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ENDANGERED SPECIES PROGRAM
NAVAL PETROLEUM RESERVES IN
CALIFORNIA

ANNUAL REPORT FY94

April 1995

LAS VEGAS AREA OPERATIONS
P.O. Box 1925, Las Vegas, Nevada 89125

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ENDANGERED SPECIES PROGRAM

NAVAL PETROLEUM RESERVES IN

CALIFORNIA

ANNUAL REPORT FY94

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EXECUTIVE SUMMARY

In FY94, EG&G Energy Measurements, Inc. (EG&G/EM) continued to support efforts to conserve endangered species and cultural resources at the Naval Petroleum Reserves in California (NPRC). These efforts are conducted to ensure NPRC compliance with regulations regarding the protection of listed species and cultural resources on Federal properties.

Population monitoring activities are conducted annually for San Joaquin kit foxes, giant kangaroo rats, blunt-nosed leopard lizards, and Hoover's wooly star. Kit fox abundance and distribution was assessed by live-trapping over a 329-km² area. Kit fox reproduction and mortality were assessed by radiocollaring and monitoring 22 adult and 14 pup foxes. Reproductive success and litter size were determined through live-trapping and den observations. Rates and sources of kit fox mortality were assessed by recovering dead radiocollared kit foxes and conducting necropsies to determine cause of death. Abundance of coyotes and bobcats, which compete with kit foxes, was determined by conducting scent-station surveys. Kit fox diet was assessed through analysis of fecal samples collected from live-trapped foxes. Abundance of potential prey for kit foxes was determined by conducting transect surveys for lagomorphs, and by live-trapping small mammals. Small mammal trapping also provided information on the abundance and distribution of several rodent species that are candidates for Federal listing.

Efforts also were initiated to monitor giant kangaroo rats and blunt-nosed leopard lizards. The methodologies used were consistent with those employed by other researchers to facilitate comparisons of results. Giant kangaroo rat abundance and demographics were assessed by live-trapping on a monitoring plot and by monitoring the size of selected giant kangaroo rat colonies. To track blunt-nosed leopard lizard population trends, two monitoring plots were established. In FY94, surveys were conducted in late summer to count, capture, and mark juvenile blunt-nosed leopard lizards. Beginning in FY95, surveys also will be conducted in spring for adult lizards. Hoover's wooly-star populations were assessed at six monitoring sites. Additionally, Hoover's wooly-star abundance was measured on study plots established to assess the effects of disturbance and the efficacy of topsoil conservation on this species. This study will be completed in FY95 and a manuscript will be prepared for publication. Also in FY94, an effort was conducted to determine whether Kern mallow was present on NPRC. Mallow specimens were collected and sent to species experts who concluded that the plants were indeed Kern mallow. Monitoring efforts for all listed species will continue in FY95.

To mitigate impacts of oil field activities on listed species, 400 preactivity surveys covering approximately 315 acres were conducted in FY94. Mitigation measures implemented as a result of survey findings resulted in avoidance of incidental takes of listed species during construction activities. EG&G/EM also assisted with mitigating effects from third-party projects, primarily by conducting biological and cultural resource consultations with regulatory agencies. Third-party projects in FY94 included three pipeline projects and two well abandonment/clean-up projects. Cultural resource support provided to NPRC consisted primarily of conducting preliminary surveys for cultural resources, and preparing a Cultural Resource Management Plan and Programmatic Agreement for NPR-1. These two documents will be finalized in FY95.

EG&G/EM has conducted an applied habitat reclamation program at NPRC since 1985. In FY94, an evaluation of revegetation rates on reclaimed and non-reclaimed disturbed lands was initiated to assess reclamation efficacy. Results will be used to direct future habitat reclamation efforts at NPRC. In addition to this effort, 347 reclaimed sites were assessed to evaluate reclamation success.

An investigation of factors influencing the distribution and abundance of kit foxes at NPRC was initiated in FY94. Factors being examined include habitat disturbance, topography, grazing, coyote abundance, lagomorph abundance, and shrub density. This investigation will continue in FY95 and a manuscript on this topic will be completed in FY96. In conjunction with other NPRC organizations, EG&G/EM initiated an evaluation of the effects of a well blow-out on plant and animal populations. This assessment will continue through FY95, and a final report will be prepared in FY96.

EG&G/EM conducted a number of activities related to program support. Such activities included supporting NPRC in a formal Section 7 consultation with the U.S. Fish and Wildlife Service for continuing oil and gas operations on NPR-1, assisting with the completion of a Supplemental Environmental Impact Statement for NPR-1, preparing a biological assessment in support of a formal Section 7 consultation for oil and gas activities on NPR-2, and assisting with the preparation of an Environmental Assessment for NPR-2.

EG&G/EM also engaged in a number of outreach activities. Technical outreach included participation and presentations at scientific meetings, preparation of four scientific manuscripts and three technical reports, and initiation of work on nine other manuscripts and reports. Other technical outreach included presentation of a poster at a Department of Energy Environment, Safety and Health Conference, progress at quarterly Endangered Species Advisory Committee meetings, presentations of results at an annual program review attended by approximately 100 individuals from government and private organizations, and participation in regional conservation efforts such as recovery planning meetings, San Joaquin Valley Biotechnical Committee meetings, and Lokern Natural Area management meetings. Educational outreach activities included the preparation of numerous articles for the *Elk Hills Weekly*, on-site tours, presentations to school children, and participation in the annual Elk Hills Earth Day celebration, Tule Elk Reserve Jamboree, Coles Levee Ecosystem Preserve educational program, and Department of Energy Science Bowl. EG&G/EM also hosted a local high school science teacher on a summer internship, employed several cooperative education students from the California State University at Bakersfield, and supported a graduate student from University of California at Berkeley who conducted research on kit fox space use.

ACKNOWLEDGEMENTS

Permission to conduct research on endangered and threatened species was granted by the U. S. Fish and Wildlife Service through permit PRT-683011, and a Memorandum of Understanding between the California Department of Fish and Game and EG&G Energy Measurements, Inc.

This is a continuing program and interpretation of facts contained in this report may change as new data are acquired and analyzed. Results should not be cited without prior consultation.

CONTENTS

Section	Title	Page
1.	INTRODUCTION	1
1.1	BACKGROUND	1
1.2	OBJECTIVES	1
2.	ENDANGERED SPECIES MONITORING PROGRAM	3
2.1	MONITOR POPULATIONS OF KIT FOXES ON NPRC	3
2.2	MONITOR REPRODUCTION AND MORTALITY OF KIT FOXES	7
2.3	MONITOR TRENDS OF CARNIVORE ABUNDANCE	8
2.4	MONITOR LAGOMORPH POPULATIONS	10
2.5	MONITOR SMALL MAMMAL POPULATIONS	12
2.6	DETERMINE DIET OF KIT FOXES	17
2.7	GIANT KANGAROO RAT POPULATION MONITORING	19
2.8	BLUNT-NOSED LEOPARD LIZARD POPULATION MONITORING	21
2.9	HOOVER'S WOOLY-STAR POPULATION MONITORING	22
2.9.1	Monitor Hoover's Wooly-Star Reference Plots	22
2.9.2	Monitor Hoover's Wooly-Star Conservation Techniques	25
2.10	ASSESSMENT OF SPECIAL STATUS PLANT SPECIES	28
3.	CONDUCT PREACTIVITY SURVEYS FOR NPRC PROJECTS	29
3.1	CONDUCT ENDANGERED SPECIES AND CULTURAL RESOURCE PREACTIVITY SURVEYS	29
3.2	CULTURAL RESOURCES SUPPORT	32

Section	Title	Page
4.	HABITAT RECLAMATION AND MANAGEMENT	35
4.1	EVALUATION OF REVEGETATION RATES	35
4.2	MONITORING RECLAMATION SUCCESS	42
5.	RESEARCH AND DEVELOPMENT	46
5.1	FACTORS INFLUENCING THE DISTRIBUTION AND ABUNDANCE OF KIT FOXES ON NPRC	46
5.2	BLOWOUT ASSESSMENT	47
6.	PROGRAM ASSISTANCE	52
7.	PUBLICATIONS	55

TABLES

Table	Title	Page
1.	Number of trap-nights, captures, individuals, and estimated minimum population size of San Joaquin kit foxes on the Naval Petroleum Reserves in California, during winter live-trapping sessions, 1981-1993 (NPR-1 study area) and 1983-1993 (NPR-2)	6
2.	The number of lagomorphs observed during summer transects in developed and undeveloped sections on NPR-1 and NPR-2 in 1994.	11
3.	Small mammal captures and diversity indices within four physiographic regions on Naval Petroleum Reserve No. 1, Kern County, California, 1994.	14
4.	Mean percent cover and mean herbaceous production estimated in four physiographic regions on Naval Petroleum Reserve No. 1, Kern County, California, 1994	15
5.	Frequency of occurrence (%) of items found in San Joaquin kit fox scat collected during FY94, Naval Petroleum Reserves in California, Kern County, California .	18
6.	Number of giant kangaroo rat precincts in colonies monitored in 1993 and 1994, Naval Petroleum Reserves in California, Kern County, California.	21
7.	Density and frequency of occurrence of Hoover's wooly-star on six reference plots on Naval Petroleum Reserve No. 1, Kern County, California, 1994. Standard errors are in parentheses	24
8.	Total vascular plant cover by lifeform on Hoover's wooly-star reference plots on Naval Petroleum Reserve No. 1, Kern County, California, 1994. Standard errors are in parentheses	24
9.	Hoover's wooly-star density and total vascular plant cover on study plots on Study Site 1 on Naval Petroleum Reserve No. 1, Kern County, California, 1994. Standard errors are in parentheses	26
10.	Hoover's wooly-star density and total vascular plant cover on study plots on Study Site 2 on Naval Petroleum Reserve No.1, Kern County, California, 1994. Standard errors are in parentheses.	27

Table	Title	Page
11.	Summary of endangered species preactivity surveys conducted during FY94 on the Naval Petroleum Reserves in California, Kern County, California.	31
12.	Summary of cultural resource surveys completed during FY94 on the Naval Petroleum Reserves in California, Kern County, California	34
13.	Average cover estimates (SE in parentheses) for 347 reclamation sites sampled in 1994 on Naval Petroleum Reserve No. 1, Kern County, California	43
14.	Evidence of use of reclamation sites by wildlife on the Naval Petroleum Reserves in California, Kern County, California, 1994	44

ILLUSTRATIONS

Figure	Title	Page
1.	Location of U.S. Department of Energy's Naval Petroleum Reserves in California, Kern County, California	2
2.	Location of San Joaquin kit fox captures during winter 1993, Naval Petroleum Reserves in California, Kern County, California	4
3.	Spring visitation indices for coyotes on the Naval Petroleum Reserves in California, Kern County, California, 1985-1994	9
4.	Lagomorphs observed during summer transects on the Naval Petroleum Reserves in California, Kern County, California, 1994	12
5.	Frequency of occurrence of lagomorph and kangaroo rat remains found in kit fox scat collected during winter trapping sessions on the Naval Petroleum Reserves in California, Kern County, California	19
6.	Assessment of reclamation success on cut/fill slopes-revegetated vs. non-revegetated on the Naval Petroleum Reserves in California, Kern County, California, 1994 .	37
7.	Assessment of reclamation success on non-cut/fill slopes-revegetated vs. non-revegetated on the Naval Petroleum Reserves in California, Kern County, California, 1994	38
8.	Assessment of reclamation success on subsample sites by aspect on the Naval Petroleum Reserves in California, Kern County, California, 1994	39
9.	Assessment of reclamation success subsample sites-disturbance type on the Naval Petroleum Reserves in California, Kern County, California, 1994	40

1. INTRODUCTION

1.1 BACKGROUND

The Naval Petroleum Reserves in California (NPRC) are operated by the U. S. Department of Energy (DOE) and Chevron U.S.A. Production Company (CPDN). Four federally endangered animal species and one federally-threatened plant species are known to occur on NPRC: San Joaquin kit fox (*Vulpes macrotis mutica*), blunt-nosed leopard lizard (*Gambelia silus*), giant kangaroo rat (*Dipodomys ingens*), Tipton kangaroo rat (*Dipodomys nitratooides*), and Hoover's woolly-star (*Eriastrum hooveri*). All five are protected under the Endangered Species Act (ESA) of 1973 (as amended) (Public Law 93-205), which declares that it is "...the policy of Congress that all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of the Act." DOE is also obliged to determine whether actions taken by their lessees on Naval Petroleum Reserve No. 2 (NPR-2) will have any effects on endangered species or their habitats.

Naval Petroleum Reserve No. 1 (NPR-1) and NPR-2 are located approximately 40 km southwest of Bakersfield, Kern County, California (Figure 1). NPR-1 encompasses 19,186 hectares (47,409 acres) in seven townships and is located just north of NPR-2. DOE owns approximately 14,994 hectares (37,049 acres) of NPR-1, while CPDN owns the remaining 4,193 hectares (10,360 acres). NPR-2 consists of 12,173 hectares (30,080 acres) in five townships. DOE administers 4,209 hectares (10,400 acres) on NPR-2, while the remainder is privately owned. The city of Taft occupies 518 hectares (1,280 acres) in the southern portion of NPR-2.

1.2 OBJECTIVES

The primary objective of the EG&G Energy Measurements, Inc. (EG&G/EM) Endangered Species Program on NPRC is to provide DOE with the scientific expertise necessary for compliance with the ESA. The specific objective of this report is to summarize progress, results, and accomplishments of the Endangered Species Program during fiscal year 1994 (FY94).

Figure 1. Location of U.S. Department of Energy's Naval Petroleum Reserves in California, Kern County, California.

2. ENDANGERED SPECIES MONITORING PROGRAM

2.1 MONITOR POPULATIONS OF KIT FOXES ON NPRC

I. INTRODUCTION

An essential aspect of all endangered species research is estimating the size or density of the population. San Joaquin kit foxes have been trapped annually on NPRC since winter, 1981 to provide continuous information on kit fox population trends. The information gathered during this project is useful in determining the factors that most strongly affect kit fox populations on NPRC. Knowledge of how these factors influence fox numbers can ultimately be used to help formulate species recovery strategies.

II. METHODS AND MATERIALS

Annual San Joaquin kit fox population monitoring was conducted during November and December, 1993 over approximately 329 km² on and adjacent to NPRC. One 38 cm x 38 cm x 107 cm collapsible wire-mesh live-trap was placed in each quarter section and operated for four consecutive nights. NPRC was divided into a number of smaller trap areas, the most important of which are the NPR-1 study area and NPR-2. The NPR-1 study area is a 117-km² area located in the south central portion of NPR-1 and the northern portion of NPR-2. A total of 712 trap-nights of effort were expended on the NPR-1 study area, while 676 trap-nights of effort were expended on NPR-2. Captured kit foxes were individually marked, sexed, weighed, measured, and released at the capture location.

The number of foxes captured and minimum population sizes were calculated for the NPR-1 study area and NPR-2 and compared with the results of previous trapping sessions. Minimum population size was calculated by adding the number of foxes captured during the trapping session to the number of uncaptured foxes that were known to be alive during the session. Because there were no foxes wearing functional radiocollars during the 1993 trapping session, the minimum population size and the number of foxes captured were equivalent for this session.

Figure 2. Location of San Joaquin kit fox captures during winter 1993, Naval Petroleum Reserves in California, Kern County, California.

III. RESULTS

A total of 40 San Joaquin kit foxes were captured 50 times on the NPR-1 study area, while 108 kit foxes were captured 131 times on NPR-2 (Table 1). Compared with 1992, 250% and 186% more individuals were captured on the NPR-1 study area and NPR-2, respectively. Minimum population sizes calculated in 1993 for the NPR-1 study area (40) and NPR-2 (109) were 250% and 188% higher, respectively, than minimum population sizes calculated in 1992 (Table 1).

Fox captures were more numerous on both NPR-1 and NPR-2 during 1993 than during both 1991 and 1992. On NPR-1, foxes were primarily captured within or near Buena Vista Valley and along the northern boundary (Figure 2). Kit foxes were captured throughout most of NPR-2 during the 1993 session.

IV. CONCLUSIONS

The numbers of individual kit foxes captured in 1993 on the NPR-1 study area and NPR-2 were the highest since 1984. Kit fox captures were more widely distributed in 1993 than in 1992, particularly on NPR-1, also indicating that fox abundance has increased over 1992 levels.

Table 1. Number of trap-nights, captures, individuals, and estimated minimum population size of San Joaquin kit foxes on the Naval Petroleum Reserves in California, during winter live-trapping sessions, 1981-1993 (NPR-1 study area) and 1983-1993 (NPR-2).

Year	Trap-nights		Captures		Individuals		Minimum Population	
	NPR-1	NPR-2	NPR-1	NPR-2	NPR-1	NPR-2	NPR-1	NPR-2
1981	711		209		141		165	
1982	710		117		87		131	
1983	712	674	17	88	17	73	75	119
1984	711	659	51	133	42	113	61	151
1985	708	673	31	106	26	80	44	128
1986	712	675	25	124	22	100	33	138
1987	712	676	27	99	23	76	36	124
1988	712	676	27	125	23	100	37	131
1989	712	676	27	77	26	66	42	103
1990	712	676	28	91	18	64	21	71
1991	712	671	2	28	2	24	13	40
1992	712	676	20	63	16	58	16	58
1993	712	676	50	131	40	108	40	109

2.2 MONITOR REPRODUCTION AND MORTALITY OF KIT FOXES

I. INTRODUCTION

Kit fox reproduction and mortality were assessed on and adjacent to NPR-1. Monitoring kit fox reproduction and mortality may help explain changes in population size. The objectives of monitoring reproduction and mortality are to: (1) determine the proportion of adult females that wean pups, (2) determine the average litter size, (3) determine the proportion of juveniles that enter the breeding population, and (4) determine the sources and rates of mortality of juvenile and adult kit foxes.

II. METHODS AND MATERIALS

Kit foxes were radiocollared and monitored to determine reproductive success, causes of mortality and mortality rates. During the 1993 annual trapping session conducted in November and December (see Section 2.2 for details concerning live-trapping and handling techniques), selected adult foxes were fitted with 50-g radiocollars equipped with mortality sensors (MOD-80, Telonics, Mesa, AZ). In May, pups were trapped at their dens and fitted with radiocollars that weighed 25 to 30 g (Model 2A, Telonics). All radiocollared foxes were monitored two to three times per week. Attempts were made to adjust and change collars as needed.

Female foxes radiocollared in November and December were monitored to assess reproduction. In the spring, fox reproduction was assessed by conducting den observations and by live-trapping. Each den inhabited by a radiocollared vixen was observed at dusk to count the number of pups present at the den. Later, traps were placed at these dens to capture and individually mark the pups. If juvenile foxes were captured or observed at a den inhabited by a radiocollared vixen, or the vixen showed signs of recent lactation when captured, it was assumed that she had weaned pups. Litter size for each family group was determined by the maximum number of pups trapped or observed at the vixens' dens.

Sources and rates of kit fox mortality were assessed by monitoring the fate of radiocollared adult and juvenile foxes. Animals transmitting a mortality signal were immediately recovered and necropsied to determine cause of death. Deaths caused by predators were identified by tooth-puncture wounds to the skin and skeleton and the associated hemorrhaging. Death due to vehicle impact was assumed when foxes were recovered in close proximity to roads and evidence of massive trauma was apparent. If the cause of death could not be determined because the carcass was too badly scavenged, decomposed, desiccated or only the radiocollar was recovered, the fox was classified as having died of indeterminate causes. If the carcass was recovered intact, but no evidence indicating the cause of death could be found, the cause of death was classified as unknown.

III. RESULTS AND CONCLUSIONS

Reproduction

Of the 22 adult foxes (11♂♂, 11♀♀) radiocollared during the 1993 annual trapping session, 18 were alive and were monitored during the pup rearing season (March - July). The dens of nine female radiocollared foxes were observed on 24 occasions during which 26 pups were observed. Each of these nine females (100%) was found to be associated with pups. Such a high proportion of radiocollared adult females raising pups has rarely been observed in previous years. However, two of the radiocollared females probably did not reproduce because they did not exhibit any signs of nursing or rufous fur on their abdomens when they were captured in the spring. These two females probably were only assisting another vixen with pup rearing. Seventeen pups were trapped at these dens (10♂♂, 7♀♀), 14 of which (9♂♂, 5♀♀) were radiocollared to monitor their survival until adulthood. An additional female pup was trapped and collared at the den of an adult radiocollared male. Litter size ranged from one to six pups. The average litter size was 3.1 pups/litter ($n = 9$, $SE = 0.47$) which was lower than the average litter size observed between 1980-1992 ($\bar{x} = 3.8$, $n = 54$, $SE = 0.16$) but did not differ significantly ($t = 1.53$, $df = 61$, $p = 0.12$).

Mortality

Of the 22 adult foxes radiocollared in November and December 1993 and monitored until September 1994, eight (36.4%) were recovered dead and four (18.2%) were lost because their radiocollars either malfunctioned or expired. Of the eight foxes that died, five (62.5%) were killed by predators, one (12.5%) died of an unknown cause, and the cause of death for two (25.0%) could not be determined.

Of the 15 pups radiocollared in May and June 1994, 13 (86.7%) were recovered dead by September, 1994. Radio contact with one pup (6.7%) was lost because its collar malfunctioned or it had dispersed beyond the area monitored. Nine (69.2%) of 13 radiocollared pups recovered dead were killed by predators, one (7.7%) was killed by a vehicle on a public road, and the cause of death for two foxes (15.4%) could not be determined. The radiocollar from one (7.7%) pup was recovered from a waste water sump in Section 10G, and a cause of death could not be determined. Mortality sources for both radiocollared adults and pups appeared consistent with that observed for previous years.

2.3 MONITOR TRENDS OF CARNIVORE ABUNDANCE

I. INTRODUCTION

Coyote (*Canis latrans*) predation is the primary source of mortality for kit foxes on NPRC and coyotes also may compete with kit foxes for food resources. As a result, scent-station surveys were established in 1984 to estimate the relative abundance of carnivores, particularly coyotes.

II. METHODS AND MATERIALS

Scent-station surveys were conducted in late February and early March. Surveys involved 25 scent-station lines (15 on NPR-1 and 10 on NPR-2). Each line contained 10 scent-stations placed on alternate sides of secondary roads and spaced at 0.5-km intervals. Each scent-station consisted of a circular 0.9-m diameter area cleared of all vegetation and debris. A thin layer of fine dust (approximately 2 mm) was sifted over the cleared area and a 2.5-cm plaster-of-Paris disk saturated with fatty-acid scent attractant was placed in the center. Scent-stations were prepared in the afternoon and then examined the following morning for the presence of coyote and other carnivore prints. The presence of at least one print at any given station constituted a positive visit. Visitation indices were then calculated as the proportion of operable stations (those not disturbed by wind, rain, or human-related factors) visited multiplied by 1,000.

III. RESULTS AND CONCLUSIONS

On NPR-1, the visitation index for coyotes was 107, suggesting that the relative abundance of coyotes continued to increase following a three year decline prior to 1993 (Figure 3). This is the highest spring index obtained for coyotes on NPR-1 since 1986 but is not significantly higher than the spring 1993 coyote index ($W = 44$, $p = 0.58$). On NPR-2, the visitation index for coyotes was 61, which was slightly greater than the 1993 index of 51. Coyote visits on NPR-2 did not change significantly from 1993 to 1994 ($W = 7.5$, $p = 1.00$) (Figure 3).

Figure 3. Spring visitation indices for coyotes on the Naval Petroleum Reserves in California, Kern County, California, 1985-1994.

2.4 MONITOR LAGOMORPH POPULATIONS

I. INTRODUCTION

Lagomorphs, such as black-tailed jackrabbits (*Lepus californicus*) and desert cottontails (*Sylvilagus audubonii*) are an important prey item for kit foxes. Lagomorph abundance is monitored annually to determine whether fluctuations in lagomorph density have a direct impact on the kit fox population.

II. METHODS AND MATERIALS

Lagomorph populations were monitored in June using line-transect surveys conducted in 78 sections on, and adjacent to, NPR-1 and NPR-2. On NPR-1, 24 of 42 transects were located in developed sections, while 18 were located in undeveloped sections. "Developed" sections were those in which more than 15% of the land was disturbed and "undeveloped" sections were those in which 15% or less of the land was disturbed. On NPR-2, 24 of 36 transects were located in developed sections, while 12 were located in undeveloped sections.

Transects were 1.6-km (1-mi) long and consisted of four 400-m legs that formed a square. Observers walked transects between 9:00 am and 4:00 pm and recorded lagomorph species, lagomorph behavior, and the perpendicular distance of observed lagomorphs to the transect line. A Fourier Series model (program DISTANCE) was used to calculate density estimates from recorded perpendicular distances. Estimated densities were compared using z-tests.

III. RESULTS AND CONCLUSIONS

A total of 145 lagomorphs were observed on NPR-1: 108 in developed sections and 37 in undeveloped sections (Table 2). This is 11% lower than the number of lagomorphs observed in summer 1993 on NPR-1 when 161 were observed. The estimated density of lagomorphs on NPR-1 was 43/km² (SE = 6.8) for all of NPR-1 and was not significantly different ($z = 0.46$, $p = 0.085$) than the 1993 density estimate of 66/km² (SE = 11.5). Estimated lagomorph density for developed sections was 56/km² (SE = 10.0) and was not significantly different ($z = 1.62$, $p = 0.105$) than the estimated density on undeveloped sections, which was 33/km² (SE = 9.7).

Table 2. The number of lagomorphs observed during summer transects in developed and undeveloped sections on NPR-1 and NPR-2 in 1994.

Year	NPR-1			NPR-2		
	Developed	Undeveloped	Total	Developed	Undeveloped	Total
1984	164	74	238	157	98	255
1985	66	49	118	141	44	185
1986	74	49	123	198	60	258
1987	59	29	88	54	20	74
1988	135	35	170	81	39	120
1989	74	41	115	74	18	92
1990	40	22	62	41	6	47
1991	8	7	15	26	6	32
1992	25	17	42	40	8	48
1993	107	54	161	112	33	145
1994	108	37	145	128	52	180

A total of 180 lagomorphs were observed on NPR-2: 128 in developed sections and 52 in undeveloped sections (Table 2). This is the highest number of lagomorphs observed in summer on NPR-2 since 1986 when 258 were observed (Figure 4). The estimated density of lagomorphs on NPR-2 was 63/km² (SE = 8.4) for all of NPR-2 and was not significantly higher ($z = 0.15$, $p = 0.697$) than the 1993 density estimate of 68/km² (SE = 19.8). Estimated lagomorph density for developed sections was 63/km² (SE = 9.5) and was not significantly different ($z = 0.04$, $p = 0.928$) than the estimated density on undeveloped sections, which was 61/km² (SE = 14.9). The estimated lagomorph density for NPR-2 was 32% higher than that for NPR-1, in 1994. This difference may be the result of varying habitat conditions between the two reserves. NPR-2 tends to have more shrubs which may provide more cover for lagomorphs.

Figure 4. Lagomorphs observed during summer transects on the Naval Petroleum Reserves in California, Kern County, California, 1994.

2.5 MONITOR SMALL MAMMAL POPULATIONS

I. INTRODUCTION

A program was initiated in FY93 to monitor abundance and habitat relationships of small mammals on NPR-1. Information obtained from this effort may help explain observed kit fox population trends because small mammals, particularly kangaroo rats, are important prey of kit foxes. Also, understanding small mammal habitat relationships may help explain kit fox distribution patterns on NPR-1. Finally, this monitoring program will provide an annual assessment of the abundance and habitat preferences of several species that are candidates for federal protection. Therefore, specific objectives of small mammal monitoring are to (1) assess the annual abundance and species composition of small mammals on NPR-1, (2) determine the

effects of physiographic and vegetation characteristics on small mammal abundance and species composition, and (3) determine annual abundance of candidate small mammals.

II. METHODS AND MATERIALS

Small mammal abundance and habitat relationships were assessed by live-trapping at 20 permanent monitoring sites. Five sites were established in each of four physiographic regions (South-Flat, South-Hilly, North-Flat, and North-Hilly) based on slope orientation (north or south side of Elk Hills ridge) and terrain (flat terrain = 0-5° slope, hilly terrain = >5° slope). At each site, 25 trap stations were established at 7.5-m intervals along an east-west transect. Two Sherman live traps were placed at each station for a total of 50 traps per site. Traps were prebaited for three days prior to trapping. During trapping, traps were set in late afternoon, and then checked the next morning. Captured small mammals were identified to species, marked ventrally with a non-toxic marking pen, sexed, aged, weighed, and released at the capture site.

To examine the relationship between small mammals and vegetation characteristics, vegetation sampling transects were established at each monitoring site. These transects were 200 m long, and were placed 10 m south of and parallel to each small mammal trapping transect. Percent cover of grasses, forbs, and all vegetation was estimated by using an ocular point projection device. Five points were sampled at 5-m intervals along the transect for a total of 200 points per site. To estimate annual primary production on sites, ten 0.25-m² quadrats were established at 20-m intervals along sampling transects. Forbs and grasses within each quadrat were clipped and placed in separate bags. Samples were oven dried and weighed to the nearest 0.1g.

III. RESULTS

Small mammal trapping was conducted for five consecutive nights from September 26-27, 1994. During this period, 780 individuals of seven species were trapped 1,868 times in 4,988 trap-nights (Table 3). Heermann's kangaroo rats (*Dipodomys heermanni*) were the most frequently captured species. Mean capture rate (mean number of individuals captured per 100 trap-nights) was highest on North-Flat sites, but did not differ statistically among regions ($F = 0.73$; 3,16 df; $p = 0.55$). On individual sites, capture rates were not correlated with either percent total cover ($r = 0.007$, $F < 0.01$, $p < 0.01$) or total production ($r = 0.06$, $F = 0.07$, $p < 0.79$).

Mean percent cover varied among regions for all vegetation ($F = 3.32$; 3,16 df; $p = 0.04$) and for grass: ($F = 4.12$; 3,16 df; $p = 0.02$), and was highest on South-Flat sites (Table 4). Percent forb cover did not differ statistically among regions. Mean production also varied among regions for total vegetation ($F = 3.38$; 3,16 df; $p = 0.04$) and for grass ($F = 4.03$; 3,16 df; $p = 0.03$), but both were highest on North-Hilly sites (Table 4). Mean forb production did not vary among regions ($F = 0.93$; 3,16 df; $p = 0.45$).

Table 3. Small mammal captures and diversity indices within four physiographic regions on Naval Petroleum Reserve No. 1, Kern County, California, 1994.

Treatment	Individuals								Trap-nights	Mean ^a Capture Rate (SE)	Mean ^b Shannon Diversity Index (SE)
	Short-nosed Kangaroo Rat	Heermann's Kangaroo Rat	Giant Kangaroo Rat	San Joaquin Pocket Mouse	Deer Mouse	Southern Grasshopper Mouse	San Joaquin Antelope Squirrel	Total			
South-Flat	143	20	2	3	0	8	21	197	1,242	15.9 (1.6)	0.35 (0.04)
South-Hilly	21	131	0	1	3	3	11	170	1,250	13.8 (1.7)	0.30 (0.05)
North-Flat	111	87	3	3	1	5	8	218	1,246	17.5 (2.3)	0.41 (0.05)
North-Hilly	3	178	0	3	8	0	1	193	1,250	15.4 (1.5)	0.13 (0.04)
Total	278	416	5	10	12	16	41	778	4,988	15.7 (0.9)	--

^a Mean number of individuals captured per 100 trapnights.

$$^b H' = \frac{n \log n - \sum f_i \log f_i}{n}, \text{ where } f_i \text{ is number of individuals of the } i\text{th species.}$$

Table 4. Mean percent cover and mean herbaceous production estimated in four physiographic regions on Naval Petroleum Reserve No. 1, Kern County, California, 1994.

Treatment	Mean Percent Cover (SE)			Mean Production (kg/ha) (SE)		
	Total	Grass	Forb	Total	Grass	Forb
South-Flat	63.6A ¹ (5.6)	52.6A (6.0)	28.0A (1.6)	302AB (62.6)	269.7AB (60.0)	32.5A (14.7)
South-Hilly	46.9B (2.5)	39.0B (2.8)	17.7A (1.5)	180.1B (47.7)	159.1B (41.3)	21.0A (7.0)
North-Flat	53.9AB (3.1)	47.3AB (3.4)	14.0A (3.2)	210.6AB (42.6)	195.0AB (36.2)	15.6A (7.1)
North-Hilly	57.8AB (4.9)	52.4AB (4.8)	11.9A (0.9)	381.9A (43.7)	368.9A (43.9)	13.0A (2.4)

¹ Means with the same letter within a column were not significantly different at $p=0.05$.

Physiographic and vegetation characteristics did not appear to significantly affect small mammal abundance, but these characteristics did have a noticeable effect on species composition (Table 3). Heermann's kangaroo rat was the most abundant species on hilly sites while short-nosed kangaroo rat (*D. nitratoides brevinasus*), a candidate species, was the most abundant species in flat sites. Another candidate species, the San Joaquin antelope squirrel (*Ammospermophilus nelsoni*), was captured in all regions, but was most abundant on South-Flat sites. Four other species were infrequently captured. San Joaquin pocket mouse (*Perognathus inornatus*), another candidate species, was present in all regions. The deer mouse (*Peromyscus maniculatus*) was captured in all regions except South-Flat while the grasshopper mouse (*Onychomys torridus*), also a candidate species, was captured in all regions except North-Hilly. Finally, the Federally endangered giant kangaroo rat was only captured on flat sites. A Shannon diversity index was calculated for all sites (Table 3). The mean index varied among regions ($F = 6.21$; 3,16 df; $p < 0.01$), and was highest for the North-Flat region and lowest for the North-Hilly region. Diversity on individual sites was not correlated to either total cover ($r = 0.13$, $F = 0.31$, $p = 0.58$) or total production ($r = 0.16$, $F = 0.49$, $p = 0.49$).

Kangaroo rats are the small mammals most frequently preyed upon by kit foxes. Therefore, kangaroo rat abundance may influence kit fox distribution and abundance. Mean capture rate for all kangaroo rat species combined across all sites was 14.1 (SE = 0.8), and did not differ

significantly among regions ($F = 0.99$; 3,16 df; $p = 0.43$). Kangaroo rat capture rates on individual monitoring sites were not significantly correlated with either percent total cover ($r = 0.04$, $F = 0.03$, $p = 0.87$) or total production ($r = 0.12$, $F = 0.25$, $p = 0.62$). Thus, in 1994, kangaroo rat abundance was similar among the monitoring sites.

IV. CONCLUSIONS

Small mammal abundance patterns on NPRC do not explain observed patterns of kit fox abundance. Kit foxes are more abundant in the portions of NPRC with relatively flat terrain. Also, despite considerably lower precipitation in 1994 compared with 1993, small mammal abundance was similar between the two years. Physiographic and vegetation characteristics on NPR-1 did not appear to influence small mammal abundance, but did influence small mammal community composition.

2.6 DETERMINE DIET OF KIT FOXES

I. INTRODUCTION

Kit fox scats were collected throughout FY94 to assess the diet of kit foxes at NPRC. Annual changes in the frequency of occurrence of prey items in kit fox scat may reflect the availability of prey species.

II. METHODS AND MATERIALS

Kit fox diet was determined by analyzing scats (fox feces). Fresh scats were collected during live-trapping of kit foxes. Scats were dried and sent to a diagnostic laboratory for analysis (Global Ecosystem Managers, Baton Rouge, LA). Differences in the frequency of occurrence for prey items between NPR-1 and NPR-2 were compared using Chi-square tests.

III. RESULTS AND CONCLUSIONS

Of 187 scats collected during the 1993 annual trapping session, kangaroo rats occurred in 75.4% of the scats and were the primary prey species. Lagomorphs had the second highest frequency of occurrence (20.3%). Remains of other animals found in scats included: snakes (1.6%), cricetids (1.6%), San Joaquin antelope squirrels (1.1%), birds (0.5%), and beetles (0.5%). The frequency of occurrence of kangaroo rats and lagomorphs (the two primary prey species for kit foxes on NPRC) differed significantly ($X^2 = 14.2$, $df = 1$, $p < 0.001$) between NPR-1 and NPR-2 (Table 5). Kit foxes exhibited a greater use of lagomorph prey as a secondary food item on NPR-2 than NPR-1. This may be due in part to a greater availability of this prey species on NPR-2. Lagomorph densities, based on line-transect surveys, were 32% higher on NPR-2 than NPR-1 (Section 2.4). An analysis of 1025 scats collected during winter trapping sessions between 1983 and 1993, has indicated that prey selection by kit foxes has changed considerably on NPRC during this period (Figure 5). Kangaroo rats continued to be the primary prey species found in scats since 1991, whereas lagomorphs were the primary prey item found in kit fox scats between 1983 and 1990.

Table 5. Frequency of occurrence (%) of items found in San Joaquin kit fox scat collected during FY94, Naval Petroleum Reserves in California, Kern County, California.

Food Item	NPR-1		NPR-2		Total	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Lagomorph	5	6.3	34	26.6	38	20.3
Kangaroo Rat	73	92.4	87	68.0	141	75.4
San Joaquin Antelope Squirrel	1	1.3	1	0.8	2	1.1
Fox Hair	1	1.3	0	-	1	0.5
Cricetidae	1	1.3	1	0.8	2	1.1
Bird	1	1.3	1	0.8	1	0.5
Snake	2	2.5	1	0.8	3	1.6
Beetle	0	-	1	0.8	1	0.5
Grass	0	-	1	0.8	1	0.5
Empty	2	2.5	12	9.4	14	7.5
Other	6	7.6	5	3.9	8	4.3
Total Scats Analyzed	79		128		187

Figure 5. Frequency of occurrence of lagomorph and kangaroo rat remains found in kit fox scat collected during winter trapping sessions on the Naval Petroleum Reserves in California, Kern County, California.

2.7 GIANT KANGAROO RAT POPULATION MONITORING

I. INTRODUCTION

In 1994, a program was initiated to monitor giant kangaroo rats on NPR-1. Objectives of the program were to (1) monitor annual population trends, and (2) collect demographic information that would contribute to regional conservation efforts.

II. METHODS

Monitoring was conducted using two strategies: live-trapping on a grid plot and assessing the dynamics of a sample of giant kangaroo rat colonies. A 12x12 trapping grid was established in summer 1994 on a site occupied by giant kangaroo rats. Trap stations were placed at 15-m intervals and one Sherman live-trap was placed at each station. In late August, traps were prebaited for three nights, and then traps were opened in the afternoon, baited, and checked for six consecutive mornings. Captured small mammals were identified to species, marked ventrally with a non-toxic marking pen, sexed, aged, weighed, and released at the capture site. All kangaroo rats were also eartagged.

To assess the dynamics of giant kangaroo rat colonies, 11 colonies were located in fall 1994. Colony size was based on the number of active precincts (burrow systems) comprising the colony. Parallel transects were walked through colonies and active precincts were marked with pin flags. Criteria used to identify active precincts included presence of clipped vegetation, haystacking of clipped vegetation, large diameter burrow entrances, vertical burrow entrances, pit caching, and large-sized scats (≥ 7 mm).

III. RESULTS

Trapping on the monitoring plot was conducted during August 22-27, 1994. Eleven individual giant kangaroo rats were captured 23 times. Other species captured included nine Heermann's kangaroo rats, 107 short-nosed kangaroo rats, 10 San Joaquin antelope squirrels, three southern grasshopper mice, and two San Joaquin pocket mice.

Number of precincts in giant kangaroo rat colonies ranged from three to 186 (Table 6). Five of these colonies were assessed during a preliminary survey conducted in 1993. From 1993 to 1994, number of precincts increased in three colonies, decreased in one colony, and remained the same in one colony.

IV. CONCLUSIONS

Data collected on giant kangaroo rat abundance in 1994 will serve as a baseline against which to compare abundance in future years. Also, vegetation characteristics will be measured on the monitoring plot to determine whether annual fluctuations in environmental conditions influence giant kangaroo rat population trends.

Table 6. Number of giant kangaroo rat precincts in colonies monitored in 1993 and 1994, Naval Petroleum Reserves in California, Kern County, California.

Colony Location	Number of Precincts	
	1993	1994
1B	3	3
9B	-	46
11B	19	16
13B	5	43
15B	-	36
17B	-	10
22B	-	186
35B	-	93
20S	-	4
11G	1	95
18G	18	68

2.8 BLUNT-NOSED LEOPARD LIZARD POPULATION MONITORING

I. INTRODUCTION

Previous studies have been conducted on and adjacent to NPR-1 to define the distribution, abundance, and habitat use of the blunt-nosed leopard lizard (BNLL). Suitable BNLL habitat is found on NPR-1 in flat areas with sparse vegetation and in gentle to moderate sloping areas with washes. Such habitat occurs generally near the periphery of NPR-1. The objectives of this monitoring task are to: (1) assess the annual abundance of BNLL, (2) determine whether BNLL population trends differ between a developed area and an undeveloped area, (3) assess the effects of habitat features (e.g., roads, pipelines, washes) on BNLL space use patterns, (4) collect demographic data to contribute to on-site and range-wide conservation and recovery efforts, and (5) determine whether annual variation in vegetation characteristics influence BNLL abundance.

II. METHODS AND MATERIALS

BNLL were monitored using transect surveys conducted on two 16-ha study plots established on NPR-1. One plot was located in a section that was less than 5% developed (4B), and the other was located in a section that was more than 15% developed (18G). Each 16-ha plot was composed of 16-20 parallel transects spaced 20 m apart. Ten surveys were conducted on each plot in the spring to assess the abundance of adults, and again in late summer/early fall to assess the abundance of juveniles. Surveys were conducted when air temperature was optimal for BNLL activity (25°-35°C). When a BNLL was observed, attempts were made to capture it with a noose pole. After capturing a lizard, it was sexed, weighed, measured, and uniquely marked by clipping one or more toes, before it was released at the capture site. The location of each lizard observed was plotted to determine the effects of disturbance and topographic features on BNLL distribution within each plot.

III. RESULTS

BNLL monitoring was initiated in July, 1994. The 4B plot (used as part of BNLL monitoring in 1993) was retained as a study plot in an undeveloped section. In August, the 18G plot was established to provide a study plot in a developed section. Due to the late start of this project, vegetation characteristics of the plots were not assessed and surveys for adult BNLL were not conducted. However, ten surveys were conducted on each plot to monitor the abundance of juvenile BNLL. One adult male and two juvenile female BNLL were observed in sparsely vegetated flat to hilly areas on the 4B plot, but no BNLL were observed on the 18G plot during the 1994 surveys. During abundance surveys for juvenile BNLL on the 4B plot last fall, seven juveniles were observed.

2.9 HOOVER'S WOOLY-STAR POPULATION MONITORING

2.9.1 Monitor Hoover's Wooly-Star Reference Plots

I. INTRODUCTION

The distribution of Hoover's wooly-star on NPRC has been well documented. Two field surveys specifically for Hoover's wooly-star were conducted in 1988 and again in 1991. In addition, numerous incidental sightings have been recorded during field surveys for other plant species and during preactivity surveys. To date over 300 locations of Hoover's wooly-star have been recorded on NPRC. The status of a Hoover's wooly-star is evaluated annually by measuring the density of plants on a representative number of known populations on NPRC.

II. METHODS AND MATERIALS

In 1993, six populations of Hoover's wooly-star were selected to serve as reference populations. Two are located on the lower slopes of the North Flank of NPR-1 (Sections 20S and 7R), two are on the lower slopes of the South Flank (Sections 12B and 17G), and two are in the uplands (Sections 33R and 33S). The reference sites also represent different levels of disturbance. The level of disturbance is based on the percent land disturbed in the quarter section where the site is located. Percentage disturbance ranges from 3% on the Section 20S reference site to 28% on the Section 17G reference site. Vascular plant cover and Hoover's wooly-star density are measured annually by sampling three permanent linear transects within each reference population.

III. RESULTS

The density of Hoover's wooly-star in 1994 was 0.3 plants/m² at the reference site in Section 20S, 1.2 plants/m² at the Section 17G reference site, 3.0 plants/m² at the reference site in Sections 12B, 33R, and 33S, and 12.4 plants/m² at the 7R reference site. The frequency of occurrence of Hoover's wooly-star averaged 30% over all sites, with a high of 46.7% at the 7R reference plot and a low of 3.3% at the 20S reference site (Table 7).

IV. CONCLUSIONS

The density of Hoover's wooly-star and frequency of occurrence were lower in 1994 than in 1993. Densities were only 3-5% of what was measured in FY93, with the exception of the reference population in Section 7R, which was 24% of 1993 density estimates. Frequency of occurrence for Hoover's wooly-star was equally low in 1994, averaging about half of what it was in 1993.

The decrease in density and frequency of occurrence of Hoover's wooly-star from 1993 to 1994 appears to be related to less favorable growing conditions in 1994 than in 1993. Not only was the density of Hoover's wooly star low in 1994, but vascular plant cover was 30-40% lower in 1994, as compared to 1993 (Table 8). The composition of the cover also changed. In 1993 cover from forbs, which includes herbaceous annuals such as Hoover's wooly-star, was 22%, or about 35% of the total vascular plant cover. In 1994, forb cover was less than 4%, which was only 18% of the total cover. The reduction in the amount of forb cover suggests that growing conditions experienced in 1994 were not favorable for forbs and as a result Hoover's wooly-star was found less frequently, and when it was encountered it occurred in lower densities.

Table 7. Density and frequency of occurrence of Hoover's wooly-star on six reference plots on Naval Petroleum Reserve No. 1, Kern County, California, 1994. Standard errors are in parentheses.

LOCATION	DISTURBANCE LEVEL (%)	HOOVER'S WOOLY-STAR DENSITY (#/m²)		HOOVER'S WOOLY- STAR FREQUENCY OF OCCURRENCE (%)	
		1993	1994	1993	1994
South Flank of Elk Hills					
Section 12B	12	56.4 (39.4)	3.1 (2.1)	60.0 (0)	26.7 (12.0)
Section 17G	28	32.1 (6.1)	1.2 (0.6)	56.7 (3.3)	13.3 (6.7)
Crest of Elk Hills					
Section 33R	22	78.4 (17.0)	3.1 (1.2)	56.7 (6.7)	23.3 (6.7)
Section 33S	21	86.3 (37.4)	2.7 (2.5)	83.3 (12.0)	30.0 (20.0)
North Flank of Elk Hills					
Section 20S	3	22.9 (1.4)	0.3 (.3)	70.0 (11.6)	3.3 (3.3)
Section 7R	16	48.8 (16.1)	12.4 (1.2)	73.3 (14.5)	46.7 (16.7)

Table 8. Total vascular plant cover by lifeform on Hoover's wooly-star reference plots on Naval Petroleum Reserve No. 1, Kern County, California, 1994. Standard errors are in parentheses.

GROWING SEASON	AVERAGE VASCULAR PLANT COVER (%)			
	Shrub	Grass	Forb	Total
1994	4.1 (1.06)	15.6 (2.20)	3.91 (1.12)	22.17 (3.38)
1993	5.3 (3.3)	35.8 (7.1)	21.9 (3.9)	63.22 (3.19)

2.9.2 Monitor Hoover's Wooly-Star Conservation Techniques

I. INTRODUCTION

In FY93, an experimental study was designed and implemented to evaluate the effects of topsoil conservation and timing of disturbance on the reestablishment of Hoover's wooly-star on disturbed sites. Topsoil conservation, a practice commonly recommended by the U. S. Fish and Wildlife Service (FWS), involves collecting the top two to four inches of soil prior to construction activities, and then respreading this soil over disturbed areas. The efficacy of this practice and the effect of time-of-year are being evaluated through this study.

II. METHODS AND MATERIALS

Two study sites were selected; one located in a dense population of Hoover's wooly-star and the second in an area void of Hoover's wooly-star, but in the same general habitat type. At both study sites 30 6-m x 30-m plots were established. Six of the plots at each site were control plots. In April, 1993, topsoil from 12 of the plots at Study Site 1 was removed. The 12 plots were then ripped and disked. Twelve study plots at Study Site 2 were also ripped and disked, but no topsoil was removed. Ripping and disking were used to simulate a typical ground disturbing activity. The salvaged topsoil from Study Site 1, which was from an area of known Hoover's wooly-star occurrence, was returned to six of the 12 disturbed study plots at Study Site 1 and relocated to six of the 12 disturbed study plots at Study Site 2. The two sets of study plots at Site 1 will be sampled to determine the effect of salvaging topsoil on reestablishment of Hoover's wooly-star following a disturbance. The plots at Study Site 2 will be sampled to determine if soils salvaged from known Hoover's wooly-star habitat can be used to introduce Hoover's wooly-star into areas where it currently is not known to occur. The same procedures implemented in April were repeated in July on the 12 study plots remaining at both Study Site 1 and Study Site 2. The treatments in April will simulate a pre-seed set disturbance and the treatments applied in July will simulate a post-seed set disturbance. Plots will be sampled to determine if timing of disturbance has an effect on the establishment of Hoover's wooly-star on disturbed habitat.

A permanent 25-m transect was located in each experimental plot. Vascular plant cover, cover composition, and Hoover's wooly-star density were measured prior to disturbance in 1993. The same data were collected in the spring of 1994.

III. RESULTS

At Study Site 1, Hoover's wooly-star was only found on two study plots: the control plot and the topsoil-removed plot within the post seed set disturbance study site. Average Hoover's wooly-star density was 1.2 plants/m² on the control plots and 0.9 plants/m² on the treatment plot (Table 9). Total vascular plant cover on the control plots averaged 46%.

At Study Site 2 no Hoover's wooly-star plants were found. Average vascular plant cover on the control plots at Study Site 2 was 34% (Table 10).

Table 9. Hoover's wooly-star density and total vascular plant cover on study plots on Study Site 1 on Naval Petroleum Reserve No. 1, Kern County, California, 1994. Standard errors are in parentheses.

TREATMENT	DENSITY OF HOOVER'S WOOLY-STAR (#/m ²)		VASCULAR PLANT COVER (%)	
	1993	1994	1993	1994
Pre-Seed Set Disturbance				
Topsoil removed	7.27 (3.0)	0	70.3 (4.3)	37.5 (7.3)
Topsoil replaced	9.27 (6.2)	0	63.5 (4.2)	46.7 (3.2)
Post-Seed Set Disturbance				
Topsoil removed	44.73 (31.2)	0.9 (1.97)	60.0 (5.5)	28.3 (4.8)
Topsoil replaced	9.87 (5.1)	0	50.7 (2.7)	41.0 (2.9)
Control	9.2 (4.1)	1.2 (1.75)	51.5 (3.4)	46.3 (1.8)

Table 10. Hoover's wooly-star density and total vascular plant cover on study plots on Study Site 2 on Naval Petroleum Reserve No.1, Kern County, California, 1994. Standard errors are in parentheses.

TREATMENT	DENSITY OF HOOVER'S WOOLY-STAR (#/m ²)		VASCULAR PLANT COVER (%)	
	1993	1994	1993	1994
Pre-Seed Set Disturbance				
Without topsoil	0	0	59.7 (7.0)	21.7 (2.5)
With topsoil	0	0	54.2 (3.4)	30.0 (5.7)
Post-Seed Set Disturbance				
Without topsoil	0	0	53.8 (4.3)	22.8 (2.7)
With topsoil	0	0	49.8 (2.8)	27.5 (2.5)
Control	0	0	46.2 (2.7)	34.4 (4.1)

IV. CONCLUSIONS

An evaluation of the different treatment effects was not possible with this year's data. Hoover's wooly-star was only found on the control plots at Study Site 1 and one treatment plot, also at Study Site 1. The reduction or absence of germination of Hoover's wooly-star was primarily due to the less-than-optimum growing conditions experienced in 1994. Vascular plant cover was 5% lower at Study Site 1 and 12% lower at Study Site 2 than it was in 1993. The density of Hoover's wooly-star on the Site 1 control plots was similarly lower than density measurements taken in 1993. Sampling of the experimental plots in future years should be conducted during a year of favorable growing conditions. Favorable growing conditions may be determined by first evaluating the Hoover's wooly-star reference plots (Section 2.9.1). If densities of Hoover's wooly-star are close to those observed in 1993, then the experimental plots should be sampled and data analyzed to assess the effects of the two conservation practices on the establishment and growth of Hoover's wooly-star.

2.10 ASSESSMENT OF SPECIAL STATUS PLANT SPECIES

I. INTRODUCTION

During surveys conducted in 1993 for special status plant species, three populations of a plant suspected of being endangered Kern mallow (*Eremalke kernensis*) were located. Two of these populations were on NPR-1 and one was on NPR-2. In 1994, at least six additional populations were located on NPR-1. EG&G/EM requested and received permission from the FWS to collect specimens for taxonomic verification. Four specimens were collected from each of three populations (the original three located in 1993).

II. METHODS AND MATERIALS

To determine the identification of the collected specimens, they were sent to Dr. David Bates, who is considered a species expert, at Cornell University. Dr. Bates identified all of the specimens as Kern mallow. A second species expert, Dr. Dean Taylor of Biosystems Analysis, Inc., also was consulted regarding the identity of the specimens. Dr. Taylor did not examine the specimens because he did not feel that a positive identification could be made due to questions regarding mallow taxonomy.

III. RESULTS AND CONCLUSIONS

Currently, the taxonomic status of mallows in the NPRC area is unsettled. Initially, only plants with white flowers in the nearby Lokern area were considered to be Kern mallow. The plants on NPRC were considered to be Parry's mallow (*E. parryi*) which is not endangered. A recent evaluation conducted by Dr. Bates resulted in a taxonomic revision for mallows occurring in the NPRC area. The revised taxonomy included a broader definition for Kern mallow and reduced this taxon to subspecific status (*E. parryi* spp. *kernensis*). As a result, the range of Kern mallow was significantly expanded and now includes the mallows occurring on NPRC. However, a number of issues directly affecting the legal status of the mallows on NPRC are unresolved. First, the taxonomy of mallows in the NPRC area is still questionable. Bates' taxonomic revision was based on morphological characteristics. Taxonomists as well as FWS feel that a genetic-based systematic evaluation is needed to clarify mallow taxonomy. Second, if the current taxonomy is accepted, then the significantly expanded distribution and abundance of Kern mallow might warrant a reevaluation of the legal status of this taxon. Until these issues are resolved, FWS has determined that the mallows at NPRC should be subjected to all protective measures afforded listed plants under the ESA.

3. CONDUCT PREACTIVITY SURVEYS FOR NPRC PROJECTS

3.1 CONDUCT ENDANGERED SPECIES AND CULTURAL RESOURCE PREACTIVITY SURVEYS

I. INTRODUCTION

As a result of formal consultation between DOE/NPRC and FWS, the preactivity survey program was developed on NPR-1 to minimize or eliminate impacts of petroleum-related activities to endangered species and their habitats. The preactivity survey program has been expanded to cover projects on NPR-2 as well.

II. METHODS AND MATERIALS

Preactivity survey request forms are completed and transmitted to EG&G/EM by the requestor, and in cases of emergency, the request may initially be made verbally. Upon receipt the request forms are logged in, and a EG&G/EM biologist is assigned the survey. Once all pre-survey arrangements have been made the designated biologist conducts the survey. During preactivity surveys the biologist examines the anticipated impact area and an adjacent buffer zone for evidence of threatened and endangered species. Specifically, the biologist looks for known San Joaquin kit fox dens, potential San Joaquin kit fox dens, giant kangaroo rat burrows, BNLLs, washes representing potential blunt-nosed leopard lizard habitat, and Hoover's wooly-star. Observed kit fox dens, giant kangaroo rat burrows, and some populations of Hoover's wooly star are then identified with wooden stakes and flagging to create avoidance zones. Recommendations are made to the survey requestor to refrain from disturbing the area marked.

Once the preactivity survey has been completed, the biologist contacts the requestor to verbally report any findings and recommendations. The biologist also completes the survey request form which lists any findings and recommendations. A copy of this form is sent to the requestor and Environmental Services.

Follow-up surveys are conducted by an EG&G/EM biologist, usually within three months of the original survey to document whether endangered species or their habitat were impacted, whether recommendations were followed, and whether activities were confined to the surveyed project area. Recommendations that are not followed are reported in a monthly summary letter and the requestors are informed of the survey results.

III. RESULTS AND CONCLUSIONS

During FY94, 400 preactivity surveys were conducted on 315 acres on or adjacent to NPRC. Of these, 165 surveys were classified as emergencies (projects requiring a preactivity survey within three working days). Most emergency surveys were conducted for cleanups, pipelines, new well pads, and other miscellaneous construction projects. Compared with FY93, 55 fewer surveys were conducted in FY94 (a 12% decrease). There was a 41% decrease in the number of acres surveyed from 836 in FY93 to 345 in FY94.

Recommendations to prevent potential impacts to endangered species, their habitats, or revegetated areas were made on a total of 88 (22%) projects in FY94. Cleanups, pipelines, and other miscellaneous construction or maintenance projects were most often affected. Alterations usually included the establishment of avoidance zones around dens and burrows, restriction of driving on revegetated sites and in washes, and establishment of avoidance zones around populations of Hoover's woolly-star. Most cleanup sites were restricted to the use of hand tools only and a powerline was slightly rerouted to avoid direct impact to endangered species or their habitat.

A total of 10 known kit fox dens and 114 potential kit fox dens were identified during surveys in FY94. Three blunt-nosed leopard lizards were observed during surveys, and eight washes representing potential blunt-nosed leopard lizard habitat were identified. Thirty-two populations of Hoover's woolly-star were identified. Seven giant kangaroo rat precincts were identified at one site and seven additional giant kangaroo rat precincts were observed at seven other sites.

All resources were avoided except for 25 potential kit fox dens which were excavated. Three dens were located at the 35R cogeneration plant, five dens were excavated for the construction of four new well pads, 14 dens were excavated near the 35R flare stacks for the firebreak, and one den was located in 28R during roadwork surveys. The entrances to all dens were dusted for three consecutive nights prior to excavation to assess if the dens were being used by kit foxes. No wildlife was found in any of the excavated dens.

Follow-up surveys were conducted on 107 of the 119 projects where evidence of endangered or threatened species, their habitats, or revegetated areas were encountered during the initial preactivity survey. Twelve projects were either canceled or postponed and were not subject to a follow-up survey. Follow-up surveys were conducted within 90 days of the initial survey, or when the project was completed. Recommendations were not followed on eight projects completed in FY94 for which recommendations were made. These results were reported to DOE/NPRC and the Unit Operator in a monthly summary letter.

In FY94, an effort was initiated to evaluate the efficacy of the preactivity survey program. A report on this evaluation will be completed in FY95.

Table 11. Summary of endangered species preactivity surveys conducted during FY94 on the Naval Petroleum Reserves in California, Kern County, California.

	Project Type								FY94 Totals
	Clean-ups	Corrosion Protection	Pipe-lines	Power-lines	New Well Pad	Well Pad Upgrade	Firebreak	Other	
Surveys Conducted	117	9	115	25	30	3	3	98	400
Acres Surveyed	47	1	117	24	49	3	30	74	345
Known Kit Fox Dens	3	0	2	0	1	0	0	4	10
Potential Kit Fox Dens	15	0	36	3	31	3	7	19	114
Giant Kangaroo Rat Burrows	0	0	2	1	1	0	0	3	7
Blunt-nosed Leopard Lizards Observed	0	0	1	0	0	0	0	2	3
Washes Observed	1	0	2	0	3	0	0	1	7
Hoover's Woolly-star Populations	2	0	11	2	7	1	0	9	32

3.2 CULTURAL RESOURCES SUPPORT

I. INTRODUCTION

Prehistoric and historic cultural resources found on NPRC are protected under the National Historic Preservation Act of 1966 (as amended) and the Archeological Resources Protection Act of 1979 (Public Law 96-95). Section 106 of the National Historic Preservation Act requires federal agencies to take into account the effects of agency actions on historic properties. Section 110 requires all federal agencies to carry out programs in accordance with the National Historic Preservation Policy. EG&G/EM coordinates cultural resource protection efforts at NPRC.

II. METHODS AND MATERIALS

In order to comply with the above federal regulations, qualified archaeologists are contracted to conduct surveys for all third-party projects. DOE projects conducted on NPR-1 are surveyed by EG&G/EM personnel who have received training from a qualified archeologist.

Cultural resource surveys on NPR-1 are conducted in conjunction with the preactivity survey program. If a potential cultural resource site is found, the Cultural Resource Management Administrator examines the site to see if the artifacts or site appear to be fifty years old or more. If the site appears to be fifty years old or more, a qualified archeologist is contacted to conduct a survey. The results of these surveys are sent to SHPO for their comments regarding potential impacts and mitigation measures.

III. RESULTS AND CONCLUSIONS

A survey for the proposed Unocal Corporation well abandonment project was completed on August 10, 1989. No cultural resources were found during the survey. A no-effect finding from the SHPO was received on May 11, 1994.

A survey for the West Kern Water District's proposed pipeline 408 was completed in October, 1992. The survey found no artifacts or archeological sites. A concurrence of a no-effect finding was received from SHPO on May 5, 1994. Another survey was conducted for the West Kern Water District's pipeline 101 replacement project on April 12-13, 1994. Several artifacts were found, however, none were judged to fit the criteria for eligibility for listing in the National Register of Historic Places (NRHP). Comments from SHPO have not been received.

On February 25, 1994, an archeologist from California State University Bakersfield did a survey in section 36R for a landfill cleanup. Although a few artifacts over fifty years old were found, most artifacts were judged to be less than fifty years old. This site did not fit the criteria for eligibility for listing in the NRHP. A no-effect finding was sent to DOE by SHPO on June 13, 1994.

A survey was conducted on April 13-14, 1994 for proposed well closures by Phillips Petroleum. Although several artifacts and two sites were found, they did not fit the criteria for eligibility for listing in the NRHP. Comments from the SHPO are pending.

The survey for the Four Corners pipeline was conducted in May, 1994. The proposed project was for an 20-cm crude oil pipeline replacement. The field survey found no evidence of cultural resources along the pipeline. Comments from SHPO are pending.

A survey for the proposed 26S East landfill cleanup was completed on August 8, 1994. Several artifacts were found, however, none were considered significant. This assessment has been sent to SHPO, and a reply is pending.

Table 12. Summary of cultural resource surveys completed during FY94 on the Naval Petroleum Reserves in California, Kern County, California.

Survey Date	Project Description	Section	Hectares	# Arch. Sites	# Isolates	SHPO ¹ Review
August 10, 1989	Unocal Well Abandonments Lease ²	34B	129.5	0	0	Received a "no effect" finding from SHPO on 5/11/94
October 1992	West Kern Water District Proposed Pipeline 408 ²	5D, 8D, 17D	6.1	0	0	Received a "no effect" finding from SHPO on 5/5/94
February 25, 1994	36R Landfill Clean-up	36R	2.4	1	0	Received a "no effect" finding from SHPO on 6/13/94
April 12-13, 1994	West Kern Water District Pipeline 101 Replacement ²	32G	12.3	4	8	Comments from SHPO are pending
April 13-14, 1994	Phillips Petroleum Well Closures ²	28B, 32G, 2C	20.0	2	7	Comments from SHPO are pending
May 1994	Four Corners Pipeline ²	18H	7.1	0	0	Comments from SHPO are pending
August 8, 1994	26S E Landfill Closure ³	25S	2.0	1	0	Comments from SHPO are pending

¹ State Historic Preservation Officer

² Third-Party Projects

³ This project located in 25S, but the location is historically referred to as 26S E. Landfill

4. HABITAT RECLAMATION AND MANAGEMENT

4.1 EVALUATION OF REVEGETATION RATES

I. INTRODUCTION

Since 1979, EG&G/EM has conducted a habitat reclamation program at the NPRC. In FY94, EG&G/EM was tasked to conduct an evaluation of the rate of revegetation on reclaimed disturbed sites (e.g., a site typically disked, fertilized, seeded and mulched) versus the rate of revegetation on non-reclaimed disturbed sites. Rate of revegetation is defined as the time required for vascular plant cover to become established on a disturbed site, and to equal or exceed 70% of the vascular plant cover on an adjacent undisturbed site.

II. METHODS AND MATERIALS

Three tasks were identified to evaluate the rates of revegetation on reclaimed and non-reclaimed sites. One task was to compare revegetation rates on non-reclaimed cut and fill slopes with rates on reclaimed cut and fill slopes. Data for this comparison were obtained by sampling 61 and 66 reclaimed and non-reclaimed cut and fill slopes, respectively. The second task was to complete an analysis, similar to the one conducted for cut and fill slopes, but for disturbances other than cut and fill slopes such as well pads, pipelines, soil borrow areas, roads, and sumps. A total of 223 reclaimed sites was evaluated, but few non-reclaimed sites could be located and only 13 were sampled.

For both tasks, field sampling included qualitative estimates of total vascular plant cover and estimates of the percentage of plant cover on reclaimed or non-reclaimed disturbed sites in relation to plant cover on adjacent undisturbed habitat. Regression analyses were completed using total vascular plant cover, expressed as a percentage of the cover on an adjacent undisturbed site, as the dependent variable and time since disturbance as the independent variable. The objective of the analyses was to determine rates of revegetation on both non-reclaimed and reclaimed disturbed sites. It was hypothesized that cover on reclaimed sites would approximate the amount of cover on an undisturbed site in fewer years than if the site had not been reclaimed.

The third task was to estimate the rate of revegetation on reclaimed sites using quantitative data collected from 306 of the reclaimed sites (referred to as "subsample sites"). Vascular plant cover, species composition, and species density were measured on each of the sites. Instead of comparing cover to that on adjacent undisturbed sites, cover estimates were compared to cover data from 16 undisturbed reference sites located on NPR-1. Eight of the 16 reference sites were located on north aspects and eight were on south aspects. Cover data from the reference sites were averaged by aspect. Cover data from the reclaimed site was averaged by number of years since reclamation and by aspect, and then divided by average cover on the respective reference site (i.e., north or south). Regression analysis was used to determine the rate of revegetation

on reclaimed sites. The amount of cover on the reclaimed site in comparison with the amount of cover on the reference sites was regressed against the number of years since reclamation. Analyses were conducted by aspect (north and south) and by type of disturbance (soil borrow area, well pad, pipeline, road and well sump).

III. RESULTS

Total vascular plant cover on cut and fill slopes was about 20% of the cover on adjacent undisturbed areas after two years (Figure 6) on both reclaimed and non-reclaimed sites. Eight years after reclamation, the amount of cover on both groups of sites had increased to about 55% of the adjacent undisturbed habitat, although the percentage for the reclaimed sites was slightly lower than on the non-reclaimed. The percent cover of adjacent undisturbed habitat approached 70% on non-reclaimed sites about 18 years after disturbance. Because data on reclaimed sites was limited to nine years after the disturbance, it was not possible to determine the time it would take for cover on reclaimed sites to attain 70% of adjacent undisturbed sites.

On sites other than cut and fill slopes, time since disturbance ranged from one year to nine years for reclaimed sites, and one year to 16 years for the non-reclaimed sites. The amount of cover on the reclaimed sites was 17% of adjacent undisturbed after the first growing season, increased to 40% after the second growing season, and was 71% after the fifth growing season (Figure 7). On non-reclaimed sites cover was 22% of adjacent undisturbed one year after the disturbance, 78% by the fourth year, and 95% and 85% on single sites representing the ninth and sixteenth year after disturbance, respectively (Figure 7).

The rate of revegetation on reclaimed subsample sites was different on north and south aspects. Cover on reclaimed sites on northerly aspects was 47% of the average cover measured on the eight respective reference sites after one growing season. It increased to 71% by the third year, then fluctuated between 56% and 74% for the next five years. Cover on reclaimed sites located on southerly aspects followed a similar early trend, increasing to 72% of average cover on reference sites by the third year, but then increased consistently to 94% by the eighth year after reclamation (Figure 8).

The type of disturbance also appeared to have an effect on the rate of revegetation. On disturbances resulting from the construction of well pads, well sumps and pipelines, average vascular plant cover exceeded 70% of the average cover measured on the reference sites three years after the sites were reclaimed. Average vascular plant cover on reclaimed roads fluctuated from 54% after the first growing season to 77% and 88% in the seventh and eighth growing seasons. Average cover on soil borrow areas in relation to the amount of cover on the reference sites was not consistently over 70% until the fourth growing season (Figure 9).

Figure 6. Assessment of reclamation success on cut/fill slopes-revegetated vs. non-revegetated on the Naval Petroleum Reserves in California, Kern County, California, 1994.

Figure 7. Assessment of reclamation success on non-cut/fill slopes-revegetated vs. non-revegetated on the Naval Petroleum Reserves in California, Kern County, California, 1994.

Figure 8. Assessment of reclamation success on subsample sites by aspect on the Naval Petroleum Reserves in California, Kern County, California, 1994.

Figure 9. Assessment of reclamation success subsample sites-disturbance type on the Naval Petroleum Reserves in California, Kern County, California, 1994.

IV. CONCLUSION

The data collected indicated that revegetation rates were similar between reclaimed and non-reclaimed disturbed sites. However, the results must be viewed with some caution because the results are not based on a strong experimental design; data were collected from sites which varied widely in site conditions and year reclaimed. Also, the analyses were based solely on total vascular plant cover and did not consider other factors potentially important to reclamation success, such as species composition, erosion control, and value to listed species. A more robust field test of reclamation success is recommended.

Reclamation does not appear to accelerate the rate of revegetation on cut and fill slopes. These sites have been severely disturbed (e.g., top soil removed, slope altered), and restoration to predisturbance conditions is unlikely. Three years after reclamation, vascular plant cover on the reclaimed cut and fill slopes was similar to that on non-reclaimed slopes.

Revegetation rates on reclaimed and non-reclaimed disturbances other than cut and fill slopes were similar. However, data were collected from 223 reclaimed sites and only 13 non-reclaimed sites, and the effect of these uneven sample sizes is unknown although the variability of the data suggests that revegetation rates would not be statistically different. Sample sizes were too small to examine revegetation rates on the different types of disturbances.

Quantitative data from subsample sites suggests that aspect has an effect on the rate of revegetation. Percent cover on south aspect sites exceeded 70% of that on the reference sites in only three years, while cover on north aspect sites was estimated to be 67% of that on the reference sites after eight years. It was anticipated that the rate of revegetation on north slopes would be faster than the rate on south slopes, because north slopes are generally more productive, (i.e., higher amounts of cover and higher plant production). Because south slopes are more sparsely vegetated, revegetation rates may be faster on south aspect sites because less growth is required to attain 70% of the cover on undisturbed sites.

The type of disturbance also appears to affect the rate of revegetation. The rate of revegetation for well pads, pipelines or sumps was faster than the rate for disturbances such as roads and soil borrow areas. This may be due to the fact that on soil borrow areas much of the topsoil is removed and not replaced thereby producing more difficult conditions for plant reestablishment. The reason or reasons for the slower rate for road disturbances are not as clear. One possibility is that roads are more likely to be redisturbed after reclamation occurs, and this may lower the rate of revegetation. Although the type of disturbance appears to affect the rate of revegetation, the goal of 70% of the cover on the reference sites is attained within five years, regardless of the type of disturbance.

4.2 MONITORING RECLAMATION SUCCESS

I. INTRODUCTION

A program to monitor the success of the habitat reclamation program at NPRC was initiated in 1987. The program consisted of qualitatively evaluating all reclamation sites the first and second growing season after reclamation to evaluate initial plant establishment, identify sites that may require remedial work, and develop and refine reclamation techniques. Beginning in 1991, and continuing annually thereafter, vegetative cover and shrub density were quantitatively determined on sites that were reclaimed five years previously. This relatively intensive monitoring program was modified in FY94 and now consists of conducting a qualitative assessment of approximately 30% of all sites reclaimed to date.

II. METHODS

In FY94, approximately 347 sites were qualitatively evaluated. Sites were randomly selected by year and disturbance type. Disturbance types included cut and fill slopes, well pads, roads, pipelines, sumps (includes well sumps and waste water sumps), and soil borrow areas.

To improve the accuracy of qualitative evaluations, vegetation was quantitatively sampled on 10 reclaimed sites. A line transect was established at each site and cover was sampled at 20 intervals along the transect using an ocular point projection device. Percent vascular plant cover, litter and bare ground were recorded. Total vascular plant cover was qualitatively estimated on the same 10 sites and compared with the quantitative data. Results of the two methods were compared so that biologists conducting the qualitative field sampling could adjustment their estimates to more accurately approximate the quantitative cover estimates.

At each of the 347 reclamation sites, the amount of cover on the reclaimed site, the amount of cover on the reclaimed site in comparison to the amount of cover on adjacent undisturbed land, and evidence of use by wildlife were recorded. A computer database was created and data were entered, proofed, edited, and summarized.

III. RESULTS

Vascular plant cover averaged 7% on sites reclaimed in 1993, 22% on sites reclaimed two years ago, and between 30 and 35% for all other sites (Table 13). The amount of litter cover was over 50% on the sites reclaimed in 1993, but was only 33% on two-year-old reclamation sites, and leveled off at about 20% for all other sites. Bare ground was lowest on the more recently reclaimed sites, but eventually stabilized at about 45-55%. Shrub cover ranged from a low of 28% on sites reclaimed in 1992 and 1993 to a high of 67% on sites reclaimed in 1985. The percentage of grass cover was 55-60% the first couple years, but decreased to 30% of total cover thereafter. The percentage of forb cover also decreased after the first couple years, averaging 16% on sites reclaimed in 1993, and then decreasing to only 2-4%. The amount of

cover on the reclaimed sites in comparison to the adjacent undisturbed habitat ranged from 13% on sites reclaimed in 1993 to 65-70% on sites reclaimed in previous years.

A large proportion of the reclaimed sites was used by wildlife (Table 14). After a couple years, small mammal burrows were found on over 80% of the sites sampled and there was evidence of use by lagomorphs and rodents on over 90% of the sites. Even after just one growing season, small mammal burrows were found on almost half of the sites sampled, and there was evidence of lagomorphs on 88% of the sites. Herbivory, evident from browsed seedlings or stems and leaves around the plant, was observed at almost 40% of the sites reclaimed in 1993 and approximately 65% of all other sites.

Table 13. Average cover estimates (SE in parentheses) for 347 reclamation sites sampled in 1994 on Naval Petroleum Reserve No. 1, Kern County, California.

Year Site Reveg.	# Sites Sampled	Vascular Plant Cover	% Litter	% Bare	% Adjacent Undisturbed	% Shrub	% Grass	% Forb	% of Sites Disturbed
1985	46	35.4 (2.36)	15.9 (0.93)	48.5 (2.56)	65.3 (4.16)	67.1 (3.47)	30.9 (3.19)	2.0 (0.82)	7
1986	37	29.1 (2.54)	16.5 (1.19)	54.7 (2.92)	61.1 (4.56)	60.8 (4.36)	35.2 (4.03)	4.1 (2.27)	3
1987	39	31.2 (2.73)	15.2 (1.21)	53.85 (3.27)	60.8 (4.90)	63.3 (4.97)	32.6 (4.64)	4.1 (2.24)	0
1988	45	32.2 (2.06)	15.38 (0.98)	52.4 (2.41)	64.22 (3.75)	62.6 (3.94)	35.31 (3.76)	1.98 (0.59)	9
1989	33	33.9 (1.95)	21.9 (1.40)	44.2 (2.18)	70.0 (4.18)	51.6 (5.23)	36.15 (4.79)	12.0 (4.28)	18
1990	36	35.6 (2.82)	17.8 (1.32)	46.6 (2.72)	68.4 (4.62)	63.7 (4.89)	30.2 (4.25)	6.2 (3.10)	25
1991	47	28.6 (2.01)	20.9 (1.39)	50.3 (2.57)	55.9 (3.76)	50.4 (4.53)	46.9 (4.27)	2.7 (0.95)	19
1992	40	21.6 (2.42)	32.6 (1.87)	45.7 (2.38)	40.9 (4.29)	28.8 (3.71)	61.5 (4.20)	9.7 (2.36)	0
1993	24	6.9 (1.85)	56.3 (3.87)	36.9 (3.80)	13.3 (3.98)	28.3 (6.45)	56.1 (7.82)	15.5 (5.87)	0

Table 14. Evidence of use of reclamation sites by wildlife on the Naval Petroleum Reserves in California, Kern County, California, 1994.

Year Sites Reveg.	Herbivory %	Percentage (%) of Reclaimed Sites With:								
		Dens/Burrows			Scat			Wildlife Observed		
		Small Mammal	Kit Fox	Lago- morph	Rodent	Kit Fox	Coyote	Lago- morph	Ground Squirrel	Bird
1985	67	98	0	93	91	0	20	11	2	2
1986	70	92	3	100	89	3	5	5	0	0
1987	64	85	0	95	85	3	21	8	0	0
1988	64	93	2	98	96	0	18	4	0	9
1989	70	85	0	97	88	0	18	9	3	3
1990	67	81	3	94	100	0	14	8	0	0
1991	66	91	0	98	87	0	19	11	0	0
1992	65	68	0	100	90	0	5	18	5	3
1993	38	46	0	88	67	0	8	0	0	0

IV. CONCLUSIONS

Average vascular plant cover on sites reclaimed in 1990, which have now gone through four growing seasons, was 36% or about 70% of the cover on adjacent undisturbed sites. The amount of cover on sites reclaimed in earlier years fluctuated between 60% and 70% of that on adjacent undisturbed habitat. The composition of the cover also changed with time. On the more recently reclaimed sites grasses made up 50-60% of the total cover, shrubs about 30%, and forbs 10-15%. However, on the older reclaimed sites grass only accounted for 30-35% of the cover, shrubs increased to around 60%, and forbs only contributed 2-4% to the total vascular plant cover.

The amount of the straw mulch that is applied as part of the reclamation process appears to diminish after three years. Litter cover averaged 56% on sites reclaimed in 1993, decreased to 33% on sites reclaimed in 1992, and then averaged approximately 20% on the rest of the sites. The amount of bare ground does not appear to change over time. The straw mulch covers much of the bare ground the first few years, and though the mulch decays and is incorporated into the soil over time, vascular plant cover increases over time.

The reclaimed sites appeared to be recolonized by various wildlife species in a relatively short period of time. After three to four years the majority of the sites were occupied by small mammals and there was evidence of use of the sites by lagomorphs. Lagomorphs appeared to use the sites almost immediately after they were reclaimed. Lagomorph scat was noted on 88% of the sites reclaimed in 1993, and over 90% of all other sites. Herbivory was also prevalent. Herbivory was noted during the first year on young seedlings. Young seedlings of saltbush typically are surrounded by numerous severed stems and young California buckwheat seedlings are usually reduced to a rosette of young stems as a result of stem leader being browsed. A few sites showed signs of kit fox and coyote use.

5. RESEARCH AND DEVELOPMENT

5.1 FACTORS INFLUENCING THE DISTRIBUTION AND ABUNDANCE OF KIT FOXES ON NPRC

I. INTRODUCTION

Information collected from live-trapping foxes is useful not only for determining population size (Section 1.2) but it also provides an opportunity for investigating the spatial distribution of these animals. Fox captures have not been evenly distributed over NPRC and there probably are biological, physiographic or land use factors underlying the distributional patterns. Therefore, this study was initiated to investigate the effects of variables such as oil field development, topographic ruggedness, and coyote and lagomorph abundance on kit fox distribution. Investigating the distribution and abundance of kit foxes in relation to these variables may yield insight into which habitat features are important for the long term persistence of kit foxes and help determine what constitutes high quality habitat for foxes. Determining the habitat requirements and preferences of foxes may help identify new strategies to enhance habitat for kit foxes and assess the effects of oil field development and other land uses on this species.

II. METHODS AND MATERIALS

Multivariate models will be used to determine whether the selected factors have influenced fox distribution. Many of the dependent and independent variables were calculated using data from long-term monitoring tasks that are described in other sections of this report.

Dependent Variables

Information on fox abundance was gathered during previous live-trapping sessions (see Section 2.2 for capture methodology). The number of adult foxes captured per trap site and the number of years that adult foxes were captured at each trap site will be used as dependent variables.

Independent Variables

Several independent variables will be investigated during this project. As analyses progress, some of the variables that do not prove useful in explaining fox distribution may be dropped from the analyses.

The percentage of land in each trap site area affected by oil field development was calculated by overlaying transparent dot grids on 1:10,000 scale aerial photographs taken in 1988. Disturbance levels were determined for each quarter section on or adjacent to NPRC. The percentage of each quarter section burned was determined by reviewing EG&G/EM and Kern County Fire Department records and aerial photographs. A dot grid was used to determine the percentage of each quarter section burned.

Within the boundaries of the NPR-1 and the DOE sections of NPR-2, it is not lawful to graze sheep. However, because NPR-2 and some areas of NPR-1 are not fenced, there is little deterrent to trespass grazing. Therefore, the proportion of each quarter section grazed by sheep was estimated by determining what proportion of each quarter section was within the boundaries of the NPR-1 fence.

Coyote abundance and lagomorph abundance was indexed for quarter sections that contain scent stations and lagomorph transects, respectively. Methods for determining coyote abundance are found in section 2.3 and methods for determining lagomorph abundance are found in section 2.4.

Distance to urban development, permanent watering basins, and the California Aqueduct were determined by estimating the distance from the center of each quarter section to each of these types of developments.

III. RESULTS

Data for this study were collected into computer databases. After some field checking, it became apparent that fire history might not explain as much of the differences in shrub cover as originally anticipated. Because shrub cover is potentially an important variable affecting fox distribution, methods for more directly determining shrub cover were investigated. Estimating shrub cover from 1988 infrared aerial photographs was determined to be feasible and EG&G/EM's Remote Sensing Laboratory was selected to do the work.

Consultations were made with a statistician and a decision was made to try a regression tree model. This type of analysis divides the cases in the data set into a hierarchical sequence of groups based on the ability of the independent variables to explain variation in a dependent variable. Several preliminary runs were made using the regression tree model with different combinations of variables. After the shrub cover variable is determined for each quarter section, it will be included in the final analyses.

5.2 BLOWOUT ASSESSMENT

I. INTRODUCTION

Well 313H-26R, located in the northwest quarter of Section 26R (T. 30S, R. 23E. M.D.B.M.) at NPR-1, blew out on June 21, 1994 resulting in deposition of oil downwind of the well site. The well was capped on June 26, 1994 and site evaluations of damage to natural resources were initiated on June 27, 1994. EG&G/EM personnel were key members of a team that prepared an assessment, remediation, restoration and monitoring plan (ARRMP) for the blow out. The ARRMP outlined the steps necessary to assess damages to biota and restore or remediate habitat affected by oil spray.

In addition to helping prepare the ARRMP, personnel from EG&G/EM conducted or assisted with biological and cultural resource surveys, mapping and geographical information system (GIS) support, determining effects to biota and cultural resources, and determining remediation/restoration goals and techniques.

II. METHODS

Mapping and GIS Support

Preliminary mapping of the affected area was accomplished using transect surveys and road surveys. Transects were spaced 40 m apart and were walked in the most heavily affected areas. During road surveys personnel drove vehicles along roads to find the perimeter of the affected area. More comprehensive maps were developed by reviewing aerial photographs taken shortly after the blow out.

EG&G/EM records of locations of threatened and endangered species were compiled and given to the Unit Operator for entry into the GIS. Specific map information included locations of kit fox captures for the past five years, observations of giant kangaroo rat burrows, observations of blunt-nosed leopard lizards, and locations of populations of Hoover's woolly-star and Kern mallow.

Remediation/Restoration Goals and Techniques

Remediation/restoration goals and techniques were determined during meetings with oil spill team members. The goal for remediation/restoration was to return those areas which were heavily impacted by oil spray to approximate pre-impact conditions. One of the problems encountered in developing and implementing a remediation/restoration plan was the lack of information on methods and successes from previous spills of this nature. Therefore, another objective of this effort will be to evaluate remediation/restoration methods. Several alternatives to cleaning up the oiled area were considered. The alternatives were ranked in an evaluation matrix that included factors such as potential environmental impacts, likelihood that the alternative will attain remediation/restoration goals, human health and safety risks, and cost.

Effects to Cultural Resources

Effects to cultural resources were assessed during surveys conducted shortly after well 313H-26R was capped and by reviewing cultural resource records from the Cultural Resource Facility at California State University, Bakersfield and by reviewing EG&G/EM files at Elk Hills.

Effects to Biota

Effects to biota were assessed during surveys shortly after the well was capped, by evaluating potential toxicological effects on small mammals, and initiating long-term monitoring of populations of animals and plants within the heavily affected area. Toxicological effects were investigated by collecting three male Heerman's kangaroo rats from each of three sites: a heavily sprayed area, an adjacent unsprayed area, and a lightly sprayed area. The captured animals were sacrificed and their livers were removed, placed in glass vials, and frozen. Stomachs were also removed and their contents were visually inspected using a dissecting microscope to check for evidence of oil residue. The liver samples were sent to a laboratory to determine if the kangaroo rats had ingested hydrocarbons. In addition, soil samples from the three sites and a sample of oil from the same formation as 313H-26R were sent to the laboratory to determine if hydrocarbons from the blow out could be linked to hydrocarbons in the livers.

Long term monitoring of animal and plant populations was initiated on the three remediation/restoration sites and the control site. The following variables will be compared between study sites and through time: abundance and species composition of rodents, reptile and invertebrate abundance, shrub survival and vigor, and production, cover, and species composition of annual plants.

Desert saltbush (*Atriplex polycarpa*) survival will be determined by individually marking 50 living desert saltbush plants in each of the study areas and revisiting those plants the following summer. The proportion of plants surviving will be compared between study areas.

Desert saltbush vigor will be determined by obtaining overhead photographs of the plants in the fall and then the following summer. A dot grid will be placed over the photographs and the number of dot intersections with green foliage will be used as an index of shrub vigor.

Vegetation transects will be used to quantify the amount and diversity of herbaceous vegetation on the study areas. Twelve 50-m transects were established in each study area and measures of herbaceous production, cover and species composition will be obtained at the end of the next growing season.

Two 7 X 7 trapping grids were established in each study area to monitor small mammal populations. Each of the 49 stations per grid will contain one Sherman live trap placed under a metal "tent" to provide protection from sun, wind, and rain. Traps will be operated for three consecutive nights and each captured rodent will be eartagged, weighed, and sexed before release at the capture site. Small mammal abundance indices will be obtained by calculating the number of individuals (total and by species captured per 100 trap-nights). These indices will be compared through time and among study areas.

Reptiles will be surveyed during small mammal trapping. The number and species of reptiles observed will be recorded. These indices of abundance will be compared between study areas to determine if the blow out has affected these species and to evaluate restoration techniques.

Ground dwelling invertebrates also will be monitored during small mammal trapping. Beetles and ants are attracted to the bait used for small mammals and the trapping sessions provide an opportunity to assess the abundance of these species. The number of ground dwelling beetles and the presence or absence of ants will be recorded while the traps are being checked.

III. RESULTS

Mapping and GIS Support

Maps of the blow out site were developed. Information on locations of threatened and endangered species and soil data were given to the unit operator for inclusion into the GIS. The field surveys and aerial photographs indicated that the heavy spray area was limited to approximately 24 hectares within approximately one-half mile of the blow out site, but very light spray was found as far as 13.6 km south of the site.

Remediation/Restoration goals and techniques

It was decided that the heavily affected area (approximately 24 hectares) would be divided into three treatment plots of approximately 8 hectares in size. Three remediation/restoration alternatives would be tested in these plots and compared with a control plot in an unaffected area. The three techniques decided upon included natural recovery, surface modification, and biostimulation. The natural recovery alternative consists of applying no further treatment to the area and monitoring the rate of natural recovery of the plant and animal communities. The surface modification alternative consists of lightly scarifying the surface vegetation and soil by dragging chain-link fence material behind a light weight tractor to break up the soil crust. The bio-stimulation alternative consists of surface modification and application of a slow-release fertilizer designed to stimulate the action of naturally occurring soil microbes.

Effects to cultural resources

Field surveys were completed and files were reviewed. Record searches indicated that there were approximately 78 archeological sites potentially affected by the blow out which were located in the light oil spray area. However, based on a preliminary review of the records, there were no recorded sites in the heavy oil spray area.

Effects to biota

Results of the field surveys provided no evidence of take of listed species. Two dead ground dwelling beetles were found and two desiccated rodent carcasses were found but no recently killed vertebrates were found during the surveys. Live vertebrates seen during surveys of the heavily affected site included forty-two lagomorphs, two coveys of quail, four burrowing owls, and one barn owl. Considerable evidence of small mammal activity, including active trails, burrows, and foraging sites were found throughout the entire area including the most heavily

impacted portions. The observations indicated that activity levels by the animals may have been near pre-impact numbers, even in the more heavily impacted areas.

Residue from the wind-blown oil formed a thin asphalt-like crust, not more than a few millimeters thick on soil and vegetation even in the most heavily affected areas. Vegetation in the heavily impacted areas was lightly coated with residue on the windward side of the plant and to a lesser degree on the leeward side.

Liver and stomach samples were collected from kangaroo rats for toxicological studies. The stomach samples were visually inspected but no obvious differences in stomach contents were detected between rodents taken from the blowout area and the control area. Liver samples were sent to a laboratory for analyses of hydrocarbons, but results were not received in FY94. Sites were established and grids were set out for the animal and plant community monitoring but no monitoring was conducted in FY94.

6. PROGRAM ASSISTANCE

A primary objective of EG&G/EM's support of the Endangered Species and Cultural Resource Program at NPRC is to provide the expert advice, guidance, and assistance necessary for DOE/NPRC compliance with the ESA of 1973 (as amended), the National Historic Preservation Act, National Environmental Policy Act (NEPA), and other laws protecting cultural and historic resources, and to provide technical and management progress reports, present and publish scientific findings, and engage in information transfer and educational outreach activities.

Support of specific compliance procedures pursuant to the ESA, the National Historic Preservation Act and other cultural resource laws, and NEPA was accomplished through preparing the necessary documentation and supporting consultations as required by these laws. A significant activity was supporting the formal Section 7 consultation between DOE/NPRC and FWS for continuing oil and gas operations at NPR-1. This activity included collating NPRC organizations' responses to FWS' draft biological opinion, providing an analysis of alternative responses, and producing a thorough written response and supporting information. In addition to this major consultation, two formal and two informal consultations were conducted for separate projects on NPR-1. EG&G/EM also supported the completion of the Supplemental Environmental Impact Statement, Record of Decision, and Mitigation Action Plan for continued MER development at Elk Hills. In addition, EG&G/EM provided support for formal Section 7 consultation between DOE/NPRC and FWS by preparing a biological assessment for continued exploration, development, and operation of NPR-2. EG&G/EM also provided input to sections of an environmental assessment pertaining to the terrestrial biota and cultural resources found on NPR-2 for compliance with NEPA. For historic and cultural resources compliance activities, please see section 3.2 of this report.

Third party projects are actions on NPRC that are not initiated or implemented by NPR-1 participants (consisting of DOE, Chevron, the NPR-1 management and operating contractor or EG&G/EM). Each proposed third party action requires a survey of the project site, the preparation of a survey report or Biological Assessment, appropriate survey and reporting for cultural resources, consultations with both FWS and the State Historic Preservation Officer (SHPO), and monitoring of the project for compliance with endangered species and cultural resource requirements. EG&G/EM's role in these projects is primarily to review documents and conduct consultations with FWS and SHPO. In FY94, EG&G/EM assisted NPRC with five third party projects. Three of the projects involved replacement of existing underground pipelines while the other two projects involved well abandonment programs. For these projects, EG&G/EM reviewed the biological assessments and initiated consultations with FWS. EG&G/EM reviewed the biological opinions that were issued for three of the projects in FY94.

Throughout FY94, EG&G/EM provided programmatic management support through a number of activities. These included the preparation of weekly coordination summaries, quarterly progress reports, monthly financial reports, annual scope of work, and detailed project plans. Written input was provided to NPR-1's annual Environmental Site Report, Annual Operating

Plan, and Long Range Plan. Numerous Elk Hills Weekly articles were drafted and provided to DOE/NPRC. EG&G/EM staff attended and provided a poster at the semi-annual Fossil Energy Environmental Safety and Health conference and attended numerous other meetings such as weekly environmental coordination meetings and DOE/NPRC Technical Assurance Branch staff meetings. Briefings were provided to NPRC management on the annual scope of work, project progress, and related compliance issues. Overall programmatic briefings were also provided to Captain Ernest Hunter and Deputy Assistant Secretary Patricia Godley.

Scientific findings based on work performed on threatened and endangered species at NPRC were presented at various forums including Endangered Species Advisory Committee meetings, professional society meetings, and at an Annual Program Review attended by approximately 100 people from various federal and state agencies, oil and gas companies, and other interested organizations.

Several technical reports and scientific manuscripts were published, and others were submitted for publication. Please see Section 7 for a list of these reports and publications.

EG&G/EM represented NPRC on a multi-agency/industry task force to propose improvements to compliance procedures for both the federal and state endangered species acts. EG&G/EM also attended meetings sponsored by the San Joaquin Valley Endangered Species Recovery Planning Program and the Lokern Natural Area Management Program to provide these groups with the information and experience gained through the endangered species program at Elk Hills.

Numerous educational outreach activities were conducted throughout the year. EG&G/EM and the University of California, Berkeley established a graduate student research agreement and supported a graduate student at Elk Hills in a study of kit fox movements and dispersal. Based on the apparent success of this first project, it is anticipated that future graduate research projects can also be supported. Two undergraduate students at California State University, Bakersfield were hired through a Cooperative Education Program between EG&G/EM and California State University, Bakersfield so that they could gain practical work experience related to their field of study. EG&G/EM worked with a high school biology teacher who was selected to participate in the DOE funded intern program for the summer months. On-site tours and briefings also were given to a variety of persons and groups, including an advisor and high school class from Arvin; high school students and their biology teacher from Taft High School; Mathematics, Engineering, and Science Achievement Program student; young ladies who visited NPRC on "Bring Your Daughters to Work Day"; a graduate student from the University of Nevada, Reno; biology instructors from Taft College and Bakersfield College; a staff member from the California Department of Fish and Game (CDFG); and staff biologists from the U.S. Fish and Wildlife Service. Two EG&G/EM staff members participated in a "Girls Enjoying Math and Science" conference held at Bakersfield College. EG&G/EM made significant contributions to NPR-1's annual Earth Day activities held both on site and at the California State University, Bakersfield campus by providing educational booths, displays, activities for visiting school children, and coordinating booths and displays from off-site organizations such as the California Living Museum, Facility of Animal Care and Treatment, and the California Department of

Water Resources. Similar displays and support were provided to NPR-1's Energy Conservation Week and the Tule Elk Reserve Jamboree. EG&G/EM staff participated in planning a cooperative education program with staff from Atlantic Richfield Company (ARCO), CDFG, and private consultants for activities to be conducted at the ARCO Coles Levee Ecosystem Preserve. Several EG&G/EM staff participated in DOE's Science Bowl by volunteering their time as coaches to high school teams. Two EG&G/EM staff members completed the CDFG Project WILD Facilitator training. EG&G/EM staff also participated in: career days at a local elementary school; a Pacific Gas and Electric Company endangered species training session; an Audubon Society meeting where a presentation was made; and several classroom visits to local schools to present information about endangered species.

Numerous unscheduled activities were also supported, the most significant being the development and implementation of a response to the blow out at well 313H-26R. For details of this activity, please see Section 5.2.

7. PUBLICATIONS

Several technical reports and scientific manuscripts were drafted, and some published during the year.

Published documents include:

Cypher, B. L., K. A. Spencer, and J. H. Scrivner. 1994. Food-item use by coyotes at the Naval Petroleum Reserves in California. *The Southwestern Naturalist* 39:91-95.

EG&G Energy Measurements, Inc. 1993. Effects of supplemental feeding on survivorship, reproduction, and dispersal in San Joaquin Kit foxes. U. S. Department of Energy Topical Report. EG&G/EM Report No. EGG 11265-2059. 28 pp.

Documents in press include:

Anderson, D. C., B. L. Cypher, G. L. Holmstead, K. L. Hammer, and N. Frost. Occurrence and distribution of special status plant species on the Naval Petroleum Reserves in California. U. S. Department of Energy Topical Report. EG&G/EM Report No. EGG 11265-2052. 37 pp.

Cypher, B. L. Coyote morphometric characteristics and mass dynamics in the San Joaquin Valley, California. *The Southwestern Naturalist*.

Cypher, B. L., J. H. Scrivner, K. H. Hammer, and T. P. O'Farrell. Viral antibodies among coyotes in the San Joaquin Valley, California. *Journal of Wildlife Diseases*.

EG&G Energy Measurements, Inc. 1995. Endangered Species Program Naval Petroleum Reserves in California Annual Report FY93. U. S. Department of Energy Topical Report. EG&G/EM Report No. EGG 11265-2047. 51 pp.

Holmstead, G. L., and D. C. Anderson. Reestablishment of Hoover's woolly-star (*Eriastrum hooveri*) following disturbance. *Conservation Biology*.

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