during the initial plant surveys. Rosy twotone beardtongue seeds were collected near Apex, Clark County, Nevada, at the intersection of the pipeline and State Highway 93. Yellow twotone beardtongue seeds were collected in a wash about 0.5 mile northeast of Wilson Tank in the Bird Spring Range, approximately 8 miles north of Goodsprings, Nevada.

Seeds of all taxa were air dried and stored at constant temperature (approximately 65 to 70 °F). Seed material of Rusby's desert mallow and Parish's phacelia was not cleaned and contained capsules, small leaves and some

stems, but seeds of the two subspecies of twotone beardtongue were cleaned by removing most of the extraneous plant matter.

Seed viability of the four taxa was tested by either the Ransom Seed Laboratory in Carpinteria, California, or the Colorado Seed Laboratory at Colorado State University in Fort Collins, Colorado. The following tests were performed to obtain the percentage of total live seed. Germination tests resulted in 1 to 2 percent germination within 21 days for Rusby's desert mallow seeds, and 0 to 6 percent within 14 days for Parish's phacelia seeds. The remaining seeds were treated with gibberellic acid and 5 to 50 percent of the seeds germinated (percent hard seed, as shown in Table 2). Ungerminated Parish's phacelia seeds were then evaluated for viability with tetrazolium. The two subspecies of twotone beardtongue were only tested with tetrazolium, resulting in 83 to 87 percent total live seed (Table 2).

Reseeding Rusby's Desert Mallow

Rusby's desert mallow, a perennial herb, was reseeded in late October and early November, 1991. Seventy-two reseeded plots (designated as E-1 through E-72) were placed in the disturbance zone on the east side of Keany Pass. Plots E-1 to E-8 were 6-foot diameter circles, and the remaining sites were 8 feet in diameter. Seven or eight plots each were placed within 10 of 11 drainages in that portion of the right-of-way. For the purpose of placing the sample plots, a drainage was defined as the area from hilltop to hilltop. West of Keany Pass, 52 plots were placed within approximately a one-mile stretch of pipeline (plots W-1 to W-52), and 5 plots were placed in the area of a disjunct population (plots W-53 to W-57) approximately 2.25 miles west of Keany Pass. Sample plots W-1 to W-20 were 8 feet in diameter, and the remaining plots each covered a 4-foot diameter circle. The 5 plots in the area of the disjunct population were placed on a west-facing slope; the other 52 sample plots were placed within 11 drainages on both east- and west-facing slopes. Each plot was marked with rebar and metal tags.

Because of pipe repair, the seed material in sample plots E-5 and E-8 was salvaged subsequent to reseeded. Topsoil and seed material were removed from those two sample sites in November 1991, and new plots were established 2 weeks

Table 2—Results of germination tests for seeds collected along the Kern River pipeline route in Nevada and California, 1991.

Species	Sample number	% Germination	% Hard seed	% Tetrazolium	% Total live seed
Rusby's desert mallow (east side)	#1	1	44	—	45
	#2	2	50	—	53
Rusby's desert mallow (west side)	#1	1	9	—	10
	#2	1	5	—	6
Parish's phacelia	#1	3	39	17	59
	#2	6	17	51	74
	#3	0	22	55	77
Rosy twotone beardtongue	#1	—	—	85	85
Yellow twotone beardtongue	#1	—	—	83	83
	#2	—	—	87	87

later. The soil was deposited within a new 4-foot diameter circular area in the vicinity of the old plot sites.

Each plot was raked prior to reseeding to loosen compacted soils. Seed material (0.5 ounce) was broadcast by hand in each sample plot and the ground was raked again to cover seeds with a small amount of soil. Seed material was estimated to contain approximately 1,190 Rusby's desert mallow seeds per 0.5 ounce. Thirty-six ounces of material were broadcast on the east side of Keany Pass, and 29 ounces on the west side. Overall, it was estimated that approximately 155,000 seeds were dispersed in the Clark Mountain area.

Reseeding Parish's Phacelia

Before reseeding the annual Parish's phacelia, special preparation of the reseeding plot was implemented. This species generally grows on desert alkaline flats, specifically in desiccation cracks of thick clay accumulations. A reseeding plot of 270 by 30 feet was chosen on the spoilsides of the pipeline within the 75-foot wide disturbance zone. The plot was sprayed with 4,000 gallons of water on 3 December, 1991. Then the site was allowed to dry and crack. An equally large unwatered control plot was chosen on the worksides of the pipeline within the disturbance zone. After 2 weeks, the soil had dried and cracked and the habitat of the reseeding plot approached nearly natural conditions. Transects were walked width-wise, and the seed material was evenly broadcast in 25 subsamples. Seeds were distributed for an additional 10 feet beyond the disturbed area, to compensate for depletion of plants during seed collection. It was estimated that approximately 1,300,000 Parish's phacelia seeds were broadcast during reseeding. The plot was marked with rebar and metal tags. To reduce motor vehicle travel through the plot, orange wooden stakes were placed across the width of the plot.

Reseeding Twotone Beardtongue

Reseeding of the two perennial subspecies of twotone beardtongue was accomplished in early November 1991. Reseeding areas were selected according to the general location of collection to maintain local gene pools. In addition,

existing populations were located near the pipeline before reseeding within the disturbance zone.

Rosy twotone beardtongue was reseeded near the intersection of the pipeline and Highway 93. Five sites were chosen within the 0.5-mile stretch west of the highway. Seeds were dispersed within 11 three-foot diameter subplots. At Site 1, which is located at the greatest distance from the highway, 1 subplot was established at the southern edge of the pipeline disturbance. Site 2 was established in a prominent wash approximately 0.4 miles from the highway. Three subplots were placed across the disturbance zone, with additional plots east of the wash. One subplot each was placed at the northern edge of the pipeline disturbance at Sites 3 and 4, located approximately 2,000 and 1,800 feet from the highway, respectively. Site 5 consisted of 2 subplots at the northern edge of the disturbance zone and a broad wash adjacent to Highway 93. Approximately 30,600 rosy twotone beardtongue seeds were broadcast in the 11 subplots.

Yellow twotone beardtongue was reseeded in a small wash dissecting the disturbance zone approximately 0.5 miles northeast of Wilson Tank in the Bird Spring Range. An approximately 115-by-53-foot plot was established and marked at the corners. The equivalent of 45 subplots of 9 to 16 square feet was established within the large plot. Individual subplots were raked and a small amount of seed was spread within the subplot. The subplots were then raked to cover the seed. Approximately 17,400 seeds were broadcast.

Reseeding Results

Reseeding success was evaluated by inventorying plant establishment the first season after reseeding activities. One species was evaluated for a second season. The survey methods and the results of reestablishment of each species are described below.

Rusby's Desert Mallow

The 57 plots located on the west side of the Clark Mountains were inventoried on 21 June and 9 August, 1992.

Table 3—Results of follow-up surveys of Rusby’s desert mallow, Clark Mountains, San Bernardino County, California, June, August 1992.

	Side of Keaney Pass			
	Standard plot		Expanded plot	
	East	West	East	West
Plots surveyed	71	57	71	57
Total plants observed	69	147	84	237
Plants/Plot	1.0	2.6	1.2	4.5
Frequency (%)	46	70	46	72
Density (plants/100 ft ²)	2.0	3.8	—	—

Seventy-one of 72 plots on the east side of the Clark Mountains were inventoried on 20 June, 1992. Locations of these plots were identified by markers that had been installed during reseeding. The boundaries of the plots were determined by observing the rake marks that were still discernible, and by measuring from the center stake. Plot E-5 was not found during the inventory.

Many Rusby’s desert mallow plants were observed, sometimes in greater densities in areas adjacent to the reseeded plots. It was speculated that seeds were transported outside of the reseeded plots by wind and rain erosion of the seedbed. As a result, counts were made in the original reseeded plot as well as in an expanded plot of approximately 40 feet in diameter.

The total number of plants counted in the original plots was 69 plants on the east side of the Clark Mountains and 147 plants on the west side (Table 3). The east-side plots contained an average of 1.0 plants, and 33 of the 71 plots contained at least 1 plant. The average number of plants per plot of the west side was 2.6 plants. Growth of at least 1 plant occurred in 40 of 57 plots. The average densities of plants in the east side and west side plots were 2.0 per 100 square feet and 3.8 per 100 square feet, respectively.

In the expanded plots, 84 plants were counted on the east side of the Clark Mountains and 237 plants on the west side. The average number of plants per plot was 1.2 (east) and 4.5 (west), respectively. The number of plots that contained at least 1 plant was almost the same as in the original plots, as shown in Table 3. Frequency of the original and expanded plots was 46 percent in the east side plots, and 70 and 72 percent on the west side.

Parish’s Phacelia

Reestablishment of Parish’s phacelia was evaluated on 18 April, 1992, and during April 1993. In addition to the reseeded plot, two additional plots were inventoried as control sites. One control site was located within the disturbance zone of the pipeline; it had not been reseeded in 1991. The other control plot was located in an undisturbed area outside the disturbance zone. Each plot measured 270 by 30 feet. The number of Parish’s phacelia plants observed in each plot was counted. The first year after reseeding, 706 Parish’s phacelia had germinated in the reseeded plot, and only 2 plants in the control plot within the disturbance zone (Table 4). In the adjacent non-reseeded plot, a total of 10 plants was found. In 1993, approximately 2,702 plants were found in the reseeded plot, which represented a density of 33.4 per 100 square feet. In the non-reseeding plots in and adjacent to the disturbance zone, 245 plants and 1,014 plants were counted, respectively.

Rosy Twotone Beardtongue

The 5 reseeding sites were inventoried on 6 October, 1992. Locations of the plots were identified by markers that had been installed during reseeding activities. Although many of the sites had been disturbed by off-road vehicle traffic, 10 of the 11 subplots contained small plants, ranging from 3 to 68 per subplot (Table 5), with a total of 300 plants. In the following year, no counts were made. However, cursory observation indicated that plants were flowering and covered the entire surface of one three-foot diameter subplot. Other subplots were less prolific.

Yellow Twotone Beardtongue

During the October 1992 inventory, the reseeding plot and surrounding area contained a moderate to dense cover of species of a wild horse seed mix, including *Penstemon* sp. seedlings. Subsequent to the sensitive species reseeding effort in 1991, the pipeline disturbance zone in that area was reseeded with a different seed mixture. The second reseeding effort was completed at the request of the Bureau of Land Management with the objective of enhancing the wild horse habitat in that area. The yellow twotone beardtongue reseeding area was included in the second reseeding effort. The wild horse seed mix contained Palmer’s

Table 4—Results of follow-up surveys of Parish’s phacelia, San Bernardino County, California, April 1992 and April 1993.

	Within disturbance zone		Adjacent to disturbance zone
	Reseeded	Non-reseeded	Non-reseeded
1992			
Number of plants	706	2	10
Density (plants/100 ft ²)	8.7	<0.1	0.1
1993			
Number of Plants	2,702	245	1,014
Density (plants/100 ft ²)	33.4	3.0	12.5

Table 5—Results of follow-up surveys of rosy twotone beardtongue, Clark County, Nevada, October 1992.

Site	Number of subplots	Number of plants observed/subplot
1	1	45
2	6	0-45
3	1	55
4	1	68
5	2	3-26
Total	11	300

penstemon (*Penstemon palmeri*). Yellow twotone beardtongue could not be distinguished from Palmer’s penstemon at this morphological stage, and reseeding efforts were not determined.

Discussion and Conclusions

Review of this project indicated successful mitigation for impacts to sensitive plant species. Avoidance and minimization of disturbance zones is still considered the preferred method, but active revegetation in the form of reseeding can be an effective mitigation alternative for some species if avoidance is not possible.

Early planning is important for successful reestablishment of sensitive plant species. Several points need to be considered. These are: site analysis of habitat prior to disturbance; biotic and physical requirements of each taxon; optimal time for seed collection; specific site preparation to create an environment favorable for reestablishment; and developing methods of monitoring.

Reseeding of Rusby’s desert mallow required no specific seedbed preparation. This species appears to be adapted to disturbed areas; many of the seeds collected came from plants found on old powerline spur roads. Other factors, however, may have influenced the difference in reestablishment between the east and west populations (2.0 plants versus 3.8 plants per 100 square feet, respectively). Specifically, the one-time seed collection was apparently suboptimal. Seeds appeared to be at a late stage of seed dispersal; the west side population was further advanced than the east side population. In addition, the east side material contained 50 percent hard seeds compared to 10 percent in the west side population. Since afterripening may break dormancy over time (Young and Young 1986), a second year of monitoring may have been beneficial. Also, seed collections should have occurred over a period of time to obtain high quality seeds.

Some species require special methods for seedbed preparation. For instance, the disturbance zone was graded and leveled at the end of construction. Parish’s phacelia specifically grows in desiccation cracks of thick clay accumulations,

and re-creating this microenvironment was critical for reestablishment. Because rain is unpredictable in desert environments, application of 4,000 gallons of water was essential for re-creating desiccation cracks. During the second year after reseeding, natural seed dispersal and subsequent rains to create desiccation cracks in the control plots apparently increased seed germination in both the reseeding and control plots.

Frequently, provisions are not made for monitoring the success of reestablishment projects, for both sensitive and common species. Hall (1987) reported that 7 of 15 mitigation projects failed because of lack of maintenance and monitoring. No monitoring was required for this project, neither of the sensitive plant taxa nor of the imprinting success and natural revegetation of the common species. Monitoring the reseeding results of these four taxa was only due to a voluntary effort of the authors. Valuable information could be gained from revegetation projects, if monitoring the success rate would be a condition of project approvals by the responsible governmental agencies.

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