

into remote areas by the BLM and the Los Padres National Forest, as well as routine surveys at the NPR-1 and NPR-2, resulted in the discovery of many new occurrences (an occurrence is analogous to a population and is defined here as a cluster of plants separated from the nearest cluster by at least 0.25 mile) of *E. hooveri*. Through a section 7 consultation with the Service, the U.S. Department of Energy conducted periodic monitoring of six representative *E. hooveri* sites from the early to mid 1990s (EG&G 1994, 1996). Responses to precipitation patterns on north and south slopes and ridgetops were documented (EG&G 1996), and increased attention was focused on observations of and research into the plants' response to various levels of habitat disturbance. The pertinent recovery planning and implementation efforts, along with their results, are summarized below.

Surveys

Abundance: The results of the 1986 status survey, which led to the *Eriastrum hooveri* listing, reflected its known distribution at the time, but did not reflect the species' larger distribution documented after 1990, probably as a consequence of the drought period and the resulting poor growing *E. hooveri* conditions during the two years preceding the survey (EG&G 1995a). Surveys by Federal agencies following the listing of the species in 1990 coincided with a change in precipitation, particularly in 1993, when abundant spring rainfall created favorable growing conditions for annual plants (EG&G 1994, 1995b). The favorable growing conditions along with the surveys resulted in a dramatic increase in the number of *E. hooveri* known populations, the size of its topographical and elevational range distribution, and a clearer understanding of its habitat associations.

Distribution: In 1992 and 1994, BLM staff surveyed private and public lands and estimated that about 1,000 *Eriastrum hooveri* sites occupied approximately 970 ha (2,426 ac) (BLM 1992, 1994). By 1998, the U.S. Department of Energy had comprehensively surveyed over 60 percent of NPR-1 for *E. hooveri*, and over 400 locations were documented; in addition, the species was also discovered on NPR-2 (Brian Cypher, Enterprise Advisory Services, Inc., pers. comm. 1998; Russ Lewis, BLM, pers. comm. 2002; Jay Hinshaw, Bureau of Indian Affairs, pers. comm. 2003).

Range: Surveys for another plant species at 820 to 910 m (2,700 to 3,000

ft) elevation in the Los Padres National Forest in 1993 led to the discovery of three populations of *Eriastrum hooveri* in Tension Canyon, Goode Canyon, and Castro Canyon (Danielsen *et al.* 1994). These populations were 800 m (500 ft) higher in elevation than all other known populations, and the first to be located in habitat dominated by juniper. In 1998, Boyd and Porter (1999) found *E. hooveri* in two locations southeast of the Tehachapi Mountains within Antelope Valley, Los Angeles County. These occurrences in the Mojave Desert represent an extension of the range of the species by approximately 140 km (87 mi) to the southeast from the nearest population in the San Joaquin Valley. Additional surveys in the Antelope Valley, conducted through 2002, documented numerous occurrences of *E. hooveri* from near Rosamond, in Kern County, and south to Lancaster, in Los Angeles County. In 2003, 7 to 12 million plants, roughly distributed over a 100-square-mi area, were also found near Edwards Air Force Base (Ray Bransfield, USFWS, pers. comm. 2003; Patrick Buorsier, H.T. Harvey and Associates, pers. comm. 2003).

In summary, surveys have resulted in the discovery of many more valley floor sites as well as foothill sites, and have shown that *Eriastrum hooveri* populations discontinuously range in the north from the Ciervo/Panoche area of the San Joaquin Valley in Fresno and San Benito Counties, southward to Antelope Valley in Los Angeles County, a distance of approximately 314 km (196 mi). A total of 1,128 new sites have been found on BLM land. Along with the increase in the number of sites, the distribution and range of *E. hooveri* has increased. *E. hooveri* has been confirmed at elevations of 3,000 ft and has been found to occur in two additional habitat types: Juniper woodland and Mojave Desert. The species has a greater abundance, distribution, and range than previously thought.

Research

At the time of listing, *Eriastrum hooveri* was identified as preferring areas with lower annual plant densities and stable, silty to sandy soils that often exhibit cryptogamic crusting (a thin microbial layer at the soil surface generally composed of a complex of mosses, algae, bacteria, fungi, and lichens, or a combination of these) (55 FR 29361). Since listing, *E. hooveri* has also been found on stable soils that do not exhibit crusting (BLM 1994), and on sandy loam and loamy soils (EG&G 1995a). Research results in 1994 documented that vascular plant cover at

sites with *E. hooveri* ranged from a low of 5% to a high of 93%; the amount of bare ground varied between 5% and 90%, and the amount of cryptogamic crusting varied between 0% and 80% (EGG 1995b). The wide-ranging values in plant cover and bare ground for sites with *E. hooveri* indicate that, although this species does better in sparsely vegetated areas, it is found in areas of dense vegetation (E. Cypher, pers. comm. 2003). A 1995 report by EG&G documented *E. hooveri* responses to varying rainfall and found that this species, like most annual species, appears to be sensitive to changes in precipitation compared to the shrub and grass components of the community (EG&G 1996). Soils with cryptogamic crusts are naturally open surface areas where nonnative grasses do not seem to encroach (Lewis pers. comm. 1995). The association that *E. hooveri* has with cryptogamic crusting may be more related to lower annual plant densities (especially lower numbers of nonnative grasses) than to an affinity with some aspect of the crusting. Areas of crusting are found throughout the species' range (R. Lewis pers. comm. 1995), and although ground disturbance will eliminate the crusting, the complex of mosses, algae, and other cryptogamic organisms that compose the crust have been observed to come back two years after ground disturbance (Holmstead and Anderson 1998) in areas where *E. hooveri* is found.

During above-average annual rainfall periods, *Eriastrum hooveri* responds quickly and well (successful seed germination, larger plants, and a higher probability of being detected during surveys), whereas during years of below-average annual rainfall, plants that germinate reach a height of only 1 in and are less likely to be detected during surveys (Ellen Cypher, Endangered Species Recovery Program, pers. comm. 2003; Jay Hinshaw, Bureau of Indian Affairs, pers. comm. 2003).

In 1995, EG&G reported that ground disturbance did not significantly affect *Eriastrum hooveri* and that the species was found as abundantly on disturbed sites as on undisturbed sites (EG&G 1995a). The average *E. hooveri* density was higher on sites where mechanical ground disturbance (typical of oilfield development) was observed, and lower on sites where other types of disturbance (by grazing, alluvial deposit, fire, unknown) were observed (EG&G 1995a). Furthermore, a study on the effects of simulated oilfield disturbance and top soil salvage showed that, although surface disturbance negatively affected *E. hooveri* density for at least two years, this species