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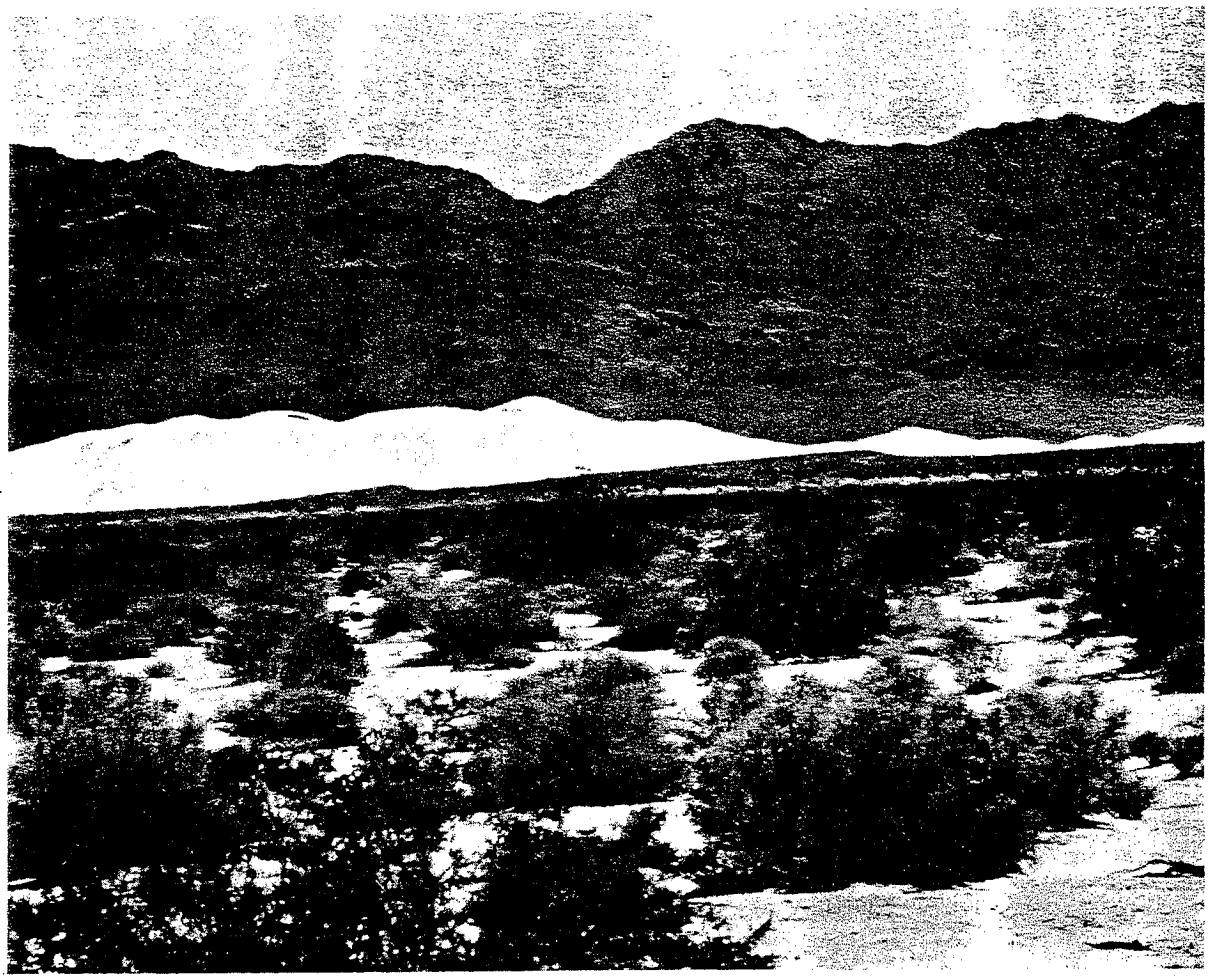

EUREKA VALLEY DUNES

Recovery Plan

EUREKA VALLEY DUNES RECOVERY PLAN

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December 13, 1982
Date

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EUREKA VALLEY DUNES RECOVERY PLAN

PART I

INTRODUCTION

Two federally listed Endangered Species (43 FR 17910-17916, April 26, 1978) endemic to the sand dunes in Eureka Valley, Inyo County, California, are the subject of this plan. These are the Eureka Valley dunegrass (*Swallenia alexandrae*) and the Eureka Valley evening-primrose (*Oenothera avita* ssp. *eurekensis*). Severely limited in range, these plants grow only in the sand dune habitats of Eureka Valley. They are components of an extremely rich ecological unit, the major part of which is centered around a ridge of sand nearly 210 m (700 feet) high and 3 miles long. This massive dune system is known as the Eureka Dunes.

EUREKA VALLEY DUNEGRASS (*SWALLENIA ALEXANDRAE*, POACEAE)

The Eureka Valley dunegrass, belonging to the monotypic genus *Swallenia*, was discovered by Annie Alexander in May 1949. She and Louise Kellogg were on a collecting expedition in that remote part of eastern California when she found a coarse grass apparently unknown to science. It was referred to Jason R. Swallen at the U.S. National Herbarium who considered it hither to undescribed genus and named it *Ectosperma alexandrae*. In 1963 it was found that the same generic

Figure 1. Eureka Valley dunegrass (Swallenia alexandrae). Close-up of flowering culms.

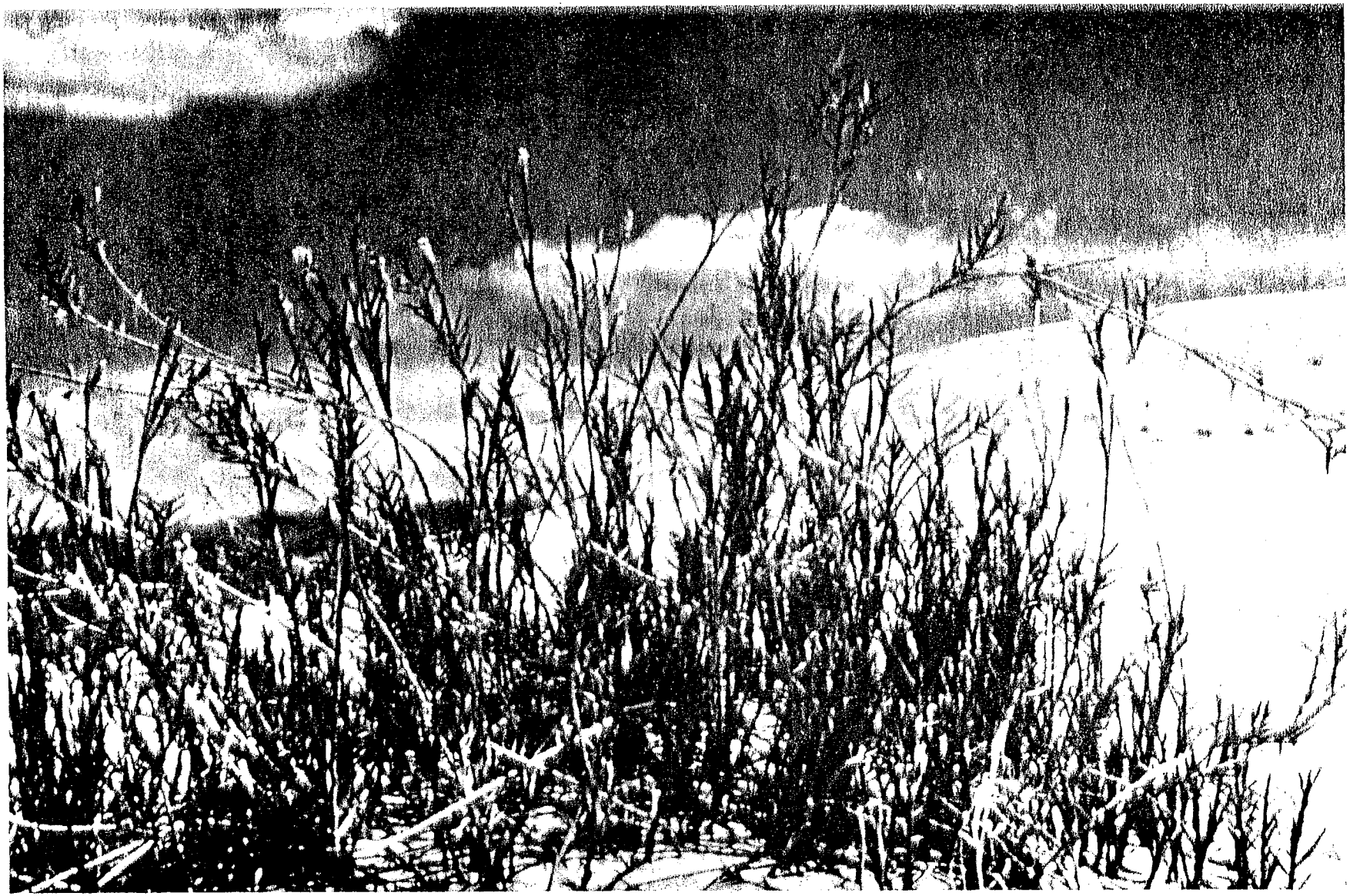

Figure 2. Habit and growth form of the dunegrass (Swallenia alexandrae).

name had been used in 1803 for a group of green algae, consequently the grass was renamed Swallenia alexandrae by Soderstrom and Decker (Pavlik, 1979a, 1979b). Its exact phylogenetic relationship to other grasses is yet to be determined.

At the present time only four populations are known, all in southern Eureka Valley growing in relatively deep sand at the sites listed on pages 10-14. By far the largest and most vigorous population is found on the massive north ridge of the Eureka Dunes where this species grows from the base of the dunes to within 50 m (150 feet) of the crest. The grass forms large clumps that enlarge as the sand is stabilized over and around them. These clumps may spread as new culms (stems) grow from those that have been buried. The culms, which root at the leaf nodes, are thus superbly adapted to the shifting sand environment of the dunes.

The grass is a coarse perennial, with flowering culms 1.5 to 10 dm tall, and stiff, lanceolate leaves; the pungently tipped leaf blades are 2.5 to 12 cm long. The panicles, which develop from April to June, are 5 to 10 cm long (phenological details of the dunegrass and primrose and two associates are presented in figure 3 and table 1). The grass is visually distinctive with an appearance unlike any other in the region. The steep dune slopes dotted with dunegrass hummocks are unusual among desert dunes. Few other perennial dune species become established in pure sand to such heights. Panicum urvilleanum at Kelso Dunes in California, also reaches as high or higher than the Swallenia.)

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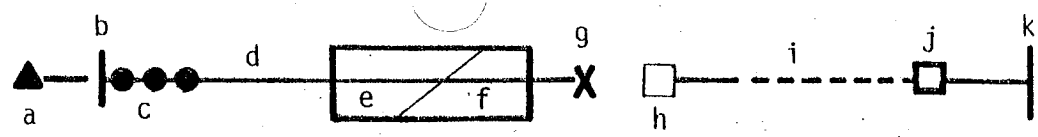


a-Germination; b-Growth begins; c-Rosette stage; d-Stem and leaf growth; e-Flowering; f-Fruiting and dispersal; g-Leaf abscission; h-New foliage; i-Lack of data; j-Death; k-Dormancy

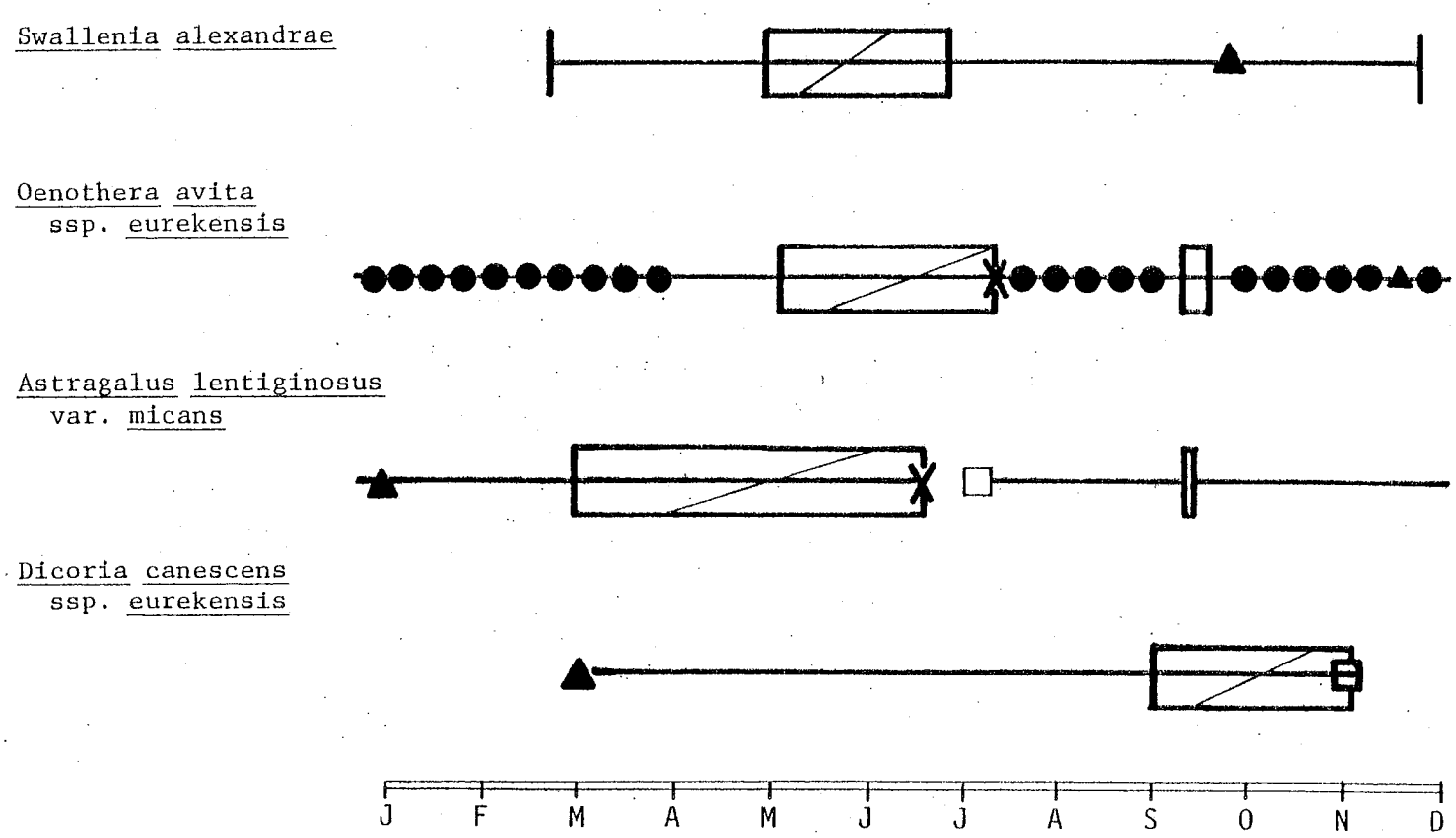


Figure 3. Phenology of the Eureka Valley dunegrass and evening-primrose and two dune associates, 1978. Adapted from Pavlik (1979 a).

Table 1. Phenological details of the Eureka Valley dunegrass and evening-primrose and two dune associates, 1978-1979. Adapted from Pavlik (1979 b).

	Feb. 1978	March	May	June	July
Swallenia alexandrae	growth of new shoots begins	new shoots 4-5 cm long; 1-4 leaves per apex	growth accelerates; shoots 15-25 cm long; flowers present on fertile culms; seed	shoot growth continues; seed matures, some seed dispersed	shoot growth continues; seeds mostly dispersed; a few shoots senescent
Oenothera avita ssp. *eurekensis*	plants in rosette stage	plants in rosette stage, many are 10-12 cm in diameter	plants have bolted; many in flower, some with fruit	shoot growth; some capsules open with seed released	some individuals vegetatively and reproductively vigorous; others are senescent or persistent as rosettes
Astragalus lentiginosus var. *micans*	shoot growth, floral initiation	leaves dense on shoots, flowers are profuse	plants have bolted, so foliage appears less dense; fruit	fruit and seed mature and dispersed; foliage begins to senesce	some plants die back, others produce new leafy shoots; fruits buried by moving sand
Dicoria canescens ssp. *clarkae*	seed germination?	seedling at cotyledon stage	plants approximately 12 cm tall, 6-12 leaves	some plants 30 cm tall, well branched	many plants 30-40 cm tall, becoming woody at base

EUREKA VALLEY EVENING-PRIMROSE

(*OENOTHERA AVITA* SSP. *EUREKENSIS*, ONAGRACEAE)

The Eureka Valley evening-primrose was collected by Phillip A. Munz and John C. Roos in 1954. Like the dunegrass, it too, has been the subject of considerable study to determine the most appropriate classification for its unique combination of characteristics. It too is a perennial that is well-adapted to unstable shifting sands, maintaining itself by developing new rosettes from the nodes of buried stems. Although closely tied to the dune systems of Eureka Valley, it does not occur upon the dune slopes. Its principal habitat is on the shallower sand bordering the dunes, often well away from the slopes. The most extensive population is east of the large ridge of the Eureka Dunes. During favorable years, the sandy border there is dotted with white blooms that extend for perhaps half a mile. Elsewhere the plants are more scattered but fairly frequent. At the Eureka Dunes, evening-primrose plants to the north and west of the high ridge were severely impacted by ORV activities. Although data were not gathered prior to the Bureau of Land Management's closure of the area in 1976, it was noted that there were substantially fewer evening-primroses by the closure date than previously. Being vespertine, the evening-primrose is at its best in the evening and early morning hours when its fragile white flowers are fresh and fully open (phenological details are shown in figure 3 and table 1).

Figure 4. Close-up of the Eureka Valley evening-primrose (Oenothera avita ssp. eurekensis).

LOCATION AND PHYSIOGRAPHY

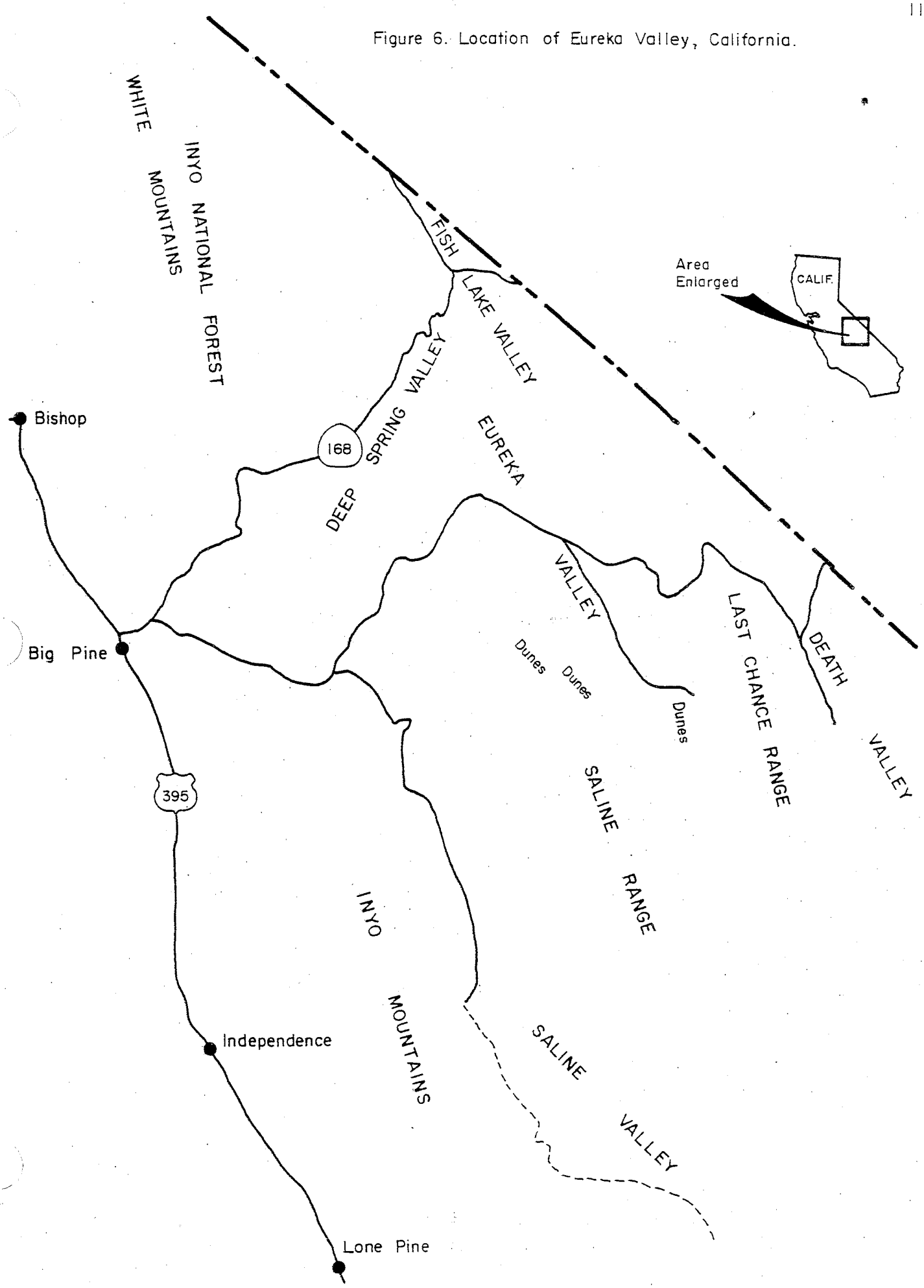
Eureka Valley is located in eastern California, in Inyo County, approximately 25 air-miles east of Big Pine (figure 6). Its boundaries are the Inyo Mountains to the north and west, the Saline Range to the south, and the Last Chance Mountains to the east. It is effectively isolated by its remoteness and limited access. Most of the traffic on the 50 miles of paved and improved roads from State Route 395 (Big Pine) is for recreational purposes in Eureka Valley or Death Valley further on the east. Some use of the improved access roads is associated with the area's mining activities.

Elevations on the valley floor range between 900 and 1,200 m (2,900 and 4,000 feet). The mountains rimming the southern and southeastern part of the valley, which are included in this management plan, are largely calcareous and include Cambrian dolomite and often exceed 220 m (7,200 ft) in elevation. Much of the Saline Range is overlain with volcanic rock. The rugged canyons and varied colors of the canyon walls add much to the scenic value, besides providing habitats for other endemic plants of the region. Rare springs or seeps occur high on the mountain rims. Those on the wall of the Last Chance Mountains east of the Eureka Dunes support bighorn sheep and a few dwarf ash (*Fraxinus anomala*) but may hardly be called true riparian habitat.

The valley floor is composed of alluvial material cut by washes that drain toward a playa in the southeast portion. Normally the playa is

Figure 5. Sunrise over the Eureka Dunes with the Last Chance Mountains in the background.

Figure 6. Location of Eureka Valley, California.



dry but during times of heavy runoff it becomes a shallow lake reflecting the mountains and sky. Nonetheless, the valley is essentially a waterless basin.

The large system known as the Eureka Dunes is located east and southeast of the playa, occupying the southeast bulge of Eureka Valley (see Figure 7). The dunes parallel the western wall of the Last Chance Range. Other sand deposits that support colonies of the dunegrass and evening-primrose occur where northerly spurs of the Saline Range provide barriers to the prevailing winds. These will be described in more detail later in the text.

Evidence of a Pleistocene lake can be seen at the Eureka Dunes, especially on the north and east side and in low places within the dune system. The outer rim of this lake is well defined by layered clay deposits indicating fluctuating water levels in the past. Occasional remnants of ancient landscapes show up between water courses on the alluvial fans. These landscapes are smooth surfaces of desert pavement. Cloudburst channels (deep gullies emerging from some of the canyons) are formed by runoff from thunderstorms.

ASSOCIATED SPECIES

Eureka Valley and its surrounding mountains fall within the Inyo Floristic Region (Stebbins and Major, 1965). It was described by Raven and Axelrod (1978) as "the richest and most interesting in

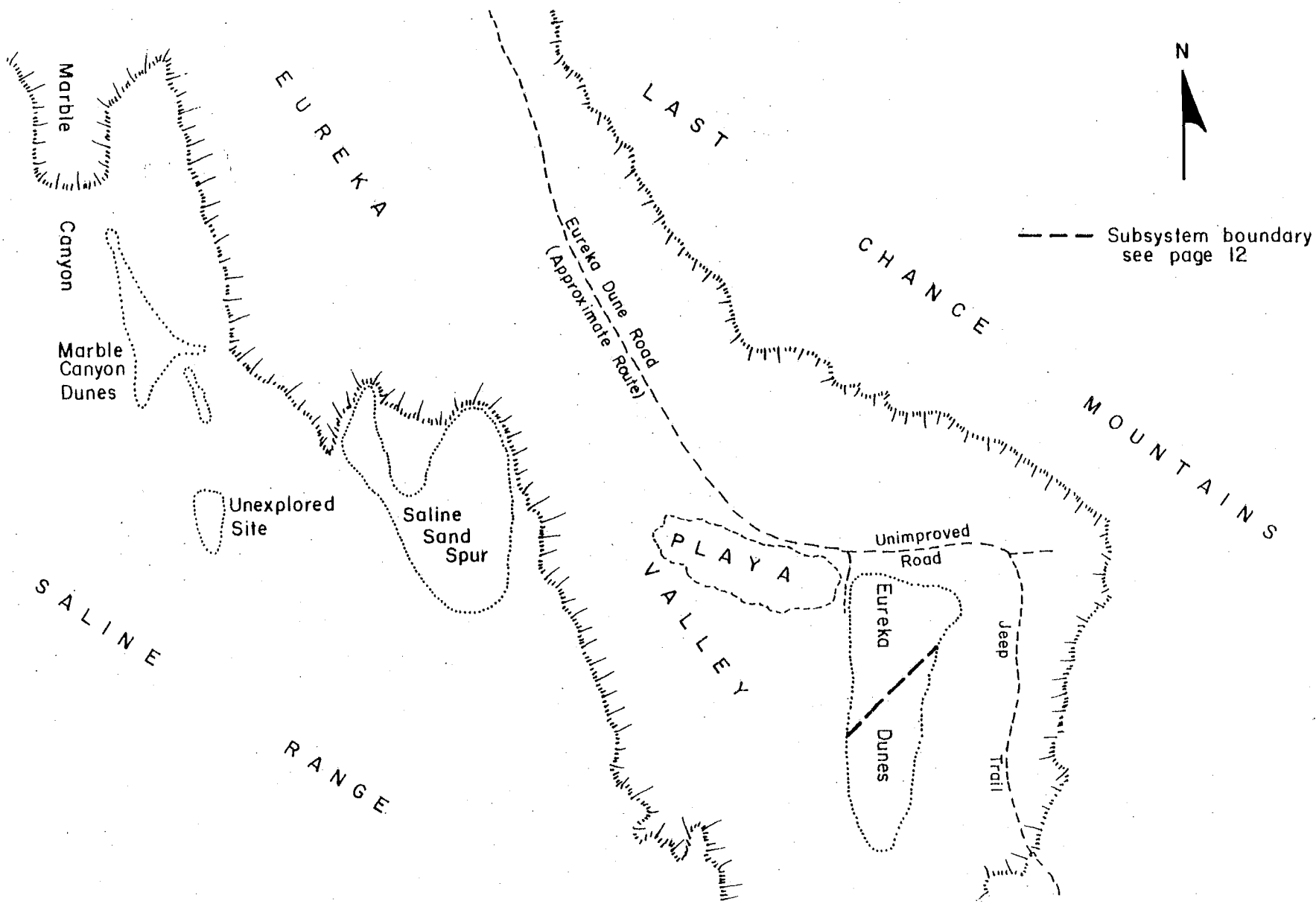


Figure 7. Map of sand dune habitats of the Eureka Valley dunegrass and Eureka Valley evening-primrose.

transmontane California." The Last Chance Mountains in the immediate vicinity of the Eureka Dunes (within 5 km or 3 miles) support the following monotypic plant genera endemic to the Inyo Floristic Region: Dedeckera, Hecastocleis, and Scopulophila, in addition to Swallenia at the dunes. Species restricted to carbonates in the same area, many of which are extremely site-specific, include Panamint milk-vetch (Astragalus panamintensis), Utah buddleja (Buddleja utahensis), Gilman's cymopterus (Cymopterus gilmanii), Gilman buckwheat (Eriogonum gilmanii), Utah fendlerella (Fendlerella utahensis), holly goldenbush (Haplopappus brickellioides), fishhook mammillaria (Mammillaria tetrancistra), rock-midget (Mimulus rupicola), Jones cloak fern (Notholaena (Cheilanthes) jonesii), limestone penstemon (Penstemon calcareus), and Death Valley sage (Salvia funerea). The floristic value of the southern part of Eureka Valley and its adjacent mountain walls is outstanding. See Appendix I.

The flora of the Eureka Valley sand dunes is an interesting assemblage of plants of various floristic provinces. Euphorbia ocellata var. arenicola, a yellow-flowered spurge, is probably at its northerly limit at the dunes. Chaetadelphia wheeleri, a broomlike perennial, comes in from the Great Basin and may reach its southerly limit in Eureka Valley. Besides typical sand dune species, it is surprising to note such non-dune species as Antirrhinum kingii (a snapdragon) and Asclepias erosa (a milkweed). For a more detailed discussion of associated plants see Appendix II.

In general, plants at the Eureka Dunes site are unusual in their large size and vigor. As for the endemics, each has developed a way of surviving and reproducing under the special conditions there. The Eureka Dunes system is considered by many to be a unique ecological island.

Little has been said of the fauna. Suffice it to say that it reflects the rich flora. Reptiles and rodents are well represented, and kit fox dens are not infrequent. Coyotes, rabbits, and other large mammals are also found there. Bighorn sheep inhabit the Last Chance Mountains east of the dunes, where they water at the springs against the high cliffs. Their trails follow the contours of resistant rock formations and penetrate the canyons. It is possible that endemic fauna still await discovery.

Insects may yield valuable clues as to what occurred during past geologic times. To date only the beetles have been studied (Giuliani, pers. comm.). Over 150 beetle species have been collected on the Eureka Dunes, and at least 20 of them require the sand dune habitat. Of these, at least five are endemic and only one of the five has a published name. Of particular interest are the migration routes by which these species came to the dunes, some migrated from the north and some from the south. Interestingly, a few species are flightless. At some time in the ancient past there obviously were open corridors or routes reaching the now isolated Eureka Dunes (D. Giuliani, pers. comm.) (see Appendix III).

EUREKA VALLEY DUNEGRASS AND EVENING PRIMROSE SITES

As mentioned previously, only four sites, all proximate to each other, are known for the Eureka Valley dunegrass and evening-primrose. There is the slight possibility, however, that small pockets of the required sandy habitat may be tucked away in the Saline Range or Last Chance Mountains where they have escaped attention. Of the four known sites, the massive north end of the Eureka Dunes is considered the key to the survival of the dunegrass and evening-primrose. The three other sand deposits are considered supplementary, being less extensive they probably could not carry the evening-primrose or dunegrass through prolonged periods of drouth or other adverse conditions. However, the overall adaptive significance of the colonies occurring at these sites is unknown.

EUREKA DUNES

Structure and composition:

Base elevation at the Eureka Dunes site is 900 m (2,900 feet). The dune system is approximately 5 km (3 miles) long, trending north and south, and up to 2.4 km (1.5 miles) in width at the broad north end. It consists of a massive sand mountain 203 m (664 feet) high covering a triangular area of approximately 10 sq km (4 square miles), and a series of transverse dunes about a third as high covering 13 sq km (5 square miles) (Dean, 1978). The sand mountain, called a seif by

Gattung et al. (1978), comprises the north end of the dune system, while lesser dunes comprise the south and southeast portion. The dividing line between these two dune subsystems runs southeast from a point about 1 km (0.6 mile) south of the northeast corner to a point about midway on the western boundary (see Figure 7). A sand sheet surrounds the dunes on all sides except on the playa and where clay deposits of a Pleistocene (?) lakebed are exposed. The lakebed is most extensive on the east side. The seif appears to be located midway in the prehistoric lakebed. The transverse dunes extend southward to overlie the alluvial fan of the Saline Range, whose crests and valleys expose the underlying land surface in places.

Each dune form is an indicator of the prevailing winds and the effect of physical barriers on air flows. According to Gattung et al. (1978) the seif is positioned in line with the strongest prevailing winds, while the rest of the dune system was formed by more complex wind patterns. The dunes are relatively stable and the general outline remains constant. Surface movement occurs, however, creating rippled patterns, and crests that build up and shift with changes in wind direction.

The sand is pale gold or cream in color, depending on light conditions. Gattung et al. (1978) state that it is predominately quartz (silicon dioxide); the particles are a larger size than those of the Saline, Panamint, or Death Valley dunes. The darker grains that often outline the wave patterns are magnetite or other heavy minerals, mostly of igneous origin.

Those who climb the high ridges may experience the vibration of a "singing dune". The cascading sand under certain conditions emits a peculiar sound similar to that of a bass violin. This is said to depend on the form and composition of sand particles, and probably on the moisture content also. Only a few dunes in the country are known to "sing" (Schad, 1979).

Microclimate and Hydrology:

Located as it is on the west side of a prominent mountain barrier, the large seif receives a good share of the precipitation intercepted by that mountain obstruction. The moisture, which may come in the form of rain or snow, is retained by the dune and slowly percolates downward and outward. There is no runoff. Thus the seif is an unusual form of reservoir, or aquifer, capable of storing a great quantity of water. The percolation process, downward into the deeper layers of the dune, is slow, water is therefore available throughout the dry summer months. This phenomenon undoubtedly accounts for the rich flora of the Eureka Dunes and survival of the evening-primrose and dunegrass in what otherwise appears to be an extremely arid environment. On the east side of the dunes, direct precipitation is supplemented by runoff from the Last Chance Mountains. Old timers recount a story of an Indian who claimed that there was a spring under the Eureka Dunes. This possibility cannot be entirely discounted without a hydrological study. Such a study would also contribute much to understanding the physiological ecology of the endemic plants.

Another remarkable feature of the Eureka Dunes' habitat is the height to which plants are established on the dune slopes. Desert sand dunes normally are barren above the lower slopes. However, the very steep west wall of Eureka Dune is populated by dunegrass up to about 50 m (150 feet) on the sandy slopes. This slope, which faces the intense west sun, is well vegetated with dunegrass, indicating substantial water retention within the sands (Pavlik, 1979a).

A relatively unknown factor that affects the hydrology is the stratification of the seif. Some layering is revealed at the north end where some seepage occurs following periods of precipitation. Otherwise there is little surfacial evidence of strata above the relic shorelines of the Pleistocene lake.

OTHER EUREKA VALLEY SITES

Saline Spur Dunes:

This site, 6.4 km (4 miles) west of the Eureka Dunes at an elevation of 1,173 m (3,850 feet), is a sand-covered spur of the Saline Range. This type of dune system is called an "obstacle system." It has enough deep sand in a partially filled ravine to support a small population of the dunegrass. There is also enough sandy border to support some evening-primroses. Precipitation is probably lower here than at the Eureka Dunes, and the sand has little storage capacity.

Marble Canyon Dunes:

The Marble Canyon site is situated at the southwest corner of Eureka Valley 14.4 km (9 miles) west of the Eureka Dunes at an elevation of 1,036 m (3,400 feet). The habitat consists of a small dune system tucked in a break in the east side of the canyon outlet, along with some of the obstacle type drifted over the projecting ridge. Marble Canyon is the dividing line between the Inyo Mountains and the Saline Range, thus the dunes are situated along a northwesterly spur of the Saline Range. The wash discharging from the canyon carries drainage from high peaks and flats of the Inyo Mountains. It drains a large area, so that runoff is frequently a raging torrent by the time it sweeps past the dunes. This prevents any significant sand accumulation in the channel along the west side of these dunes. An extensive sandy border, characteristic of good evening-primrose habitat, apparently cannot develop at this site because the dunes are hemmed in by the surrounding mountains. A disjunct sand sheet has developed, however, near the north end of the spur in the outwash channel, and it supports a fair sized evening-primrose population. A small population of dunegrass also occurs on these dunes. However, this colony lies within the rain shadow of the Inyo Mountains, so precipitation is probably lower than at the Eureka Dunes. The decreased precipitation no doubt accounts for the relatively poor vigor of the dunegrass at this site. It is possible, though, that the evening-primrose site may benefit from subsurface water from Marble Canyon.

Site #4 or unnamed site:

Nearby, 3 km (1.8 miles) south of the Marble Canyon Dunes, a population of dunegrass was noted by Pavlik and DeDecker from a helicopter in July 1978. This site is an isolated deposit of sand in the Saline Range, remote enough that it has not yet been reached on foot. Hence it has not been investigated and there are no data available. It is not known whether the evening-primrose also occurs there.

LAND-USE AND OWNERSHIP

The entire Eureka Valley is public land administered by the Bureau of Land Management, except for a few school parcels, which are State land. The region in the area of the dunes has not been surveyed into sections and townships. The northwest corner of Death Valley National Monument comes to within 10 km (6 miles) east of the center of the Eureka Dunes. There are no privately owned parcels in the valley.

Some unpatented mining claims are on record for the Last Chance Mountains, all north of the Eureka dunes. Mining activity in the Inyo Mountains bordering the valley is situated well away from the dune sites, and access roads to the various claims are along the west side of the valley. The Eureka Dunes themselves are on withdrawn land. There has been no agricultural use of the southern part of the valley, and none north of the main road, except for illegal grazing during exceptionally good water years.

HUMAN IMPACTS

Although isolation and the absence of water were long the chief factors in protecting the area and its endemic species, the very isolation of the dunes, along with aesthetic appeal, also attracted the first recreational visitors. The early recreationists enjoyed camping at the immense dune and experiencing the solitude. Dune-walking and sand-play were popular, and photographers were attracted by the dramatic beauty of the place. It was not an easy trip, so visitor use was at first extremely limited.

During the 1960's the character and intensity of human use of the southern Eureka Valley changed rapidly. The unusually high slopes of the Eureka Dunes began attracting off-road vehicle (ORV) enthusiasts. Recreational use increased markedly and indiscriminate ORV use of the dunes began to exhibit a most destructive effect on the dune vegetation and fauna. The adverse effects of such human and vehicular use on desert ecosystems have been discussed elsewhere (Wilshire and Nakata, 1976; Wilshire et al., 1977; Keefe and Berry, 1973; Berry, 1973; Busack, in Berry, 1973; Bury et al., 1977; Weinstein, 1978). The Eureka Dunes became a favorite challenge to ORV fans while other, non-vehicular, types of recreation declined.

Because the access road reached the Eureka dunes at the northwest corner, most activity centered there or nearby. During the period of intense ORV use the long, gentle slope ascending from that corner was

used as an access ramp to the higher ridges. For the most part the campers avoided sandy places. They stayed right at the impacted access point or sought out the clay surfaces of the old lakebed north of the seif. Some camped along the edge of the playa on the west. Vehicular activity indiscriminately fanned out between the camp spots and the dune slopes, and racing and other disruptive activities occurred around the perimeter of the dunes.

PAST MANAGEMENT

Although few documented archeological or biological studies had been undertaken in the Eureka Valley (see Pavlik, 1979b), many people began to realize that the sensitive biota and archeological treasures of the Eureka Dunes were being destroyed. Consequently, the southern Eureka Valley, and especially the Eureka Dunes, became a focal point in the Bureau of Land Management's ORV Management Plan[1] in the early 1970's.

In the course of the planning procedure, the Saline Range was proposed for wilderness classification and the Eureka Dunes a Special Design Area (Bureau of Land Management, 1976). The Bureau of Land Management eventually appointed an advisory committee for the Eureka Dunes Special Design Area. The outcome was official closure of the dunes in November 1976.

[1] Available from District Manager, BLM, Desert District, 1695 Spruce Street, Riverside, CA 92507; 714/251-6386.

The recovery of the dunes was dramatic following the vehicle closure and the good rains of November 1976. Seedlings became abundant on the lower slopes and matured as the season progressed. The perennial Eureka milk-vetch (Astragalus lentinosus var. micans), endemic to the dunes (see letter from R. Barneby in Appendix 1-A), made a remarkable comeback alongside the heavily impacted "ramp". Non-vehicular recreationists began to return.

In time, however, it became evident that the closure was not being fully enforced (DeDecker 1976, 1979; USFWS 1979). Although it had been respected for the most part, flagrant violations became more common each year. The peak occurred over the spring holidays of 1979, with large "events" being held over Easter weekend. Protests by the public increased substantially after the weekend of Easter 1979. As a result, signs were erected and maintained by BLM and enforcement was evident on Easter week of 1980. There has been little ORV activity since that time. Camping along the perimeter of the dunes is a lesser problem, but one that nonetheless also adversely impacts the dunegrass and evening-primrose. See Appendix IV, Management Recommendations.

PART II

RECOVERY

The primary objective of this recovery plan is to restore the Eureka Valley dunegrass (*Swallenia alexandrae*) and Eureka Valley evening-primrose (*Oenothera avita* ssp. *eurekensis*) to non-endangered status by protecting the extant populations from existing human threats and ensuring that vigorous self-sustaining populations are maintained in their natural dune habitats (estimated at 6,000 acres) without the need for intensive management.

Threats to the dunegrass and evening-primrose stem mainly from unauthorized off-road vehicle (ORV) activities and other unmanaged recreational uses of the dunes. These activities have destroyed individual plants and adversely modified the dune habitats and geological process upon which they depend. Protection of their habitat by sensitive management and adequate enforcement should enable recovery of these plants to non-endangered and non-threatened status. It is not considered necessary to transplant or seed areas or otherwise supplement the natural reproductive processes at this time. Well planned monitoring and research programs are also essential to the recovery effort and are outlined below.

STEP-DOWN OUTLINE

PRIMARY OBJECTIVE: To restore the Eureka Valley dunegrass and Eureka evening-primrose to Threatened status by protecting the extant populations from existing and potential human threats; to determine the number of individuals/populations/acres of habitat necessary for each species to maintain itself, without intensive management, in a vigorous, self-sustaining manner within their natural historical dune habitat (estimated at 6,000 acres) and implement recovery tasks to attain these criteria; and delist both species.

1. Remove existing human threats to the dunegrass and primrose by enforcing existing laws and regulations and managing human access to and use of the southern Eureka Valley.
    - 11. Protect and manage the Eureka Dunes.
        - 111. Enforce and maintain existing closure of roads presently in use which violate the closure or which impact the dunes borders.
        - 112. Confine vehicle use to designated roads.
        - 113. Prohibit camping on dune slopes and sandy borders.
        - 114. Insure that recreational use of the Eureka Dunes occurs in a manner compatible with the objectives of this recovery plan.

1141. Provide for camping away from sensitive dune borders, slopes and ecotones.

11411. Establish and maintain a well defined camping area just east of the main road and 0.8 km (½ mile) north of the northwest corner of the Eureka Dunes.

11412. Provide for an overflow or group camping area adjacent to and north of the main camp area.

11413. Designate an area for primitive camping only, 3.2 km (2 miles) east of main camp area, located beyond the curve of the undeveloped road.

1142. Establish and maintain a picnic/day-use area and accompanying vehicle parking area at the heavily disturbed ramp site at the northwest corner of the dunes.

1143. Provide interpretive signs and displays.

115. Adjust restrictions as necessary to avoid unforeseen impacts.

12. Protect and manage all other plant sites (e.g., Saline Sand Spur, Marble Canyon Dunes, and unexplored site).

121. Maintain and enforce closure to unauthorized vehicles.

122. Adjust restrictions as necessary to avoid unforeseen problems or impacts.

13. Protect all adjoining areas of the valley watershed (i.e., bordering mountains, playa and ecotone between the mountains and dunes).

    131. Confine vehicles to designated roads.

    132. Modify or prohibit activities that would cause excessive erosion or vegetation disturbance.

    133. Modify or prohibit activities that would significantly alter the watershed or hydrological regimen within the southern Eureka Valley.

    134. Adjust restrictions as necessary to avoid unforeseen impacts.

14. Provide for enforcement.

    141. Provide adequate ground patrols.

        1411. Determine level or frequency of ground patrol needed.

        1412. Provide extra patrols during peak use times.

    142. Provide for air patrols.

        1421. Determine frequency of patrols needed.

        1422. Determine air patrol personnel.

    143. Post signs describing allowed uses, restrictions, and those roads open and closed to motor vehicles.

    144. Post an informative sign at the turn-off to the Eureka Dunes giving distance to the dunes, and warning of ORV restrictions, and the fact that water and firewood are not available.

145. Replace all signs removed by vandals as soon after their removal as possible.

15. Develop and implement a habitat management plan for the southern Eureka Valley that is compatible with this recovery plan.

2. Determine the population levels and habitat conditions needed to ensure that vigorous self-sustaining populations are maintained in their natural dune habitats, and manage to ensure continuation of such conditions.

21. Determine essential habitat.

211. Collect, collate, analyze, and interpret data from the monitoring program and make management recommendations as necessary.

2111. Monitor dunegrass and evening-primrose populations at the Eureka Dunes every three months.

21111. Determine monitoring techniques.

21112. Recommend monitoring personnel.

2112. Monitor all other dunegrass and evening-primrose populations twice yearly.

21121. Determine monitoring techniques.

21122. Recommend monitoring personnel.

212. Analyze and interpret ecological studies and make management recommendations as necessary.

2121. Examine evening-primrose pollinators and their habitat needs.

2122. Identify the watershed boundaries for each dune system and determine how watershed dynamics relate to dune hydrology.

2123. Investigate the hydrology of all of the dunes supporting the dunegrass and evening-primrose and evaluate how the water balance affects the survival and vigor of each species.

2124. Undertake demographic studies of the dunegrass and evening-primrose.

21241. Examine seed production, seedling mortality, and germination in the field.

21242. Study survivorship of mature plants.

2125. Undertake synecological studies to determine composition, structure, and dynamics of the ecosystem upon which the dunegrass and evening-primrose depend.

21251. Inventory the animal components.

21252. Study plant-animal interactions (e.g., herbivory, role of animals in seed dispersal, toxicity of plants to animals, effects of burrowing animals, etc).

213. Apply results of research to management of Eureka Valley Dunes ecosystem.

22. Foster public awareness and support for the preservation of the Eureka dunegrass, evening-primrose and associated species (flora and fauna) and their essential dune habitats.

    221. Provide interpretive markers, panels or signs explaining points of interest and the significance of the Eureka Valley and its associated plant and animal life.

    222. Encourage scientific research on the dunes and within the valley.

    223. Make available supplemental folders and/or booklets explaining details about the dunegrass and evening-primrose at BLM offices and interpretive centers.

    224. Develop and provide an interpretive program at the dunes explaining the origins of the dune systems and biota inhabiting them.

NARRATIVE

To accomplish the primary objective of this recovery plan all existing colonies of the dunegrass and evening-primrose must survive and flourish. Vigorous self-sustaining populations must be maintained and, where possible, allowed to naturally expand in their native dune habitats.

The recovery of these two species and maintenance of the ecosystem upon which they depend will essentially involve the management of human use and influence within the southern Eureka Valley and especially at the Eureka Dunes. Threatening impacts, such as detrimental and indiscriminate ORV use and excessive human intrusion into the dune habitat, must be reduced, and, if possible, eliminated (1). However, the high recreational values of the Eureka Dunes, and indeed the southern Eureka Valley, must be recognized and activities accommodated insofar as they are compatible with the objectives of this recovery plan. The Eureka Dunes, harboring the most extensive colonies of both the dunegrass and evening-primrose, provide the habitat most critical to the survival of these species. These dunes also have the greatest recreational value and, consequently, have received the greatest abuse. Protection and management of the Eureka Dunes is therefore imperative (11).

Closure of Eureka Dunes to all ORV use must be maintained and enforced (111). Clear communication of legal restrictions, accompanied by adequate enforcement, will greatly assist in the recovery of these two plants. Restrictions should include confining all vehicles to designated roads (112), and prohibiting camping on dune slopes and borders (113).

Recreational use of the Eureka Dunes can be accommodated in a manner compatible with the objectives of this plan (114) by:

A) Providing for camping away from sensitive dune borders. slopes and ecotones (1141);

B) Establishing and maintaining a picnic/day-use area at the northwest corner of the dunes (1142) including a vehicle parking area, and;

C) Providing interpretive signs and displays (1143).

The highest concentration of dune life, flora and fauna, is on the lower slopes and sandy perimeter of Eureka Dunes; consequently no concentration of activity should take place there. Appropriate locations for camping areas are given in 11411, 11412 and 11413 (see Figure 8). Also, Appendix IV provides additional suggestions for campground design and aesthetic considerations.

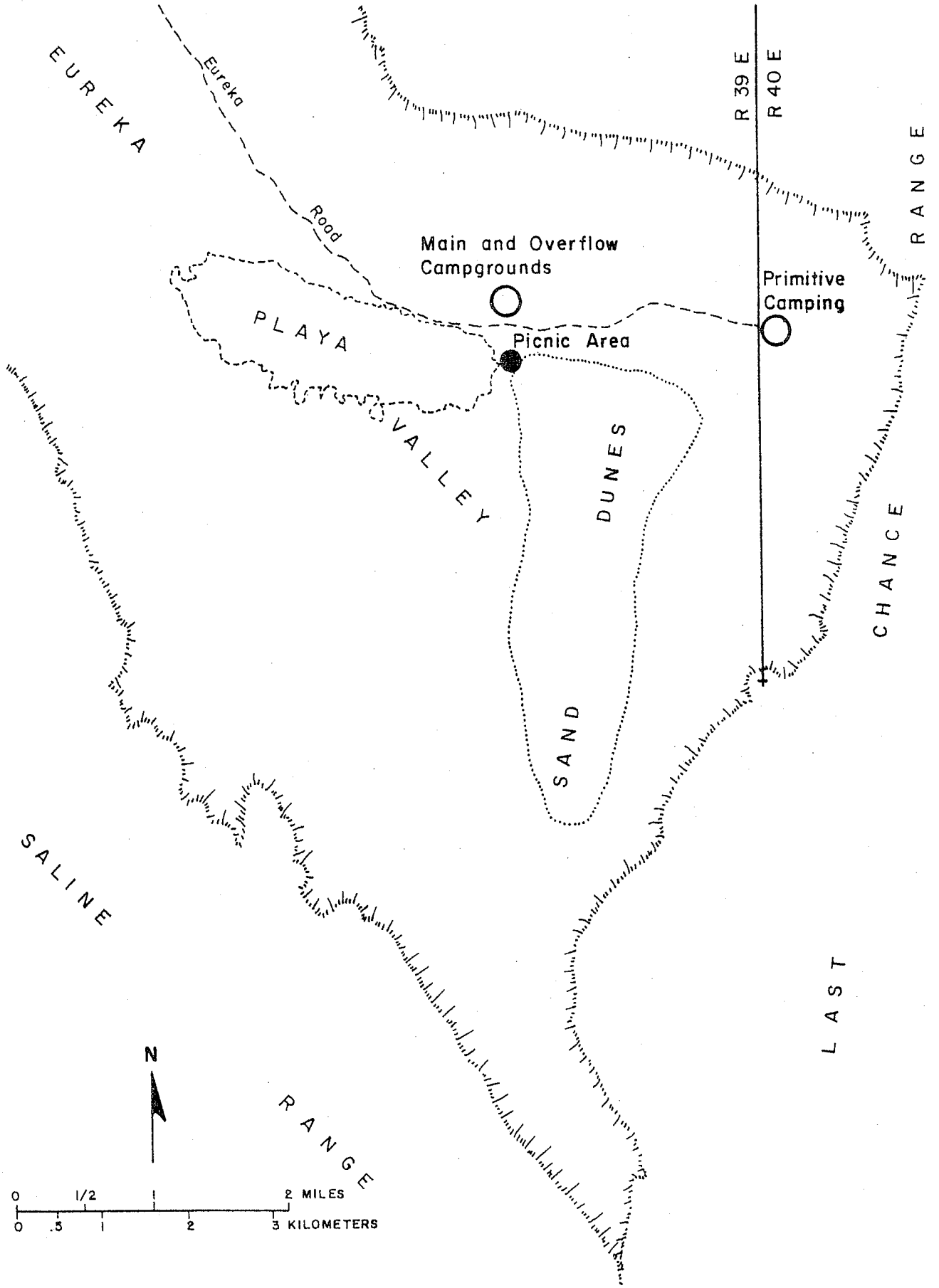


Figure 8. Approximate locations of proposed campground and picnic areas Eureka Dunes, California.

A picnic area for day use is recommended for the northwest corner of the dunes (1142). A long, gentle slope ascends from that point, so it provides an appropriate access to the higher slopes. During the days of ORV activity it was used as a ramp by the vehicles. Since it has been the scene of the most severe impact in the past, it may be considered the best choice for a "sacrifice" area. A small picnic and parking area should be planned, with dune activity focused there rather than dispersed.

Interpretation should play a major role in recreation management at Eureka Dunes. Interpretive signs and displays are recommended initially (1143) with the possibility of expanding the program as necessary. (See Appendix IV for specific suggestions on design and see also #224 of this outline.) Finally, management should be responsive enough to anticipate potential problems, avoid unforeseen impacts, or eliminate unnecessary restrictions (115).

Other locations of the dunegrass and primrose have been identified as the Saline Sand Spur, Marble Canyon Dunes, and the "unexplored site". Although these sites are considered largely supplementary to the main colonies at Eureka Dunes, full recovery can only be effected by protecting and managing these sites as well (12). This can be accomplished by:

(121) Maintaining and enforcing closure to unauthorized off-road vehicles onto these sites.

(122) Being flexible and adjusting restrictions to anticipate and avoid unforeseen problems or impacts.

The southern Eureka Valley is viewed as an ecological unit, and, as such, the entire valley watershed and the dependent biota should be protected (13). This includes the bordering mountains (Saline Range, Last Chance Mountains, Inyo Mountains, the ecotones between the mountains, the dunes and the playa). To protect all of these it is necessary to:

(131) Confine or restrict all vehicle use to designated roads and trails.

(132) Prohibit or, if possible, modify activities that would cause excessive unnatural erosion (i.e., ORV free play).

(133) Prohibit or, if possible, modify activities that would significantly alter the watershed or hydrological regime within the southern Eureka Valley (e.g., open-pit mining).

(134) As restrictions are implemented the results should be evaluated so that ineffective or unnecessary restrictions can be corrected in a timely manner.

Successful implementation of the laws, regulations and restrictions protecting the dunes will require increased enforcement (14). At the Eureka Dunes it is critical that adequate ground patrols be provided (141). The frequency and manpower required to provide adequate enforcement can only be determined by the type and amount of use within the valley (1411). Extra patrols during peak times would provide additional needed protection (1412). The Bureau of Land Management is discouraging ORV use in the valley and has closed the dunes to this activity, but existing ranger patrols have only been partially effective in protecting the dunes.

This recovery plan recommends that BLM increase the patrol frequency, especially during peak use times. Air patrols (142) should also continue with increased frequency. Full implementation of this aspect of the recovery plan is essential to the recovery of these species and will involve cooperative efforts between the Bureau of Land Management and the Fish and Wildlife Service.

Signing roads, trails and sensitive areas (143, 144, 145) is absolutely essential to the recovery effort. People must be made aware of restrictions pertaining to the use of the fragile areas within the valley. Additional signs are recommended to indicate general information about the valley and its uniqueness.

Much is yet to be learned about the physical and biotic attributes of the Eureka dunes, their sandy borders, the surrounding mountains

and their alluvial slopes. Without question, significant degradation in any of these areas could have an adverse effect on the dune habitats. It is therefore recommended that a habitat management plan that outlines additional management objectives for the southern Eureka Valley be developed and implemented. This would greatly assist in the recovery of these two plants (15). The plan should be broad in perspective, encompassing animal as well as plant components and other natural features (i.e., archeological sites, geological formations and aesthetics).

Central to the recovery effort is the need to determine and achieve the population levels and habitat conditions which will assure the continued existence of the dunegrass and evening-primrose and, if possible, allow them to be delisted. This determination will require a much greater understanding of the dune ecosystem, especially the biotic structure, function, composition, and dynamics of the system. Therefore, the recovery plan must include a monitoring program (211), active research (212), and a public awareness program (22). A determination of essential habitat (21) should result from the monitoring and research efforts.

The monitoring program must include populations of the dunegrass and evening-primrose at the Eureka Dunes (2111) as well as all other sites (2112). The Eureka Dunes should be monitored at least once per quarter. (Ideally, for seedling survival, monthly monitoring would be best.) The other sites (Marble Canyon Dunes, Saline Sand Spur and the

"unexplored site") should be monitored at least once every six months. Monitoring techniques will need to be determined (21111, 21121) and monitoring personnel need to be selected (21112, 21122). Recommended methods include: 1) complete count of plants in sample areas or on the whole site; 2) marking of individuals, clumps or stems to determine growth, reproduction, expansion and mortality; 3) brief observations of vigor, color, size of individual plants, wildlife observed, noticeable problems (e.g., tire tracks, trash, etc.); reestablishment of BLM photographic stations using permanent reference markers. All research efforts should be coordinated with the Fish and Wildlife Service and BLM.

Research should be used to enhance our knowledge for management (212). Individual studies of varying time spans should be undertaken (2121-2124). These include: pollinator research for the evening-primrose; determination of the watershed boundaries for each dune system with emphasis on its relation to dune hydrology; investigations of dune hydrology to specifically determine water balance and its relation to the survival of the dune endemics; demographic studies (2124) for both the evening-primrose and dunegrass emphasizing seed production, germination in the field and seedling mortality (21241). Studies of adult survivorship (21242) should also provide information on potential expansion and survival. Since the primary purpose of the Endangered Species Act is to conserve the ecosystems upon which endangered and threatened species depend, it will be necessary to develop an understanding and knowledge of the

composition, structure, and dynamics of the desert ecosystem upon which the dunegrass and evening-primrose depend. At this time very little is known about the function or dynamics of the Eureka Valley ecosystem. Therefore, various community-oriented studies are recommended (2125). It will be necessary to: 1) inventory the various animal components of the dunes and adjacent habitats (21251) and; 2) study plant-animal interactions such as herbivory, role of animals in seed dispersal, the effects of burrowing animals upon the dune plant community, animal population turnover rates, toxicity of plants to animals etc. (21252). In addition, autecological studies of specific organisms, such as the various dune beetles and other insects; birds; small mammals, especially rodents, which serve as food for local carnivores; and the carnivores; themselves could add important insights into the management of the dune ecosystem. Overall, the research program should also be flexible in terms of recognizing and providing for other, as yet, unidentified, research needs relating to the recovery and management of the dunegrass, evening-primrose, and associated species.

Results of the research should be directly applied to managing the Eureka Valley ecosystem (213). Management actions are expected to be mostly passive in nature (i.e., visitor-use related). But, some active habitat work may be required. Once the basic synecological and autecological information has been gathered and boundaries to the ecosystem delimited, it may be appropriate to designate Critical Habitat. This plan, however, does not propose this action at this time.

Public awareness should be given special consideration for funding and development (22). Although an awareness program cannot contribute directly to the recovery and maintenance of the dunegrass and primrose, it can provide very significant and worthwhile long-term benefits for this and other endangered species endeavors. A well planned and implemented awareness program can inform the public about the significance of the dunes, and their unique biota of endangered species. Unless the public is thoroughly aware of the ecological, historical, and aesthetic values of the Eureka Valley ecosystems, effective protection and recovery of these habitats will always be difficult, if not impossible. Numbers 221-224 are brief recommendations for an awareness program (a fundamental need) with respect to recovery of the Eureka Valley dunegrass and Eureka Valley evening-primrose. Appendix IV includes additional suggestions for interpretive programs.

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PART III

IMPLEMENTATION SCHEDULE

The table that follows is a summary of scheduled actions and costs for the Eureka Valley Dunes recovery program. It is a guide to meet the objectives of this plan, as specified in Part II, Narrative. This table indicates the tasks to meet the objectives, which agencies are responsible to perform these tasks, a time-table for accomplishing them, and lastly, the estimated costs to perform them. Implementing Part III is the action of the recovery plan, that, when accomplished, will protect the Eureka Dunes species and allow them to be removed from the Federal list of Endangered and Threatened species.

GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULES

Information Gathering - I or R (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Other - O

1. Information and education
2. Law Enforcement
3. Regulations
4. Administration

RECOVERY ACTION PRIORITIES

1 = An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.
2 = An action that must be taken to prevent a significant decline in species population/habitat quality, or some other significant negative impact short of extinction.
3 = All other actions necessary to provide for full recovery of the species.

PART III

IMPLEMENTATION SCHEDULE

General Category	Plan Task	Task Number	Task Priority*	Task Duration (Yrs.)	Responsible Agency* FWS Region	FWS Program	Other Agencies	Fiscal Year Costs[1] (in $1,000's) 84	85	86	Comments/Notes
0-02	Enforce and maintain closure	111	1	Ongoing	1	LE	BLM CDFG				Lead-BLM. Costs undetermined.
0-02	Confine vehicles to designated roads	112	1	Ongoing			BLM				Lead-BLM. Costs undetermined.
0-02	Prohibit camping on dune slopes and sandy borders	113	1	Ongoing	1	LE	BLM CDFG	2.0	2.0	2.0	Lead-BLM.
M-07	Insure that recreational use of Eureka Dunes occurs in a manner compatible with the Recovery Plan Objectives	114	1	Ongoing	1	SE	BLM* CDFG				Lead-BLM. Costs undetermined.

* BLM - Bureau of Land Management
CDFG - California Department of Fish and Game
FWS - U.S. Fish and Wildlife Service (LE - Law Enforcement
SE - Endangered Species)
USGS - U.S. Geological Survey

General Category	Plan Task	Task Number	Task Priority*	Task Duration (Yrs.)	Responsible Agency* FWS Region	Responsible Agency* FWS Program	Responsible Agency* Other Agencies	Fiscal Year Costs[1] (in $1,000's) 84	85	86	Comments/Notes
M-07	Establish main camping area	11411	2	1			BLM		127.0		Lead-BLM.
M-07	Provide an overflow or group campground	11412	3	1			BLM				
M-07	Provide for a primitive campground	11413	3	1			BLM				
M-07	Establish and maintain picnic/day-use area near dunes	1142	2	1			BLM		10.0		Lead-BLM.
O-07	Provide interpretive signs and displays	1143	2	1			BLM		1.0		Lead-BLM.
O-03	Adjust restrictions and management policies to avoid unforseen problems and impacts	115	2	1	1	SE	BLM* CDFG				Lead-BLM. Costs undetermined.
O-02	Maintain and enforce closure of all roads and trails leading to Marble Canyon Dunes, Saline Sand Spur and "unexplored site"	121	2	Ongoing			BLM				Lead-BLM. In progress. Costs undetermined.
O-02	Adjust restrictions as necessary.	122	3	Ongoing			BLM				Lead-BLM. In progress.

General Category	Plan Task	Task Number	Task Priority*	Task Duration (Yrs.)	Responsible Agency* FWS Region	FWS Program	Other Agencies	Fiscal Year Costs[1] (in $1,000's) 84	85	86	Comments/Notes
0-02	Confine vehicles to designated roads	131	1	Ongoing			BLM				Lead-BLM. Cost undetermined.
0-02	Prevent excessive erosion or vegetation disturbance	132	1	Ongoing			BLM				Lead-BLM. Cost undetermined.
0-02	Protect dune's watershed and hydrology	133	2	Ongoing			BLM				Lead-BLM. Cost undetermined.
0-02	Adjust restrictions as necessary	134	3	Indeter-minate			BLM				Lead-BLM. Cost undetermined.
0-02	Provide adequate ground patrols	141	1	Ongoing	1	LE		2.0	2.0	2.0	Lead-BLM. In progress.
							BLM	10.0	10.0	10.0	
							CDFG	1.0	1.0	1.0	
0-04	Determine level of ground patrol needed	1411	1	1	1	BLM					Lead-FWS. In progress. Cost undetermined.
0-02	Provide extra patrols during peak use times	1412	1	Intermit-tent			BLM	2.0	2.0	2.0	Lead-BLM.
0-02	Provide for air patrols	142	2	Ongoing			BLM	5.0	5.0	5.0	Lead-BLM.
0-04	Determine frequency needed	1421	2	1	1	LE		.5			Lead-FWS.
							BLM	.5			
							CDFG	.5			
0-04	Determine patrol personnel	1422	2	1			BLM	.5			Lead-BLM.

General Category	Plan Task	Task Number	Task Priority*	Task Duration (Yrs.)	Responsible Agency* FWS Region	Responsible Agency* FWS Program	Other Agencies	Fiscal Year Costs[1] (in $1,000's) 84	85	86	Comments/Notes
O-01	Provide signs describing allowed uses, restrictions, etc.	143	1	2			BLM	4.0	4.0		Lead-BLM. In progress.
O-01	Post sign at Eureka Dunes turn-off	144	3	1			BLM				Lead-BLM.
O-01	Replace vandalized signs	145	3	Indeter-minate			BLM				Lead-BLM.
M-07	Develop and implement habitat management plan	15	1	Contin-uous			BLM				Lead-BLM. In progress.
I-01	Monitor the Eureka Dunes each quarter	2111	2	Contin-uous			BLM	8.0	8.0	8.0	Lead-BLM.
R-01	Determine monitoring techniques	21121	2	1	1	SE	BLM				Lead-BLM. Costs undetermined.
O-04	Recommend monitoring personnel	21112	2	Ongoing			BLM				Lead-BLM. Cost undetermined.
O-01	Monitor other sites	2112	3	Contin-uous			BLM				Lead-BLM. Cost undetermined.
R-01	Determine monitoring techniques	21121	3	Contin-uous			BLM				Lead-BLM. Cost undetermined.
I-14	Examine evening-primrose pollinators and their habitat needs	2121	3	3	1	SE	BLM* DFG				Lead-BLM. Cost estimated at 2.5K/yr.

General Category	Plan Task	Task Number	Task Priority*	Task Duration (Yrs.)	Responsible Agency* FWS Region	Responsible Agency* FWS Program	Other Agencies	Fiscal Year Costs[1] (in $1,000's) 84	85	86	Comments/Notes
I-14	Determine watershed boundaries for all dune systems	2122	3	1	1	SE	BLM* DFG				Lead-BLM. Cost undetermined.
I-14	Study the hydrology of the various dunes	2123	3	3	1	SE	BLM* USGS				Lead-BLM. Cost undetermined.
I-01	Examine seed production, germination in the field, and seedling mortality	21241	3	5	1	SE	BLM* DFG				Lead-BLM. Cost estimated at 1.5k/yr.
I-01	Study survivorship of adult plants	21242	3	5	1	SE	BLM* DFG				Lead-BLM. Cost estimated at 1.0k/yr.
I-02	Inventory animal components	21251	3	3	1	SE	BLM* DFG				Lead-BLM. Cost estimated at 2.0k/yr.
I-02	Study plant-animal actions	21252	3	3	1	SE	BLM* DFG				Lead-BLM. Cost estimated at 5.0k/yr.
M-03	Apply results of research to management of Eureka Dunes' ecosystem	213	3	Continuous	1	SE	BLM* DFG				Lead-BLM. Cost undetermined.
O-01	Provide interpretive markers	221	3	Continuous			BLM				Lead-BLM. Cost estimates for 2 years is 2.5k/yr.

General Category	Plan Task	Task Number	Task Priority*	Task Duration (Yrs.)	Responsible Agency* FWS Region	Responsible Agency* FWS Program	Other Agencies	Fiscal Year Costs[1] (in $1,000's) 84	85	86	Comments/Notes
0-04	Encourage scientific research	222	3	Contin-uous			BLM				Lead-BLM. Cost undetermined.
0-01	Provide supplemental folders/booklets	223	3	Contin-uous			BLM				Lead-BLM. Cost estimated at .5k/yr.
0-01	Provide an interpretive program at the Dunes	224	3	Contin-uous			BLM				Lead-BLM. Cost estimated at 3.0k/yr.
Above information for FWS data storage program.						Subtotals	FWS	2.5	2.0	2.0	FWS - $ 6.5
							BLM	31.5	169.0	27.0	BLM - 227.5
							CDFG	1.0	1.0	1.0	CDFG - 3.0

APPENDIX I

Flora of the Eureka Dunes and immediate vicinity showing habitats of major occurrence. Nomenclature follows Munz (1974) except where more recent work is accepted.

	High Dune	Low Dune	Ecotone	Playa	Bajada
Abronia turbinata. Sand Verbena.		x	x		
Allionia incarnata. Windmills.			x		x
Ambrosia dumosa. Burrobush.			x		x
Antirrhinum kingii. Least snapdragon.			x		
Asclepias erosa. Desert milkweed.			x		
Astragalus lentiginosus var. *micans*. Eureka Valley milkvetch.		x	x		
Astragalus sabulonum. Sand rattle-weed.			x		
Atrichoseris platyphylla. Parachutes, gravel ghost.					x
Atriplex argentea. Silverscale.				x	x
Atriplex canescens. Four-wing saltbush.			x	x	x
Atriplex confertifolia. Shadscale.		x	x	x	x
Atriplex polycarpa. Allscale.			x	x	

APPENDIX I

	High Dune	Low Dune	Ecotone	Playa	Bajada
Atriplex truncata. Wedgescale.			x	x	
Baileya pleniradiata. Woolly marigold.			x		
Bouteloua barbata. Six-weeks grama.			x		x
Camissonia claviformis ssp. *calviformis*. primrose.					x
Camissonia claviformis ssp. *funerea*. Brown-eyed primrose.		x	x		
Camissonia munzii. Munz primrose, red-eyed primrose.					x
Chaenactis carphoclinia. Pebble pincushion					x
Chaetadelpha wheeleri. Dune broom.		x	x		
Cleome sparsifolia Naked cleome.		x	x		
Conyza coulteri. Coulter conyza.				x	
Corispermum hypossifolium. Bugseed.		x	x		
Cryptantha circumscissa. Capped forget-me-not.					x
Cryptantha micrantha. Purple-rooted forget-me-not.		x	x		
Dicoria canescens ssp. *clarkae*. Clark dicoria.	x	x			

APPENDIX I

	High Dune	Low Dune	Ecotone	Playa	Bajada
Echinocactus polycephalus. Cottontop cactus					x
Eriogonum inflatum. Desert trumpet.					x
Eriogonum insigne. Ladder buckwheat.			x		
Eriogonum reniforme. Kidney-leaved buckwheat.			x		
Eriogonum trichopes. Little trumpet.					x
Erioneuron pulchellum. Fluff-grass.					x
Euphorbia micromera. Desert sand-mat.		x	x		
Euphorbia ocellata var. arenicola. Yellow-flowered spurge.		x	x		
Hymenoclea salsola. Cheese bush.		x	x		
Kochia americana. Gray molly.				x	
Langloisia setosissima. Bristly gilia.					x
Larrea tridentata. Creosote bush.			x		x
Lupinus shockleyi. Sand lupine, Shockley lupine.		x	x		
Nama demissum. Purple mat.			x		
*Oenothera avita ssp. eurekensis. Eureka Valley evening-primrose.		x	x		
Oenothera primiveris. Large yellow evening-primrose.			x		
Opuntia basilaris. Beavertail cactus.					x

APPENDIX I

	High Dune	Low Dune	Ecotone	Playa	Bajada
Opuntia echinocarpa. Cholla.					x
Oryzopsis hymenoides. Indian rice-grass.		x	x		
Palafoxia arida (=P. linearis.) Spanish needle.			x		
Pectis papposa. Chinch weed.			x		x
Psorothamnus fremontii (=Dalea fremontii.) Fremont dalea.					x
Psorothamnus polyadenius (=Dalea polyadenia.) Dotted dalea.		x	x		
Salsola paulsenii. Barbwire Russian thistle.		x	x		
Sphaeralcea ambigua. Apricot mallow.		x	x		
Stanleya pinnata ssp. inyoensis. Inyo desert plume.		x	x		
Stephanomeria pauciflora. Desert milk-aster.			x		
Suaeda torreyana. Inkweed.				x	
*Swallenia alexandrae. Eureka Valley dune-grass.	x	x			
Tamarix ramosissima. Salt cedar.				x	
Tidestromia oblongifolia. Honey-sweet.			x		x
Tiquilia plicata (=Coldenia plicata). String plant.		x	x		

*Federally Endangered

APPENDIX I-A

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DEPARTMENT OF BOTANY DAVIS, CALIFORNIA 95616

January 20, 1980

Rupert C. Barneby
New York Botanical Garden
Bronx, New York 10458

Dear Dr. Barneby:

It has been nearly a year since you consented to look at my astragali from desert dunes in California and Nevada. I hope you are still willing. Please find enclosed 12 collections, five color slides, and a few pages of my observations and opinions. Included is material from dunes which possess Astragalus populations and that are geographically close to Eureka Dunes. Your thoughts on these matters would be very helpful and greatly apprciated. Please keep the plant material, photos, and notes for your own collections.

Hopefully I will be able to spend another spring collecting at more dune sites. The floristic patterns are beginning to make sense and I am now in the process of testing hypotheses relating to plant migrations in the Great Basin during and after the Pleistocene.

If I can be of any service to you please let me know. Thank you.

Sincerely,

Bruce Pavlik
Botany
U.C. Davis
Davis, Ca 95616

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In my opinion, the material referred to as A. lentiginosus var. micans is quite distinct and confined to Eureka Valley Dunes. Plants which I tagged over three years ago continue to flourish to date and are summer active (possessing foliage). The inflorescence and flower of micans tend to be more robust, although the measurements presented are not the result of intensive sampling and analysis. Coloration of the corolla and pods before drying is very different in var. micans compared to the material here assigned to var. variabilis (see photos). It is clear that micans is probably a derivative of the variabilis complex which is generally widespread both on and off dunes.

I am very interested in the unusual material labeled BMP 153 because of its odd vegetative characteristics and the fact that no members of the population seemed successful in producing flowers (or else the flowers are so diminished I can't recognize them).

The other material seems more straightforward and I would greatly appreciate your comments.

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BMP 38,39 Eureka Dunes, Inyo Co., California (dune restricted)

Habit: Strong perennial, erect, retains foliage during summer

Flower: Calyx length 8.0, 9.5, 7.5 mm, tooth of calyx 3.2, 3.5, 3.0 mm long

Keel about 10 mm long in some

Color of corolla yellow (pale or cream) w/ blue or indigo distally, drying cream or lt. blue. Rarely with dark purple dots on wings and banner

Fruit: Pod strongly inflated, not mottled or very rarely so

Taxon: Astragalus lentiginosus var. micans

BMP 157 Big Dune, Nye Co., Nevada (not dune restricted)

Habit: annual, biennial, (perennial ?), erect

Flower: Calyx length 5.0, 6.0, 5.6 mm, tooth 2.0, 2.2, 2.0 mm long

Keel 7 to 8 (-9) mm

Color of corolla bright magenta drying indigo (see photo) purple dots on wings and keel sometimes present

Fruit: Pod strongly inflated, red mottling is conspicuous (photo)

Taxon: Astragalus lentiginosus var. variabilis

BMP 230 Panamint Dunes, Inyo Co., Ca. (mostly dune restricted)

Habit: annual, biennial, (perennial ?), erect

Flower: Calyx length 5.5, 6.5, 6.5 mm long, tooth 2.0, 2.5, 2.5 mm l

Keel about 10 mm or slightly less

Color of corolla bright magenta (see phto), occasionally with purple dots, wings are white distally

Fruit: Pod inflated, red mottling is conspicuous

Taxon: Astragalus lentiginosus var. variabilis

APPENDIX I-A

BMP 239 Olancha Dunes, Inyo Co., Ca. (base of dunes only)

Habit: annual or biennial, erect

Flower: Calyx length 5.5, 5.0, 5.0 mm long, tooth 2.0, 1.5, 1.5 mm

Keel about 10 mm long

Color of corolla reddish-purple, not bright, with the purple dots on wings and keel

Fruit: Pod inflated, red mottle is conspicuous

Taxon: Astragalus lentiginosus var. variabilis

BMP 153 Goldfield "Dunes", (1 mi N of Goldfield), Esmeraldo Co., Ne

Habit: low, erect, with woody rhizome, perennial, stipules spinesc

Flower: ?, the entire population appeared to have aborted flowers

Fruit: ?

Taxon: Astragalus ?

Note: found on deep but stabilized sand sheet, 6000', with Hilaria jamesii, Stanleya pinnata, Lycium andersonii, Oenothera avita ssp. avita, Tetradymia glabrata, Sarcobatus baileyi

BMP 69 Sand Mountain, Churchill Co., Nev.

Taxon: Astragalus lentiginosus var. kennedyi

BMP 201 Kelso Dunes, San Bernadino Co., Ca.

BMP 173 Big Dune, Nye Co., Nev.

BMP 108 Eureka Dunes, Inyo Co, Ca.

Taxon: Astragalus sabulonum (last three collections)

BMP 182 Dumont Dunes, San Bernadino Co., Ca

BMP 205 Kelso Dunes, San Bernadino Co, Ca

Taxon: Astragalus lentiginosus var. borreganus (last two collectio

BMP 244 Mono Dunes, Inyo Co, Ca.

Taxon: Astragalus monoensis

The New York Botanical Garden

Bronx, New York 10458 (212) 220 8700

Mr. Bruce M. Pavlik,
UC Davis, Calif. 8.II.1981

Dear Mr. Pavlik: The fine specimens of Astragalus from dunes in the Mohave Desert have just reached me. Thank you for the material, which is a valuable acquisition to our herbarium. I was delighted with your notes on color, with the accompanying kodachromes (returned herewith), and with your conclusion, with which I'm in full agreement, that the lentiginosus of the Eureka Dunes really is different from the superficially similar, silvery-leaved variabilis of the eastern Mohave. Your records of A. didymocarpus and A. sabulonum are the first I've seen from Inyo Co. Your puzzle with spiny stipules is Peteria thompsonae S. Wats. For the record I am returning your two pages of field notes with my comments and identifications (almost all simply ratifying your own).

Once again many thanks for the specimens. I hope you will be publishing your findings eventually. I'll look forward to your paper with anticipation.

Sincerely yours

Rupert Barneby

Barneby

APPENDIX II

Discussion of Significant Plant Associates

Only the most interesting or significant of the 50 or more plant associates are discussed here. (See Appendix I for a more complete list.)

Astragalus lentiginosus var. *micans*. Eureka Valley locoweed or milk-vetch.

(Fabaceae, Pea family)

Among their collections in 1954, Munz and Roos had a robust perennial *Astragalus* that R. C. Barneby determined was a variety of *A. lentiginosus*. He named it var. *micans* because of its "shining, silvery vesture." It, too, occupies the sandy perimeters of the dunes, but usually in somewhat deeper sand than the evening-primrose. Its best development has been in the vicinity of the northeast corner of the seif. Like most of the other dune plants at Eureka Dunes, it also has suffered from ORV impact. After the reduction of ORV activity, however, it rapidly became reestablished in the northwest portion. Otherwise the plants are scattered on the dune borders. Young plants are silvery-green and vigorously bushy, becoming rather straggly on maturity. They have a habit of putting out new shoots from the old stems during the summer to begin a renewed period of

APPENDIX II

blooming in the fall. The flowers vary from whitish to lavender, but are less conspicuous than the inflated pods, which usually angle upward. The var. micans was reported from Big Dune in Nevada by J. Beatley, but according to Barneby plants at Eureka Dunes are very distinct. Eureka Valley milk-vetch is on the California Native Plant Society's list of Rare and Endangered plants, and is a Federal candidate under the U.S. Fish and Wildlife Service December 15, 1981, Notice of Review (45 FR No. 242 Part IV). It is considered endemic to the dunes of Eureka Valley.

Dicoria canescens ssp. clarkae. Clark's dicoria. Asteraceae.

A frequent associate of Swallenia alexandrae on the higher dune slopes, and even above it in some places, Dicoria is an annual of considerable importance in the dune's ecological system because it matures in the fall and thus its seeds provide a winter food source for the dune animals. Evidence that it was used for human food at the time of the advent of the white man was discovered in a food cache of Dicoria seeds not far from the dunes. The mature seeds, enclosed in curved bracts, are blown readily over the dune surface until they come to rest long enough to be covered by blowing sand. Thus, the colonies commonly occur where the seeds were deposited in the hollows or on wavy slopes.

APPENDIX II

Tiquilia plicata (*Coldenia plicata*). String plant. Boraginaceae.

Common on the low dunes, this small perennial is well adapted to surface movement. Each above ground part of the plant is attached to a slender, dark, stringlike root that may be up to 7 dm long. At the end of the "string" is a fleshy cylindraceous terminal root 4-5 cm long and approximately 3 mm thick. The deeply buried terminal root appears to serve as an anchor, while the tethered plants are allowed to move with the shifting sand. The flat little plants form a good groundcover where they are well established. They seem to be a favored food of the desert iguana (*Dipsosaurus dorsalis*).

Oryzopsis hymenoides. Indian rice-grass. Poaceae.

Scattered on the lower dune slopes and sandy borders, Indian rice-grass is common. An almost pure stand of perhaps 40 acres (16 ha) occurs on the sand sheet east of the seif. Although this species is not confined to dune habitats, it appears to find ideal conditions at the Eureka Dunes. The grass seeds are an important food source for the dune animal life.

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Sphaeralcea ambigua. Apricot mallow. Malvaceae.

A dominant perennial in the vicinity of the northeast corner of the dunes, associated in part with the rice-grass. In favorable years it creates a wash of rusty-red on the landscape. This species, too, is widespread, but the plants at the Eureka Dunes are unusually large and vigorous. There is considerable evidence that both the herbage and seeds are utilized as food by a number of animals.

Cleome sparsifolia. Naked cleome. Capparidaceae.

This robust annual occurs sporadically on the lower slopes and sandy borders of the dunes, usually in colonies. Its seeds are undoubtedly important in the food web.

Stanleya pinnata ssp. *inyoensis*. Inyo desert plume. Brassicaceae.

This woody-based *Stanleya* was among the collections made by Munz and Roos in 1954 and later described by them. (El Aliso: April 1955.) At that time it was thought to be endemic to the dunes of Eureka Valley, but it has since been found elsewhere in the region. Occasional plants are found on the sandy borders. Shrikes have been seen using its tall stalks as observation points. An excellent population of this *Stanleya* was noted at the Marble Canyon dune site.

APPENDIX II

Psorothamnus polyadenius (*Dalea polyadenia*). Dotted dalea. Fabaceae.

Dotted dalea is the principal shrub on the dunes and it plays an important role there. Its large, rounded bushes provide cover and shade for rodents and reptiles, and its roots stabilize the sand for their burrows. The shrubs occur well up on the lower slopes as well as on the dune borders.

APPENDIX III

Endemic or probable endemic species of beetles that occur at the Eureka Dunes:

Miloderes nelsoni.	Related species are known only from dunes to the far south.
Trigonoscuta sp. nov..	Others are known from Owens Valley, Panamint Valley, and several other dunes in the far south; none to the north. This genus has coastal dune species also.
Genus nov. not yet published	The number of related species increases southwardly.
Horistonotus sp. nov..	The only related species known is from a dune in the far south.

Cardiophorus sp. nov . . . . . Of the 15 sand dunes where populations of this group are known to occur, only 2 of them are south of the Eureka Dunes. Populations in the north tend to be fully winged, while flightlessness and other dune adaptations increase to the south.

Non-endemic dune-obligated species include: (Mostly flightless)

Lariversius tabialis . . . . . Widespread throughout sand dune areas in northern Nevada but known from only 2 dunes south of Eureka Dunes.

Trogloderus costatus . . . . . Widespread in dune areas to the north but known from only 2 or 3 localities to the south.

Aegialia conferta	Known from 5 dunes to the north and 2 dunes to the south. This genus contains other species from both inland and coastal dunes.

Source: Derham Giuliani, personal correspondence, 8/25/80.

APPENDIX IV

MANAGEMENT RECOMMENDATIONS

Camping and Visitor-use Management

Recreational use of the southern Eureka Valley and the Eureka Dunes is largely controlled by seasonal weather conditions. The Eureka Valley is subject to colder weather than neighboring Saline, Panamint, or Death Valleys because it is farther north and at a higher elevation. The elevation at the base of Eureka Dunes is 600-900 meters (2,000-3,000 ft) higher than the dunes of the other valleys. Although hot in summer, the temperatures at Eureka Dunes are unlikely to soar to the extremes recorded in the lower valleys. Winter weather may be too cold for comfortable camping, but spring and fall days are ideal in calm weather. Wind may be a problem any time, especially in cold weather when it increases the chill factor. Blowing sand may add to the discomfort close to the dunes.

The general pattern of visitor use has been that it is very low in July and August, the period of hottest weather, but increases in the fall and continues until Thanksgiving. Visitor-use then drops off during the winter months and resumes again to a peak during the spring holidays, until the height of the flowering season in May. Occasionally group field trips may occur as late as June after school is out.

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Proper visitor-use management requires consideration of traditional periods of high and low visitation as influenced by the seasonality of the area and various holidays. Patrolling should be increased during anticipated peak-use periods and may be reduced during periods of low use.

In keeping with the objectives of the recovery plan, and considering the problems of maintenance in such a remote area, camping areas should be simple and servicing kept to a minimum. Considerations of aesthetic compatibility are also very important. Further, visitors should be expected to be self-sufficient.

Camping areas are best located near the access road. The location recommended in Part II provides the best view of Eureka Dunes (see figure 4). Camp sites, as mentioned previously, should be simple and relatively primitive. Due to the distance from any service center, servicing and maintenance will be costly. Further, campers should be informed (before they arrive at the dunes) that they must bring their own water and firewood, as well as enough gasoline to make the return trip. They <u>must</u> also be responsible for carrying out their garbage and trash.

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Even though simple and casual, campgrounds should be well defined to prevent spreading haphazardly across the desert. Camp sites should be well separated to allow appreciation of space and solitude. Metal barriers, such as used on highways, might be the most practical form to outline the campground and camp sites. They should be low, however, and painted to blend with the desert colors. Rows of rock would be more acceptable, aesthetically, but rocks are easily moved. Photographers will appreciate having the campground located away from the dunes, out of line with the scene to be photographed.

A critical factor in locating campgrounds is to choose stabilized surfaces away from or between drainage courses. The sites suggested are on desert pavement, a surface undisturbed by drainage channels. Here the "pavement" is extensive enough that it has been used as an airstrip. Disturbance of the surface by camp use would expose the fine, loose soil underneath, however. A cement slab at each camp site, large enough for the picnic table and a fire ring toward one end, is recommended. It not only would keep the camper out of the dust but would also be an incentive to confine camping to designated sites, and fires to fire rings. Similar areas a short distance above (northward) would be appropriate for a group campground. Three group sites are recommended, large enough to accommodate 12 people each. The campground locations are just off the main access road and east of

APPENDIX IV

it, north of the present intersection with a jeep trail that runs eastward.

Many visitors will come in recreation vehicles such as campers or travel trailers, and thus will be relatively self-sufficient. However, tent campers and those who prefer to sleep under the stars must also be considered. They should be provided with suitable sites somewhat apart from the more developed camping sites.

Notices should be posted urging cooperation in maintaining the camping areas and in considering fellow campers. Radios and mechanical noises should be kept subdued. Campers should be reminded that native vegetation is sparse and slow growing, and should not be damaged or removed. They should be advised that fire rings are provided for their comfort and should be kept clean for the next visitor.

The undeveloped, completely primitive camp area (designated for those who prefer that type of camping), should be about two miles (3.2 km) east of the campground, well away from the dunes. Access should be by the spur off the primitive road where it turns southward.

As recommended in Part II of the recovery plan, a small day-use and parking area should be provided at the dunes. Such a drive-in site

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for day-use allows an intimate dune experience for those unable to walk from the campground. It also provides a convenient place for small children to enjoy sand play. The parking area, as recommended, should have barriers to keep vehicles apart from the picnic and play areas. Visitors here will be referred to the rest rooms at the campgrounds.

It may be necessary to improve the road between the campground and the picnic site. At the present time there is danger of getting stuck in the mud in wet weather. The road should not continue beyond the picnic parking area. The existing track southward from that point should be closed to limit impact to the dune biota.

An existing primitive road turns left (east) just below the proposed campground. It continues eastward until it curves around the sandy borders and clay surfaces beyond the northeast corner of the dunes. The access road to the primitive camp area branches off here. Beyond this point the road is a 4-wheel drive route and should be posted accordingly. It continues southward past a massive mudslide formation and up a wash toward a canyon in the Last Chance Mountains. The route beyond the Eureka Dunes camp area should not be improved or maintained. One "shortcut" with a particularly bad sandtrap should be closed. As long as the road is not improved its impact is not

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expected to be objectionable. It brings one closer to the rugged formations of the Last Chance Mountains east of the dunes and broadens the interpretive opportunities. It will be necessary, however, to restrict certain activities such as camping along a portion of the 4-wheel drive route through the mountains. Such activities will adversely affect that portion above the series of three drop-offs, an area where fragile ecological values require protection.

Interpretation

In the long range plan, interpretation should play a major role. The geologic story of the Eureka Dunes, the focus on them by early man, and the unique development of the flora and fauna as the site became isolated after the Pleistocene Epoch are among those which should be told. An interpretive chart identifying tracks in the sand would be of interest to all ages. Meaningful interpretation will foster respect for the values addressed in this plan.

Vandalism could be a problem, especially during the period of adjustment to passive forms of recreation. Former permissiveness will have to be overcome. In the beginning a simple interpretive display is recommended, with the idea of expanding it from time to time. A panel of general interest but modest in outlay should be adequate for the first period. It should be located at the campground entrance. A display to interpret tracks on the sand might be located at the picnic

APPENDIX IV

area. A small interpretive folder or booklet, or both, should be prepared and made available at the nearest BLM offices and information centers. A reasonable charge could be made to cover the cost. This would give satisfaction to those truly interested in learning more. To show relationship to other points, stationary pointers could be aimed at prominent landmarks such as Waucoba Mountain and White Mountain Peak, giving the elevations of each along with pertinent information. An on-site interpretive specialist during peak visitor-use periods could present slide shows, walks, talks, and provide some policing of the site.

Safety and Enforcement

Regular ground as well as some air patrols recommended in Part II are necessary to protect the area and avoid abuses to recreation. They are essential to a successful management plan. It must be made evident from the beginning that regulations are backed by reason and that they are to be enforced. The informative sign, placed at the turnoff for the Eureka Dunes, should give the distance to the dunes, provide campground information, and advise that no water or firewood are available. All signs should be positive in nature. Visitors should be made aware of the fact that they are visiting a unique area in which restrictions are necessary, but that their welfare and pleasure are being considered.

APPENDIX IV

Most recreationists are inclined to come alone or in small groups. Thus, it is important that road conditions be safe. A lone camper who becomes stuck in sand or mud could be in serious trouble at that isolated site. This plan has considered the dangerous isolation. It has recommended improvement of problem areas in roads that will remain a part of the plan. Hazardous places, such as south of the picnic area and the sandtrap on the cutoff north of the dunes should be closed. Any other than designated roads should be closed.

Dehydration is always a danger in remote desert places as more liquid is required where relative humidity is low. Informative publications should include this warning and advise taking plenty of water. In years past local people made a habit of leaving jugs of water at the dunes for emergency use. It might be well to reestablish that practice. A bin to protect jugs "for emergency use only" could be provided at the end of the road.

APPENDIX V

AGENCIES CONTACTED DURING AGENCY REVIEW

Responded

U.S. Fish and Wildlife Service - Washington, D.C. and Portland, OR

Bureau of Land Management - Sacramento, CA

U.S. Geological Survey - Menlo Park, CA

California Department of Fish and Game - Sacramento, CA

California Division of Mines and Geology - Sacramento, CA

California Department of Conservation - Sacramento, CA

Inyo County Planning Department - Independence, CA