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THE OCCURRENCE AND STATUS OF CANDIDATE SPECIES LISTED BY THE U. S. FISH AND WILDLIFE SERVICE ON NAVAL PETROLEUM RESERVE #1, KERN COUNTY, CALIFORNIA

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This report is unclassified: Lonnie P. Hocker

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ABSTRACT

The distribution and status of four plant and nine animal species being considered by the U.S. Fish and Wildlife Service (FWS) for protection under the Endangered Species Act and one animal species recently listed in the Act as endangered was determined for the Naval Petroleum Reserves in California (NPR-1 and 2). Hoover's woolly-star (Eriastrum hooveri), a Category 2 plant species, was located at 28 sites on NPR-1. The California jewelflower (Caulanthus californicus), Kern mallow (Eremalche kernensis), and San Joaquin woolly-threads (Lembertia congdonii) were not observed. Of these, the Kern mallow is most likely to occur based on habitat utilization and autecology. No evidence was gathered that suggests the Buena Vista Lake shrew (Sorex ornatus relictus) was present on either of the Reserves. Nelson's antelope ground squirrel (Ammospermophilus nelsoni) and the short-nosed kangaroo rat (Dipodomys nitratoides brevinasus) are both Category 2 mammals that were relatively abundant on NPR-1 and 2. The San Joaquin pocket mouse (Perognathus inornatus) was also captured on NPR-1 and 2, but was less numerous. The Tipton kangaroo rat (Dipodomys nitratoides nitratoides), a recently listed endangered species, was found in Section 23S of NPR-1 and Section 18H of NPR-2. No evidence was found that Morrison's blister beetle (Lytta morrisoni), Moestan blister beetle (Lytta moesta), Hopping's blister beetle (Lytta hoppingi), and the Molestan blister beetle (Lytta molesta) exist on either of the Reserves. Similarly, a survey conducted for the striped-skinned snail (Helminthoglypta callistoderma) found no evidence that the snail exists on either of the Reserves. No additional surveys for candidate species that were undetected are needed unless new evidence is collected that suggests the species are or may be present.

ACKNOWLEDGEMENTS

JoAnne Ando of EG&G/EM assisted in deriving sorts of computerized small mammal data. Permission to trap, handle, and eartag small mammals was granted by the California Department of Fish and Game through permit 5206. Permission to trap and mark mammalian species of special concern and state-threatened species was granted by a Memorandum of Understanding between the California Department of Fish and Game and EG&G Energy Measurements, Inc. Permission to trap, handle, and eartag the endangered giant and Tipton kangaroo rat was granted by the U.S. Fish and Wildlife Service through permit PRT-683011.

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1. INTRODUCTION

In compliance with the Naval Petroleum Reserves Production Act of 1976 (Public Law 94-258), the U.S. Department of Energy (DOE) undertook a major program on Naval Petroleum Reserve #1 (NPR-1, Elk Hills) to produce oil and gas at the maximum efficient rate (MER) consistent with sound engineering practices (U.S. Department of Energy, 1979). The first draft Biological Opinion which assessed the effects of implementing MER recommended that DOE determine the occurrence and status of candidates for federal listing as threatened or endangered species.

DOE has always been proactive about determining the status of species of concern on NPR-1 and NPR-2. In the past such information, like that on the giant kangaroo rat (Dipodomys ingens) (O'Farrell, et al., 1987b; O'Farrell and Kato, 1987), was valuable in defusing unwarranted concerns about affects of DOE activities on sensitive species. It also provides DOE with early warning about species that may be listed and require conservation measures in the near future. The information will also be needed for the development of a Supplemental Environmental Impact Statement to assess the environmental effects of the expansion of steamflood activities at NPR-1.

Management of the Reserve can only be achieved through cooperative efforts between various land users. The occurrence and status of endangered or threatened populations of wild animals must be documented before sound management plans can be developed.

The objective of this report is to describe the occurrence and status of one recently listed endangered species (Tipton kangaroo rat, Dipodomys nitratoides nitratoides) and 13 plant and animal species that are presently being considered for addition to the list of endangered and threatened species. All but one of the species (San Joaquin woolly-threads, Lembertia congdonii) being considered for listing as threatened or endangered is presently listed as a Category 2 species. Category 2 species " . . . comprises taxa for which information now in possession of the Service indicates proposing to list the species as endangered or threatened is possibly appropriate, but for which conclusive data on biological vulnerability and threat(s) are not currently available to support proposed rules at this time." (Federal Register, 49:21664). Although Category 2 species receive no substantive or procedural protection under the Endangered Species Act, the U.S. Fish and Wildlife Service (FWS) encourages federal agencies to take such taxa into account in environmental planning. San Joaquin woolly-threads has no federal status. It was included in the plant survey because FWS is proposing that this species be listed as threatened (Jim Bartell, FWS, Sacramento, California, personal communication, December 1986).

This report specifically discusses the occurrence and status of four plant species (Hoover's woolly-star, Eriastrum hooveri; Kern mallow, Eremalche kernensis; California jewelflower, Caulanthus californicus; San Joaquin woolly-threads), five vertebrate species (Buena Vista Lake shrew, Sorex ornatus relictus; Nelson's antelope ground squirrel, Ammospermophilus nelsoni; San Joaquin pocket mouse, Perognathus inornatus; short-nosed kangaroo

rat, Dipodomys nitratoides brevinasus; Tipton kangaroo rat) four blister beetle species (Hopping's blister beetle, Lytta hoppingi; Moestan blister beetle, Lytta moesta; Molestan blister beetle, Lytta molesta; Morrison's blister beetle, Lytta morrisoni), and one snail species (striped-skinned snail, Helminthoglypta callistoderma).

Field surveys were conducted on NPR-1 and portions of NPR-2 to assess the occurrence and status of the above species. The plant survey (Chapter 3) was done by D. W. Taylor, R. E. Palmer, G. L. Clifton, and K. A. Teare of Biosystems Analysis, Inc. The vertebrate survey (Chapter 4) was done by EG&G Energy Measurements, Inc. Most of the data used in the vertebrate survey were collected when trapping was done to monitor trends in populations of small mammals used as alternate prey by the San Joaquin kit fox (Vulpes macrotis mutica). The blister beetle survey (Chapter 5) was done by F. G. Andrews and A. R. Hardy of Scarabaeus Associates; and the snail survey (Chapter 6) was done by B. Roth.

2. STUDY AREA

NPR-1 and NPR-2 are located approximately 26 miles west-southwest and southwest, respectively, Bakersfield, Kern County, California (Figure 1). NPR-1 is located adjacent to the northwestern border of NPR-2 and consists of 47,245 acres in townships Z (T30S, R22E), R (T30S, R23E), S (T30S, R24E), T (T30S, R25E), B (T31S, R23E), G (T31S, R24E), and M (T31S, R25E). NPR-2 consists of 30,080 acres in townships B (T31S, R23E), C (T32S, R23E), D (T32S, R24E), G (T31S, R24E), and H (T32S, R25E). DOE has jurisdiction over only 10,400 acres of NPR-2. The remainder of NPR-2 is privately owned and developed, and the city of Taft occupies 1,280 acres in the southern corner.

NPR-1 is bisected by the Elk Hills which are low foothills of the Temblor Range that extend southeastward into the San Joaquin Valley. The Buena Vista Hills extend the length of NPR-2, northwest to southeast, and are roughly parallel with the Elk Hills to the north. These two sets of hills are separated by the Buena Vista Valley. Together the Elk Hills and Buena Vista Hills form a region of steep terrain rising from the floor of the southwestern edge of the San Joaquin Valley just east of, but disjunct from, the Temblor Range. Elevations range between 290 and 1,551 feet above sea level on NPR-1 and between 310 and 1,288 feet on NPR-2.

Annual weather patterns consist of hot, dry summers and cool, damp winters. Mean maximum temperatures in summer and winter are 95°F and 65°F, respectively (data for Bakersfield, California; National Weather Service, no date). Mean minimum temperatures are 65°F in summer and 40°F in winter. Nearly all of the 4.5 to 6 inches of annual precipitation occurs during the winter months.

The vegetation association on NPR-1 and NPR-2 is Lower Sonoran grassland (Twisselmann, 1967). The vegetation is dominated by a dense annual ground cover of red brome (Bromus rubens) and red-stemmed filaree (Erodium cicutarium). Desert saltbush (Atriplex polycarpa) grows throughout the two Reserves and is especially dense along washes and in draws and in disturbed areas such as road sides and edges of well pads. Other locally common shrubs include spiny saltbush (Atriplex spinifera), cheesebush (Hymenoclea salsola), matchweed (Gutierrezia bracteata), winter fat (Ceratoides lanata), and buckwheat (Eriogonum fasciculatum). Section 18H of NPR-2 is dominated by the alkali sink association characterized by inkweed (Suaeda fruticosa).

NPR-1 and NPR-2 contain a diverse and abundant vertebrate fauna. A total of 92 species of birds, 24 species of mammals, 8 species of reptiles, and 2 amphibians have been observed on NPR-1 (O'Farrell and Scrivner, 1987). Twenty species of mammals, 45 species of birds, and 8 species of reptiles have been observed on NPR-2 (O'Farrell, et al., 1987a).

More detailed descriptions of the Reserves can be found in O'Farrell, et al. (1986), and O'Farrell and Sauls (1987).

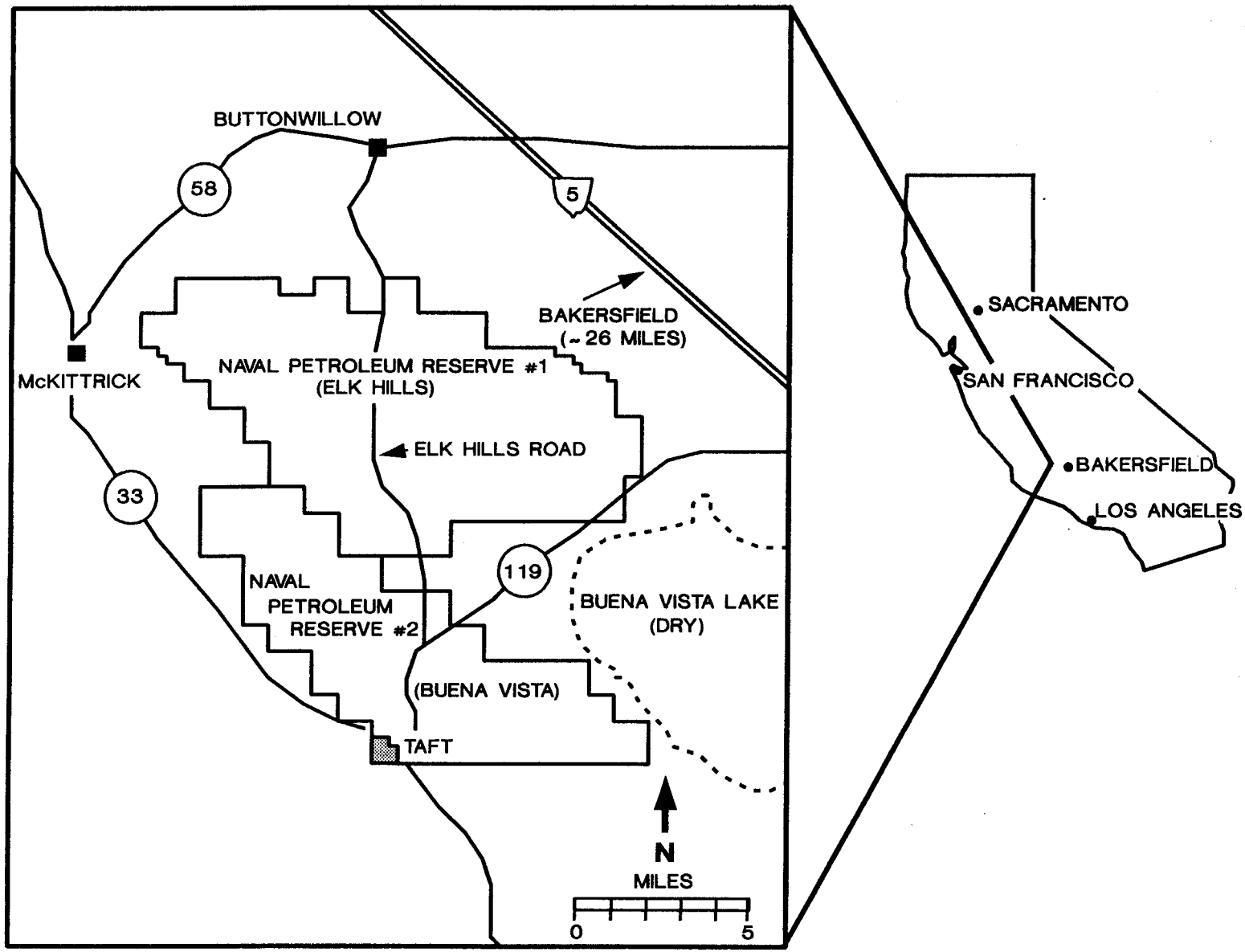

Figure 1. Location of the U.S. Department of Energy's Naval Petroleum Reserve #1 (Elk Hills) and NPR-2 (Buena Vista).

3. DISTRIBUTION AND ABUNDANCE OF PLANTS

3.1 BACKGROUND

One task of the 1979 field program at the Naval Petroleum Reserves was to determine whether the following candidate threatened or endangered species of plants occurred on Elk Hills: Bakersfield cactus (Opuntia basilaris treleasei), cottony buckwheat, (Eriogonum gossypinum), slough thistle (Cirsium crassicaule), and tule shadscale (Atriplex tularensis) O'Farrell, 1980). Cottony buckwheat was found at 255 locations of NPR-1. In general, cottony buckwheat was found to be more widespread than expected; Bartell (FWS, Sacramento, California, personal communication, December 1986) indicated that FWS has recommended that the cottony buckwheat be reclassified as a Category 3c species, which are species that have proven to be more abundant than previously thought and/or are not subject to any identifiable threat. No other evidence of endangered or threatened flora was found during the 1979 survey.

Excluding cottony buckwheat, three plant species are likely present or known to occur on NPR-1 and are classified as Category 2: California jewelflower, Hoover's woolly-star, and Kern mallow (Federal Register, 50:39538-39549). Bartell (FWS, Sacramento, California, personal communication, July 1988) indicated that a listing package that includes these species and also San Joaquin woolly-threads, a fourth species suspected of occurring at Elk Hills, is under review within FWS; a Notice of Review to list these species under the Endangered Species Act may soon appear in the Federal Register. For each of these species, a detailed range-wide field survey has been conducted to determine the degree of endangerment of each taxon and its appropriateness for listing. FWS has published the results of these listing-support surveys (Taylor and Davilla, 1986; Taylor, 1988a). Table 1 provides the relevant endangerment classification status for each of these taxa.

3.2 METHODS

Because of the large size of the Reserve, the entire region could not be surveyed in equal detail given seasonal (phenologic) and budgetary constraints. Identification of the most appropriate habitat for the four species was based on published information on habitat selection for these species (Taylor and Davilla, 1986; Taylor and Stebbins, 1988; Taylor, 1988a,b). Based on available information, it was determined that the sites where the four plant species would most likely occur were essentially confined to the lower flanks of the Elk Hills. Most of the interior portion of NPR-1 consists of steep slopes and narrow intervening ridges. Based on the historical and present distribution of these species, this type of physiographic setting is not optimal habitat.

One-square-mile sections of the NPR-1 were evaluated for appropriate habitat. If an entire section was considered to contain potential habitat, one or more quarter sections were randomly chosen for survey.

Table 1. Plant species on or adjacent to Naval Petroleum Reserve #1 being considered by the U.S. Fish and Wildlife Service for listing under the Endangered Species Act.

Taxon	1985 Federal Status[1]	Recommended Listing Status[2]
California jewelflower	Category 2	Endangered
Kern mallow	Category 2	Endangered
Hoover's woolly-star	Category 2	Threatened
San Joaquin woolly-threads	None	Endangered

1. Federal Register 50(188):39526-39527. Category 2 species are those which the U.S. Fish and Wildlife Service has information suggesting that "proposing to list them as endangered or threatened is possibly appropriate, but for which substantial data on biological vulnerability and threat(s) are not currently known or on file to support the immediate preparation of rules."

2. J. A. Bartell, U.S. Fish and Wildlife Service, Sacramento, California, personal communication, July 1988.

Section and/or quarter sections surveyed for the four plant species are identified in Figure 2.

Within each section or quarter-section, a meander method (Nelson, 1987) was used to identify candidate plants. Surveys were floristic in nature: the degree to which all habitats within a given section were inspected for candidate plants was judged by the rate of observation of plant species as a function of survey effort. For each site, a tally of species was maintained as the survey proceeded. The surveys continued until no new species were encountered, whereupon a new site was visited.

3.3 RESULTS AND DISCUSSION

Plant species observed in each section surveyed are listed in Table 2. Only one of the four species for which the survey was conducted was observed: a total of 28 populations of Hoover's woolly-star were identified (Figures 3-10).

None of the other plants being considered for listing were observed on NPR-1. Judging the likelihood that these plants occur on NPR-1 is predicated on the fact that knowledge of their ecology and habitat selection is based on a very few extant populations. Based on field observations, rainfall during the beginning of the 1988 growing season was sufficient for germination and early growth at all known populations of these species. However, an unusually early onset of drought occurred (in mid-January), making conditions less than optimal during the survey period.

The survey was sufficiently detailed and growing conditions were sufficient to judge that California jewelflower is not likely to occur on NPR-1. Similarly, much of NPR-1 is not likely to provide habitat for San Joaquin woolly-threads. For the Kern mallow, much of the northern base of NPR-1 is appropriate habitat. The significance of NPR-1 as habitat for candidate plants is discussed below.

3.3.1 Hoover's Woolly-Star

The 28 populations of Hoover's woolly-star that were observed on NPR-1 were largely confined to the alluvial fans and plains on the northern and eastern boundary of the Reserve. Two closely related taxa of Eriastrum predominately occur parapatric on the Reserve with Hoover's woolly-star: Eriastrum pluriflorum spp. pluriflorum and Eriastrum pluriflorum spp. sherman-hoyteae generally occur on the summit or upper slopes of rounded, barren hills. However, at two locations, Eriastrum hooveri and Eriastrum pluriflorum spp. pluriflorum were observed growing together in a mixed stand. Both taxa of Eriastrum pluriflorum can be distinguished from Eriastrum hooveri by corolla size and color: Eriastrum hooveri has small, greenish-white corollas about 0.2 inches long that barely exceed the calyx, whereas Eriastrum pluriflorum has large, 0.4-0.6 inch long lavender corollas with a yellow band at the throat.

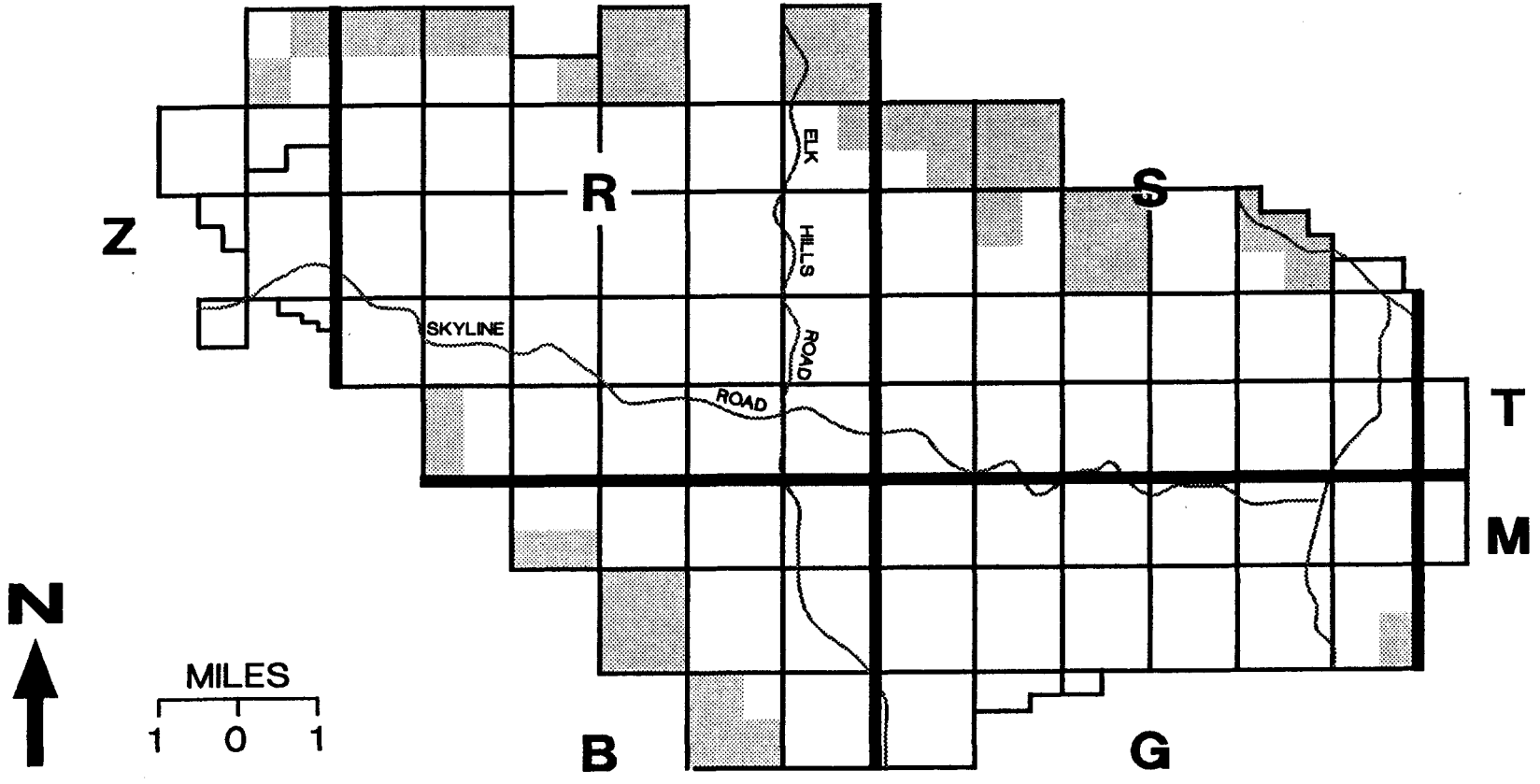

Figure 2. Areas of Naval Petroleum Reserve #1, Kern County, California, surveyed for plants being considered for listing by the U.S. Fish and Wildlife Service as threatened or endangered. Bold letters and lines define townships.

Table 2. List of vascular plants observed during the survey for candidate plant species on Naval Petroleum Reserve #1, Kern County, California.

Family Species Name	Location													
	12Z	8R	10R	12R	25R	32R	17S	18S	19S	21S	23S	25S	4B	12-13G
DICOTYLEDONS														
Aizoaceae														
Mesembryanthemum nodiflorum														x
Asteraceae														
Agoseris grandiflora			x	x										
Agoseris heterophylla		x			x				x	x				
Centaurea solstitialis				x							x	x		
Chaenactis stevioides					x				x					
Eastwoodia elegans	x	x												
Gutierrezia bracteata		x	x	x	x	x	x		x	x			x	x
Haplopappus acradenius bracteosus			x				x		x	x	x			
Haplopappus linearifolius					x	x			x					
Hemizonia pallida	x	x				x			x				x	x
Hemizonia pungens											x			
Hymenoclea salsola		x	x	x	x	x	x	x	x	x	x	x	x	x
Hypochoeris glabra		x									x			
Hypochoeris radicata									x	x				
Lactuca serriola				x										
Lasthenia californica	x	x	x	x	x	x	x	x	x	x	x		x	
Lasthenia ferissiae											x			
Lasthenia glabrata												x		
Layia pentachaeta albida				x									x	
Lessingia nemaclada												x		
Malacothrix californica												x		
Malacothrix coulteri	x	x	x	x	x	x	x		x		x		x	
Matricaria matricarioides											x			

Table 2. List of vascular plants observed during the survey for candidate plant species on Naval Petroleum Reserve #1, Kern County, California (continued).

Family Species Name	Location													
	12Z	8R	10R	12R	25R	32R	17S	18S	19S	21S	23S	25S	4B	12-13G
Microseris douglasii		x												
Microseris lindleyi			x							x		x	x	
Monolopia stricta					x				x					
Rafinesquia californica									x					
Senecio vulgaris	x	x	x	x	x	x	x	x	x	x	x	x		x
Sonchus asper							x		x					
Sonchus oleraceus	x	x									x			
Stephanomeria pauciflora						x						x		
Stylocline gnaphalioides		x	x	x	x	x		x	x	x	x	x	x	x
Boraginaceae														
Amsinckia intermedia	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Cryptantha flaccida											x			
Pectocarya penicillata heterocarpa	x	x	x	x	x		x	x	x	x		x	x	x
Plagiobothrys bracteatus								x					x	
Plagiobothrys canescens		x	x	x	x	x	x		x	x	x	x	x	x
Plagiobothrys infectivus			x							x				
Brassicaceae														
Brassica geniculata											x			
Brassica nigra							x							
Brassica rapa olifera											x			
Capsella bursa-pastoris						x						x		
Caulanthus lasiophyllus	x	x	x	x		x			x	x	x			
Lepidium dictyotum			x								x			
Lepidium nitidum	x	x	x	x	x	x	x		x	x	x	x	x	x
Sisymbrium irio		x		x		x								

Table 2. List of vascular plants observed during the survey for candidate plant species on Naval Petroleum Reserve #1, Kern County, California (continued).

Family Species Name	Location													
	12Z	8R	10R	12R	25R	32R	17S	18S	19S	21S	23S	25S	4B	12-13G
Sisymbrium officinale											x	x		
Tropidocarpum gracile				x										
Capparidaceae														
Cleome isomeris		x		x		x		x						
Cariophyllaceae														
Cerastium glomeratum											x			
Loeflingia squarrosa			x	x	x		x	x	x	x	x		x	x
Chenopodiaceae														
Allenrolfea occidentalis											x			
Atriplex patula												x		
Atriplex phyllostegia											x			
Atriplex polycarpa	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Atriplex spinescens											x			
Atriplex vallicola														?
Ceratoides lanata	x	x		x	x	x			x	x				
Chenopodium album											x			
Monolepis nuttalliana														x
Salicornia subterminalis											x			
Salsola iberica											x			
Suaeda californica											x			
Crassulaceae														
Crassula erecta	x	x	x	x	x	x	x	x	x	x	x		x	x
Cucurbitaceae														
Cucurbita foetidissmia							x							
Euphorbiaceae														
Eremocarpus setigeruns			x											

Table 2. List of vascular plants observed during the survey for candidate plant species on Naval Petroleum Reserve #1, Kern County, California (continued).

Family Species Name	Location													
	12Z	8R	10R	12R	25R	32R	17S	18S	19S	21S	23S	25S	4B	12-13G
Fabaceae														
Astragalus didymocarpus						x			x	x				
Astragalus lentiginosus nigricalycis	x	x	x	x	x	x	x	x		x	x	x	x	
Astragalus lentiginosus variabilis											x			
Lotus subpinnatus	x	x	x		x	x			x	x	x	x	x	
Lupinus bicolor					x	x								
Lupinus concinnus agardhianus			x			x								
Lupinus nanus menkerae	x	x	x		x	x			x	x	x	x	x	x
Lupinus ruber	x	x	x						x	x		x		
Melilotus indica											x			
Prosopis juliflora torreyana											x			
Frankeniaceae														
Frankenia grandifolia											x			
Geraniaceae														
Erodium cicutarium	x	x	x	x	x		x	x	x	x	x	x	x	x
Erodium macrophyllum			x						x	x		x		
Hydrophyllaceae														
Phacelia ramosissima ramosissima				x							x			
Phacelia tanacetifolia					x				x					
Lamiaceae														
Marrubium vulgare							x							
Salvia carduacea		x	x	x		x	x	x	x	x	x	x		x
Salvia columbariae		x												
Loasaceae														
Mentzelia affinis			x											
Mentzelia dispersa	x	x			x	x			x	x				

Table 2. List of vascular plants observed during the survey for candidate plant species on Naval Petroleum Reserve #1, Kern County, California (continued).

Family Species Name	Location													
	12Z	8R	10R	12R	25R	32R	17S	18S	19S	21S	23S	25S	4B	12-13G
Malvaceae														
Eremalche parryi		x	x		x				x	x		x	x	x
Malva neglecta											x			
Sida hederacea											x			
Onagraceae														
Camissonia boothii decorticans		x	x		x	x			x	x				
Camissonia campestris		x	x		x	x	x		x	x				x
Papaveraceae														
Eschscholtzia californica											x			
Eschscholtzia caespitosa											x			
Platystemon californicus			x		x									
Stylomecon heterophylla		x				x		x						
Plantaginaceae														
Plantago hookeriana	x	x	x		x	x			x	x		x		x
Polemoniaceae														
Eriastrum hooveri		x	x	x		x	x	x		x	x	x	x	x
Eriastrum pluriflorum pluriflorum		x	x		x									
Gilia latifolia			x											
Linanthus dictyotum			x											
Linanthus liniflorus		x								x			x	
Polygonaceae														
Chorizanthe perfoliata		x	x											
Eriogonum temblorense										x				
Eriogonum angulosum		x			x	x		x		x				
Eriogonum fasciculatum			x			x								
Eriogonum gossypinum	x	x	x		x			x	x					

Table 2. List of vascular plants observed during the survey for candidate plant species on Naval Petroleum Reserve #1, Kern County, California (continued).

Family Species Name	Location													
	12Z	8R	10R	12R	25R	32R	17S	18S	19S	21S	23S	25S	4B	12-13G
Eriogonum maculatum									x					
Eriogonum ordii	x	x												
Eriogonum viridescens		x												
Hollisteria lanata					x									
Ranunculaceae														
Delphinium gypsophilum gypsophilum	x	x	x		x				x	x				
Resedaceae														
Oligomerus linifolia												x		x
Scrophulariaceae														
Orthocarpus brevistylus	x	x	x	x		x	x		x	x	x		x	x
Orthocarpus purpurascens	x	x	x			x			x	x	x			
Veronica peregrina xalapensis											x			
Solanaceae														
Lycium andersonii					x				x					
Nicotiana glauca							y				x	x		
Urticaceae														
Urtica dioica											x			
MONOCOTYLEDONS														
Liliaceae														
Dichelostemma pulchellum		x	x		x	x	x		x	x				
Poaceae														
Avena barbata		x	x		x	x	x	x		x	x	x		
Bromus diandrus			x		x			x	x	x	x	x		
Bromus rubens	x	x	x	x	x	x	x	x	x	x	x	x	x	
Bromus trinii	x	x								x	x			
Distichlis spicata stricta											x			

Table 2. List of vascular plants observed during the survey for candidate plant species on Naval Petroleum Reserve #1, Kern County, California (continued).

Family Species Name	Location													
	12Z	8R	10R	12R	25R	32R	17S	18S	19S	21S	23S	25S	4B	12-13G
Koeleria pheloides												x		
Hordeum depressum											x			
Hordeum geniculatum			x			x					x	x		x
Hordeum leporinum	x									x	x		x	
Hordeum vulgare									x		x			
Poa scabrella		x	x		x			x	x	x	x			
Schismus arabicus	x	x	x	x	x	x	x	x		x	x	x	x	x
Schismus barbatus	x	x	x							x		x		
Vulpia microstachys vars.	x	x		x	x		x		x	x	x	x	x	
Vulpia myuros	x	x	x	x	x	x	x	x	x	x	x	x	x	x

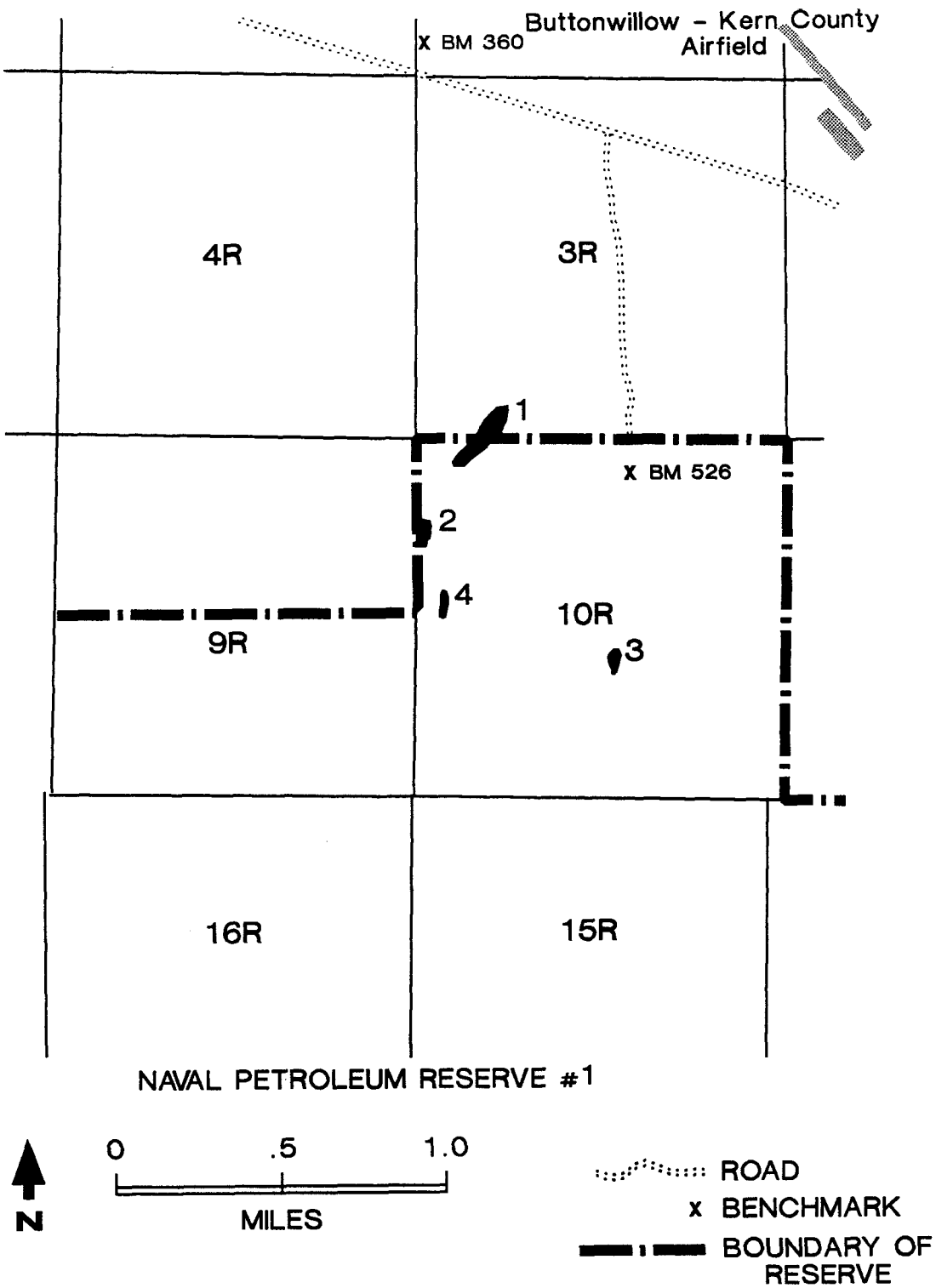

Figure 3. Location of Eriastrum hooveri populations 1 through 4 in Section 10R on Naval Petroleum Reserve #1, Kern County, California. Numbers followed by letters indicate section and township codes.

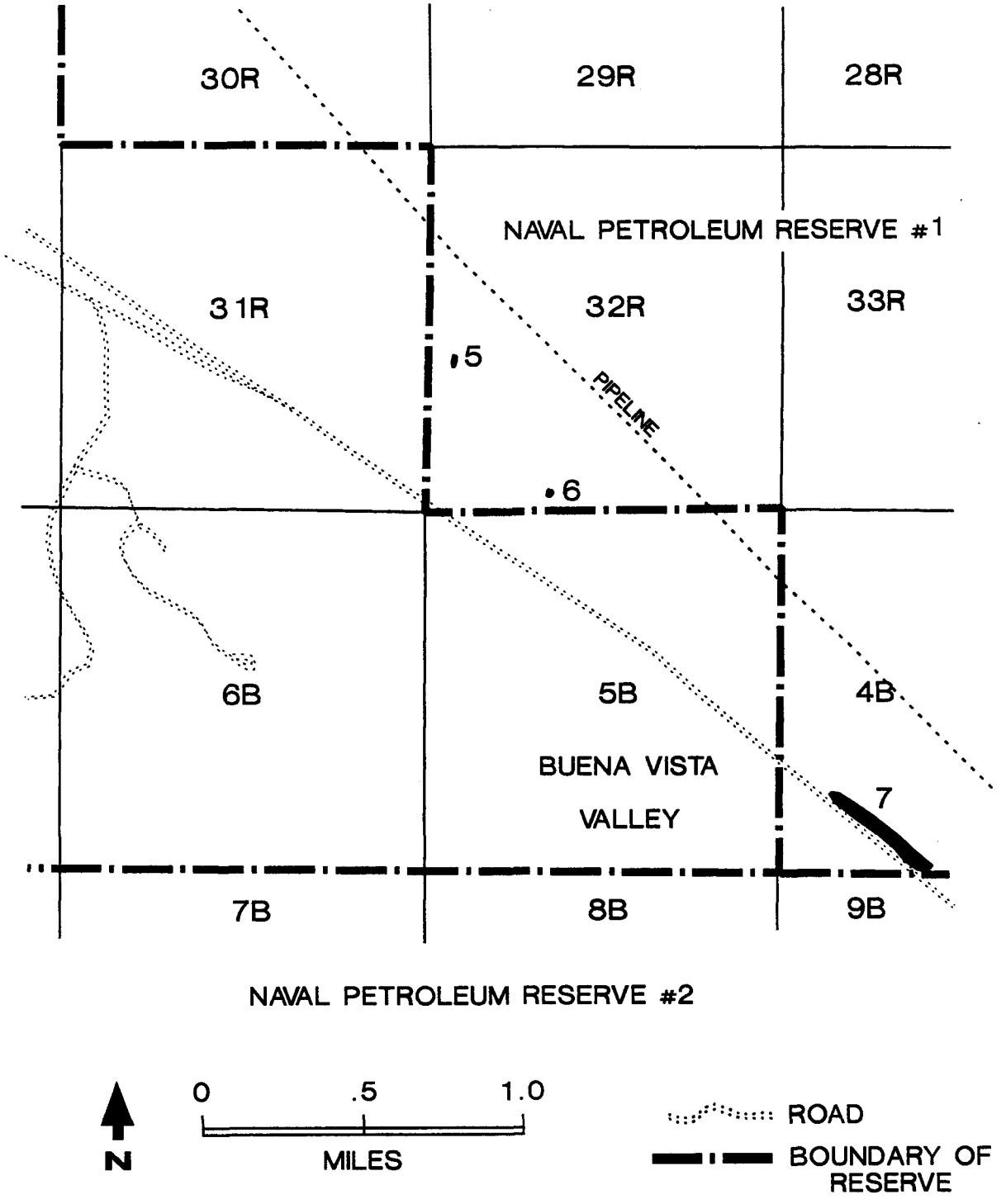

Figure 4. Location of Eriastrum hooveri populations 5 through 7 in Sections 32R and 4B on Naval Petroleum Reserve #1, Kern County, California. Numbers followed by letters indicate section and township codes.

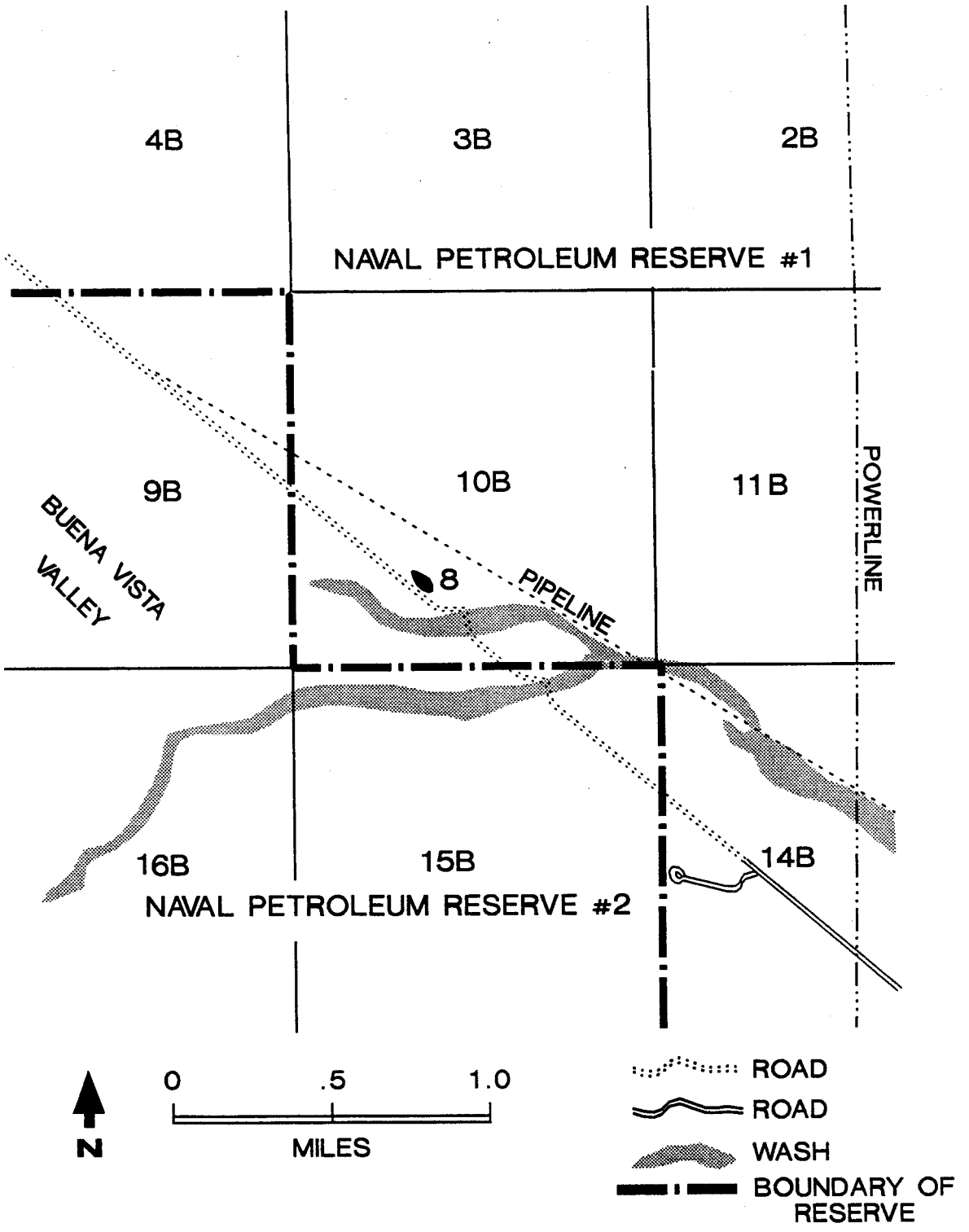

Figure 5. Location of Eriastrum hooveri population 8 in Section 10B on Naval Petroleum Reserve #1, Kern County, California. Numbers followed by letters indicate section and township codes.

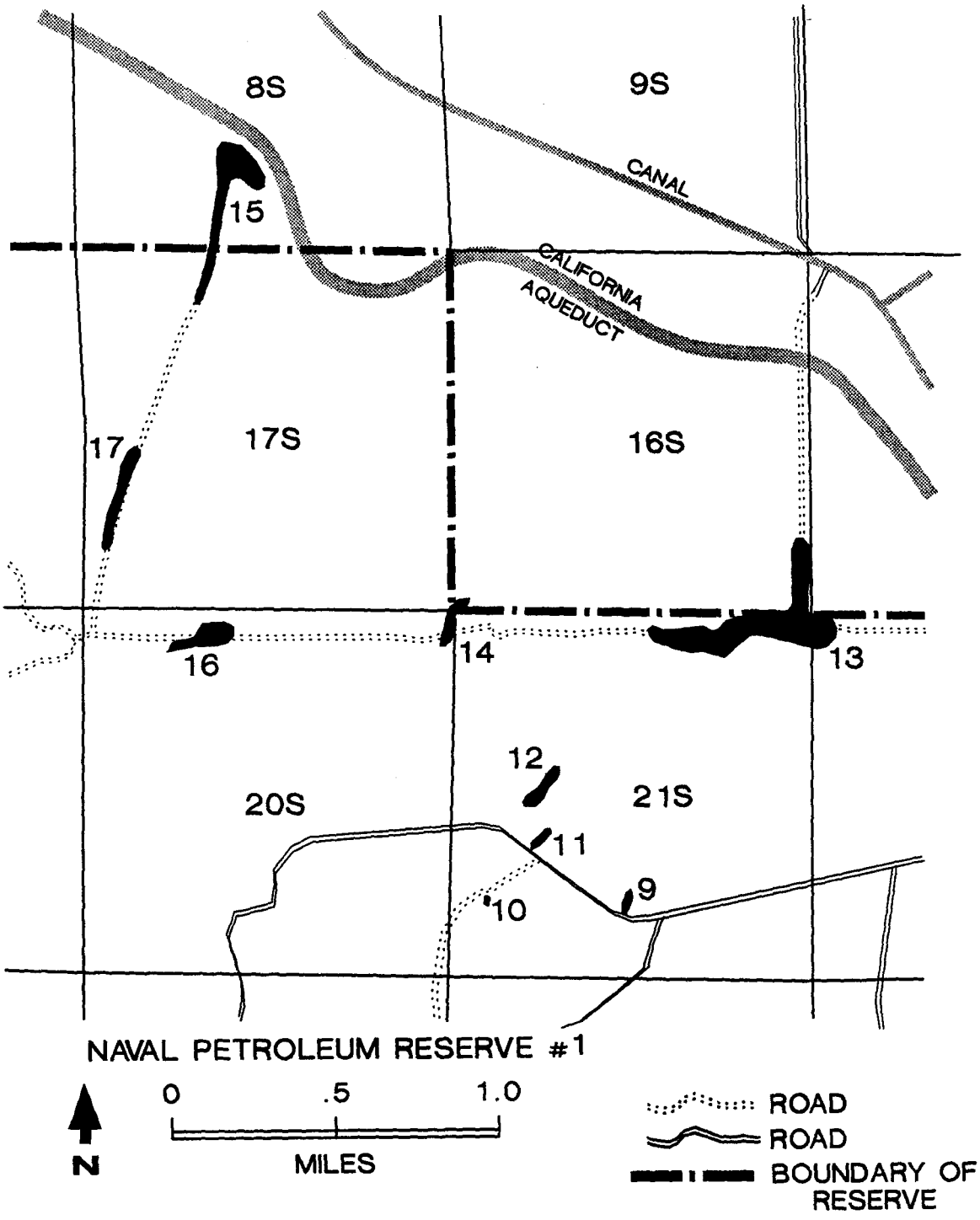

Figure 6. Location of Eriastrum hooveri populations 9 through 17 in Sections 17S, 20S, 21S, and 22S on Naval Petroleum Reserve #1, Kern County, California. Numbers followed by letters indicate section and township codes.

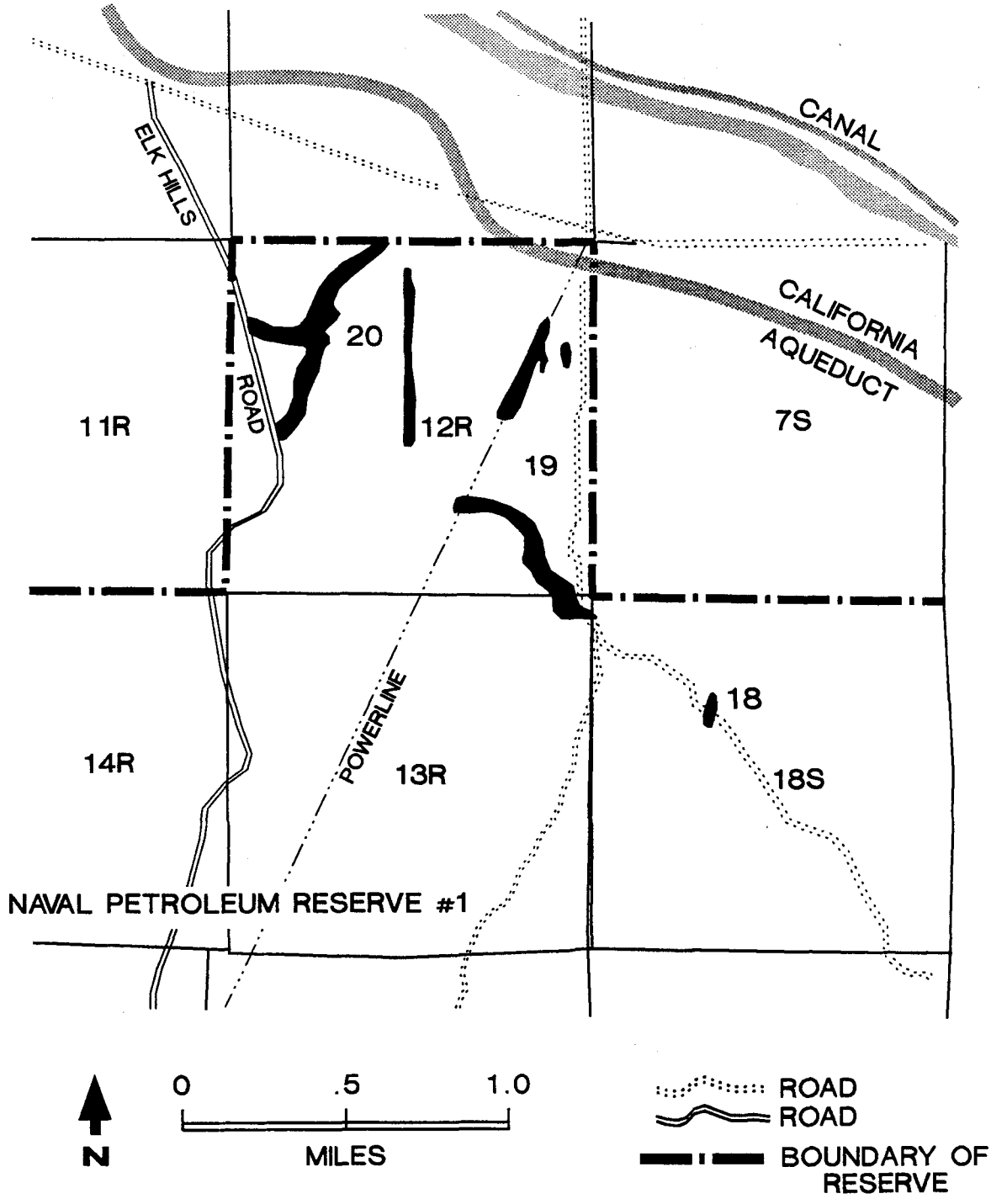

Figure 7. Location of Eriastrum hooveri populations 18 through 20 in Sections 18S and 12R on Naval Petroleum Reserve #1, Kern County, California. Numbers followed by letters indicate section and township codes.

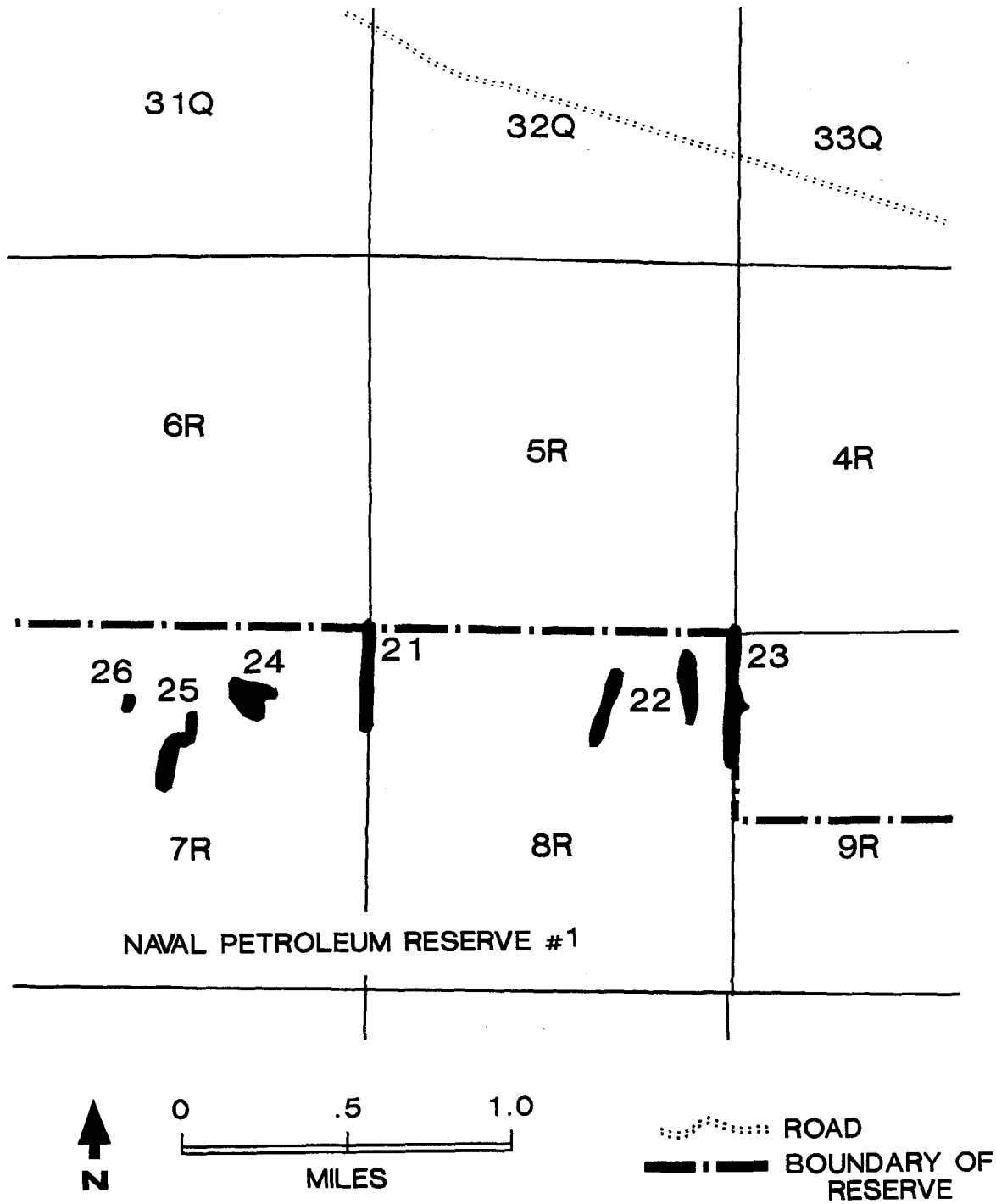

Figure 8. Location of Eriastrum hooveri populations 21 through 26 in Sections 7R and 8R on Naval Petroleum Reserve #1, Kern County, California. Numbers followed by letters indicate section and township codes.

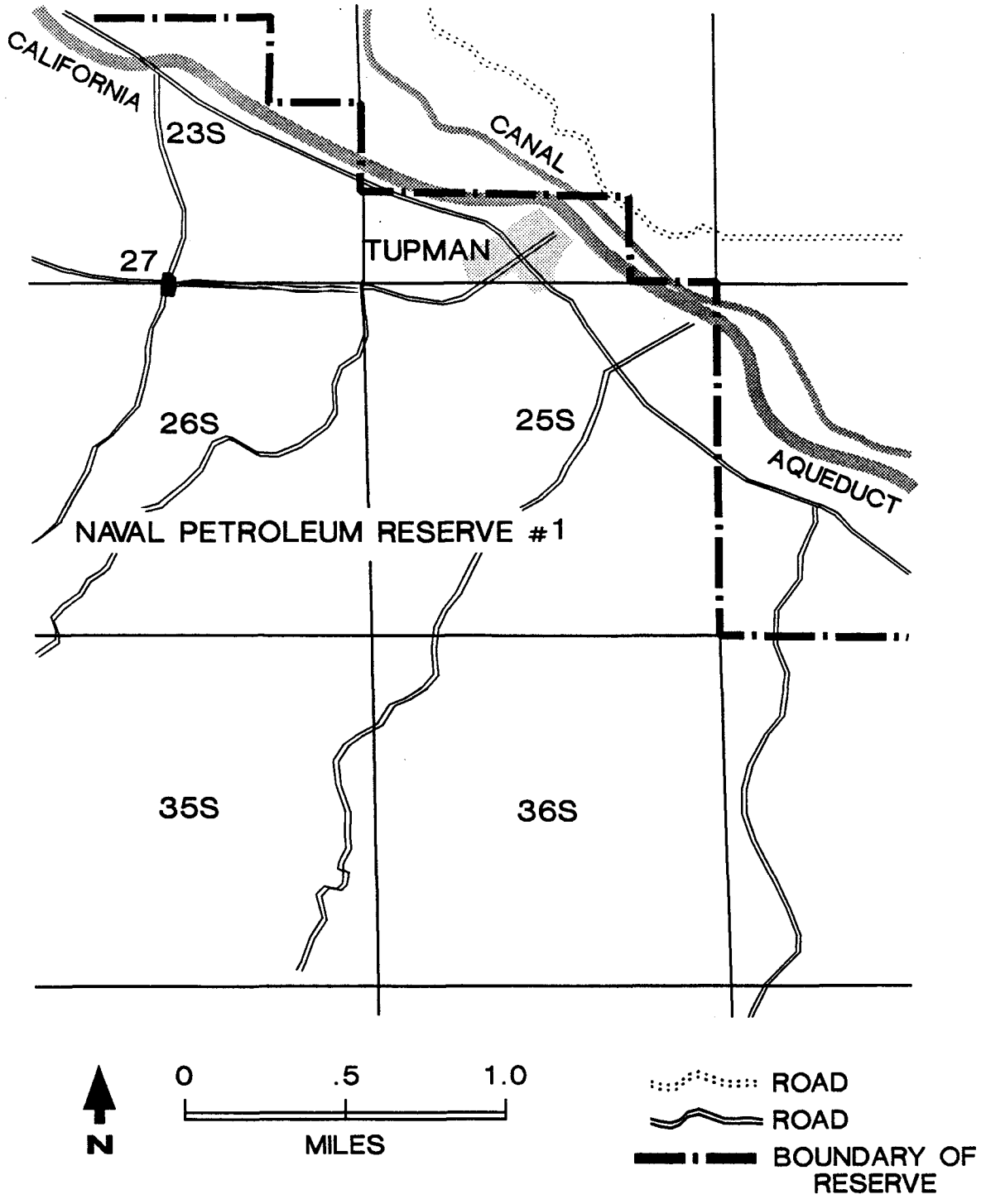

Figure 9. Location of Eriastrum hooveri population 27 in Section 23S on Naval Petroleum Reserve #1, Kern County, California. Numbers followed by letters indicate section and township codes.

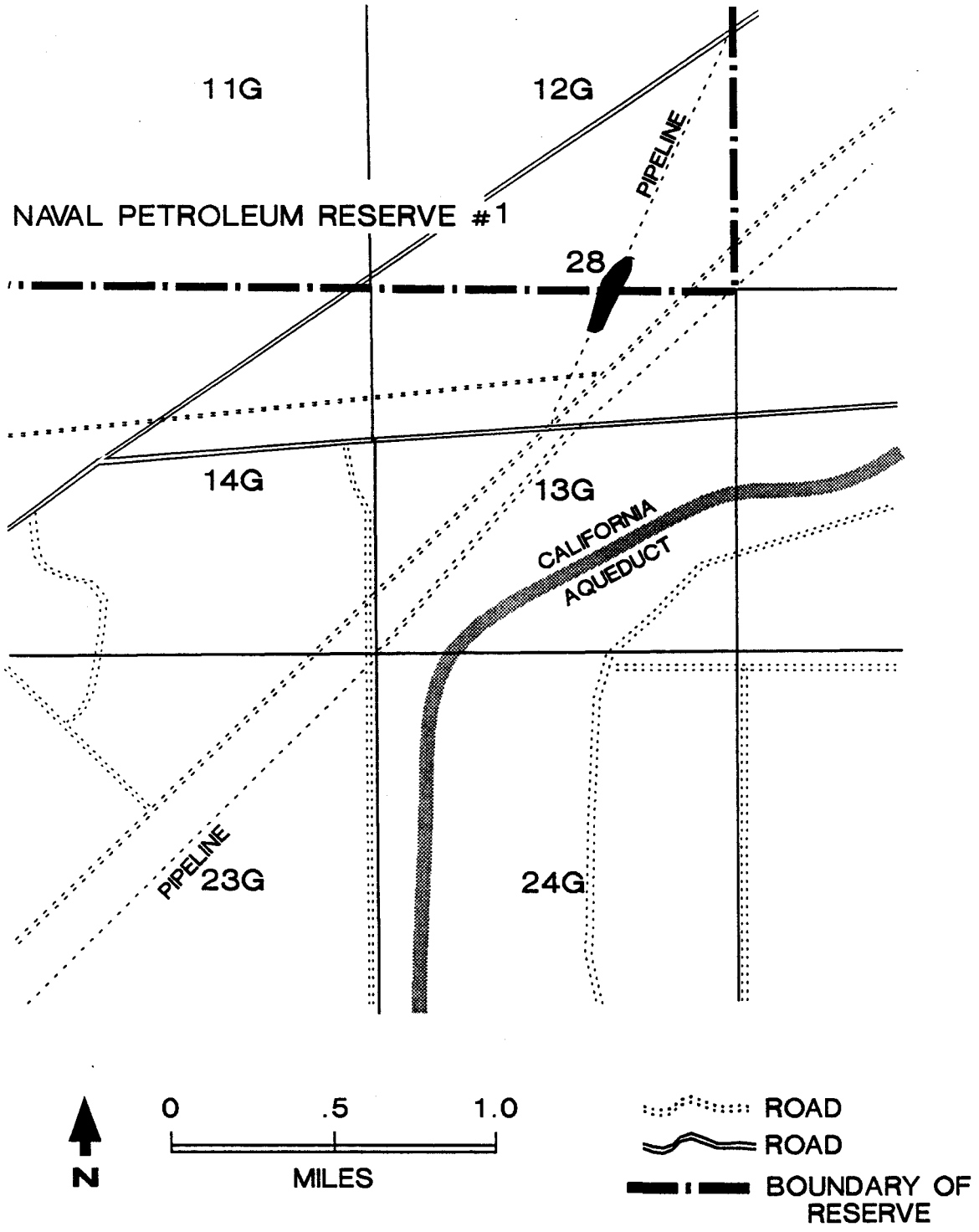

Figure 10. Location of Eriastrum hooveri populations 28 in Section 12G on Naval Petroleum Reserve #1, Kern County, California. Numbers followed by letters indicate section and township codes.

Table 3. The location and number of individuals within 28 populations of Eriastrum hooveri on Naval Petroleum Reserve #1, Kern County, California.

Population Number	Quadrangle	Location	Number of Individuals
1	East Elk Hills	10R	500
2	East Elk Hills	10R	100
3	East Elk Hills	10R	50
4	East Elk Hills	10R	5
5	West Elk Hills	32R	50
6	West Elk Hills	32R	40
7	West Elk Hills	4B	1,000
8	Taft	10B	50
9	East Elk Hills	21S	50
10	East Elk Hills	21S	25
11	East Elk Hills	21S	50
12	East Elk Hills	21S	200
13	East Elk Hills	21S	10,000
14	East Elk Hills	20S	1,000
15	East Elk Hills	17S	5,000
16	East Elk Hills	20S	1,000
17	East Elk Hills	17S	1,000
18	East Elk Hills	18S	100
19	East Elk Hills	12R	5,000
20	East Elk Hills	12R	1,000
21	East Elk Hills	7,8R	10,000
22	West Elk Hills	8R	1,000
23	West Elk Hills	8,9R	1,000
24	West Elk Hills	7R	1,000
25	West Elk Hills	7R	2,000
26	West Elk Hills	7R	100
27	Tupman	23S	35
28	Mouth of Kern	12G	75

Locations of the Hoover's woolly-star populations observed during the survey are detailed in Figures 3-10. Table 3 provides an enumeration of the location and size of Hoover's woolly-star populations on NPR-1.

Populations of Hoover's woolly-star occur in "open" sites on NPR-1: sites free of dense annual herbaceous or graminoid vegetation. Most of the largest populations were observed in formerly disturbed sites, particularly on or adjacent to abandoned or little-used roadways. Alternate habitat for Hoover's woolly-star on NPR-1 is the channel and banks of washes, where grass cover is reduced relative to nearby uplands.

Prior to this survey, populations of Hoover's woolly-star were not frequently found in disturbed sites. Taylor and Davilla (1986) observed the species most frequently in sites with a dense cryptogammic crust, which reduces grass competition. In general, this pattern of microsite selection of Hoover's woolly-star is typical for most occurrences on strongly alkaline soils (pH 7.8-9.0) on the floor of the San Joaquin Valley. However, along the gently sloping alluvial plain of the northern Elk Hills, Hoover's woolly-star is most often found in open sites. Associated with this shift is an edaphic gradient: alluvial soils of the region are somewhat less alkaline (pH 7.5-8.2) and have a greater proportion of sand than the fine silts of the valley floor. Prior to this survey, this shift in habitat selection was not documented, and the response of Hoover's woolly-star to disturbance was not well understood.

Populations of Hoover's woolly-star located near roads provides evidence that the species can respond favorably to disturbance. However, without pre-disturbance information or experimental data, the mode, tempo, and degree of response of Hoover's woolly-star to disturbance is still unknown. Although many populations of Hoover's woolly-star occur in dirt roads, this does not necessarily mean that they can tolerate direct disturbance (grading, trampling, vehicle traffic, etc.). Observation of secondary succession (invasion of shrubs) in roadways along the northern base of the Elk Hills indicate that many old roads have been left unmaintained in recent years, and that frequency of use is low. Under these conditions, the density and cover of annual grasses is low within the roadways, a setting favorable to the success of Hoover's woolly-star populations.

Given the frequency with which Hoover's woolly-star was found on little-used or abandoned dirt roads on NPR-1, the species can be judged to be a colonizing species under the present composition of the regional vegetation (enriched with aggressive introduced annual graminoids). Based on available autecological information, the degree to which a given population of Hoover's woolly-star can tolerate disturbance related to oil field activities is unknown.

3.3.2 California Jewelflower

Judging from conditions at two extant populations, habitat for California jewelflower on NPR-1 is suboptimal. As presently understood, California jewelflower is apparently largely confined to flat terrain. At the Santa Barbara Canyon population (in the Cuyama Valley), which is situated on

an elevated terrace, California jewelflower plants grow largely on the gently sloping surface of the terrace, not on dissected terrain flanking the terrace. At the newly discovered Carrizo Plain population, California jewelflower exhibits high fidelity to flat to gently sloping topography. It does not grow on slopes exceeding approximately 10 percent, even though vegetation composition in the region does not notably change on nearby slopes which can exceed 30 percent. From these observations, it appears that appropriate habitat for California jewelflower is limited to flat or gently inclined topography, and that it would be largely absent from steep hill slopes and associated ridge crests.

The density and uniformity of cover of introduced annual grasses is probably the main reason little good habitat for California jewelflower exists. Diversity of native annual herbs is much higher at the two sites supporting California jewelflower. In general, appropriate terrain for California jewelflower on NPR-1 (gentle alluvial plains) consists largely of dense swards of red brome and generally lacks diversity of native annual herbs. Because the habitat best suited for California jewelflower had few native plants, the occurrence of the species on NPR-1 appears unlikely.

3.3.3 Kern Mallow

The Kern mallow is a poorly understood species endemic to the upper San Joaquin Valley. Taylor and Davilla (1986) provide a recent status report of the species. As presently understood, the distribution of Kern mallow is limited to the northeast flank of the Elk Hills and Temblor Range (in the vicinity of Buttonwillow and McKittrick). Reports of Kern mallow from areas of the San Joaquin Valley outside this range have been based on a related species, Eremalche parryi. Recent observations of experimental hybridization (Taylor unpublished), indicate that Kern mallow is a valid taxon that can be distinguished from Eremalche parryi by leaf shape and pubescence (Taylor and Stebbins, 1988).

The survey failed to locate Kern mallow. Suitable habitat for the species was observed in the far northwestern portion of NPR-1 (Sections 12Z, 13Z, and 14Z). The species may eventually become established in this portion of Reserve because populations of Kern mallow are known to occur within 5 miles without any direct physiographic barrier.

3.3.4 San Joaquin Woolly-Threads

Optimal habitat for the San Joaquin woolly-threads consists of moderately alkaline, sandy soils situated on the valley floor. Suitable habitat for San Joaquin woolly-threads occurs on the northern flank of the Elk Hills and in the Buena Vista Valley.

No San Joaquin woolly-threads were found during the survey. As with other native annual herbs, San Joaquin woolly-threads is intolerant of dense swards of introduced annual grasses (Taylor, 1988b). It has been observed to grow in annual grassland dominated by red brome but only when lightly grazed by sheep or cattle (grazing serves to reduce grass cover sufficiently to allow native herbs to persist). Because the vegetation cover

on most of the suitable terrain on NPR-1 consists of dense swards of red brome, the probability of San Joaquin woolly-threads occurring on the Reserve is low. San Joaquin woolly-threads may eventually be found; its absence could only be concluded following extensive field searches in wet years.

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4. DISTRIBUTION AND ABUNDANCE OF SMALL MAMMALS

4.1 BACKGROUND

Information on small mammals was needed because the Tipton kangaroo rat was listed as an endangered species on 8 July 1988 (Federal Register, 53:25608-25611), and four species (Nelson's antelope ground squirrel, short-nosed kangaroo rat, San Joaquin pocket mouse, and Buena Vista Lake shrew), were included as Category 2 candidate species in a Review of Vertebrate Wildlife published by FWS (Federal Register, 50:37958-37967).

Although San Joaquin pocket mice were included in this survey of candidate species, no attempt was made to use karyotypes to determine subspecies of pocket mice captured. Perognathus inornatus inornatus is a Category 2 subspecies and is found within the southern San Joaquin Valley. Because of the proximity of the Reserves to McKittrick, California, the subspecies most likely present on the Reserves is Perognathus inornatus neglectus (McKittrick pocket mouse) (Hall, 1981; Williams, 1986). Perognathus inornatus neglectus is not currently on the FWS list.

The objective of this report is to provide DOE with information on the presence and relative abundance of a recently listed endangered mammal and candidate small mammals that occur on the Naval Petroleum Reserves in California.

4.2 METHODS

4.2.1 Transect Surveys

Eight 1-mile transects spaced 200-yd apart were walked through each section of the Reserves, and all observations of Nelson's antelope ground squirrels were recorded (O'Farrell and Mathews, 1987; O'Farrell and Sauls, 1987).

4.2.2 Live-Trapping

On NPR-1 one trapline was established in each of four general habitat types: flat valley lands (Trapline B, Section 10B, 0 wells), low relief hills with low petroleum development (Trapline A, Section 35R, 18 wells), low relief hills with moderate petroleum development (Trapline C, Section 6G, 56 wells), and high relief hills with extensive petroleum development (Trapline D, Section 33S, 79 wells) (Figure 11). Traplines consisted of 25 covered trap stations spaced 15-yd apart; one or two Sherman live-trap(s) (3 x 3 x 12 in.) were placed at each station. Trapping sites were established in five sections of NPR-2 that had increasing densities of petroleum wells: Traplines A and B, Section 18B, 2 wells; Traplines C and D, Section 21B, 17 wells; Traplines E and F, Section 22B, 45 wells; Traplines G and H, Section 28B, 75 wells; Traplines J and K, Section 35B, 130 wells (Figure 12). Two small mammal traplines, each consisting of 15

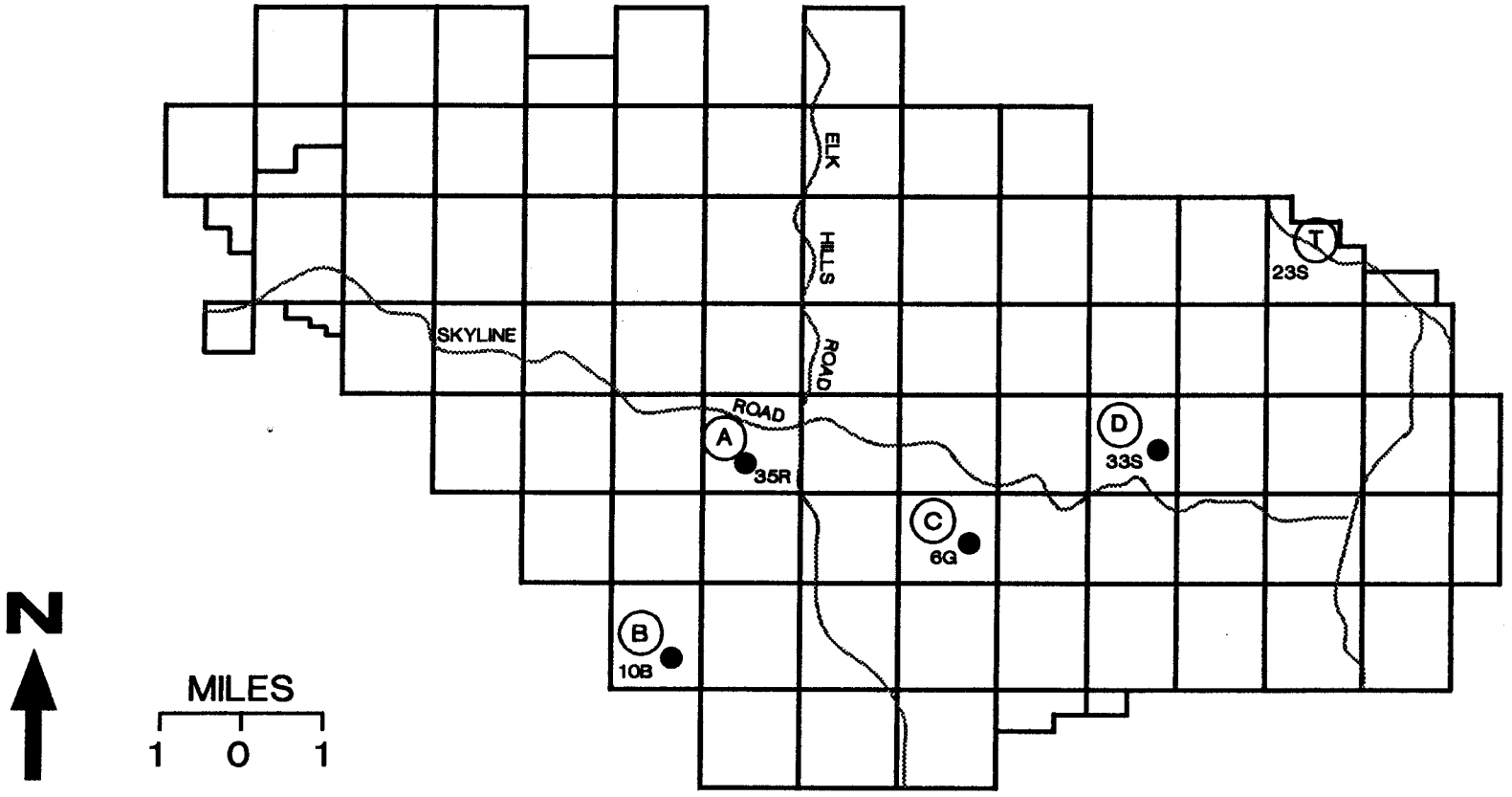

Figure 11. Locations on Naval Petroleum Reserve #1, Kern County, California, 1980-1984, where small mammal trapping lines were located. Lines are identified by letters in circles; numbers followed by letters are section and township codes.

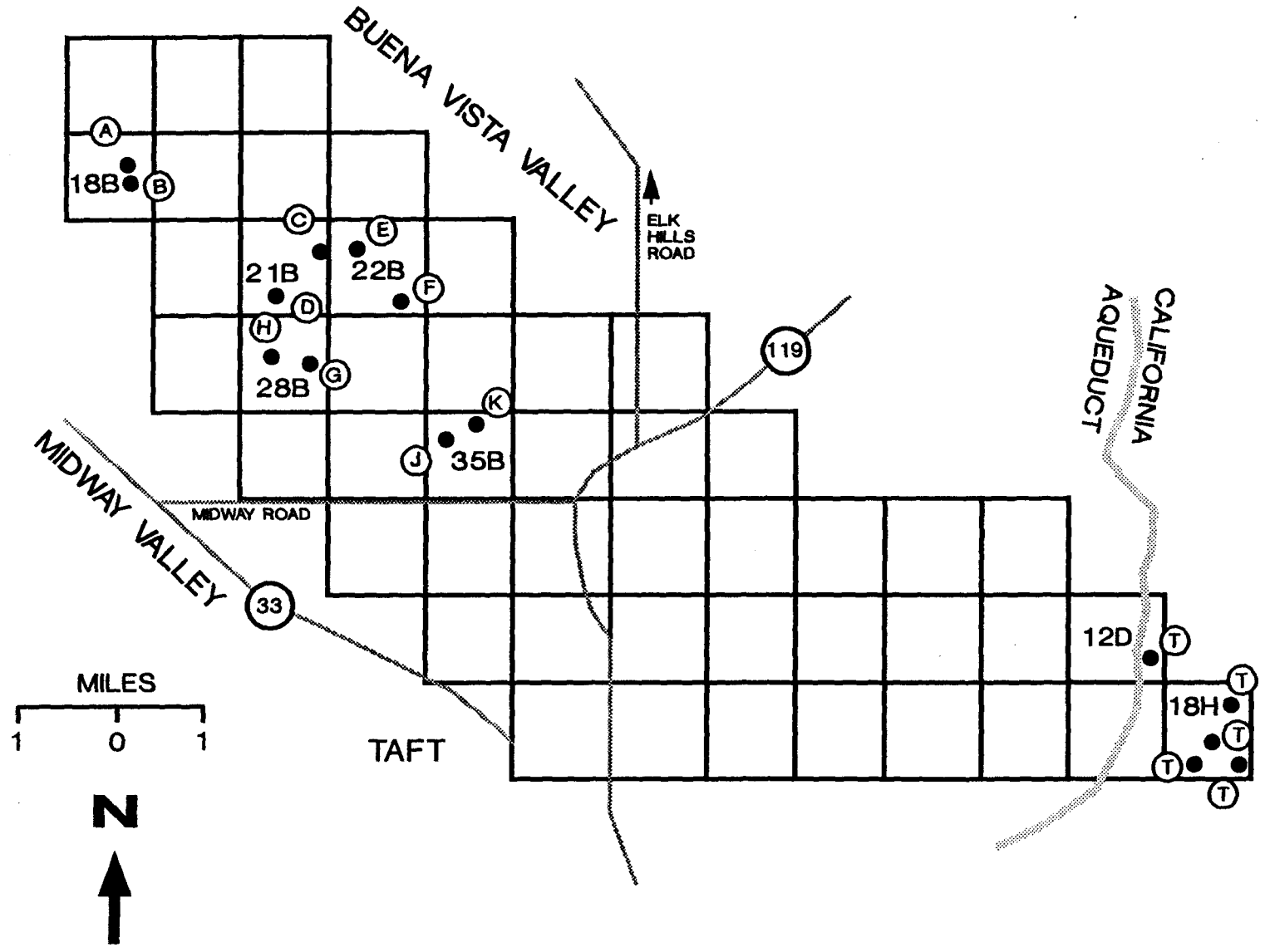

Figure 12. Locations on Naval Petroleum Reserve #2, Kern County, California, 1983-1984, where small mammal trapping lines were located. Lines are identified by letters in circles; numbers followed by letters are section and township codes.

covered trap stations spaced 15-yd apart and two traps per station were set out in each section. Each trap contained Dacron batting for nesting material and wild bird seeds for food.

A survey for Tipton kangaroo rats was conducted from 31 August - 2 September 1988. One trapline each was set in 23S (NPR-1) and 12D (NPR-2) (Figures 11 and 12). Four traplines were set in Section 18H of NPR-2 (Figure 12). Twenty-five traps per trapline were set using one trap per station.

Traplines were operated simultaneously for three consecutive nights each sampling session. All traps were set in late afternoon and baited with a mixture of rolled oats and peanut butter. Captured animals were removed the following morning and species and sex were determined. Small mammals were individually identified with either eartags or toe amputations except those animals captured during the Tipton kangaroo rat survey, which were released unmarked. Observations were made of their reproductive condition, age, pelage, and ectoparasites before they were weighed on a spring scale and released at the point of capture.

A survey for the presence of Buena Vista Lake shrews was conducted in Section 18H of NPR-2 where the only probable habitat is located. Plastic pails were used as pitfall traps and were placed in the ground slightly below ground level at 15-yard intervals along 5 transect lines (Figure 13). Initially, pitfall traps were checked at 0700, 1230, and 1800 hours. Eventually, pitfall traps were not checked at 1230 and 1800 because so few animals were trapped.

4.3 RESULTS

4.3.1 Live-Trapping

Small mammal trapping on NPR-1 was conducted between September 1980 and December 1984. During 20,076 trap-nights, 812 individual candidate small mammals were trapped 4,226 times. Forty-eight percent of the individual small mammals captured on NPR-1 were candidate species. Short-nosed kangaroo rats accounted for 30.7% of all individuals captured; Nelson's antelope ground squirrels, 8.8%; San Joaquin pocket mice, 8.7%; and other small mammals, 51.9% (Table 4).

Trapping on NPR-2 was conducted between July 1983 and August 1984. A total of 11,700 trap-nights of effort was spent capturing 312 individual candidate small mammals 1,285 times. Of individual small mammals captured on NPR-2, 46.5% were candidate species. Short-nosed kangaroo rats represented 26.2% of all individuals captured; Nelson's antelope ground squirrels, 17.0%; San Joaquin pocket mouse, 3.3%; and other small mammals, 53.5% (Table 5) (O'Farrell, et al., 1987a).

In addition to candidates captured, six other species were trapped on NPR-2 (O'Farrell, et al., 1987a) and NPR-1, including: deer mouse (*Peromyscus maniculatus*), Southern grasshopper mouse (*Onychomys torridus*),

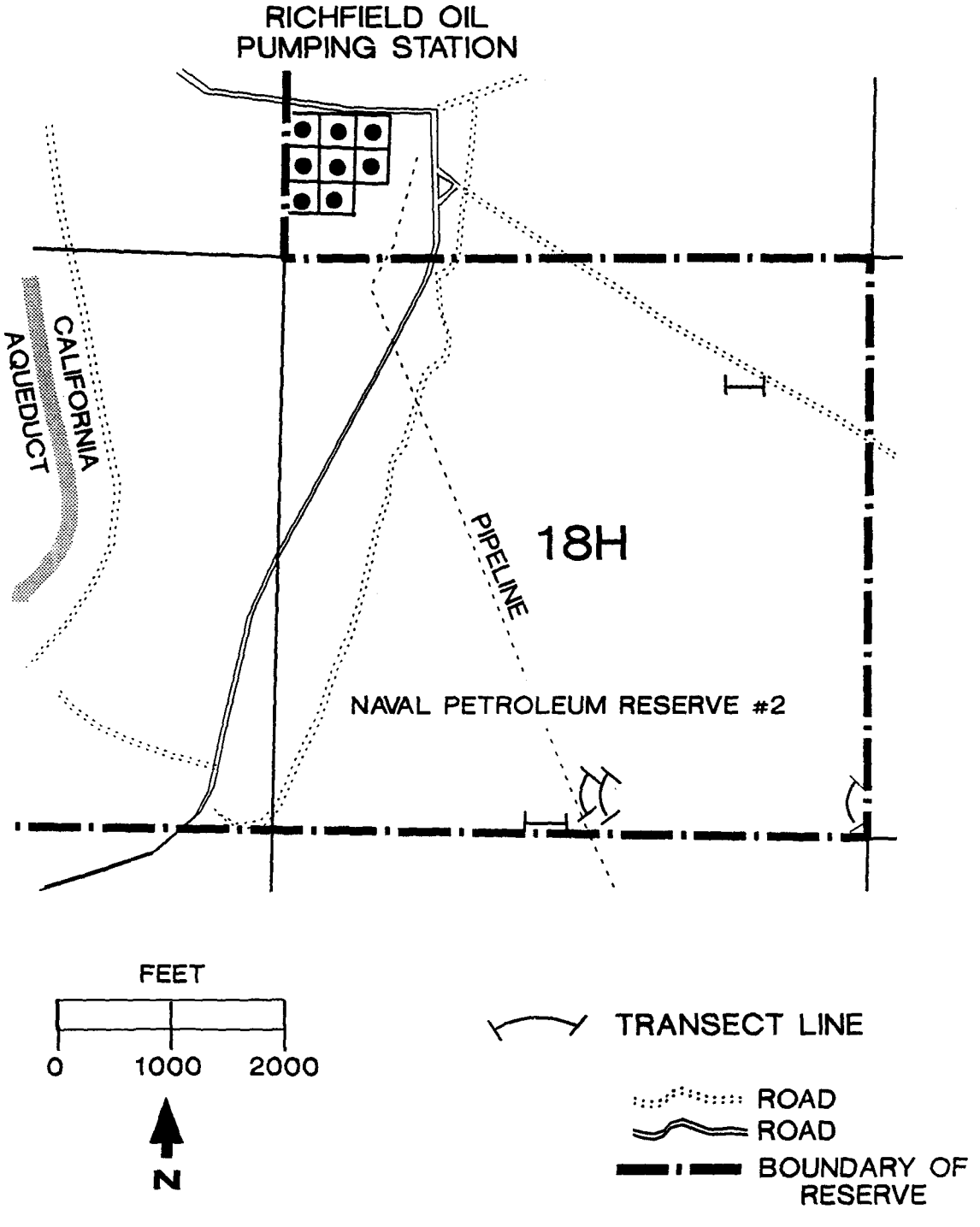

Figure 13. Location of transect lines used to survey for the presence of the Buena Vista Lake shrew (Sorex ornatus relictus) in Section 18H of Naval Petroleum Reserve #2, Kern County, California, 1988.

Table 4. Relative abundance of small mammals captured on Naval Petroleum Reserve #1, Kern County, California, 1980-1984.

Trap-line	Species	No. of Trap-Nights	No. of Captures	Percent Trapping Success	Individuals	
					No.	%
A	Nelson's Antelope Ground Squirrel	3,982	128	3.2	60	22.4
	San Joaquin Pocket Mouse		274	6.9	96	35.8
	Short-Nosed Kangaroo Rat		24	0.6	9	3.4
	Other Small Mammals		384	9.6	103	38.4
	Total		**810**		**268**	
B	Nelson's Antelope Ground Squirrel	6,399	72	1.1	38	7.2
	San Joaquin Pocket Mouse		49	0.8	13	2.5
	Short-Nosed Kangaroo Rat		3,097	48.4	417	79.3
	Other Small Mammals		183	2.9	58	11.0
	Total		**3,401**		**526**	
C	Nelson's Antelope Ground Squirrel	3,973	28	0.7	18	6.4
	San Joaquin Pocket Mouse		92	2.3	35	12.5
	Short-Nosed Kangaroo Rat		333	8.4	74	26.4
	Other Small Mammals		577	14.5	153	54.6
	Total		**1,030**		**280**	
D	Nelson's Antelope Ground Squirrel	5,722	58	1.0	32	5.2
	San Joaquin Pocket Mouse		3	0.1	2	0.3
	Short-Nosed Kangaroo Rat		68	1.2	18	2.9
	Other Small Mammals		2,708	47.3	562	91.5
	Total		**2,837**		**614**	
	TOTALS	**20,076**	**8,078**		**1,688**	

Table 5. Relative abundance of small mammals captured on Naval Petroleum Reserve #2, Kern County, California, 1983-1984.

Trap-line	Species	No. of Trap-Nights	No. of Captures	Percent Trapping Success	Individuals	
					No.	%
A	Nelson's Antelope Ground Squirrel	1,170	6	0.5	6	12.2
	San Joaquin Pocket Mouse		22	1.9	6	12.2
	Short-Nosed Kangaroo Rat		202	17.3	32	65.3
	Other Small Mammals		19	1.6	5	10.2
	Total		**249**		**49**	
B	Nelson's Antelope Ground Squirrel	1,170	24	2.1	20	52.6
	San Joaquin Pocket Mouse		6	0.5	4	10.5
	Short-Nosed Kangaroo Rat		9	0.8	6	15.8
	Other Small Mammals		22	1.9	8	21.1
	Total		**61**		**38**	
C	Nelson's Antelope Ground Squirrel	1,170	50	4.3	17	37.8
	San Joaquin Pocket Mouse		0	0	0	0
	Short-Nosed Kangaroo Rat		22	1.9	4	8.9
	Other Small Mammals		175	15.0	24	53.3
	Total		**247**		**45**	
D	Nelson's Antelope Ground Squirrel	1,170	7	0.6	4	17.4
	San Joaquin Pocket Mouse		7	0.6	3	13.0
	Short-Nosed Kangaroo Rat		36	3.1	9	39.1
	Other Small Mammals		22	1.9	7	30.4
	Total		**72**		**23**	
E	Nelson's Antelope Ground Squirrel	1,170	72	6.2	21	21.4
	San Joaquin Pocket Mouse		0	0	0	0
	Short-Nosed Kangaroo Rat		320	27.4	45	45.9
	Other Small Mammals		186	15.9	32	32.7
	TOTALS		**578**		**98**	

Table 5. Relative abundance of small mammals captured on Naval Petroleum Reserve #2, Kern County, California, 1983-1984 (continued).

Trap-line	Species	No. of Trap-Nights	No. of Captures	Percent Trapping Success	Individuals	
					No.	%
F	Nelson's Antelope Ground Squirrel	1,170	18	1.5	9	9.6
	San Joaquin Pocket Mouse		12	1.0	6	6.4
	Short-Nosed Kangaroo Rat		74	6.3	22	23.4
	Other Small Mammals		201	17.2	57	60.6
	Total		**305**		**94**	
G	Nelson's Antelope Ground Squirrel	1,170	19	1.6	9	28.1
	San Joaquin Pocket Mouse		0	0	0	0
	Short-Nosed Kangaroo Rat		7	0.6	1	3.1
	Other Small Mammals		64	5.5	22	68.8
	Total		**90**		**32**	
H	Nelson's Antelope Ground Squirrel	1,170	31	2.7	12	14.6
	San Joaquin Pocket Mouse		1	0.1	1	1.2
	Short-Nosed Kangaroo Rat		11	0.9	5	6.1
	Other Small Mammals		385	32.9	64	78.1
	Total		**428**		**82**	
J	Nelson's Antelope Ground Squirrel	1,170	23	2.0	9	8.7
	San Joaquin Pocket Mouse		8	0.7	2	1.9
	Short-Nosed Kangaroo Rat		193	16.5	34	33.0
	Other Small Mammals		197	16.8	58	56.3
	Total		**421**		**103**	
K	Nelson's Antelope Ground Squirrel	1,170	17	1.5	7	6.5
	San Joaquin Pocket Mouse		0	0	0	0
	Short-Nosed Kangaroo Rat		88	7.5	18	16.8
	Other Small Mammals		392	33.5	82	76.6
	Total		**497**		**107**	
	TOTALS	**11,700**	**2,948**		**671**	

Western harvest mouse (Reithrodontomys megalotis), Heermann's kangaroo rat (Dipodomys heermanii), giant kangaroo rat (Dipodomys ingens), and house mouse (Mus musculus).

4.3.1.1 Nelson's Antelope Ground Squirrel

Traplines were not specifically operated to capture Nelson's antelope ground squirrels; traps were closed during the day when the species were most active. Presumably Nelson's antelope ground squirrels were captured in the late afternoon after traps were baited and set.

The number of captures of Nelson's antelope ground squirrels on NPR-1 ranged between 28 and 128 (Trapline C, Section 6G); numbers of individuals captured ranged between 18 and 60 along the same traplines, respectively (Table 4).

On NPR-2, the number of Nelson's antelope ground squirrels captured varied between six (A, 18B) and 72 (E, 22B). Number of individuals captured ranged between four (D, 21B) and 21 (E, 22B) (Table 5) (O'Farrell, et al., 1987a).

4.3.1.2 San Joaquin Pocket Mouse

San Joaquin pocket mice were captured on all four traplines of NPR-1. Total captures of San Joaquin pocket mice ranged between three (D, 33S) and 274 (A, 35R). The number of individual pocket mice captured ranged between two (D, 33S) and 96 (A, 35R) (Table 4).

On NPR-2, San Joaquin pocket mice were captured on six of ten traplines. Total captures of San Joaquin pocket mice ranged between one (H, 28B) and 22 (A, 18B). The number of individual pocket mice captured ranged between zero (C, 21B; E, 22B; G, 28B; K, 35B) and six (A, 18B; F, 22B) (Table 5) (O'Farrell, et al., 1987a).

4.3.1.3 Short-Nosed Kangaroo Rat

Short-nosed kangaroo rats were captured on all four traplines on NPR-1. Total captures of short-nosed kangaroo rats ranged between 24 (A, 35R) and 3,097 (B, 10B). Number of individuals captured ranged between 9 (A, 35R) and 417 (B, 10B) (Table 4).

Short-nosed kangaroo rats were captured on all lines of NPR-2 and were captured in relatively large numbers on traplines A, E, and J, in 18B, 22B, and 35B, respectively (Table 5). The number of short-nosed kangaroo rats captured varied between seven (G, 28B) and 320 (E, 22B) (Table 5). Number of individual short-nosed kangaroo rats captured varied between one (G, 28B) and 45 (E, 22B) (Table 5) (O'Farrell, et al., 1987a).

4.3.1.4 Tipton Kangaroo Rat

A total of 94 Tipton kangaroo rats were caught in 450 trap-nights. Total captures ranged between 6 and 12 in Section 23S on NPR-1 and between 3

and 10 in Section 18H on NPR-2. Tipton kangaroo rats comprised 83% of all captures. There were no captures of Tipton kangaroo rats in Section 12D of NPR-2.

4.3.1.5 Buena Vista Lake Shrew

No shrews were captured in Section 18H of NPR-2 during 3,750 trap-nights; no evidence was collected that suggested shrews were present. Although numerous invertebrates were captured, no small mammal species were captured.

4.3.2 Transect Surveys

Two-hundred seventy-one Nelson's antelope ground squirrels were observed along transects in 70 sections (range 1-15 per section) of NPR-1 during the 1984 five-year resurvey of NPR-1 (O'Farrell and Mathews, 1987) (Figure 14). The greatest number of sightings occurred in Section 19R (n=15). Relative density was 5.7 per 1,000 acres and did not change significantly with either increasing levels of development or habitat disturbance (O'Farrell and Mathews, 1987).

During the 1981 survey of NPR-2, 761 Nelson's antelope ground squirrels were counted along transects in 45 sections (O'Farrell and Sauls, 1987). Observations of Nelson's antelope ground squirrels ranged from 1-50 per section (Figure 15). Estimated relative density of Nelson's antelope ground squirrels was 34.4 per 1,000 acres for all of NPR-2. Relative density did not appear to be directly related to intensity of development (light development = 24.6 per 1,000 acres; moderate development = 31.9 per 1,000 acres; heavy development = 24.1 per 1,000 acres). No sightings of Nelson's antelope ground squirrels were recorded for land adjacent to housing developments in the northern end of Taft.

4.4 DISCUSSION

Nelson's antelope ground squirrels were widely distributed and numerous throughout NPR-1 and 2. O'Farrell and Mathews (1987) and O'Farrell and Sauls (1987) point out that Nelson's antelope ground squirrel seemed to be adapted to various levels of petroleum development. Nelson's antelope ground squirrels were absent only in heavily disturbed areas. California ground squirrels (Spermophilus beecheyi) are numerous in areas where disturbance is great and may have displaced Nelson's antelope ground squirrel in areas that have been disturbed by oil field or urban developments on NPR-1 and 2 (O'Farrell and Mathews, 1987; O'Farrell and Sauls, 1987). Nelson's antelope ground squirrel may have a more generalized habitat requirement than other species as indicated by its broad distribution on NPR-1 and 2 (O'Farrell, et al., 1987a).

San Joaquin pocket mice were not numerous but were captured in all habitat types of NPR-1 and 2. Trapline A in developed hilly habitat of NPR-1 had the most captures of San Joaquin pocket mice. Captures of San Joaquin pocket mice were less along traplines C and D in developed hilly habitat of

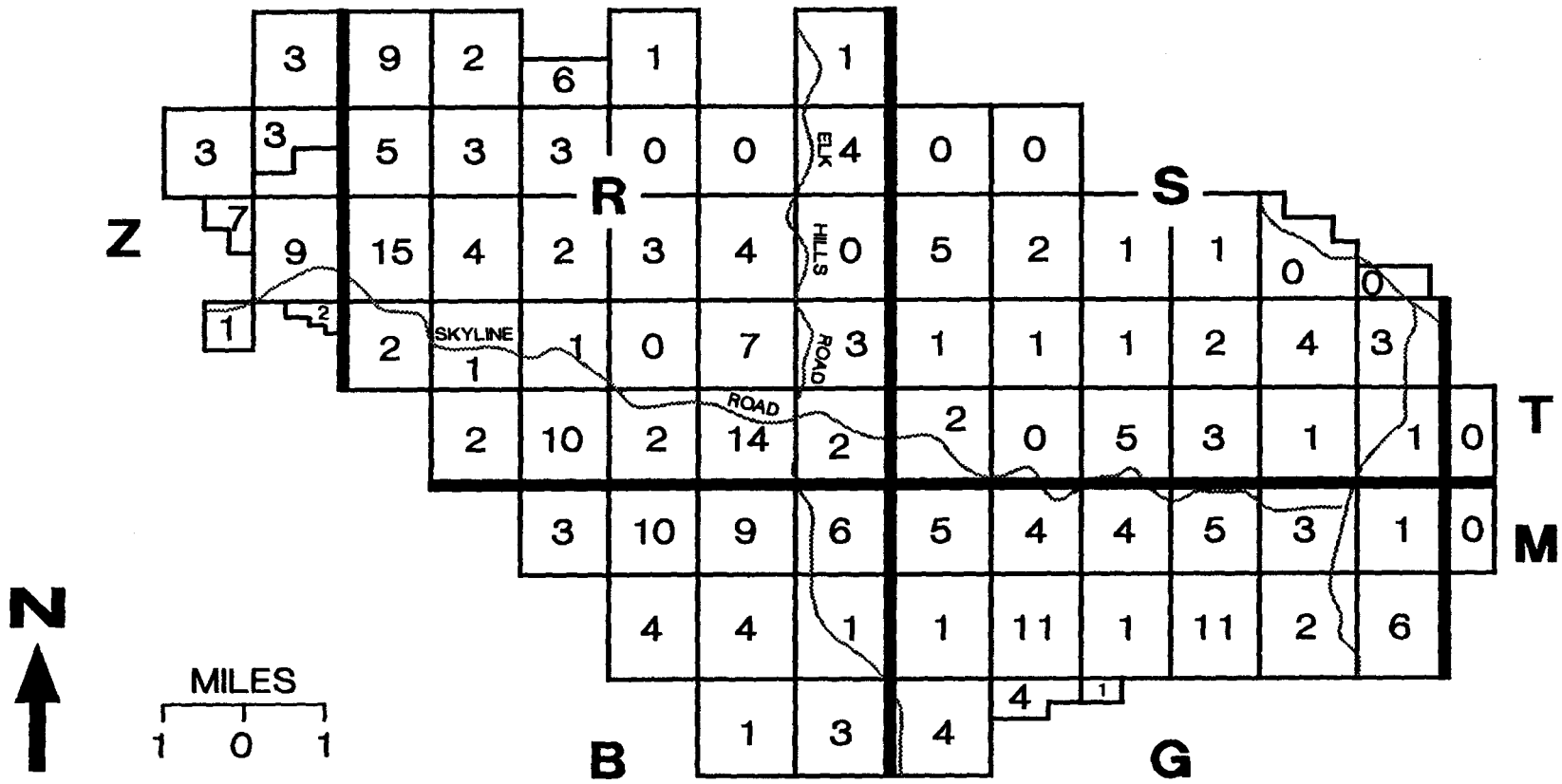

Figure 14. Distribution of Nelson's antelope ground squirrels observed during transect surveys on Naval Petroleum Reserve #1, Kern County, California, 1984. Bold letters and lines define townships.

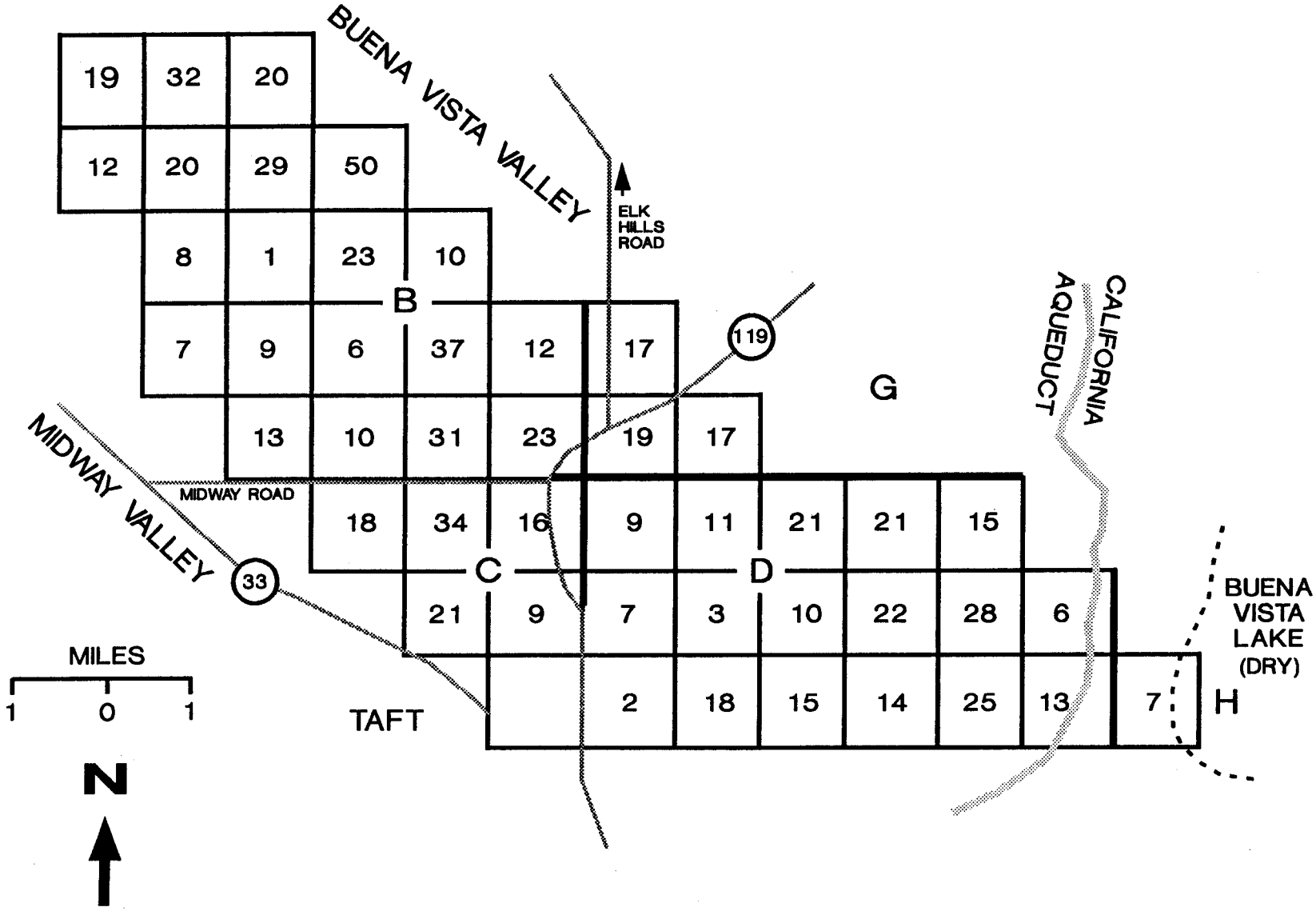

Figure 15. Distribution of Nelson's antelope ground squirrels observed during transect surveys on Naval Petroleum Reserve #2, Kern County, California, 1981. Bold letters and lines define townships.

NPR-1. On NPR-2, pocket mice were captured frequently in developed flats (trapline A). Microhabitat in a given area may play an important part in the distribution and abundance of pocket mice. As mentioned previously, although San Joaquin pocket mice were included in this candidate species survey, the subspecies of pocket mouse on the Reserves is probably Perognathus inornatus neglectus (Hall, 1981), a subspecies that presently has no federal listing status.

Short-nosed kangaroo rats are typically found on gentle slopes and low rolling hilltops where bushy growth is present (Hawbecker, 1951). Few short-nosed kangaroo rats were captured on traplines A, C, and D on NPR-1, which consists of hilly developed habitat. Short-nosed kangaroo rats were captured abundantly in flat, undeveloped terrain (trapline B of NPR-1) and on flat, developed habitat (trapline A) of NPR-2, indicating that short-nosed kangaroo rats may be able to tolerate some levels of disturbance. The large number of individual short-nosed kangaroo rats that were captured on trapline B of NPR-1 possibly suggests that other factors (vegetational, edaphic, and/or others) may be present that account for differences in number of individuals that were captured.

The western boundary of distribution of the Tipton kangaroo rat was defined by Williams (1986) as being approximately coincident with the route of the California Aqueduct. A contact zone of interbreeding between short-nosed and Tipton kangaroo rats was thought to have occurred along the area of the aqueduct prior to its establishment, but the two subspecies are thought to no longer come into contact (Williams, 1986). All Dipodomys nitratoides trapped east of the aqueduct were therefore assumed to be Tipton kangaroo rats.

Tipton kangaroo rats were relatively abundant in areas of flat, undeveloped habitat that were surveyed east of the California Aqueduct on NPR-1 and 2. Tipton kangaroo rats were captured on all traplines except in 12D; only deer mice were captured in line D. The reason why Tipton kangaroo rats were not trapped in Section 12D, but were trapped in the adjacent section (18H) is unknown. Ninety-one percent of all captures during the Tipton kangaroo rat survey were kangaroo rats (Tipton and Heermann's kangaroo rat). Tappe (1941) points out that a scarcity of small mammals other than kangaroo rats in areas of sparse vegetation is probably due in part to lack of suitable cover for escaping predators.

Grinnell (1932) noted that Buena Vista Lake shrews were found in marshy areas around the perimeter of Buena Vista Lake, and he speculated that shrews were found in marshy areas throughout the San Joaquin Valley and most of the Tulare Basin (Grinnell, 1933). No Buena Vista Lake shrews were captured on NPR-2. The species is probably not present on NPR-2. Therefore, future proposed activities by DOE on Section 18H will probably not affect the species. There is no known suitable habitat for Buena Vista Lake shrews on NPR-1.

5. DISTRIBUTION AND ABUNDANCE OF FOUR SPECIES OF BLISTER BEETLES

5.1 INTRODUCTION

5.1.1 Background

Selander (1960) lists 128 species of blister beetles of the genus Lytta from North America; 13 of these are known from the southern San Joaquin Valley. Five species of Lytta are on the federal list as Category 2; four of these species occur in the southern San Joaquin Valley. They include Morrison's blister beetle, Moestan blister beetle, Hopping's blister beetle, and Molestan blister beetle.

The Moesta blister beetle, Molestan blister beetle, and Morrison's blister beetle are known to occur within 20 miles of the Elk Hills; Hopping's blister beetle occurs within 40 miles. The conversion of the valley floor to agriculture has been a gradual process over the last half century, but has intensified in the southern San Joaquin Valley in recent years. Of the 55 separate collections of the 4 species (Table 6) 51 occurred before 1950.

5.1.2 Life History

The four species of Lytta under consideration are rare in nature and rare in collections. Information on labeled specimens in museums comprise most of the available data concerning the species. Dates on museum specimens indicate a spring activity period for the adults. There are several collections with fall dates, but nearly all specimens were collected during April and May (Table 7). No one site has numerous collections from a single year and, therefore, the length of time adults are active in a single year is unknown, but it is likely that the appearance and length of activity for a single year is a function of the weather in that year. Anthophorinae bees (which Lytta parasitize) and timing of host plant blooming are the keys to Lytta activity. When bee nesting activity and host plant blooming cease, the activity of adult Lytta ceases.

The assumption can be made that the biology of the species is similar to the typical biology of the genus. To this end, a generalized biology is presented below; specifics on each species are included where appropriate. The sources for this generalized biology are Selander (1960), Linsley and McSwain (1942), and McSwain (1956).

All species of Lytta are believed to be parasitic on wild bees. Four of the Lytta species occurring in the southern San Joaquin Valley have been associated with Anthophoridae bees of the genus Anthophora. Adult beetles congregate on various food plants such as those within the families Leguminosae, Convolvulaceae, Compositae, Papaveraceae, and Rosaceae. Data on specimen-collection labels indicates the use of Lupinus spp. by the Molestan blister beetle. The adult beetle feeds on both the petals and the pollen. Mating occurs on the plants during the feeding period.

Table 6. Number of collection sites and number of specimens in each collection of candidate species of blister beetle.

Species	Number of Collection Sites	Number of Specimens
Lytta morrisoni	7	27
Lytta moesta	13	19
Lytta hoppingi	7	114
Lytta molesta	28	243

Table 7. Months in which Lytta hoppingi, Lytta moesta, Lytta molesta, and Lytta morrisoni have been collected.

Species	Month				
	February	March	April	May	June
Lytta hoppingi		X	X	X	X
Lytta moesta			X	X	X
Lytta molesta		X	X	X	X
Lytta morrisoni		X	X	X	

The female leaves the host plant and constructs a shallow burrow of 1-1.5 inches deep. Eggs are deposited into the burrow, and the burrow is then covered. The eggs hatch and the larvae emerges from the soil. The larval development of Lytta is hypermetamorphic, i.e., larval instars vary greatly in appearance. The first instar (triungulin) is active, mobile, and highly sclerotized. The way in which the triungulin finds the nest site of the bee host is unknown. Two speculations have been made. The first is that the active triungulin randomly searches until it discovers the nesting site of the bees. The second is that the triungulin moves to the food plants of the bees and congregates on the flowers where it attaches to a foraging bee and is carried back to the bee's nesting site. This second speculation was strengthened by the collection of several hundred triungulins of the Molestan blister beetle on the flower heads of a species of Lupinus (McSwain, 1956).

Once in the nest, the triungulin begins to actively feed in a cell of the host bee. It is thought that the larvae feeds on both the bee larvae and stored pollen. Occasionally this feeding extends to a second cell. The feeding stage of the larvae passes through four instars. The second through fourth are grub-like, with short legs and a greatly reduced ability of movement. The fourth instar leaves the cell and constructs a burrow where it metamorphoses into the fifth instar (coarctate), a mummy-like, legless resting stage for passing the winter. A sixth instar develops in the spring and moves to near the surface where a pupal chamber is constructed, and the change to pupa is effected. The pupal stage lasts approximately ten days, and the adult stage emerges and moves to the surface to start the cycle again. It is thought that the life-cycle is one year long. In arid areas during drought years, it is possible that emergence is delayed until a more salubrious year.

5.2 METHODS

Information on distribution and habitat requirements of the beetles was initially assessed using label data from California insect collections. Label data were gathered from insect collections at the California Department of Food and Agriculture, Sacramento; Bohart Museum, University of California, Davis; California Insect Survey Collection, University of California, Berkeley; Insect Collection, California Academy of Sciences, San Francisco; Insect Collection, University of California, Riverside. In addition, a request for information about the beetles was also sent to the Los Angeles County Museum, California State University at Long Beach, San Diego Natural History Museum, and the Tulare Agricultural Commissioners Office. Information from the literature, label data, and correspondence with private and government agencies was used to plan the survey of the Reserve.

The beetle survey ran from early April to mid-May, which was from the peak of bee activity and host plant blooming to the functional cessation of both. NPR-1 was divided into four quadrants. Approximately 60 of the 75 sections were covered in the initial survey. The procedure was to slowly drive the roads and locate flowering plants. When patches of flowering plants were found, a walking inspection of the area was made. At each of these

stops, a visual check of all flowering plants was made for the presence of the adult beetles or foraging Anthophorinae bees.

Twelve sites determined to have the highest probability of having the beetles present were mapped and visited routinely in succeeding weeks (Figure 16). An additional site with the suitable host plants for both the beetle and bee, but without bee activity was also inventoried. At each site plants determined to be potential feeding hosts for the beetle and plants used by foraging Anthophorinae bees were examined to determine the presence or absence of the beetles or bees, respectively. The standard procedure followed for each site included visual inspection for the beetles on all plants within 150 feet from the center of the site, inspection of the heads of flowering plants for the presence of meloid triungulins, the collection of a sample of each species of bee foraging on the plants, and a search for nesting sites for the bees foraging at the site.

5.3 RESULTS AND DISCUSSION

None of the species of Lytta for which this survey was conducted were found in either the field or in museum collections from the Elk Hills. A single specimen of Lytta sublaevis was collected in Section 22R by EG&G/EM personnel in March of 1988.

Plants and bees previously associated with species of Lytta were located within the Reserve. Two Anthophorinae bees, Anthophora californica and Euphoropsis spp., were present where the plants Salvia carduacea or Salivi columbarae were found. A search for nesting sites of the bees was conducted at each study site without success. Bee populations were at all times low; no more than two bees were seen at a site at the same time. The plant group most commonly fed upon by Lytta is the Leguminosae. There are numerous records of Lytta feeding on the petals and pollen of Lupinus. Lytta are non-specific in feeding habits, and it is likely that Astragalus lentiginosus would be a preferred host. This plant is common throughout the Reserve and was at its best growth in or near areas where Salvia was found.

A large number of plants were inspected for Anthophora utilization, including the shrubs Eriogonum and Isomeris, and the annuals Hemizonia, Astragalus, Convolvulus, Amsinckia, and unidentified species of Leguminosae, Onograceae, and Compositae. The Salvia was at a peak in the first week of April, as was the Anthophorinae bee populations; the Astragalus was still blooming, but had set many seed pods and apparently had been blooming for some time. The Amsinckia, a known feeding host for Lytta sublaevis, was just past its peak flowering. The number of plants blooming declined as the study progressed; few plants were still in bloom by the first week in May. The bee populations also declined and were absent at some sites as early as late April and gone at all sites by early May.

That none of the Category 2 Lytta were found on NPR-1 is consistent with the observation that the beetles have never been known to occur there; it has been 40 to 50 years since any of the species have been recorded from the San Joaquin Valley, and the closest historical record of a

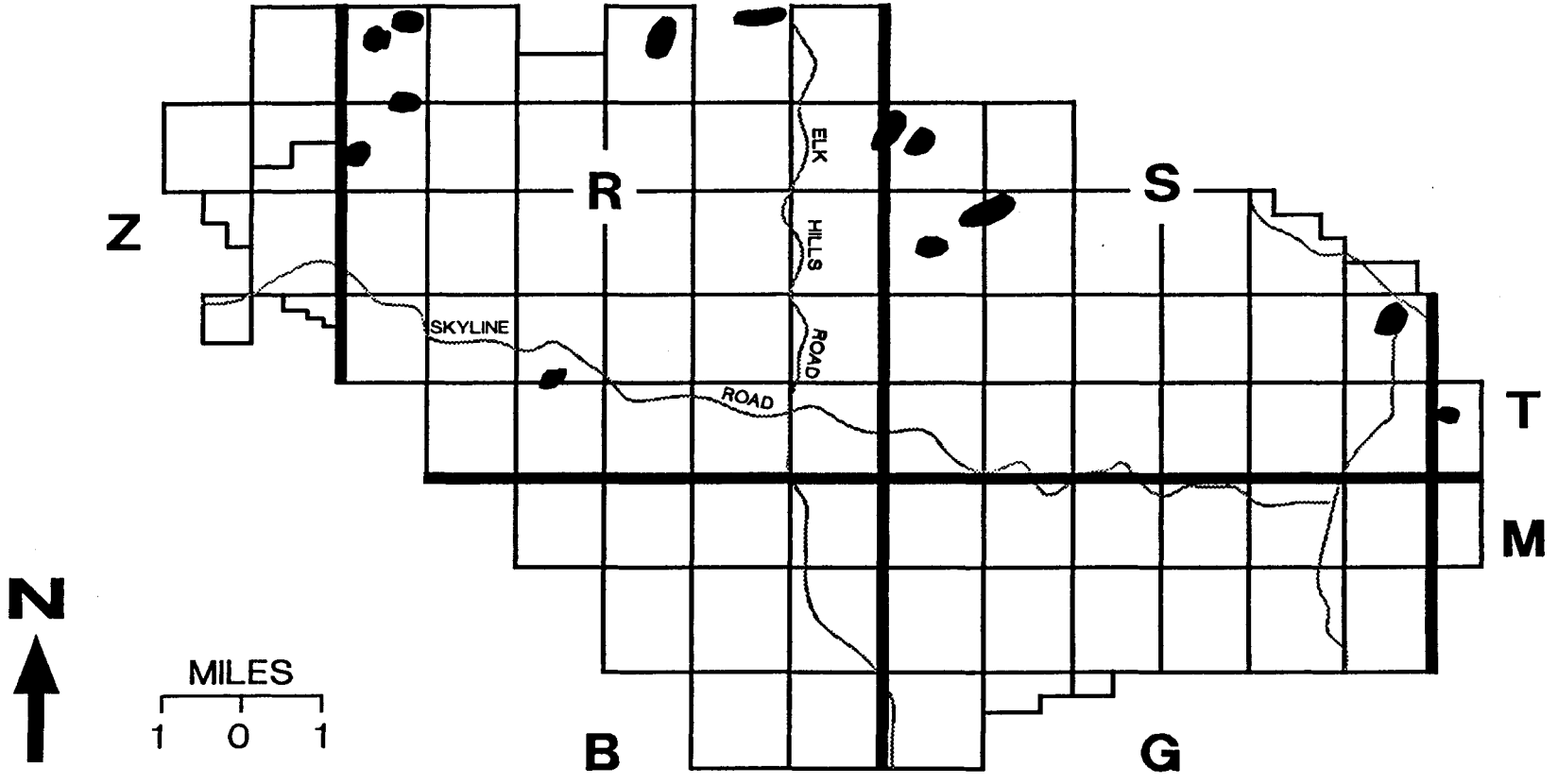

Figure 16. Location of 13 sites intensively monitored for the presence of candidate blister beetles on Naval Petroleum Reserve #1, Kern County, California. Bold letters and lines define townships.

collection is more than 20 miles away from Elk Hills from areas with different soil types and at different elevations.

It is also possible that the beetles were present, but were not found. This conclusion is based on the observation that portions of Elk Hills appeared to provide suitable habitat for the species. Some areas were relatively undisturbed, had a food source commonly used by adult beetles (Astragalus), and had Anthophorinae bees as a prey source and several species of Salvia as forage for the bees.

It is also possible that the beetles were absent because of drought conditions present this year. The beetles, like many other insects, may not emerge in years of reduced rainfall.

6. DISTRIBUTION AND ABUNDANCE OF THE STRIPED-SKINNED SNAIL

6.1 INTRODUCTION

6.1.1 Background

The striped-skinned snail (Helminthoglypta callistoderma) is a little-known terrestrial snail that apparently has been collected fewer than 12 times, at about 10 localities, all in the southeastern San Joaquin Valley, Kern County, California. The FWS has listed the species as a Category 2 species (Federal Register, 49:21674).

The species was described from a sample of seven specimens collected from dead vegetation on the margin of the Kern River, two miles north of Bakersfield. The first published description of the species was Pilsbry's (1917) figure and discussion of the reproductive system; later a formal illustration of the shell (Pilsbry and Ferriss, 1917) and written description of the species (Pilsbry and Ferriss, 1918) were published. By the rules of nomenclature, Pilsbry (1917) is considered the original author of the species. Berry (1938) briefly compared the striped-skinned snail with two other species. Pilsbry (1939) commented that the original striped-skinned snail specimen was slightly immature. However, the dissection or dissections figured by him (Pilsbry, 1917, 1939) appear to be reproductively mature, in that the penis, atrial sac, and other accessory organs are fully developed.

Branson, et al. (1966), reported a specimen from Hot Springs Ranger Station, Tulare County, at approximately 3,000 feet elevation. However, their specimen was 1.3 inches (32 mm) in shell diameter (compared to 0.9 inches [23 mm] for the original material of the striped-skinned snail) with the entire body (rather than just the mantle over the lung) reticulated in black. The collection locality is also some 2,500 feet higher in elevation than any other known locality for the striped-skinned snail. In view of these differences, their report should not be accepted as pertaining to the striped-skinned snail until this or other specimens from Hot Springs Ranger Station can be examined.

Both Smith (1970) and Roth (1972) included the striped-skinned snail in a list of possibly endangered snails. There are few other published accounts of the species.

6.1.2 Life History

The only species of Helminthoglypta that has had its life history intensively studied is Helminthoglypta stiversiana, van der Laan (1971, 1975a, 1975b, 1980; as Helminthoglypta arrosa). Helminthoglypta stiversiana is found in the central Californian coastal lupine scrub, a cool-temperate, highly equable setting characterized by an abundance of summer fog. The following observations on life history of Helminthoglypta stiversiana are probably broadly applicable to Helminthoglypta species in general.

Helminthoglypta species are predominantly ground-dwelling snails. They seek shelter under vegetation, rocks, debris on the ground, or rotting logs, and do not tend to sit out exposed as do some snails in Mediterranean regions or the American South. Most are probably generalized plant detritus feeders, although some may feed on living herbs or fungi. No specific host-plant relationships have ever been documented. Helminthoglypta are hermaphroditic and generally outcross; copulation is often reciprocal.

Most activity occurs during winter wet seasons; mating, oviposition, hatching, and most growth occur at these times. During the dry season they become dormant and attach by a mucous seal to solid objects such as twigs, leaves, clods, or rocks. Shelter sites, rather than food, may usually be a limiting resource. Individual snails may have customary browsing ranges, if not specific home sites. In discontinuous habitat, dispersal from patch to patch may be a rare event. It probably takes most species a minimum of three years to reach maturity. They may survive for several years after reaching maturity. Desiccation may be the most frequent cause of mortality. Predators include carabid beetles, rodents, shrews, birds, snakes, and lizards. In dry settings, empty shells may last for many years.

6.2 METHODS

A field survey for the striped-skinned snail was conducted between 20 May and 23 May 1988 by vehicle and on foot in all quadrants of NPR-1 and in Section 18H of NPR-2. Reference was constantly made to U.S. Geological Service 7.5-minute series topographic quadrangle maps and a blue-line road map of NPR-1. Primary, secondary, and lesser roads were driven to identify potential habitat of the snail. Where potentially promising habitat was seen, the area was searched for living snails, empty shells, and snail signs such as feces, slime trails, or seal-marks (the traces left where a snail has been attached by a mucous seal to a solid object such as a branch or stone) (Figure 17).

Early in the survey it was determined that the congeneric species, Helminthoglypta carpenteri, was living at the base of desert saltbush shrubs near the bottoms of shallow draws draining from the Elk Hills to the alluvial plains below. Such areas were searched for empty shells and boards, stones, branches, or other debris on the ground were inspected. A small number of Atriplex shrubs were dug in an attempt to find snails or snail sign. Where Helminthoglypta were present, the general extent of the saltbush habitat at that site was noted.

A particular effort was made to find the areas that are known to form Helminthoglypta habitat elsewhere in California, such as stable talus accumulations or rockpiles with crawl spaces, logs, or deadfalls on the ground, woodrat (Neotoma spp.) nests, or stream-drift brush accumulations. Special attention was paid to locations where surface water was present (as runoff from pipes of the Reserve's fresh water system or artificially constructed flow sites or basins).

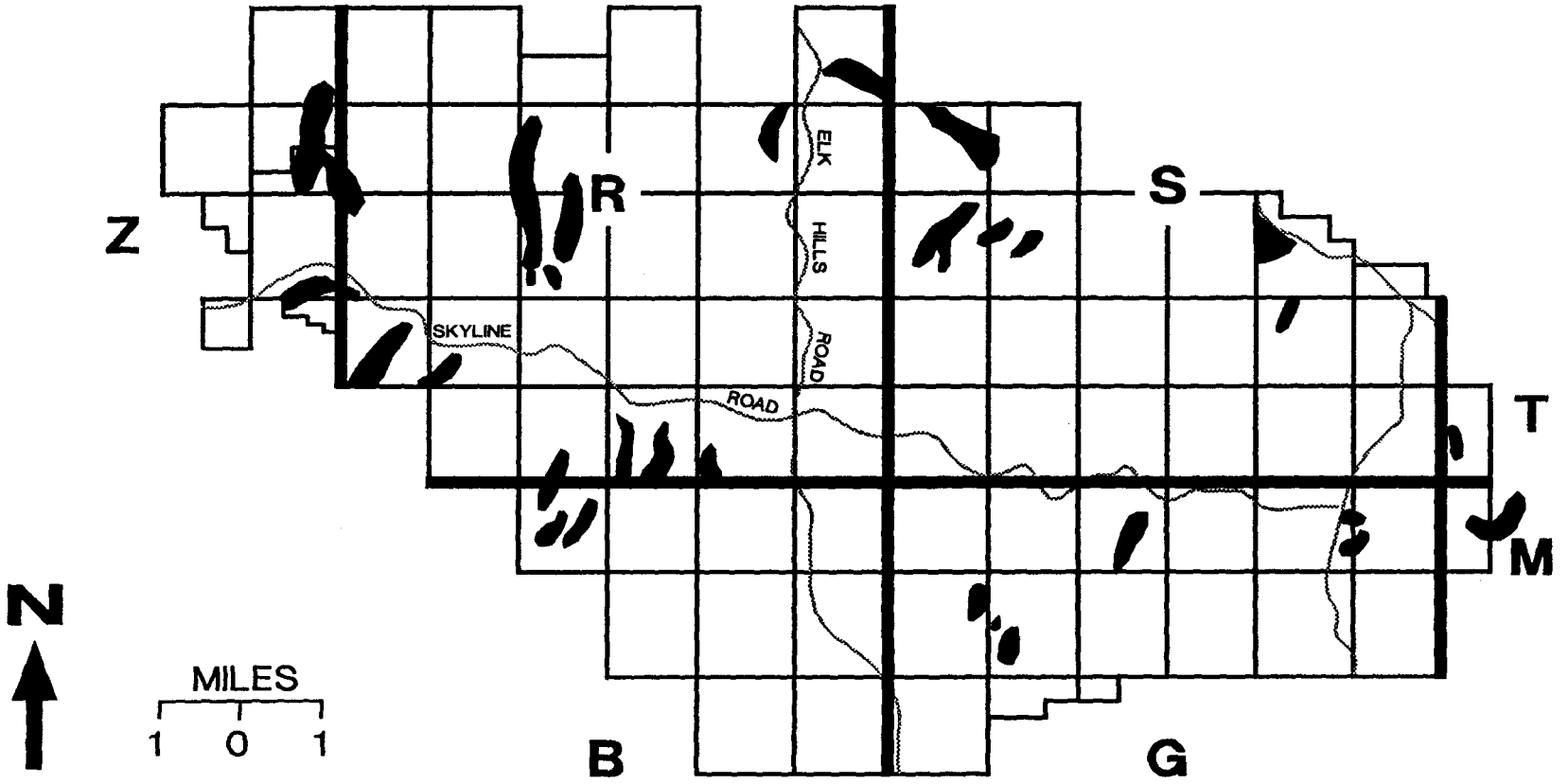

Figure 17. The distribution of habitat on Naval Petroleum Reserve #1, Kern County, California, intensively searched for the presence of Helminthoglypta callistoderma. Bold letters and lines define townships.

Section 18H of NPR-2 was also inspected because it has some especially moist sites, and it was thought that portions of 18H provided some suitable habitat for the species.

6.3 RESULTS

No striped-skinned snails were found on NPR-1 or NPR-2 during the course of this survey.

Over most of the area surveyed, desert saltbush was virtually the only shrub present, although at certain sites (e.g., a major northwest-draining wash in the northeast quarter section of 19S) greater shrub diversity was present and bladderpod (Isomeris arborea var. globosa) was locally prominent.

Atriplex tended to be least dense on the tops of ridges and most dense in the bottoms of draws. The shrubs were normally about three feet or less in height, although along sites of pipe runoff they sometimes formed thickets six feet high. There was little debris such as boards or stones on the ground that could form shelter for snails (although two boards partly embedded in the ground in the midst of an Atriplex stand in the southeast quarter of Section 24Z supported a large population of Helminthoglypta carpenteri).

Many of the types of settings known to form Helminthoglypta habitat elsewhere in California were not found in NPR-1. No stable talus accumulations or rockpiles with crawl spaces were found. The only talus was in loose, rubbly accumulations generally resulting from cut-and-fill activities. There were few natural outcrops of bedrock of any kind. Logs and deadfalls are absent in the essentially treeless Elk Hills. No woodrat's nests were seen; no woodrats were captured in the EG&G/EM trapping programs. Only a few water-carried brush accumulations were noted in washes, and these were devoid of snails. They were probably too small and too transitory to form good snail habitat.

The only snails found in the course of the survey were Helminthoglypta carpenteri, which were common at the base of desert saltbush particularly under older, recumbent trunks partly embedded in soil.

Specific sources of surface water that were inspected were:

1. The warm flow from a pipe in SE/NE 21R, immediately west of the dirt road that follows a northward-draining draw across the west one-half section of Section 21R. For several yards the water flows sluggishly northward before being absorbed into the gravelly soil. In and adjacent to the water there is a dense growth of grasses, fleshy forbs such as sow thistle (Sonchus spp.), and a patch of cattails (Typha spp.). Atriplex spp. growing next to the water is somewhat more lush than elsewhere in the same draw. No snails were found associated with the water. Two empty

Helminthoglypta carpenteri shells were found under the dead trunks of a burned desert saltbush clump on the road embankment about one yard above the water.

2. Damp ground in a gully near the head of a southwest-draining draw in SW/NE 30R. A willow (Salix spp.) and a patch of cattails are present. No snails were found associated with the damp ground. One immature Helminthoglypta carpenteri was found sealed to the underside of a dead trunk of Atriplex spp. partly embedded in the sandy to silty soil outside the zone of obvious moisture.

3. The flow from an elevated pipe into a rather steep side-canyon in NE/SW 23S, forming a short stream and zone of muddy ground. Atriplex spp. growing from the moist ground forms a tall, dense thicket. No snails or sign of snails were found in this area.

4. A watering basin in the northern half of Section 2G on a ridge immediately south of Skyline Road East, surrounded by oleanders (Nerium spp.) and 10-15 trees. No snails or sign of snails were found on the damp ground around the basin or under plant litter, branches, or stones on the ground.

5. A drainage ditch along the common boundary of NPR-1 and the State Tule Elk Reserve, north of the California Aqueduct in SW/NE 23S. The bottom of the ditch was mud-cracked and slightly damp. Dense weeds grow along the ditch and fence-line. A small amount of trash was turned over without snails or sign of snails being found.

6. Drip from a fresh water standpipe west of North Access Road just north of Four Corners (NE/NE 2G). Water puddles at road level then trickles into a gully running into a culvert beneath North Access Road. Weeds and lush scrub grow on the damp ground. No snails or sign of snails were found.

Section 18H was visited on 20 May. East of the east flank of the Buena Vista Hills, most of Section 18H is flat with fluffy-silty, little-compacted soil. The vegetation is dominantly Atriplex with considerable areas of bare ground. A small amount of trash on the ground was turned over without snails or snail sign being found. Over much of the eastern part of Section 18H, the soil is coated by a thin layer of silt-covered, twiggy-plant debris, indicating that this area is sometimes inundated. Also toward the eastern boundary there is a dense weedy growth of exotic cereal grasses. No shells were found in the waterlaid plant debris.

In addition to the negative results of the field survey, there are several habitat considerations that make it seem unlikely that the striped-skinned snail occurs or has occurred on NPR-1 or NPR-2.

All documented occurrences of striped-skinned snails are in the southeastern San Joaquin Valley, in the vicinity of Bakersfield and the adjacent foothills. All of these occurrences are associated with the Kern River or its tributary, Cottonwood Creek. The westernmost documented locality for the striped-skinned snail is the right bank of the Kern River near the Stockdale Highway bridge, west of Bakersfield. Two other reported occurrences, not documented by specimens now available for study, are six and ten miles west of Bakersfield, along the Kern River.

All previous records of striped-skinned snails indicate habitat probably associated with the Streambank Association of Twisselmann (1967). Potential habitat such as logs, woodrat's nests, or large stream-drift debris piles are absent from the Elk Hills.

The phylogenetic affinities of striped-skinned snails are with species of higher elevations in the southern Sierra Nevada and Tehachapi Mountains (B. Roth, unpublished data). The striped-skinned snail is probably best interpreted as a species of this group which has managed to extend downhill and westward in favorable riparian habitats along the Kern River. Even before its modification by agriculture, the floor of the San Joaquin Valley was probably a barrier to the further westward spread of snails of this group, owing to lack of suitable habitat.

Sympatry between species of Helminthoglypta is known, but is not common; most species are allopatric. The Atriplex scrub habitat is a very specialized one; Helminthoglypta carpenteri may have unique adaptations that allow it to exist (and attain large numbers) on the Reserves. The otherwise rare and localized striped-skinned snail would not seem likely to be a promising competitor to the dominant Helminthoglypta carpenteri in this specialized setting. Therefore, the presence of Helminthoglypta carpenteri on NPR-1 may be regarded as evidence that the striped-skinned snail is not present on NPR-1.

The artificial sources of surface water at NPR-1 do not modify the environment enough to affect the presence of snails. The only snails found near surface water sites were the usual Helminthoglypta carpenteri and those occurrences were not significantly different from occurrences of that species elsewhere in the Reserve.

The episodically inundated flats of Section 18H (NPR-2) do not appear to support Helminthoglypta.

7. CONCLUSIONS

1. One plant species, Hoover's woolly-star, was located at 28 sites. Observations of Hoover's woolly-star suggest that it is a colonizing species, occurring in open habitats (washes, old roadbeds). The ability of this species to withstand disturbance will allow for flexibility in oil field construction and maintenance activities.

2. The California jewelflower, Kern mallow, and San Joaquin woolly-threads were not observed on the Reserve. Based on habitat requirements and autecology, only the Kern mallow is likely to occur.

3. Nelson's antelope ground squirrel, San Joaquin pocket mouse, and the short-nosed kangaroo rat were all trapped on NPR-1 and NPR-2. No evidence was found that the Buena Vista Lake shrew exists on either of the Reserves.

4. Tipton's kangaroo rat, a recently listed endangered species, was found in Section 23S of NPR-1 and in Section 18H of NPR-2.

5. No evidence was found that Hopping's blister beetle, Moestan blister beetle, Molestan blister beetle, and Morrison's blister beetle are present on the Reserves. None of the beetles have ever been collected from Elk Hills. The closest historical record of collection is more than 20 miles away. It appears unlikely that any of the species are present.

6. No evidence was found that the striped-skinned snail exists on either NPR-1 or in Section 18H of NPR-2. The Reserves generally lack habitat reported to be suitable for the species (i.e., logs, woodrat nests, or similar shelter on the ground near a sizeable perennial stream). Based on published and unpublished data, the range of the species is apparently restricted to riparian situations near Bakersfield and the adjacent foothills.

8. RECOMMENDATIONS

1. Observations for candidate species should continue to be made in conjunction with other biological surveys conducted on Elk Hills. This will provide current information on the status of candidate species known to occur on the Reserves.

2. When feasible, surface disturbances within populations of Hoover's woolly-star should be permitted only when there is sufficient biological information to indicate that the population will recover from the disturbance. The way in which Hoover's woolly-star responds to habitat disturbance should then be monitored using systematic, quantitative ecological sampling methods.

3. Practices to enhance native grass and herb species at sites where vegetation manipulation or revegetation for erosion control is necessary should be implemented. Maintaining a diversity of native annual plants should increase the likelihood that existing and undetected populations of candidate plants will be protected.

4. The subspecies of San Joaquin pocket mouse present on Elk Hills should be determined. Confirmation that the subspecies is Perognathus inornatus neglectus would reduce concerns that the species of pocket mouse on Elk Hills is threatened or endangered.

5. No further surveys are needed for candidate species that were undetected unless new information becomes available that suggests that one or more of the species are or may be present.

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