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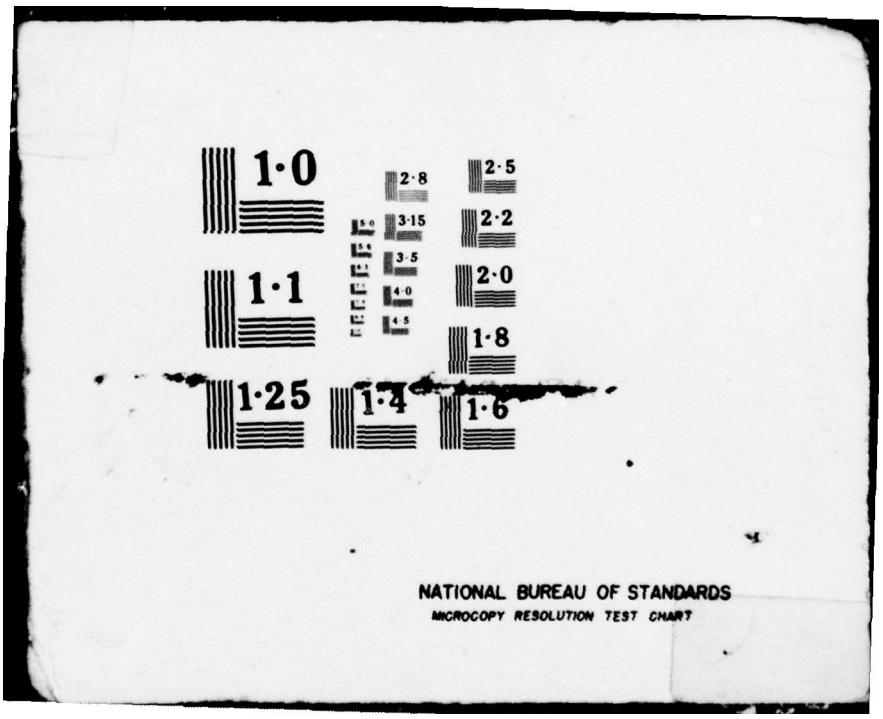
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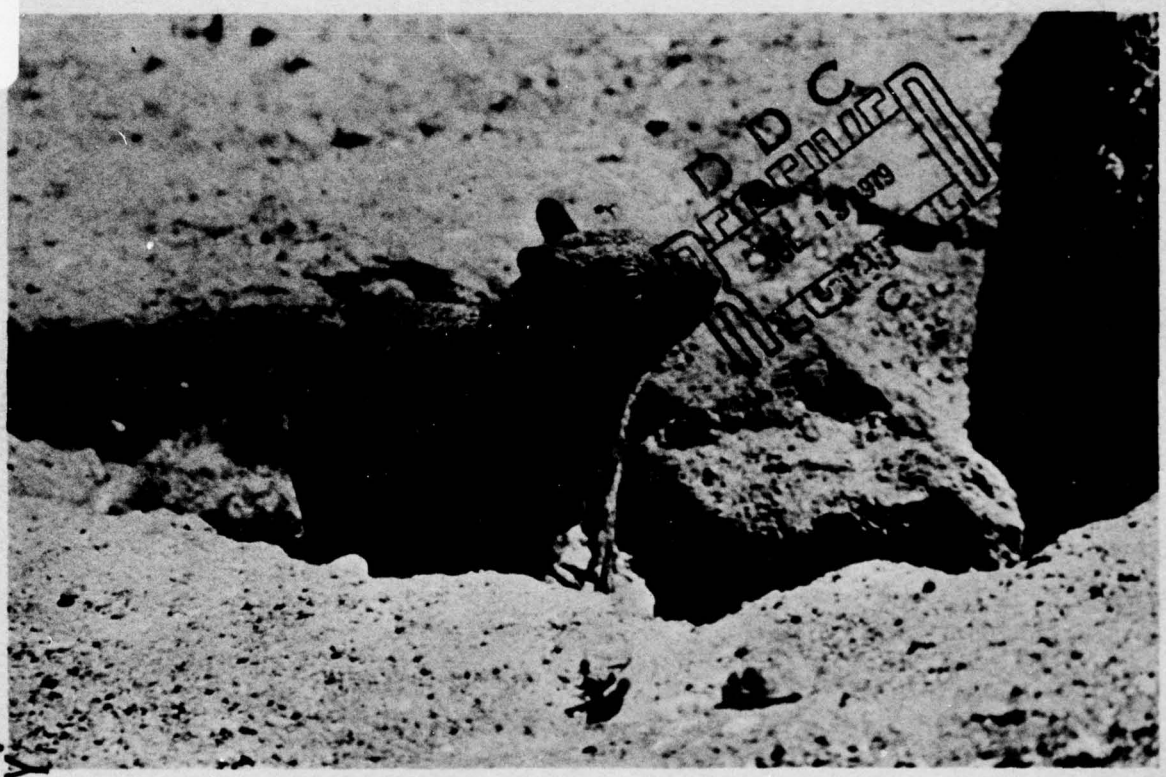
Draft

# ENVIRONMENTAL IMPACT STATEMENT

February 1977



# GROUND SQUIRREL CONTROL FORT ORD COMPLEX, CALIFORNIA

DEPARTMENT OF THE ARMY
HQ, 7TH INFANTRY DIVISION, FORT ORD

(7th)

(9) DRAFT ENVIRONMENTAL IMPACT STATEMENT,
(6) GROUND SQUIRREL CONTROL, FORT ORD COMPLEX
Fort Ord, California
February 1, 1977

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GROUND SQUIRREL CONTROL ON THE
FORT ORD MILITARY COMPLEX

(X) Draft ( ) Final Environmental Statement

Responsible Office: Fort Ord, California

1. Name of Action: (X) Administrative ( ) Legislative

2. Description of the Action:

It is proposed to significantly reduce ground squirrel populations occupying large areas of grassland and woodland-grassland upon Fort Ord, Fort Hunter Liggett and Camp Roberts located in the counties of Monterey and San Luis Obispo in the central coastal area of California.

These ground squirrels constitute a large potential reservoir for sylvatic (bubonic) plague; have caused damage to military structures and facilities; damaged crops on adjacent private lands; and compete with other wildlife and with domestic stock for food.

Significant ground squirrel control formerly in effect upon these areas was last applied in 1971, and has not been resumed since Executive Order #11870 prohibited the use of secondary poisons for pest control upon federal lands. Present ground squirrel control measures are limited to anticoagulants and zinc phosphide applied only within 200 yards of occupied structures.

Large-scale ground squirrel control measures using 1080 (a secondary poison) have been used on private lands adjacent to the military lands for many years, but squirrels from the military lands are claimed to reinfest the treated private lands, causing crop damage and rendering the ground squirrel control program on private lands ineffective.

Rodents and carnivores have been collected on Fort Hunter Liggett during 1976 and serological results have demonstrated that a number of carnivores show a positive reaction for sylvatic (bubonic) plague, indicating that a source of the plague organism is present on military or adjacent lands. The Surgeon General's Office and the California Department of Public Health recommend that control of ground squirrels and flea vectors be carried out in areas of significant human use.

A number of grazing leases have been issued for the military lands, and there is considerable controversy with respect to the amount of damage to vegetation which the ground squirrels cause. If the ground squirrel population were reduced, the range could support more livestock or desirable wildlife such as deer. On the other hand, there is a question as to whether grazing should be continued at present levels, since the range condition may be improved. This factor of range use must be considered with respect to minimizing fire hazards on the military lands.

The proposed action would treat the open range ground squirrel habitat at Fort Hunter Liggett and Camp Roberts with 1080-treated bait from the air. Zinc phosphide would be applied by hand to open-range ground squirrel habitat on Fort Ord. This action would be supplemented by using anticoagulants, zinc phosphide and fumigants to treat ground squirrel concentrations in areas of human use (accompanied or preceded by flea control using Carbaryl dust) and near structures and facilities. The action would be conducted in cooperation with the Department of Interior, California Department of Fish and Game, California Department of Public Health, and the Counties of Monterey and San Luis Obispo. In addition the resources of the plague center at the Center for Disease Control in Fort Collins, Colorado and of the Letterman Army Research Institute in San Francisco will be called upon.

3. Summary of Impacts

Environmental

The proposed action will significantly reduce the population of ground squirrels upon the Fort Ord military complex. The reduction of ground squirrel numbers will have no significant effect upon ground squirrels elsewhere, and probably at least 10 percent of the present population on military lands will remain unaffected.

The major beneficial impact will be a significant reduction in the threat to human health (plague).

The action will result in less damage to structures and facilities, less damage to crops on adjacent private lands, and a lessening of competition for forage on grazing lands. It will improve the relations between the Army and the community.

The population of other seed-eating rodents such as meadow voles, kangaroo rats, field mice and of seed-eating birds (quail) will be reduced due to primary poisoning. Carnivores will also be affected due to secondary poisoning.

Adverse Environmental Effects

Adverse effects will include a loss of some coyotes, bobcats, domestic cats and dogs and possibly (though unlikely) of kit foxes. Loss of seed-eating birds will be minimal, if at all No adverse effects are expected upon condors, vultures or raptorial birds. Seed-eating rodents will be lost. The loss of ground squirrels and other rodents will reduce the prey food base for predators; however, this is not considered significant since the ground squirrel is relatively unavailable due to its habits of aestivation and hibernation.

4. Alternatives

The following alternatives have been considered:

- Substitution of zinc phosphide for 1080. This would meet ground squirrel control objectives, but would be less efficient.

- Reduction in the area of open range which would be treated. Continue to treat with 1080 or zinc phosphide a one-mile wide buffer zone of squirrel habitat adjacent to private crop lands and around cantonments bivouacs and other areas of human use or of special concern (dams, roads etc.). Continue to treat the areas of human use or of special concern with anticoagulants, zinc phosphide, fumigants and Carbaryl (as necessary for flea control). This alternative would achieve control objectives with the minimum amount of adverse impacts to the nontarget species, but there would remain the problem of constant reinvasion of the treated areas by ground squirrels from the untreated areas.

- Trapping, flooding, introduction of predators, destruction of burrows, etc., were considered but not developed since their use on a large-scale did not appear feasible.

- No action. The present hazard to health and damage to crops and structures will continue at an estimated minimum cost of $5,500 per year for repair and maintenance on Fort Hunter Liggett alone, and a possible crop damage of over $700,000 per year.

# INTRODUCTION

## PROJECT DESCRIPTION

Fort Ord, Fort Hunter Liggett and Camp Roberts support multiple-use recreational programs, and each installation has a natural resource conservation program. However, the primary use of each installation is military training. All other uses are secondary. The present high populations of ground squirrels and the subsequent potential health hazard and damage they represent interfere with the U. S. Army's primary mission and cause damage to the property of surrounding landowners. To remedy these problems, the Army has developed a ground squirrel control program which involves the use of several poisons, applied by a variety of methods. The poisons projected for use are 1080 (sodium monofluoroacetate), zinc phosphide, diphacinone (anticoagulant) and fumigants. Following recommendations of health officials the Army also plans to control fleas with an insecticide, carbaryl, prior to or in conjunction with the application of poison bait.

Sodium monofluoroacetate (1080)-treated grain bait will be applied aerially across open rangeland on Fort Hunter Liggett and Camp Roberts in 1977 following the guidelines of Marsh (1967). Only the active colonies of squirrel-infested acreage will be treated. Follow-up treatment with 1080-treated grain will be conducted every 2-3 years wherever squirrel populations recover or reinfestations occur.

Zinc phosphide grain bait will be applied by hand to squirrel colonies in the open rangeland and maneuver areas of Fort Ord. Zinc phosphide will also be used within the city limits of Fort Ord in areas such as the football field and vacant lots. Zinc phosphide will also be used as a long-range control measure on all three installations along road banks and dam faces whenever damage by squirrels occurs.

Diphacinone or other anticoagulants offered in bait boxes, and fumigants such as carbon bisulphide, methyl bromide or gas cartridges will be used to control squirrels in cantonment areas or other areas of human use. Diphacinone and fumigants will also be used in areas near water impoundments on all three installations.

To control ground squirrel fleas, carbaryl dust will be applied within burrows in cantonment areas or other sites having high human use on all three installations on the orders of the Surgeon General. Flea control where needed will precede application of poison baits.

A more detailed discussion of the project description covering the specific control measures, including amounts of toxicants, methods of application, manpower, equipment and safety measures, etc. is found in the section -- Proposed Action and Alternatives - Impacts and Mitigations.

## Military Mission

Fort Ord, Fort Hunter Liggett and Camp Roberts are Department of Army installations owned and managed to further the Army's overall military mission.

Fort Ord is responsible for training of the 7th Infantry Division. Fort Ord also provides support to the Combat Development Experimental Command, the Defense Language Institute, plus active and reserve military programs in central and southern California.

Fort Hunter Liggett's primary mission is to support training and maneuvers of the 7th Infantry Division and field experimentation of the Combat Development Experimental Command.

Camp Roberts is presently licensed to the California National Guard and is used primarily for National Guard and Reserve component training. The 7th Infantry Division has also recently begun to use the camp for training and maneuvers.

## Other Land Uses

Based upon the multiple use concept, the military lands are also used for a variety of outdoor recreation pursuits. One of the principal activities is a hunting and fishing program. Other outdoor recreation programs include golfing, dog field trials, riding, swimming and picnicking, wildlife observation and photography, organized sports, i.e., baseball.

The military lands are also used to provide income through grazing leases for sheep and cattle and honey bee leases.

## Natural Resource Conservation Program

Fort Ord and Fort Hunter Liggett have natural resource conservation programs. The Fort Ord program was started over 20 years ago. Both installations have received national Department of Army recognition for their activities. The programs include water and soil conservation; forestry; fish and wildlife protection and enhancement elements as well as the user programs indicated above.

## Ground Squirrel Problems

The beechey ground squirrel is considered by many as one of the most destructive pests of California, annually causing millions of dollars of damage to agricultural crops, grazing lands and man-made structures. The burrowing habits of these animals are the primary cause of structural damage to roads, dams and buildings and have been cited as a means of accelerating soil erosion (DeVos, 1969). Their foraging activities on grazed lands, as with livestock, often leads to an alteration of plant species and density of cover which enables them to become more abundant and to compete even more with livestock for forage (Howard, 1953). In addition, the ground squirrel acts as host for vectors carrying rodent-borne diseases (including bubonic plague) communicable to humans.

Various ground squirrel control laws and programs have been in effect in California for many years (Jacobsen, 1962). Major control efforts have been initiated and promoted by federal, state and local government. Monterey County's 1908 ordinance, which has not been repealed, authorizes fines or imprisonment for failure to kill ground squirrels.

## Control by Army

Ground squirrel problems have occurred on three U. S. Army installations in California -- Fort Ord, Camp Roberts and Fort Hunter Liggett. Several different control measures were used in early programs, including zinc phosphide, strychnine, cyanide, thallium sulfate and periodic trapping and shooting. During World War II a new rodenticide, sodium monofluoroacetate (1080), came into use and replaced most of the previously used rodenticides. Initially, the lands were treated with zinc phosphide and/or 1080-treated grain dispersed near the burrow entrances of active ground squirrel colonies.

However, this procedure was time-consuming and expensive with only limited efficacy and control (Hunter Liggett Military Reservation, report, 1968). With the development of an aerial dispersal procedure for 1080-treated grain, described by Marsh (1967), a more efficient and cheaper method of control was possible. This procedure was used at Fort Hunter Liggett in 1968 and 1969 and at Camp Roberts in 1969 and 1970. Because of less favorable habitat, soil, or climate, the ground squirrel problem at Fort Ord was deemed less serious than at the other two installations; therefore, zinc phosphide was continued as the control measure at Fort Ord.

## 1972 Executive Order

Due to increasing public awareness concerning the poisoning of wildlife on public lands and the recommendations published in the Cain report (Cain, et.al., 1972), Executive Order 11643 was issued. Basically the Cain report (entitled Predator Control - 1971) recommends that "immediate Congressional action be sought to remove all existing toxic chemicals from registration and use for operational predator control...that these restrictions extend to those toxicants used in field rodent control whose action is characterized by the secondary poisoning of scavengers... and that the Secretary of Interior disallow use of the aforementioned chemicals in federal operational program of predator and rodent control". As a consequence of the recommendations of this report, the President issued Executive Order 11643 on February 9, 1972, establishing "Environmental Safeguards on Activities for Animal Damage Control on Federal Lands". The Executive Order briefly states that secondary-type poisons may not be used on public lands, unless a finding is made that "any emergency exists that cannot be dealt with by means which do not involve use of chemical toxicants, and that such use is essential: 1) to the protection of the health or safety of human life; 2) to the preservation of one or more wildlife species threatened with extinction, or likely within the foreseeable future to become so threatened; 3) or to the prevention of substantial irretrievable damage to nationally significant natural resources".

To comply with the Executive Order, the use of all chemicals to control ground squirrels was discontinued on the three military installations.

## Action Since 1972

Since the Executive Order 11643 (revised as Executive Order 11870 in 1975), ground squirrel control programs using 1080 on the Fort Ord complex have been discontinued. Some minor controls are presently being used on all three installations wherever damages by ground squirrels require immediate attention, or where their close proximity to human use areas is deemed a health hazard. Poisons currently being applied by hand on a small-scale basis are diphacinone, and zinc phosphide. Carbaryl dust (Sevin) is also being used in the cantonments to control ground squirrel fleas.

The ground squirrel population at Fort Ord, Camp Roberts and Fort Hunter Liggett has increased dramatically, extending over a considerable part of each installation including cantonment and bivouac areas (letter dated April 27, 1973). Neighboring farmers allege that constant reinvasion by squirrels from adjoining federal lands nullifies their control measures and causes serious economic crop losses. Monitoring the rodent and predator populations has produced serological evidence of plague foci on the installations or in the vicinity of the military lands (letter from Surgeon General, dated June 11, 1976). The Director of the Department of Health, State of California (June 30, 1976) has concluded that "it is inevitable that [rodent-borne diseases] will enter the highly susceptible ground squirrel population, and it is imperative that actions be initiated to assure protection of human health". The Surgeon General's office has presented the rationale for the determination that a threat to human health exists (memorandum dated August 17, 1976).

For the Army to effectively reduce the ground squirrel population using these toxicants at these installations, they have requested an exemption from the Executive Order. Under the terms of the Executive Order, the Army must make a written finding that such use is essential after consultation with the Environmental Protection Agency (EPA, Health, Education and Welfare (HEW) and the Department of Agriculture and Interior. It has further been determined that an Environmental Impact Statement (EIS) must be prepared (CEQ [Petersen], August 24, 1976).

In Monterey County several poisons and methods are used to control ground squirrels. These are 1080 applied aerially or by hand, zinc phosphide applied by hand, diphacinone, carbon bisulphide, methyl bromide, and gas cartridges. In 1975, 1080 bait (76,064 pounds) and diphacinone bait (29,422.5 pounds)

were the two most commonly used rodenticides. The majority of 1080 bait was applied by hand. Of 91,340 acres flown with 1080, only 2.4 percent (2,247 acres) were actually treated with poison bait (California Department of Food and Agriculture, 1976).

San Luis Obispo County uses only 1080 grain bait to control ground squirrels. In 1975 a total of 99,942 pounds were used. In 1968, of 379,819 acres flown with 1080 bait, only 3.7 percent (14,049 acres) actually had bait on the ground (San Luis Obispo County, 1968).

# ENVIRONMENTAL SETTING

## Regional

This section provides physical, biological and socio-economic information on the areas of Monterey and San Luis Obispo Counties as general background for the region where Fort Ord, Fort Hunter Liggett and Camp Roberts are located (Figure 4). More site-specific environmental information follows for each of the Army installations.

## Climate

The prevailing climatic conditions associated with the North Central Coast Basin and typical of the Fort Ord area are cool, dry summers, mild winters and light annual precipitation. During the summer months the Pacific Subtropical High (a high pressure ridge) lies over the ocean to the west. Air descending from this high produces the moderate northwest to west winds that cross the coast during the summer months (Unger, 1975).

Upwelling cools the air offshore, causing frequent fog during the night and early morning hours. Toward the end of summer the fog becomes less frequent. During the transition season of fall the westerlies shift southward through California, and frontal passages may produce showers and rain. Generally, about 90 percent of the precipitation will occur from November through April. Winters are mild but there is considerably more change in weather than during the warmer months. Tables 1 and 2 describe the mean monthly recording (1971-1975) of temperature and precipitation characterizing the areas near each installation.

The climatic pattern of the South Central Coast Basin is typical of Hunter Liggett, Camp Roberts and the associated interior valley. Summers are warm and dry, and winters are cool and humid (Kinney, 1975). Generally the maximum temperature for the North and South Central Coast Basin occurs during the morning hours preceding the sea breeze in the mid or late morning. The summer maximum usually occurs in September or October after the seasonal weakening of the sea breeze and the persistent fog season that usually ends in August.

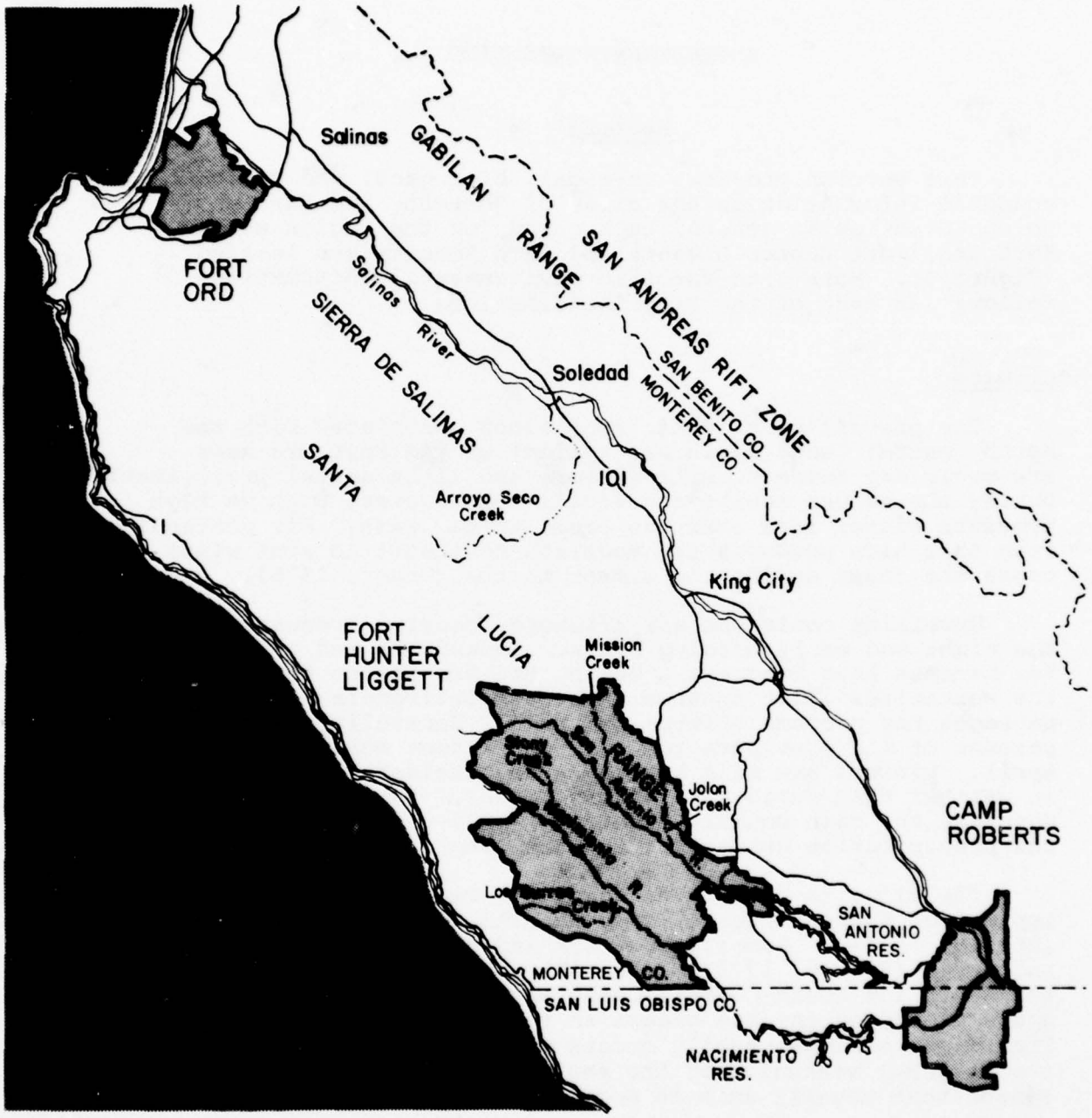



FIGURE 4 REGIONAL MAP

Table 1

MEAN MONTHLY TEMPERATURE RECORDINGS FOR EACH INSTALLATION FROM 1971-1975[1]

| | Year | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fort Ord | 1971 | 51.4 | 51.4 | 52.5 | 52.1 | 53.5 | 57.6 | 58.3 | 62.4 | 64.4 | 57.1 | 54.1 | 47.4 | 55.2 |
| | 1972 | 48.7 | 53.4 | 54.7 | 54.2 | 56.1 | 58.3 | 62.7 | 62.7 | 61.9 | 61.3 | 54.4 | 48.3 | 56.4 |
| | 1973 | 49.7 | 54.0 | 51.2 | 55.7 | 56.3 | 61.4 | 59.5 | 59.1 | 61.9 | 59.4 | 53.5 | 51.7 | 56.1 |
| | 1974 | 49.0 | 51.0 | 52.8 | 54.7 | 54.2 | 58.0 | 60.4 | 61.1 | 61.4 | 61.2 | 55.3 | 49.9 | 55.8 |
| | 1975 | 51.7 | 51.9 | 51.8 | 50.6 | 56.4 | 57.1 | 59.1 | 60.5 | 60.0 | 57.8 | 53.6 | 51.2 | 55.1 |
| Fort Hunter Liggett | 1971 | 47.4 | 50.1 | 52.6 | 54.7 | 59.9 | 68.7 | 75.3 | 77.2 | 71.9 | 60.4 | 52.4 | 44.1 | 59.6 |
| | 1972 | 45.2 | 52.8 | 59.0 | 57.5 | 64.3 | 69.5 | 74.9 | 73.9 | 67.3 | 60.9 | 51.2 | 44.0 | 60.0 |
| | 1973 | 45.0 | 50.6 | 49.2 | 57.1 | 65.5 | 71.4 | 72.7 | 73.1 | 68.6 | 61.7 | 52.0 | 49.4M | 59.7M |
| | 1974 | 47.3 | 49.0 | 52.8 | 54.4M | 62.5M | 69.5M | 73.7 | 73.9 | 72.4M | 64.7 | 54.5 | 48.6 | 60.3M |
| | 1975 | 49.1 | 49.8M | 51.0 | 51.0 | 63.5 | 68.4 | 72.1 | 71.9 | 72.3 | 60.9 | 52.8 | 49.7 | 59.4M |
| Camp Roberts | 1971 | 48.2 | 51.1 | 53.6 | 54.2M | 59.3 | 64.9M | 68.1 | 68.8M | 67.5 | 57.8 | 51.8 | 45.5 | 57.6M |
| | 1972 | 46.5 | 54.0 | 58.9 | 57.3 | 61.9 | 66.8 | 70.2 | 69.2 | 64.7 | 61.9M | 52.4M | M | --- |
| | 1973 | 46.8M | M | M | 58.7M | 64.6M | 69.8M | 67.3 | 67.7 | 65.8 | 62.3M | 51.3M | M | --- |
| | 1974 | 47.0M | 48.1M | M | 57.1M | 60.2 | 65.3 | 68.2 | 68.0 | 67.4 | 63.0M | M | M | --- |
| | 1975 | 45.7M | M | 51.9 | 51.7M | 60.5 | 63.3 | 65.2 | 65.2 | 67.9 | 60.5 | 51.8M | 49.5 | --- |

[1] Data taken from stations on or near each installation.
M Missing data.
Source: U. S. Department of Commerce, National Oceanic and Atmospheric Administration.

Table 2

MONTHLY PRECIPITATION RECORDINGS FOR EACH INSTALLATION FROM 1971-1975[1]

| | Year | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fort Ord | 1971 | 1.10 | 0.50 | 1.26 | 1.28 | 0.29 | 0.01 | 0.01 | 0.16 | 0.13 | 0.03 | 1.82 | 1.83 | 8.42 |
| | 1972 | 0.70 | 0.83 | 0.02 | 0.49 | 0.02 | 0.02 | 0.05 | T | 0.04 | 1.72 | 5.02 | 1.56 | 10.47 |
| | 1973 | 3.45 | 5.48 | 3.21 | 0.06 | 0.02 | T | T | T | 0.05 | 1.70 | 4.10 | 3.00 | 21.07 |
| | 1974 | 3.67 | 1.08 | 5.49 | 3.74 | T | 0.38 | 0.40 | 0.02 | T | 1.48 | 0.47 | 1.79 | 18.52 |
| | 1975 | 0.90 | 3.31 | 3.15 | 1.27 | 0.02 | T | 0.13 | 0.55 | T | 1.02 | 0.23 | 0.17 | 10.75 |
| Fort Hunter Liggett | 1971 | 0.72 | 0.19 | 0.49 | 0.60 | 0.27 | 0.00 | 0.00 | 0.00 | T | 0.42 | 0.55 | 4.21 | 7.45 |
| | 1972 | 0.71 | 0.20 | 0.00 | 0.37 | 0.02 | 0.19 | 0.00 | 0.00 | 0.03 | 3.01 | 4.95 | 0.88 | 10.36 |
| | 1973 | 6.23 | 6.77 | 2.46 | T | T | 0.00 | 0.00 | 0.00 | T | 0.84 | 2.33 | 1.79 | 20.42 |
| | 1974 | 8.04 | 0.07 | 4.06 | 0.71 | 0.00 | T | 0.00 | 0.00 | T | 0.55 | 0.33 | 2.96 | 16.72 |
| | 1975 | 0.05 | 4.64 | 3.24 | 1.29 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.60 | 0.21 | 0.10 | 10.17 |
| Camp Roberts | 1971 | 0.35 | 0.08 | 0.62 | 0.67 | 0.23 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 | 0.42 | 3.34 | 5.74 |
| | 1972 | 0.61 | 0.22 | 0.00 | 0.26 | 0.00 | 0.55 | 0.00 | 0.00 | 0.00 | 1.46 | 4.28 | 0.79 | 8.17 |
| | 1973 | 4.25 | 6.47 | 1.94 | 0.00 | 0.00 | 0.00 | 0.00 | T | 0.00 | 0.81 | 1.47 | 1.78 | 16.72 |
| | 1974 | 5.08 | 0.07 | 2.49 | 0.46 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.91 | 0.36 | 3.05 | 12.42 |
| | 1975 | 0.14 | 5.14 | 3.72 | 0.92 | 0.00 | 0.00 | 0.08 | 0.08 | 0.00 | 0.63 | 0.12 | 0.11 | 10.94 |

[1] Data taken from stations on or near each installation.
T Trace.
Source: U. S. Department of Commerce, National Oceanic and Atmospheric Administration.

Generally the temperatures will be warmer farther inland, as evidenced by the higher maximum temperatures recorded at Camp Roberts, especially in areas sheltered by the terrain from the winds and in areas of significant tree cover. In areas of dense overstory precluding the penetration of the sun's rays, cooler daytime temperatures will be recorded; however, nighttime temperatures will be higher in these areas as opposed to open areas where the heat has a chance to escape.

## Topography

Monterey and San Luis Obispo Counties are located in the Central Coast Basin. Variation in terrain is the product of uplift that has occurred since the Middle Pleistocene, accompanied by considerable folding and faulting. The trend of the ranges, relative to onshore air mass movement, imparts a marked climatic contrast between the coastal area, exposed summits and interior basins. The variations in terrain, climate and vegetation account for a variety of intricate and different landscapes. The major terrain of the basin is generally expressed in terms of the San Benito and Salinas Valleys and the surrounding mountain ranges of Santa Lucia, Santa Cruz, Gabilan and Diablo (Kinney, 1975).

The San Benito Valley is situated between the Gabilan and Diablo Ranges and is the smaller of the two major valleys. Farther north of the San Benito Valley lies the Santa Cruz Range in a nearly straight alignment with the Gabilan Range. The Santa Lucia Range rises abruptly from the Pacific Ocean with hundreds of sharp peaks; the highest peak reaches 5,844 feet. Separating the Santa Lucia from the Gabilan Range is the Salinas Valley, one of the longest and broadest valleys of the Central Coast Basin (Figure 4). The sides of the valley are defined by hundreds of low-rolling, grass-covered hills from 200 to 400 feet high, which make ideal cattle and sheep grazing areas (Monterey County Planning Commission, 1972).

The Salinas River bisects the county, running north from San Luis Obispo County through Monterey County into Monterey Bay. The principal tributaries are the Arroyo Seco, Nacimiento and San Antonio Rivers from the Santa Lucia Range and the San Lorenzo Creek which flows west from the Gabilan Range.

## Soils

The soil survey of Monterey County, California (U. S. Department of Agriculture, Soil Conservation Service, 1975), presents general soil associations for a large part of the study area. Soils along the Salinas River and other major streams are formed from sedimentary alluvium on floodplains and from granitic and schist-like rocks. Soils showing these characteristics are Antioch, Arroyo Seco, Clear Lake, Gloria, Mocho and Pacheco. These soils are used primarily for irrigated row crops and dry land pasture.

Uplands underlain by sandstone, shale and sedimentary rocks consist of Gaviota, Gazos, Linne, Los Gatos, Los Osos, McMullen, Nacimiento, Santa Lucia and Santa Ynez soil series. Vegetation consists mostly of annual grasses, forbs and scattered oaks. These soils are well drained and support range, wildlife habitat and watershed-protective vegetation.

Some lower elevations are characterized by aeolian sand dunes and soft marine sediments on uplands. Arnold, Baywood, Garey, Metz, Marlon and Oceano soil series have these features. These soils support range, recreation and military land uses.

Steep bluffs along major rivers consist of soil materials of unconsolidated or weakly consolidated alluvium. The alluvium commonly has gravel, cobblestone and stones. These soils are suited to range and some limited woodland.

## Geology

The study area lies within the California Coast Range province, a series of north-northwest mountain ranges and several major structural valleys. The geology of these ranges is extremely complex. Typically, the area consists of old and recent sand dunes, Upper Cretaceous marine, Lower and Middle marine, and Plio-Pleistocene nonmarine sedimentary deposits. Along streams and near the coast are more recent alluvial and stream deposits.

A peculiar feature of the Coast Range province is the abutment of two regions consisting of entirely different core complexes -- the Sur series and quartz diorite to the west, and the Late Jurassic to Late Cretaceous Franciscan Formation to the east. The two unrelated core complexes are separated from each other by an intricate system of fault blocks. The most active in the area is the San Andreas fault, striking approximately N35°W in a nearly straight line in the Coast Range province and extending southward for a total length of about 250 miles from Shelter Cove on the coast of Humboldt County to the Salton Sea (Oakeshott, 1966).

## Water Resources

Surface Waters. The Salinas River is the major surface stream in the study area, running north from San Luis Obispo County through Monterey County into the Monterey Bay. The principal tributaries are the Nacimiento and San Antonio Rivers and the Arroyo Seco. Mission and Jolon Creeks are the principal tributaries of the San Antonio River, and Stony and Los Burros Creeks contribute to the Nacimiento River within the boundaries of Hunter Liggett. Small man-made impoundments and ephemeral streams exist on each of the three installations; however, these streams are normally dry during late summer and fall. Nacimiento and San Antonio Reservoirs were constructed in 1957 and 1965, respectively, and are operated by the Monterey County Flood Control and Water Conservation District. The primary purpose of the reservoirs is groundwater recharge in the Upper Valley and Forebay aquifers and flood control in the basins. See Figure 4 for major water sources in the study area.

The lower Nacimiento River below the Nacimiento Dam is located in north central San Luis Obispo County. It flows in a northeasterly direction and joins the Salinas River in south central Monterey County. The total distance is about ten miles, with the upper two miles winding through private land and the lower eight miles bisecting Camp Roberts.

During the wet season, runoff is stored in the reservoir. Releases generally begin between April and July when the flows diminish in the Salinas River. The total capacity of the dam is 350,000 acre-feet, providing an estimated 85,000 acre-feet for use in Monterey County and 17,500 acre-feet in San Luis Obispo County.

The San Antonio Reservoir controls the flow of the San Antonio River. It has a gross storage capacity of 350,000 acre-feet and provides an annual yield of approximately 32,000 acre-feet for groundwater recharge in the Salinas River downstream from Bradley (California Regional Water Quality Control Board, Central Coast Region, 1975).

Groundwater. Groundwater in the Salinas Valley is a mixture of natural surface waters, water released from storage projects, agriculture, municipal and industrial wastewater and sea water. The major sources of recharge to the groundwater basin are the Salinas River and Arroyo Seco. These waters are generally of very good quality with average total dissolved solids (TDS) values of 210 mg/l and 170 mg/l, respectively. Recorded groundwater TDS values range from 300 mg/l to 2,400 mg/l. The following groundwater data were summarized from the Fort Ord Mission Change, Draft EIS, 1975.

*Fort Ord*. The groundwater resources of the lower Salinas Valley provide an abundant supply of groundwater in the northern part of Fort Ord. More than 90 percent of the total water taken from the Salinas Valley groundwater system goes to agriculture. The Salinas River marks the southwest side of a clay-layered, confined artesian aquifer condition referred to as the "pressure area".

Under Fort Ord itself the subsurface conditions are difficult to interpret as there are many undulating areas of sand and gravel that have been layed down to varying depths of thickness. There are, however, at least three geographical subunits within the Fort Ord area.

Northern Fort Ord is underlain by the pressure area of the Salinas Valley aquifer described above. The 180- and 400-foot aquifers are both present in this area. In the southeasternmost area, wells are most likely supplied from isolated pockets of water. There is no significant recharge to northern Fort Ord from this south or southeast area. In the Ord Village/Seaside area, there is an almost total lack of data; however, it can be inferred that groundwater in this area is recharged from the local southwest Fort Ord area.

The quality of "normal" water at Fort Ord is generally good. The quality of groundwater is substantially the same at all depths so far tapped by wells in the Salinas Valley and northern Fort Ord.

East of Fort Ord and west of Salinas the 180-foot aquifer contains water with high chloride content and total dissolved solids. In addition, sulfates and bicarbonates as well as calcium, magnesium and sodium are found in this water, indicating a contamination source perhaps distinct from typical saltwater intrusion. The clay cap covering the 180-foot aquifer is thin in this area and apparently groundwater perched on top of the cap finds its way into the aquifer below. There is the possibility of unconsumed irrigation water, some sewage effluent and some industrial wastes entering the aquifer in this area. It is perhaps from these sources that the other pollutants are found. The 400-foot aquifer in this area is not degraded. This is thought to be because the seal layer between the 180- and 400-foot aquifers is more effective than the clay cap above the 180-foot aquifer.

On the west side of Fort Ord, saltwater intrusion has primarily affected the 180-foot contour and led to the development of wells in the 400-foot aquifer. However, in the Marina-Fort Ord area, the separation between the 180- and 400-foot aquifers can intermingle freely.

*Fort Hunter Liggett*. Water-bearing formations of the HLMR area are the Paso Robles, the Older and Recent Alluvium and an unnamed Tertiary formation. The Paso Robles formation has the best water-producing potential and extends from the surface to 1,000-foot depths in areas northwest of the San Antonio Valley. The alluviums are very permeable, but are shallow and do not produce wells of very great yield. The Monterey formation, essentially non-water bearing, covers a larger portion of the reservation and underlies some of the alluvium. A groundwater geologist concluded that extensive and suitable water-bearing formations do exist within the reservation (Dewante and Stowell, 1967).

*Camp Roberts*. Camp Roberts is underlain by a major groundwater basin, made up of the Paso Robles and the Cholame Valley basins. The Paso Robles Basin is reported to have a usable storage capacity of 1,700,000 acre-feet. The average withdrawal capacity of wells drawing from the Paso Robles Basin is reported to be 500 gallons per minute, and from the Cholame Valley Basin 1,000 gallons per minute.

Water Quality. The U. S. Geological Survey and the California Department of Water Resources continuously monitor flows in the Salinas River. The Monterey County Flood Control and Water Conservation District records flows in the Main Reclamation Ditch and smaller tributaries to the Salinas River, and maintains flow release data for Nacimiento and San Antonio Reservoirs. These reservoirs regulate downstream flows of the San Antonio and Nacimiento Rivers.

Water quality standards observed in this report are those of the state's RWQCB and the EPA.

The extreme seasonal fluctuations in the surface flow of the Salinas River and the large input of domestic wastewater and agricultural runoff that reach its lower stretches have combined to create adverse water quality conditions. High bacterial counts and pesticide levels and nuisance algal blooms are the major water quality problems.

There are three distinct aquifers of the Salinas River groundwater basin within the northern part of the study area. The estimated safe yield of the 180-foot and the 400-foot aquifers is 78,000 acre-feet per year, and the estimated safe yield of the East Side Aquifer is 19,000 acre-feet per year (Yoder-Trotter-Orlob & Associates, 1973).

The 180-foot and 400-foot aquifer are called pressure aquifers because they are overlain by impermeable material. The East Side aquifer is an unconfined aquifer; if enough groundwater were present, it could rise to ground surface. Quality data for the 180- and 400-foot aquifers are presented in Table 3.

Table 3

GENERALIZED GROUNDWATER QUALITY IN THE SALINAS RIVER BASIN

| Characteristic | 180-foot Aquifer | 400-foot Aquifer |
|---|---|---|
| TDS - mg/l | 1,414 | 400 |
| Boron - mg/l | 0.6 | 0.19 |
| Sodium - mg/l | 225 | 41 |
| Chloride - mg/l | 243 | 27 |
| Nitrate - mg/l | 0 | 0 |
| Sulfate - mg/l | 624 | 102 |

Source: California Regional Water Quality Control Board, Central Coast Region, 1974.

## Flora

Monterey and San Luis Obispo Counties contain a wide variety of natural vegetation as a result of the influence of climate, topography and various other factors. The vegetation can be grouped into six general vegetative cover types: coastal strand, riparian, grassland, woodland, scrub-chaparral, and coniferous forest. The coastal strand is characteristically vegetated by succulent ice plants and other beach grasses. Riparian habitat is dominated by willow and cottonwood. This cover type also includes marsh habitat and the associated plant species. Grasslands are typified by annual grasses (such as wild oats, brome and fescues, which have been introduced by man), as well as associated forbs (such as bur clover and filaree). Woodland habitat is characterized by open and closed stands of deciduous hardwoods, such as live and blue oak. Scrub-chaparral habitat consists of the coastal scrub zone dominated by low-growing, woody plants, such as manzanita, and the more arid chaparral of the interior which is characterized by open or closed stands of a great variety of species, which includes sage brush, bitter brush, mountain mahogany and chamise. The coniferous forest cover type includes redwood and closed-cone pine forests along the coast and ponderosa pine or juniper-pinon pine forests of the interior.

Over 40 rare or endangered plant species occur in each county. The rare Monterey cypress and several manzanita species occur only within Monterey County. Several rare lupine and mariposa species are limited in distribution to San Luis Obispo County (California Native Plant Society, 1974).

## Fauna

As a result of the diversity of habitat within Monterey and San Luis Obispo Counties, a wide variety of animal life can exist. Each habitat type -- coastal, riparian, grassland, woodland, scrub-chaparral, and coniferous forest -- supports its own complement of animal life. Some animal species may be restricted to a certain habitat type, while others are adaptable to several habitat types.

Along the coast, birds are the most evident form of animal life. Many species of gulls, shorebirds, murres and cormorants, as well as the rare California brown pelican can be observed along the coast. Marine mammals such as the stellar sea lion and the protected southern sea otter occur in the coastal waters of both counties.

The complexity of riparian vegetation and the close proximity to water provide suitable habitat for a great number of wildlife species. The reservoirs, streams and ponds on the region provide habitat for many game fishes, such as trout and bass as well as nongame fishes, including minnows and suckers. A list of native and introduced fishes in the Pajaro-Salinas drain can be found in Moyle (1976). Shrub growth provides cover for a variety of small mammals (rodents, rabbits) and many songbirds and gamebirds (quail, dove, pheasant). The larger trees of this zone contribute nest sites and cover for tree squirrels, as well as many bird species (raptors, songbirds, woodpeckers).

Grassland provides habitat for foraging forms of wildlife (raptors, coyotes, skunks, foxes, rodents and seed-eating birds). Greater value to wildlife occurs wherever grassland joins chaparral or woodland creating an "edge" effect with greater habitat diversity.

Woodlands, often associated with grass or brush understories, provide an important source of food and cover for many species, including the blacktail deer, wild pig and grey squirrel. The tree canopy provides food and cover for many bird species.

Scrub-chaparral habitat, despite its location in more arid topography, supports populations of blacktail deer, brush rabbits, coyotes, fox and several rodent species. Quail, dove, scrub jays and various songbirds can be observed in this habitat.

The wildlife value of coniferous forests ranges from low in dense redwood forests to high in the less dense ponderosa pine forests. The coniferous forests of both counties provide important habitat for many bird species, including the *nuthatch, creeper* and stellar's jay. Many mammals (coyotes, bobcats, foxes, deer and bears) inhabit these forests.

All habitat types support many species of snakes and lizards and where water or moisture is present pond turtles and several species of frogs, toads and salamanders exist.

Eight rare and endangered animal species are known to occur in Monterey County (2 mammals, 5 birds, 1 amphibian) and 10 occur in San Luis Obispo County (3 mammals, 6 birds, 1 reptile). One endangered species of butterfly occurs in Monterey County. See Table 4 for a list of rare, endangered or fully protected wildlife of the region.

## Land Use

The major uses of the developed land in Monterey County are agriculture, recreation, residential use and industry. Agriculture is the most important source of income for the county. Approximately 290,000 acres are cultivated each year, of which 180,000 acres are irrigated (Monterey County Planning Commission, 1972; Monterey County Department of Agriculture, 1975). Row crops (lettuce, artichokes, peas, and brussel sprouts), suitable to cool climates are grown along the coast and in the lower Salinas Valley. Lettuce, which is valued at over $100 million annually, is the most profitable crop followed by strawberries, celery and tomatoes (Monterey County Department of Agriculture, 1975). Approximately 1,019,000 acres in the foothills and smaller valleys are devoted to dry and irrigated pasture, making livestock raising a primary economic resource.

Important natural resources of the county besides agricultural soils are petroleum, granite, limestone and timber. The San Ardo oil field near King City is the sixth largest producer in the state. There are over 16,000 acres of commercial forest within Monterey County (Monterey County Planning Commission, 1972).

A large portion of Monterey County is comprised of public lands. The Los Padres National Forest extends over 325,000 acres. Additional recreational and open space land includes 13 state parks, beaches and reserves with over 1.5 million visitors in 1974 (California Department of Parks and Recreation, 1974).

San Luis Obispo County is presently dominated by rural and open space uses. The most important land use is agriculture. Approximately 60 percent of the county land is devoted to the less intensive or large-scale uses such as grazing and field crops. The cattle industry, which is valued at over $25 million annually, is the single most important segment of the agricultural

Table 4

RARE, ENDANGERED AND FULLY PROTECTED FAUNA WHOSE PRESENT DISTRIBUTIONS INCLUDE THE STUDY AREA

| Common Name | Scientific Name | Status* Federal | Status* State | Comments |
|---|---|---|---|---|
| **BIRDS** | | | | |
| California least tern | Sterna albifrons browni | E | E | Breeds on coast from lower California to San Francisco Bay. |
| California brown pelican | Pelecanus occidentalis occidentalis | E | E | Occurs on California coast August through November, breeds on Anacapa Island. |
| California condor | Gymnogyps californianus | E | E | Breeds in coast range in San Luis Obispo, Santa Barbara and Ventura Counties. |
| Southern bald eagle | Haliaeetus leucocephalus leucocephalus | E | E | Occurs statewide, particularly along coast and in interior around large lakes, reservoirs and wetlands. |
| Peregrine falcon | Falco peregrinus anatum | E | E | Breeds in california along the coast. |
| Golden eagle | Aquila chrysaetos | | P | Statewide. |
| **MAMMALS** | | | | |
| Morro Bay kangaroo rat | Dipodomys heermanni morroensis | E | E | South side of Morro Bay. |
| San Joaquin kit fox | Vulpes macrotis mutica | E | R | Foothills of the southern end, western and eastern (in part) edge of San Joaquin Valley. Occurs in 14 counties. |
| Southern sea otter | Enhydra lutris nereis | | P | Along coast from Santa Cruz County in Santa Barbara County. |
| Ring-tailed cat | Bassariscus astutus | | P | Statewide in chaparral, rocky ridges, near water. |
| **REPTILES** | | | | |
| Blunt-nosed leopard lizard | Crotaphytus silus | E | E | San Joaquin Valley to eastern San Luis Obispo County. |
| **AMPHIBIANS** | | | | |
| Santa Cruz long-toed salamander | Ambystoma macrodactylum croceum | E | E | Two locations in Santa Cruz County; one location in Monterey County. |
| **INSECTS** | | | | |
| Smith's blue | Shijimiaeoides enoptes smithi | E | | Coastal sand dunes, Monterey County. |

* STATUS:

Federal

E Endangered Species - "means any species which is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insecta determined by the Secretary to constitute a pest whose protection under the provisions of this Act would present an overwhelming and overriding risk to man."

State

E Endangered - "is an animal of a species or subspecies of birds, mammals, fish, amphibians, or reptiles, the prospects of survival and reproduction of which are in immediate jeopardy from one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease."

R Rare - "is an animal of a species or subspecies of birds, mammals, fish, amphibians, or reptiles that, although not presently threatened with extinction, is in such small numbers throughout its range that it may be endangered if its environment worsens."

P Fully Protected - "is an animal of a species or subspecies of birds, mammals, fish, amphibians, or reptiles that by law may not be taken or possessed at any time.

Sources: United States Congress, 1973; California State Legislature, 1970; California Department of Fish and Game, 1975 and 1976; U. S. Fish and Wildlife Service, 1976.

economy. The inland valleys are dominated by grazing and field crops, such as wheat and barley. San Luis Obispo County is the state leader in wheat acreage (Lantis, et.al., 1970). The coastal region provides land for truck crops, which place second in economic importance. Other specialty crops with high economic value per acre include fruits, nuts, citrus and grapes. Over 6,000 acres of almond orchards are located near Paso Robles (San Luis Obispo County Planning Department, 1975).

Important natural resources are petroleum and mineral operations but they comprise only 3,264 acres in the county. Sixteen percent of San Luis Obispo County is public domain or national forest lands. Included are the Los Padres National Forest and 13 state parks, reserves, beaches and historical monuments which received over 6 million visitors in 1974 (California Department of Parks and Recreation, 1974).

## Socio-Economics

The economic life of the region is principally dominated by agriculture and its population growth is typical of other agriculturally-oriented counties. The population of the two counties has grown from 357,776 residents in 1969 to 374,437 in 1973. During the same period the percentage of the population in the labor force increased from 156,064 to 164,133, representing 44 percent of total population. The largest single source of employment for the area was government services, employing 7,206 federal civilians and 27,698 military. Other large employment industries are agriculture, forestry and fisheries (13,129), state and local (21,550), construction (6,689), wholesale trade (4,500), eating and drinking establishments (5,659), and retail trade (7,455) (Construction Engineering Research Laboratory, Environmental Impact Computer System, 1976).

Civilian employment at Fort Ord in fiscal year 1975 generated $50.1 million in payroll receipts from military operations. Military payrolls for the same time period totaled $156.1 million. Payments for goods and services purchased off the military reservations amounted to $28.7 million.

The urban areas in the Fort Ord region are served by existing commercial-retail, office or industrial services and facilities. Additional commercial-retail type space at Fort Ord is located within the boundaries of the military reservation, including the main exchange, the commissary, and the clothing sales store. Commercial-retail operations in the vicinity of Fort Ord range from small neighborhood grocery stores to large regional shopping centers with specialty shops. Regional shopping centers are located in Monterey, Salinas and Santa Clara.

Housing. A total of 3,379 family housing units are available on the three installations. The Fort Ord installation maintains five family housing tracts in the Main Post area which consists of 1,941 buildings with 3,264 family units. Noncommissioned officers occupy 2,543 of the family units, the remainder are occupied by 721 commissioned officers and their families. An additional 106 family units are located at the Presidio of Monterey and nine at Hunter Liggett Military Reservation. Camp Roberts is mostly used for National Guard training and does not accommodate military families. These post facilities provide housing for 50 percent of the families associated with the military installations.

At Fort Ord there are 47 permanent barracks which provide space for 8,982 enlisted men without families. An additional 330 temporary facilities designed to house 42 men each are currently being used. Permanent bachelor officer facilities are of two types. There are seven apartment-style buildings having a capacity for 172 occupants, and sixteen temporary buildings currently housing 377 tenants. Additional housing within Monterey and Santa Cruz Counties, accessible to Fort Ord within a 60-minute rush hour commute provides 792 men single-family units, 570 two- and three-bedroom condominiums, 669 one- and two-bedroom apartments. Also, 140 vacant mobile home spaces are located in the Watsonville area.

A study of family housing needs at Hunter Liggett is presently being performed. The exact magnitude of future housing for Hunter Liggett is to be established.

Schools. Approximately 30 percent (105,362) of the population in the two counties attend school. The Monterey Peninsula Unified School District presides over the five schools within the boundaries of Fort Ord as well as schools in the areas adjacent to the installation. Federal funds applied to the Monterey Peninsula Unified School District during the 1975 fiscal year totaled $3.97 million. Pacific Grove School District received $45,000 and Carmel District was given $14,000. All other school districts received a total of $100,000. At present, 3,500 elementary students and 1,200 junior high students are located within the boundaries of Fort Ord.

The nearest schools available for Hunter Liggett dependents are San Antonio Elementary School at Lockwood and King City Union High School at King City. The nearest schools to Camp Roberts are in the Paso Robles area (Department of Army, Fort Ord Mission Change, 1976).

Transportation. The Fort Ord complex is serviced by several highways and airports. Major roadways leading to Fort Ord are State Routes 1, 68 and 156 and U. S. Highway 101. One commercial and municipal airport is located in Monterey and Salinas respectively. Major routes servicing Fort Hunter Liggett are Highway 101 and State Highway 198 connecting Highway 101 with Interstate 5 through Coalinga. County roads G14 and G18 (Jolon Road) from King City and Bradley, respectively, lead to Fort Hunter Liggett from Highway 101. One small municipal airport is located in King City. Camp Roberts is serviced by Highway 101 and State Routes 46 and 41 connecting Paso Robles with Interstate 5. Commercial airports are located in Paso Robles and San Luis Obispo further south. Amtrak services Salinas and San Luis Obispo.

Each installation of the Fort Ord complex supports an interior network of roads, many of which are available for public use. Fort Ord provides access roads for recreational activities such as hunting and fishing as well as to the Laguna Seca Road Race Course. Several interior roads of Fort Hunter Liggett, including the Nacimiento-Fergusson and Milpitas Roads, travel through the installation to Highway 1 on the coast and the Los Padres National Forest to the north. Access is also available within military property for recreational activities and tourism of the San Antonio Mission and other historical or archeological sites. The interior roads of Camp Roberts also provide access for limited public recreational activities within military property.

## Fort Ord

### Military Land Use

Fort Ord is located in the Monterey Bay area approximately 118 miles south of San Francisco. The post covers an area of 28,038 acres. Fort Ord's military mission provides for the activation and training of the 7th Infantry Division and its components. A total of 16,000 acres (57 percent of the installation) comprising 19 training areas with 23 specific training sites are available for field exercises, maneuvers, firing ranges, and impact areas (see Figure 5). A total

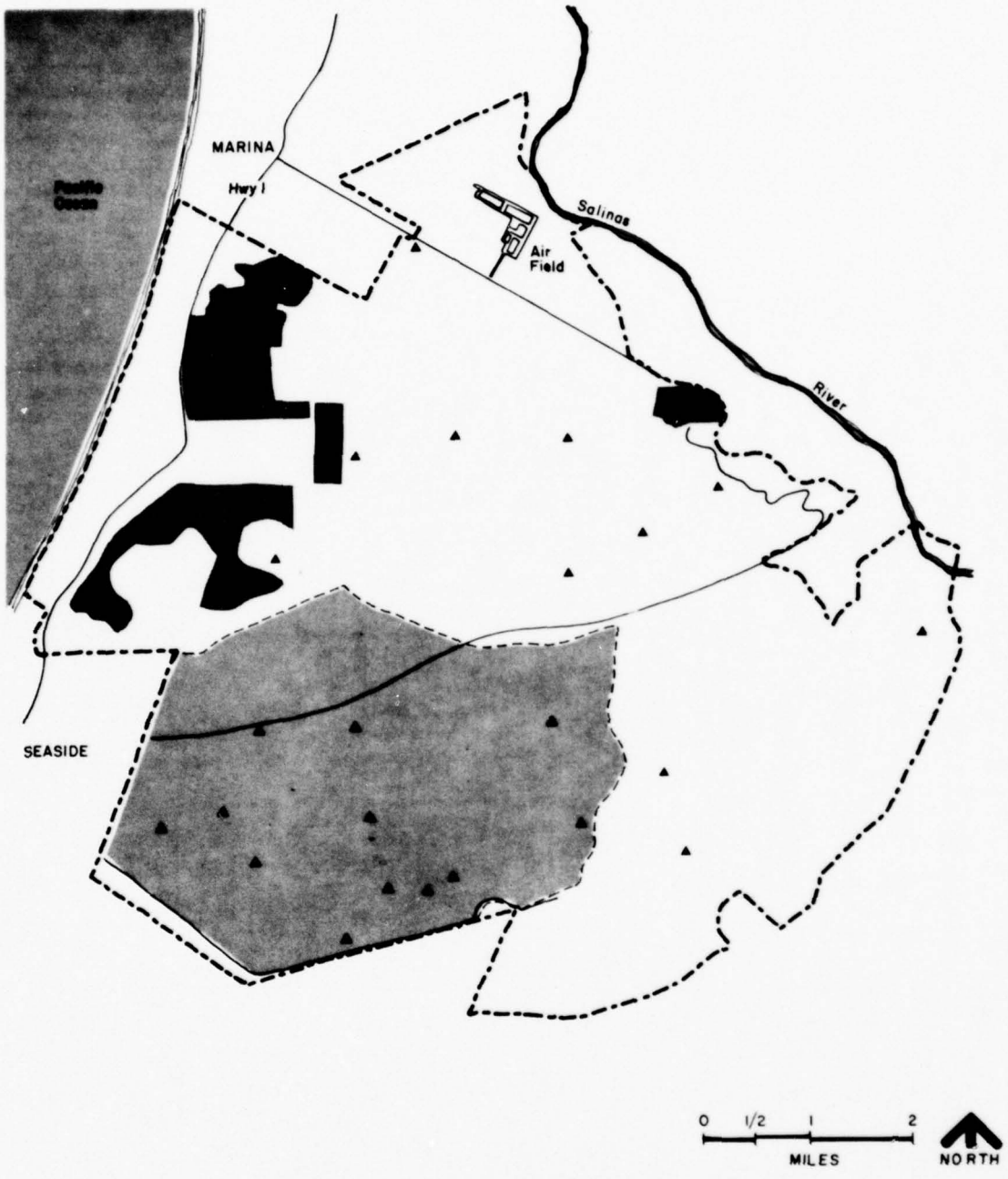



FIGURE 5
MILITARY LAND USE ON FORT ORD

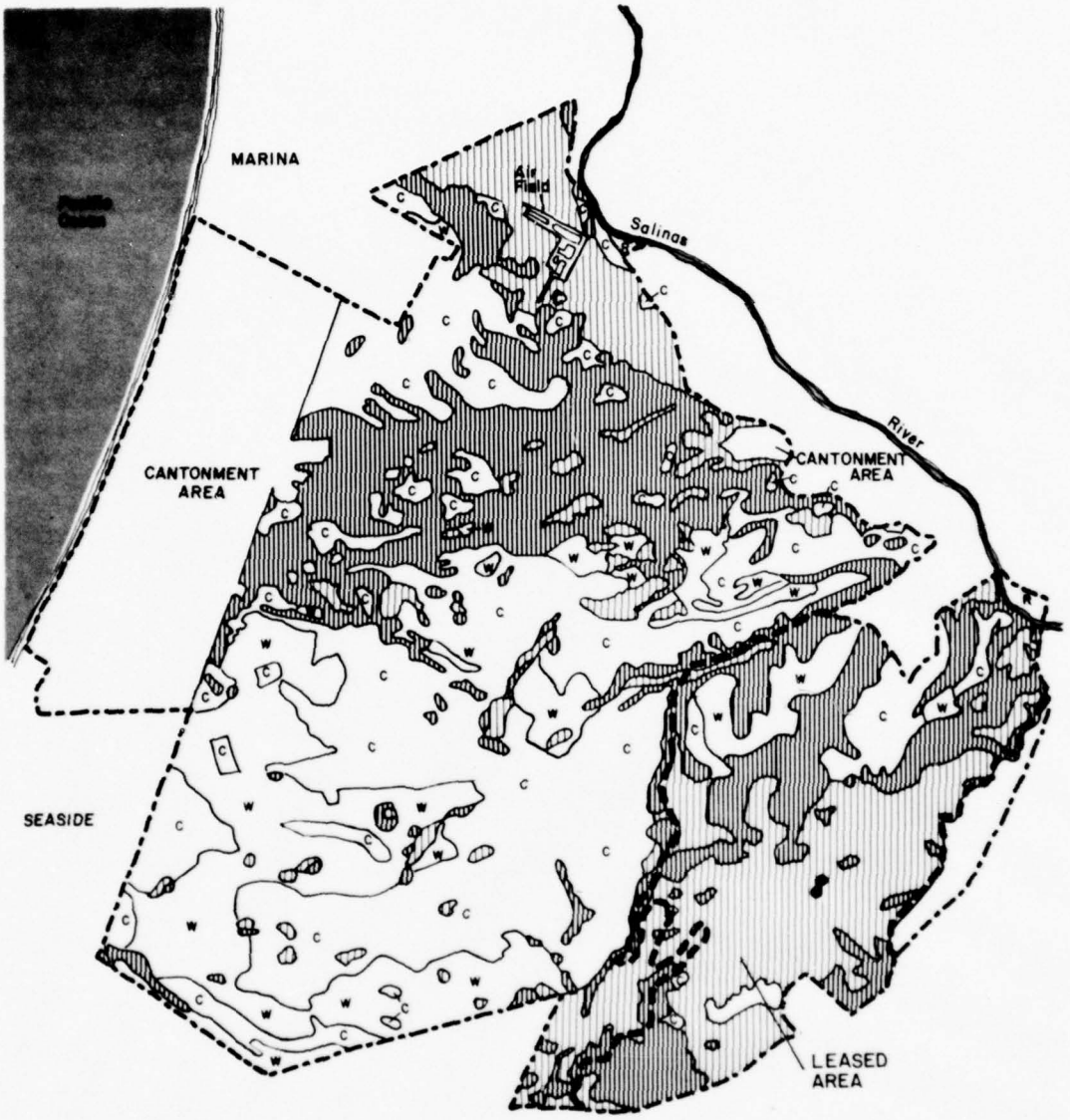



FIGURE 6
VEGETATIVE COVER TYPES OF FORT ORD

of 4,191 acres (15 percent of the installation) are used by the Main Post including permanent facilities such as the Regimental and Brigade Headquarters and five major family housing areas. Approximately 1,524 acres or 5.4 percent of Fort Ord is occupied by the facilities and airstrip used by Fritzsche Army Airfield. The four miles of coastline fronted by the installation are used for the operation of firing ranges (Department of the Army, 1976).

The Natural Resources Conservation Program on Fort Ord involves the entire installation. Included in this program are the grazing outlease program and the fish and game program. The grazing outlease program was established to reduce the fire hazard during summer months. The one sheep lease under this program involves 6,031 acres to be grazed primarily during the months between February and June. Fort Ord also permits one apiary lease for 100 hives on two one-half acre plots to be used from March through September. The fish and wildlife program provides for such projects as habitat enhancement, fish stocking, and associated hunting, fishing and recreational activities. There were over 4,000 hunter and angler days of use on Fort Ord in 1975 (Department of the Army, 1975).

## Adjacent Land Use

Land use adjacent to Fort Ord includes a variety of interests. The urban centers of Seaside and Marina are located to the southwest and northwest of the installation. Northeast of Fort Ord lies the Lower Salinas Valley. Here valuable row crops, such as lettuce, celery, cauliflower, broccoli and potatoes are grown. Limited acreage of dry and irrigated pastureland is also maintained along the northeastern border of the installation. Lands to the south and east are primarily private dwellings and open grazing range. The Toro Regional Park adjoins Fort Ord along its eastern border (Monterey County Planning Commission, 1972).

## Archeological/Historical Resources

There are no known archeological or historical sites within the boundaries of Fort Ord. Archeological investigations at Fort Ord have been sporadic and have shed little light on aboriginal settlement patterns or subsistence. Fort Ord is located in what was once the territory of northern Costanoans (from Spanish Costanos, "coast people") who were linguistically affiliated with the Miwok and other Penutian speakers to the east and north (Kroeber, 1970). The Costanoans occupied a region along the coastline from San Francisco Bay to south of Monterey and inland to the Diablo Ranges.

Relatively little of their culture is known because of efforts by the Spanish to establish missions in the 1700s and the subsequent development of Monterey Bay as a major harbor. Today, the Costanoan group is virtually extinct.

## Flora

Fort Ord, which lies in the Monterey Peninsula area, is represented by a diversity of vegetation (Figure 6), including several rare and endangered species (Table 5). A species list is found in Appendix A (California Native Plant Society, 1974; California Natural Areas Coordinating Council, 1975; and Department of the Army, 1976).

The coastal strand is characterized by dune grasses, native and exotic ice plants (Mesembryanthemum sp.) and various other beach plants. The coastal scrub, a stabilized dune community, lies eastward of the coastal strand. This community is characterized mainly by several unique species of manzanita (Arctostaphylos sp.).

Farther inland, oak woodland, grassland and chaparral communities are common. The northwestern and eastern portions of the reservation are dominated by open grasslands and grass interspersed, open stands of oak woodland. Foxtail grasses (Hordeum sp.), brome (Bromus sp.), wild oats (Avena sp.) and annual rye grasses (Lolium sp.) as well as several forb species such as bur clover (Medicago polymorpha) and filaree (Erodium sp.) are common. The coastal live oak (Quercus agrifolia) is the predominant tree. Bracken ferns (Pteridium aquilnum) and poison oak (Rhus diversiloba) are often found in the oak woodland understory.

The remaining major portions of the reservation are dominated by chaparral communities comprised mainly of several species of manzanita and ceanothus (Ceanothus sp). A limited amount of marshland and riparian habitat with their associated plant species occurs within the reservation.

To protect the rare or endangered plant species and unique plant communities, nine native plant preserves have been established in conjunction with the California Native Plant Society of the University of California, Davis. Plants represented in the preserves include: sand-mat manzanita (Arctostaphylos pumila), toro manzanita (A. montereyensis), Monterey ceanothus (Ceanothus rigidus), Eastwood's ericamerica (Haplopappus eastwoodiae), coast wallflower (Erysimum ammophilum), slender flowered gilia (Gilia tenuiflora ssp. arenaria) and coast silktassel (Garrya elliptica).

Table 5

VERY RARE AND RARE AND ENDANGERED PLANTS FOUND IN THE STUDY AREAS

| Common Name | Scientific Name | Rarity Code* R | E | V | D | Habitat and Plant Community | Study Area Location |
|---|---|---|---|---|---|---|---|
| Coast wallflower | Erysimum ammophilum | 1 | 2 | 1 | 3 | Dunes, coastal strand | Fort Ord |
| Ben Lomond wallflower | Erysimum teretifolium | 3 | 2 | 2 | 3 | Dunes, coastal strand | Fort Ord |
| Eastwood's ericamerica | Happlopappus eastwoodae | 3 | 3 | 3 | 3 | Dunes, coastal strand coastal scrub | Fort Ord |
| Toro manzanita | Arctostaphylos montereyensis | 2 | 1 | 1 | 3 | Sand hills and woods, coastal scrub | Fort Ord |
| Sand-mat manzanita | Arctostaphylos pumila | 2 | 2 | 2 | 3 | Sand hills and woods, coastal scrub | Fort Ord |
| Seaside bird's beak | Cordylanthus littoralis | 3 | 2 | 1 | 3 | Back of coastal strand | Fort Ord |
| Monterey ceanothus | Ceanothus rigidus | 2 | 2 | 1 | 3 | Sand hills and flats, coastal scrub | Fort Ord |
| Purple amole | Chlorogalum purpureum var. purpureum | 3 | 3 | 1 | 3 | Plains at 1,000 feet, foothills | Jolon; Fort Hunter-Liggett |
| One-awned spine flower | Chorizanthe rectispina | 2 | 2 | 1 | 3 | Dry slopes, chaparral | Fort Hunter-Liggett |
| Carmel Valley bush-mallow | Malacothamnus palmeri var. involucratus | 2 | 2 | 1 | 3 | Foothills, dry rocky slopes, chaparral | Fort Hunter-Liggett |
| Indian Valley chorizanthe | Chorizanthe insignis | 2 | 2 | 1 | 3 | Foothills, sandy places, chaparral | Fort Hunter-Liggett |
| Santa Lucia pogogyne | Pogogyne clareana | 3 | 2 | 1 | 3 | Foothills, chaparral | Fort Hunter-Liggett |
| Hickman sidalcea | Sidalcea hickmanii ssp. hickmani | 2 | 1 | 1 | 3 | Dry ridges, chaparral | Fort Hunter-Liggett |
| Hardham bedstraw | Galium hardhamae | 2 | 1 | 1 | 3 | Rocky dry places, pine forests | Fort Hunter-Liggett |

* RARITY - ENDANGERMENT CODES

The California Native Plant Society's (1974) Rarity Endangerment Code consists of a series of four numbers used to rate the status of rare or endangered plants. The codes are a series of four digits. The first digit represents rarity; the second, endangerment; the third, vigor; and the fourth, general distribution.

Rarity (R) (..."amount of the plant both in terms of numbers and also in terms of manner and extent of distribution.")
1. Rare, of limited distribution, but distributed widely enough that potential for extinction or extirpation is apparently low at present.
2. Occurrence confined to several populations or one extended population.
3. Occurs in such small numbers that it is seldom reported; or occurs in one or very few highly restricted populations.

PE Possibly extinct or extirpated.

Endangerment (E) (..."embodies the concept of a plant being threatened with extinction or extirpation.")
1. Not endangered.
2. Endangered in part.
3. Totally endangered.

Vigor (V) (..."dynamics of the plant in terms of numbers of individuals or populations.")
1. Stable or increasing.
2. Declining.
3. Approaching extinction or extirpation.

General Distribution (D)
1. Not rare outside California.
2. Rare outside California.
3. Endemic to California.

Sources: California Native Plant Society, 1974; Munz, 1959 and 1968; Department of the Army, 1975.

Many exotic grasses, forbs, shrubs and trees are also found on Fort Ord. Several introduced trees such as eucalyptus and several species of pines have been planted in some developed areas.

## Fauna

The diverse habitat of Fort Ord supports a large number of fish and wildlife species. Over 200 species of vertebrates have been identified, including 23 species of reptiles and amphibians; six freshwater and anadromous species of native and introduced fishes, as well as numerous salt water species; 149 species of birds either residential or migratorial; and 35 species of marine or terrestrial mammals (Department of the Army, 1975). See Appendix B species list.

An active fish and game management program exists on Fort Ord. Some species important to recreational activities are the California valley quail (Lophortyx californicus), mourning dove (Zenaida macroura), jack and brush rabbits, deer, rainbow trout (Salmo gairdneri) and largemouth bass (Micropterus salmoides).

Many nongame species also inhabit the reservation lands. Included are 13 species of raptors (hawks, eagles, owls, falcons), a wide variety of marine and passerine bird species, and numerous small and large mammal species including the coyote (Canis latrans), badger (Taxidea taxus) and striped skunk (Mephitis mephitis).

Two rare or endangered birds have been observed on Fort Ord property: the southern bald eagle (Haliaeetus leucocephalus leucocephalus), and the California least tern (Sterna albifrons browni) (Department of the Army, 1976). Four protected reptile species may occur in the area. They are the coast horned lizard (Phrynosoma coronatum frontale), California legless lizard (Anniella pulchra), San Joaquin whipsnake (Masticophis flagellum roddocki) and the California mountain kingsnake (Lampropeltis zonata multifasciata) (Department of the Army, 1975). One endangered species of butterfly, Smith's blue (Shijimiaeoides enoptes smithi), occurs on the coastal sand dunes of Fort Ord. Their numbers on base property have been reduced as the result of heavy foot and vehicular traffic, as well as the spread of introduced ice plant (U. S. Fish and Wildlife Service, 1976). In addition, the rare and endangered Santa Cruz long-toed salamander (Ambystoma macrodactylum var. eroceum) may inhabit moist zones of Fort Ord (Department of Fish and Game, 1976).

## Soils

The predominant soils found on Fort Ord Reservation are associated with the Arnold, Santa Ynez and the Baywood soil series and the dissected Xerorthents found along the Salinas River. The Arnold and Santa Ynez soils series are moderately to excessively drained with slopes of 9 to 30 percent. Runoff is medium to rapid and erosion hazard is moderate to high. These soils are suited for seeding to adapted grasses and legumes and are typically covered with annual grasses, forbs, oaks, eucalyptus, manzanita, and chamise.

Cantonment and military maneuver areas are situated on Baywood soils series. This soil is primarily found on stabilized aeolian sand dunes. Included within the Baywood soil mapping areas were mixtures of Oceano soils and Duneland.

Soils along the Salinas River are representative of the Mocho series. These are well drained soils formed on flood plains, alluvial fans, terraces, and river benches in mixed alluvium. Soil textures vary from fine sandy loam, loam, silt loam, to silty clay loam. They are suited for dryland grain, hay, and pasture.

The steep bluffs along the Salinas River consist of dissected Xerorthents soils which require good range management as well as protection from overgrazing. The banks along rivers and streams are typically moderately to severely eroded in areas where these soils are present (Soil Survey of Monterey County, California, Department of Agriculture, Soil Conservation Service, 1975).

# Fort Hunter Liggett

## Military Land Use

Fort Hunter Liggett is located in southwestern Monterey County approximately 60 miles south of Fort Ord. The total acreage of the reservation is 166,535 acres. The Fort's primary mission is to support the U. S. Army's Combat Development Experimental Command (CDED) field experimentation, and the training and maneuvers of the 7th Infantry Division both headquartered at Fort Ord. Approximately 165,000 acres are used for infantry, armor, artillery and aircraft experiments (bivouacs, 790 acres; impact area, 27,500 acres; magazine and other training areas, 136,723 acres) (see Figure 7). The headquarters and cantonment facilities occupy 140 acres of the installation (Department of the Army, 1976).

Under Fort Hunter Liggett's Natural Resources Program, certain areas of the installation totalling approximately 106,390 acres are under four cattle grazing leases. The Fort also provides for a fish and wildlife program involving such projects as pond improvements, fish stocking, game and nongame surveys, research, and hunting and fishing access. In 1973 there were over 12,000 hunter days and over 3,900 angler days of use on the installation. In addition, a forestry program providing for tree planting and firebreak maintenance and environmental programs are underway on the installation (Department of the Army, 1973).

## Adjacent Land Use

The Los Padres National Forest is adjacent to Fort Hunter Liggett along the majority of its western and northern borders. Monterey County Flood Control District land adjoins the installation at the southeastern corner adjacent to the San Antonio Reservoir. All other land to the east and south is private field cropland, mainly grain crops such as barley and wheat and dry or irrigated pastureland (Monterey County Planning Commission, 1972).

## Archeological/Historical Resources

The Salinan Indians were the first inhabitants of the Hunter Liggett area. Their range extended from the ocean on the west to the Salinas Valley on the east with the center of tribal territory located along the Nacimiento and San Antonio Rivers.

Edwards (1973), as reported in Fort Ord Mission Change (1976), investigated 77 archeological sites within a sample area in and near Hunter Liggett. He estimates that at least 400 to 600 archeological/historical sites exist (or did exist) within the area. The Maria Jose Gil Adobe, Dutton Hotel and the Painted Cave are currently listed in the National Historical Register. The San Antonio de Padua (mission) was listed on the National Historic Register, April 26, 1976. It is also listed as a California Landmark. Other sites on the post being considered for the National Historical Register are Tidball or Jolon Store, Upper Stoney Valley Indian Occupational Site, San Miguelito Ranch House Ruins Indian Occupational Site, and 4-MNT-349 Indian Occupational Site.

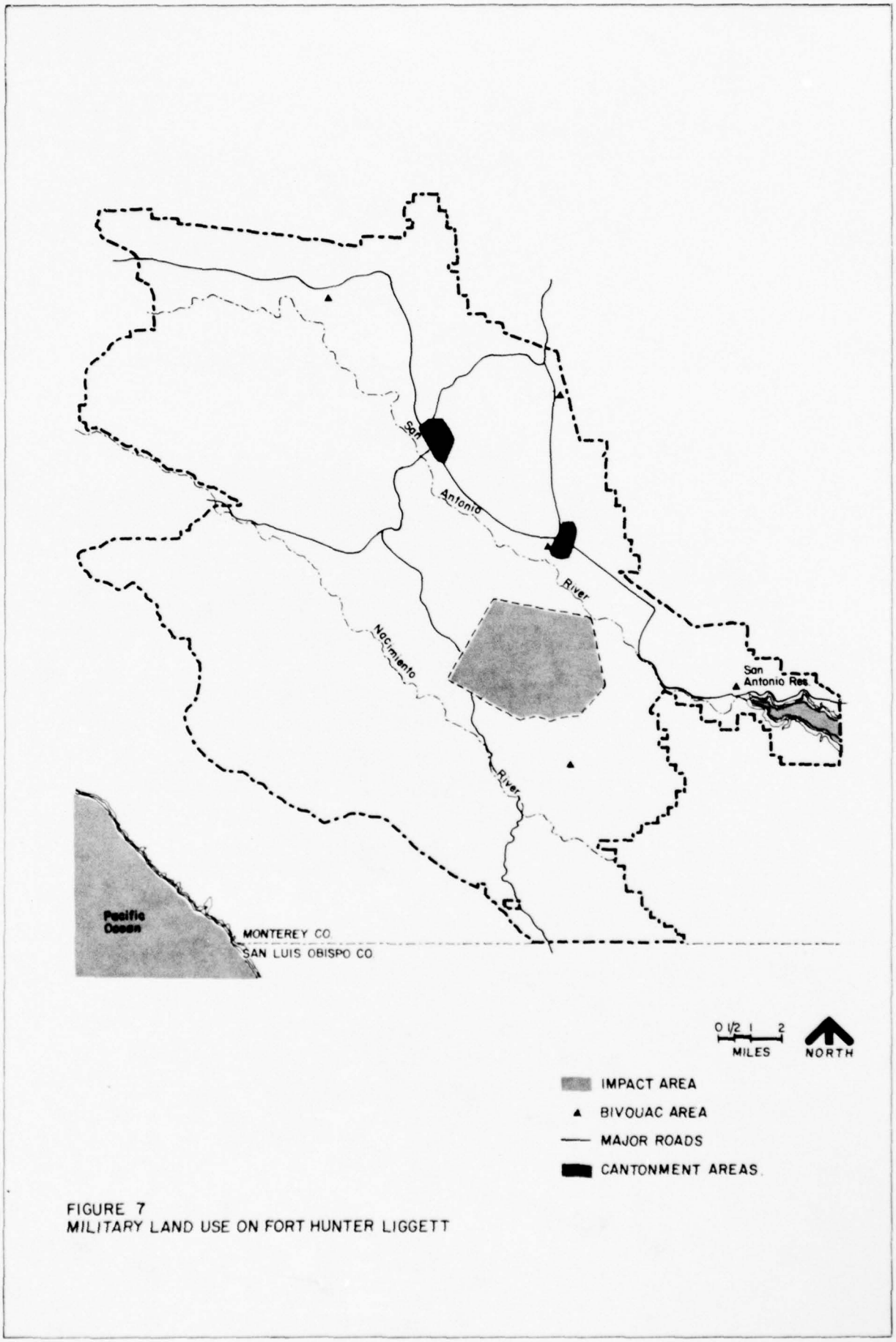



FIGURE 7
MILITARY LAND USE ON FORT HUNTER LIGGETT

UNITED STATES
DEPARTMENT OF THE INTERIOR
Bureau of Sport Fisheries and Wildlife
Division of Wildlife Services
Washington, D. C. 20240

Wildlife Leaflet 337
Revised April 1968

# CHARACTERISTICS OF COMMON RODENTICIDES (FOR RATS AND MICE)

An effective rat poison that meets all requirements under all conditions has not yet been produced. Most of the materials now available have one shortcoming or another. A rodent control investigator or operator must be familiar with the characteristics of all useful rodenticides in order to select the one or the series which best fits each particular circumstance. Factors such as toxicity, dosage levels, and relative effectiveness are obviously important. Less often considered, but of equal importance, are degrees of acceptance and reacceptance and the development of tolerances. Odor and taste may be considerations in some instances. Solubility has a definite bearing on bait mixing techniques and the types of bait that can be used. Safety precautions are also essential. Attention must be given to hazards to the user, as well as to other persons and animals coming into contact with exposed baits. The table on page 2 lists several different characteristics of common rodenticides so that they can easily be compared for these purposes.

It is obvious that, in the abbreviated space allowed in the tabulation, minor technical differences have been sacrificed for the sake of brevity. For example, while there is no such thing as a "safe" poison, the degree of hazard from any particular rodenticide is broadly stated because it is directly related to the ability and care of the user. The term "antidote" actually means the counteracting of an effect, whereas most so-called antidotes of economic poisons are in reality first-aid treatments, followed by palliatives and sedatives. In the case of anticoagulants, Vitamin K most nearly fits the term of an antidote. The statements listed in that column are simple abbreviated descriptions and are not intended as complete directions. The differences between solutions and suspensions and between different types of oils have led to a simple listing of whichever material serves a useful purpose in bait mixing; even then some qualifications are necessary and occasional variations in technique have to be ignored.

Reaction to Rodenticides: Not all animals react alike to rodenticides. Even among the same species, some individuals are considerably more resistant than others. Some effects vary with seasons, and with age, diet, and even sexes of the animals. Dosage levels are usually set for animals with above-average resistance. Increasing these levels is not recommended--in fact, is objectionable because acceptance by rodents is usually decreased while the hazard to other animals is increased. Continued re-use of the same poison in the same location, except as noted below, generally results in decreased acceptance, bait shyness, and poor control. Poisons highly effective in one location can be much less effective on adjacent properties. A thorough knowledge of the materials available will assist in overcoming these problems.

# SOME CHARACTERISTICS OF COMMON RODENTICIDES (RATS AND MICE)

| POISONS | LETHAL DOSE (Mg/Kg) | PERCENT USED IN BAIT | DEGREE OF EFFECTIVENESS | ACCEPTANCE | REACCEPTANCE | CUMULATIVE | TOLERANCE DEVELOPED | ODOR | TASTE | CHEMICAL DETERIORATION IN BAITS | SOLUBILITY | | TYPE OF BAIT MIXTURES | | | ACTION (CAUSE OF DEATH) | RELATION TO HUMANS AND TO OTHER ANIMALS | | | ANTIDOTES[8] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | WATER | OIL | DRY | FRESH | WATER | | SECONDARY POISONING | ABSORBED THRU SKIN | DEGREE OF HAZARD IN USE | |
| ANTICOAGULANTS WARFARIN PUMARIN PIVAL ●●● | 1[1] | .025 | GOOD | GOOD | GOOD | YES | NO | NONE | SLIGHT | NONE | YES | YES | YES | NO | YES | Inhibits clotting of blood, causes internal hemorrhages ■ | YES | NO | SLIGHT | Vitamin K, and transfusions of whole blood |
| ANTICOAGULANT DIPHACINONE ●●● | 0.5[1] | .005 | GOOD | GOOD | GOOD | YES | NO | NONE | SLIGHT | NONE | NO | YES | YES | NO | NO | ditto ■ | YES | NO | SLIGHT | ditto |
| ANTU ● | 8[2] | 1.5 | GOOD | GOOD | POOR | NO | YES | SLIGHT | MEDIUM | SLIGHT | NO | NO | YES | YES | NO | Pleural effusion (over-production of fluid in the lungs) ■ | NO | NO | MEDIUM | NONE |
| ARSENIC ●● | 100[3] | 3.0 | FAIR | FAIR | FAIR | NO | YES | NONE | MEDIUM[6] | NONE | YES | NO | NO | YES | YES | Kidney destruction, Gastro-enteritis, Central nervous system affected ■ | NO | NO[7] | MEDIUM | Milk of magnesia, milk, and water, Oxide of iron |
| PHOSPHORUS, YELLOW ●● | 1.7 | .05[4] | GOOD | GOOD | FAIR | NO | NO | STRONG | STRONG | MEDIUM | NO | YES | YES | NO | NO | Heart paralysis; Gastro-intestinal and liver damage ■■ | NO | NO | MEDIUM | Copper sulfate before emetic, Cathartic and water Avoid fats and oils (as milk) |
| RED SQUILL ● | 500[5] | 10.0 | FAIR | FAIR | POOR | NO | NO | MEDIUM | STRONG[6] | MEDIUM | YES | YES | YES | YES | YES | Heart paralysis ■ | NO | NO | SLIGHT | Acts as own emetic to animals capable of vomiting |
| SODIUM FLUOROACETATE (1080) ●●● | 5 = NORWAY 2 = ROOF R. 10 = MICE | 1/2 Oz / Gal. 1 Oz / 25 Lbs | GOOD | GOOD | GOOD | NO | NO | NONE | SLIGHT | SLIGHT | YES | NO | NO | YES | YES | Paralysis of heart and the central nervous system ■■ | YES | NO[7] | EXTREME | NONE Monoacetin or ethyl alcohol and acetic acid recommended |
| STRYCHNINE (ALKALOID) ●●●● | 6 | 0.6 | FAIR | FAIR | POOR | NO | YES | NONE | STRONG[6] | SLIGHT | YES | NO | YES | NO | NO | Convulsions due to over-stimulation of nervous system, exhaustion, asphyxia ■■■ | NO | NO | MEDIUM | NO emetic after 10 minutes! Charcoal in water and laxative, Keep in dark room |
| STRYCHNINE SULFATE ●●●● | 8 | 0.8 | FAIR | FAIR | POOR | NO | YES | NONE | STRONG[6] | SLIGHT | YES | NO | YES | NO | NO | ditto ■■■ | NO | NO | MEDIUM | ditto |
| THALLIUM SULFATE ●●● | 25 | 1.5 (2% in Water) | GOOD | GOOD | GOOD | YES | NO | NONE | SLIGHT | NONE | YES | NO | YES | YES | YES | Gastro-intestinal hemorrhage kidney and endocrine damage Respiratory failure ■ | YES | YES | EXTREME | NONE Sodium iodide and sodium thiosulfate recommended |
| ZINC PHOSPHIDE ●●● | 40 | 1.0 | GOOD | GOOD | GOOD | NO | NO | STRONG | STRONG | MEDIUM | NO | YES | YES | YES | NO | Same as phosphorus ■■ | NO | NO | MEDIUM | Same as phosphorus |

● Effective against Norway Rats only
●● Effective against Norway Rats and Roof Rats
●●● Effective against Norway Rats, Roof Rats, and House Mice
●●●● Mice only

■ Slow acting
■■ Fast acting
■■■ Very fast acting

1. More or less. Successive doses required for 5-10 days or more.
2. Norway rats only, on first exposure.
3. Particle sizes of USP grades very widely; some coarse powders test as high as 600 Mg., micronized at 25 Mg.; latter recommended, at 1.5 percent.
4. Commercial preparations vary from 1-3 % in paste form, use as label directs.
5. Minimum acceptable level, more toxic squills give better results.
6. Normally objectionable to rats
7. Can be taken through cuts or breaks in the skin; also danger of inhaling loose powder.
8. Emetics are used as first aid except as noted, speed is essential, 1 tablespoon of salt in a glass of warm water is usually effective, call a physician immediately.

Types of Rodenticides: Anticoagulants, including diphacinone, fumarin, pival, and warfarin, are recommended for general use by the public. They are available commercially, either as concentrates or in prepared, ready-to-use baits, and are safest for the untrained individual to use. Commercially prepared baits containing phosphorus or strychnine are commonly sold in retail stores; their use is best restricted to indoor, protected stations where there is little chance of accidental poisoning. Barium carbonate, once rather widely recommended, is now considered too weak to be effective. Sodium monofluoroacetate (Compound 1080) and thallium sulphate should not be used by the general public because of their extreme toxicity and hazard.

Anticoagulants: Anticoagulants have proven to be outstanding in their value to the general public. Warfarin, the first of this group to be developed, belongs, along with fumarin, to the group of chemicals known as hydroxycoumarins. Pival and diphacinone are indandiones. Both prevent the blood from clotting, hence the term anticoagulants. These chemicals must be taken daily for several days to be effective. Rodents apparently do not associate the cumulative effect of internal hemorrhaging with their food supply, and return to feed on treated baits again and again. Thus, use of anticoagulants avoids the common problem of bait shyness. At the same time, hazards to other animals from single, accidental feeding are greatly reduced. Anticoagulants possess the added advantage of being effective against both rats and mice.

Zinc Phosphide: Of the single-dose poisons mentioned in the table on page 2, zinc phosphide is the most satisfactory all-around material. It is not, however, as readily available as most other materials. It has an offensive odor and is unattractive in color, and most domestic animals will not eat baits prepared with it. All species of rats and mice readily accept it.

Red Squill: Red squill is one of the best known and least hazardous poisons for the untrained individual to handle. Its natural emetic characteristic offers protection to animals capable of vomiting. However, since some farm animals do not vomit, care must be taken to prevent their contact with the material. There are two major shortcomings to red squill: it is relatively distasteful and it is quite mild. So much squill must be included in the bait that some rats object to the taste and soon learn to refuse it. Red squill is generally ineffective against house mice.

ANTU: If used properly, ANTU gives good results against Norway rats, but is ineffective against roof rats and is of no value against house mice. The strong reluctance of rats to accept a second dose and the marked tolerance which develops, limits the usefulness of ANTU. It should not be used more often than at 6-month intervals to obtain best results. Baits containing the material should not be left in place for more than three or four days.

Strychnine: Strychnine is a highly toxic, single-dose poison, which is very effective for mouse control. It is not effective in controlling rats. It has a very bitter taste, which causes many rodent species (including rats) to avoid it. Care should be used in placing this material in order not to endanger other animals. To obtain best results strychnine should not be used more often than at 6-month intervals.

Hazards of Rodenticides: An increased degree of protection to other animals, when either zinc phosphide or ANTU is used, may be obtained by incorporating tartar emetic (antimony and potassium tartrate) in the bait mixture. Approximately equal amounts when mixed with ANTU, or three parts to eight parts of zinc phosphide, provides about the same degree of protection to other animals as may be expected with red squill.

Anticoagulants are exposed in such small concentrations that accidental primary poisoning requires consuming large quantities of bait.

A few cases of secondary poisoning have been reported, due to pets feeding on dead rats or mice. Efforts should be made, therefore, to recover rodent carcasses whenever possible. Most accidents are due to faulty exposure or failure to maintain a fresh, acceptable bait supply until the entire rodent colony has been eliminated. Since some rats may not feed on the bait until it has been exposed for some time, two or three weeks may be necessary to produce effective rat control. A mouse colony may require as long as thirty days.

General: No mention has been made of desirable bait materials, since local availability and cost are determining factors. Also, acceptance is so widely varied, even on adjacent premises, that selection must be left to the judgment of the operator. Therefore, only the most commonly used types are listed in the table. Dry baits include loose cereal mixtures, as well as treated grain and seeds. Fresh baits can be meat, fruits or vegetables. Many times water baits are successful either alone or when used alongside a solid bait. Often only trial and error will provide the correct answer. Prebaiting is a useful technique. Here, again, knowledge of the poisons' characteristics is important, as many bait formulations are based on the specific chemical being used. Weather conditions should be considered before making outdoor exposure. Above all, hazards to humans and other animals must be taken into account. Materials and techniques best calculated to destroy rodents without attracting or being readily available to people or other animals should be used.

Poisons are a very efficient tool in destroying rats and mice. Full advantage should be taken of the particular characteristics of each rodenticide to select those most likely to produce the desired results under existing conditions.

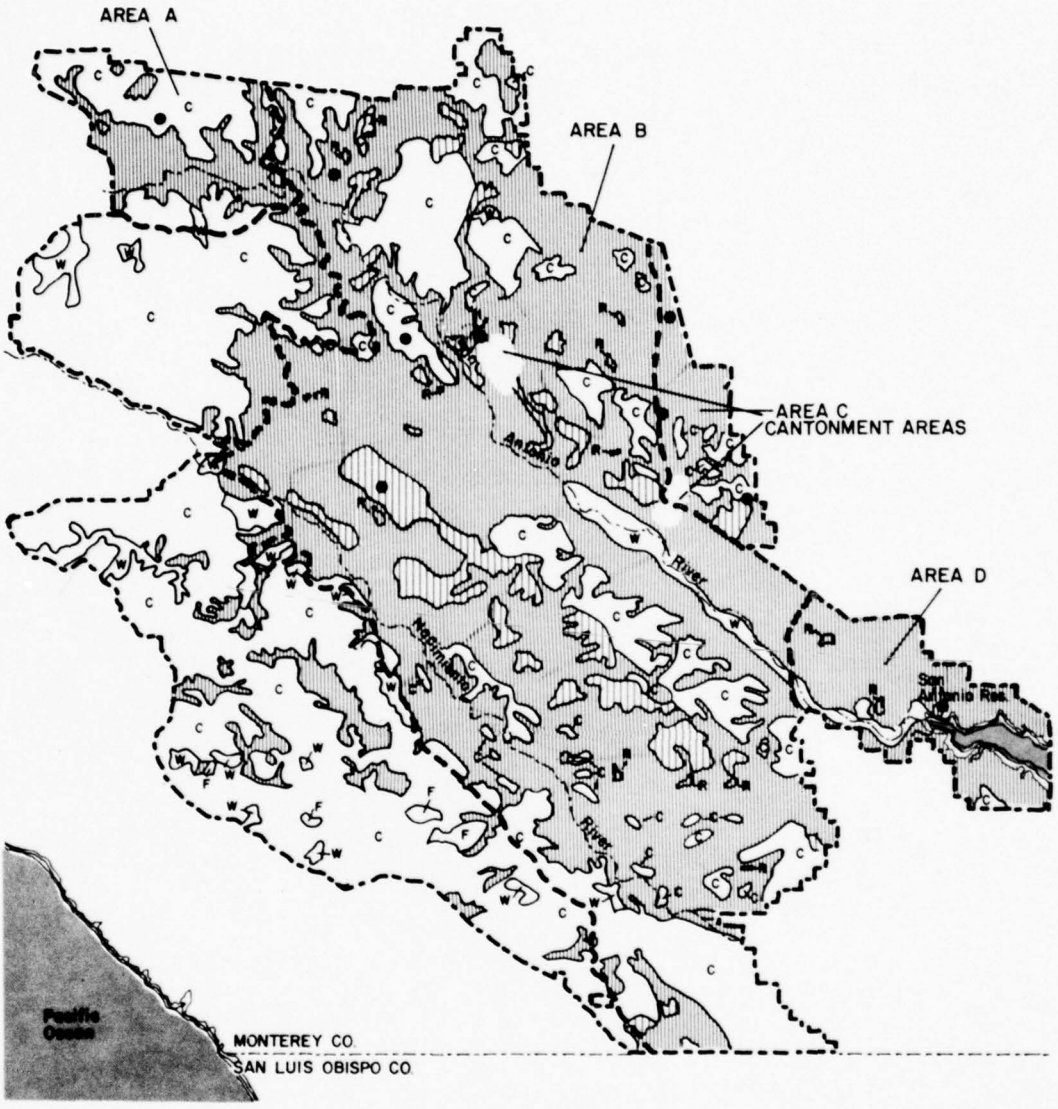



FIGURE 8
VEGETATIVE COVER TYPES OF FORT HUNTER LIGGETT

## Flora

Four general vegetation types occur on Fort Hunter Liggett. These are the valley white oak grassland, the blue oak grassland, mixed chaparral and chamise chaparral (Department of the Army, 1973) (Figure 8). See Appendix A for species list.

The valley white oak grassland is dominated by large California white oaks (Quercus lobata) and many annual grasses and forbs, such as bromes, wild oats, bur clover and filaree. This vegetation type, composed mostly of non-native forbs and grasses, is generally found on the more moist, level or gently-sloping topography and covers approximately 25 percent of the reservation.

The blue oak woodland grass community occurs on less moist, sloping to steep topography, covering approximately 40 percent of the reservation. The density of oaks is greater in this vegetative type than in the valley white oak community. The dominant tree is the blue oak (Quercus douglasii). Grasses, such as wild oats, bromes, fescues and wild barleys (Hordeum sp.) also occur here.

Mixed chaparral covers approximately 30 percent of the reservation, occurring on moderate to very steep, north- and east-facing slopes. Principal shrub species are scrub oak (Quercus dumosa), chamise (Adenastoma fasciculatum), toyon (Heteromeles arbutifolia) and many species of manzanita and ceanothus.

The remaining 5 percent of the reservation is characterized by dense chamise chaparral, which is dominated by the one shrub species. This vegetation type generally occurs on the hotter, drier, south- and west-facing slopes.

One unique botanical area exists on Fort Hunter Liggett in the vicinity of Jolon. A rare, endemic species (Chlorogalum purpureum vs. purpureum), the purple amole, purple snaproot or soap plant is found here. Six additional rare and endangered plant species occur on installation property (Table 5).

## Fauna

Hunter Liggett Military Reservation also supports a wide variety of wildlife with many of the same nongame and game species as Fort Ord. See Appendix B for partial species list. Two fully protected species are known to occur on Hunter Liggett Military Reservation. These are the ring-tailed cat (Bassariscus astutus) and golden eagle (Aquila chrysaetos) (Department of the Army, 1976). Four rare and endangered species, the California condor (Gymnogyps californianus), southern bald eagle (Haliaeetus leucocephalus), American peregrine falcon (Falco peregrinus) and San Joaquin kit fox (Vulpes macrotis mutica), have been observed on the reservation.

Reservoirs on the installation support several game species. The San Antonio Reservoir, lying along the southeastern border, is a warmwater body providing habitat for game fish such as smallmouth bass (Micropterus dolomieui) and sunfish, including bluegill (Lepomis macrochirus) and green sunfish (Lepomis cyanellus). Nongame fish present include the Sacramento squawfish (Ptychocheilus grandis) (Snider, pers. comm.).

A fish and game management program is also maintained at Hunter Liggett Military Reservation. Several species important to recreational activities include deer, wild pigs (Sus scrofa), mourning dove, California valley and mountain quail (Oreortyx pictus), rabbit, black bass, sunfish and rainbow trout.

Several reptiles and amphibians can be found on the installation. The California newt (Taricha torosa) and the California toad (Bufo boreas halophilus) are common amphibians in moist areas of the reservation. The numerous reservoirs on the installation also support the western pond turtle (Clemmys marmorata). In drier areas, the common western fence lizard (Sceloporus occidentalis) and western rattlesnakes (Crotalus viridis) can be found. See Appendix B for partial list.

## Soils

Soils on Hunter Liggett include Santa Lucia, Reliz, Chamise, Gazos, Nacimiento, Chualar, San Benito, Los Osos soil series and rock outcrops. The Santa Lucia and Reliz soils consist of well drained to excessively drained soils formed on uplands, underlain by shale and sandstone with slopes from 30 to 75 percent. Runoff is rapid to very rapid and erosion hazard is very high. Vegetation consists of annual grasses, forbs, scrub oaks, coastal oaks, chamise,

and manzanita. These soils generally occur together and are used for limited range, wildlife and watershed. When producing at potential the total herbage production is available for livestock and wildlife. These soils require good range management practices including protection from overgrazing.

Rock outcrops consist of strongly sloping to extremely steep mountainous uplands with rock outcrops and very shallow soils. This is typical of the area east of the Coast Ridge Road, west of the Nacimiento River and between Burma and McKern Roads on Hunter Liggett. Vegetation consists of sparse annual grasses and forbs, brush hardwoods, and pines. Runoff is very rapid and the erosion hazard is very high where soil is exposed. Rock outcrop value is mostly for watershed, wildlife habitat, recreation and scenic value.

The steep Nacimiento and Los Osos series consist of well drained soils formed on mountainous uplands with slopes from 9 to 75 percent. Runoff is medium and erosion is moderate. Vegetation is similar to Santa Lucia and Reliz soils. These soils are primarily used for range and in some areas dryland grain.

Along some of the valleys on Hunter Liggett are Chualar soils underlain by shale, sandstone, granite or schists. Also in the same area are inclusions of brown sandy loam soils that occupy low knolls and are 10 to 14 inches deep to bedrock. This soil is used for irrigated row crops and field crops and dryland grain. Some areas are used as ranges for grazing (Soil Survey of Monterey County, California, Department of Agriculture, SCS, 1975).

## Camp Roberts

Camp Roberts is located 5 miles south of the southern border of Fort Hunter Liggett. The camp, covering an area of approximately 43,745 acres, lies within both Monterey and San Luis Obispo counties. Camp Roberts is currently licensed to the California National Guard and is used primarily for National Guard and Reserve Component training. The 7th Infantry Division also uses the camp for training and maneuvers. Approximately 41,300 acres are available for infantry, artillery, and aircraft training exercises. Post facilities occupy approximately 1,400 acres (Department of the Army, 1976) (Figure 9).

Certain areas of Camp Roberts are also under livestock grazing leases. There are two sheep and one cattle lease with the primary grazing season for sheep from January to June. The cattle lease is for 5,854 acres and the sheep leases total 31,237 acres. Limited hunting and fishing access is permitted on Camp Roberts during regular seasons (Department of the Army, 1976).

## Adjacent Land Use

The San Antonio River runs along the northwestern border of Camp Roberts with the land being controlled by the Monterey County Flood Control District (Monterey County Planning Commission, 1972). The City of Bradley is situated on the northern border of the installation. Private land on the northwestern and western borders is primarily dry pastureland. East of Camp Roberts, land is utilized for crops (including wheat, barley and safflower and for dry pastureland (San Luis Obispo County Department of Agriculture, 1976). To the south and southeast lies unused private land much of which is dominated by heavy tree and brush cover (San Luis Obispo County Planning Department, 1969.

## Archeological/Historical Resources

There are to date no known archeological studies or known archeological sites on Camp Roberts. Archeologists have not evidenced any interest in making investigations of the area (Fort Ord Mission Change Draft EIS, 1976).

## Flora

The species composition of Camp Roberts is similar to that of Fort Hunter Liggett. The dominant vegetation types are grassland, valley oak grassland, which includes riparian habitat characterized by cottonwood (Populus sp.), willow (Salix sp.), sycamore (Platanus racemosa), and box elder (Acer rugundo); and the blue oak grassland found in more sloping topography. Throughout these vegetation types, most of the forbs and grasses are exotic species introduced by the early missionaries. A limited amount of mixed chaparral habitat occurs on drier, more elevated slopes (Figure 10).

No rare or endangered plant species have been reported for Camp Roberts. See Appendix A for species list.

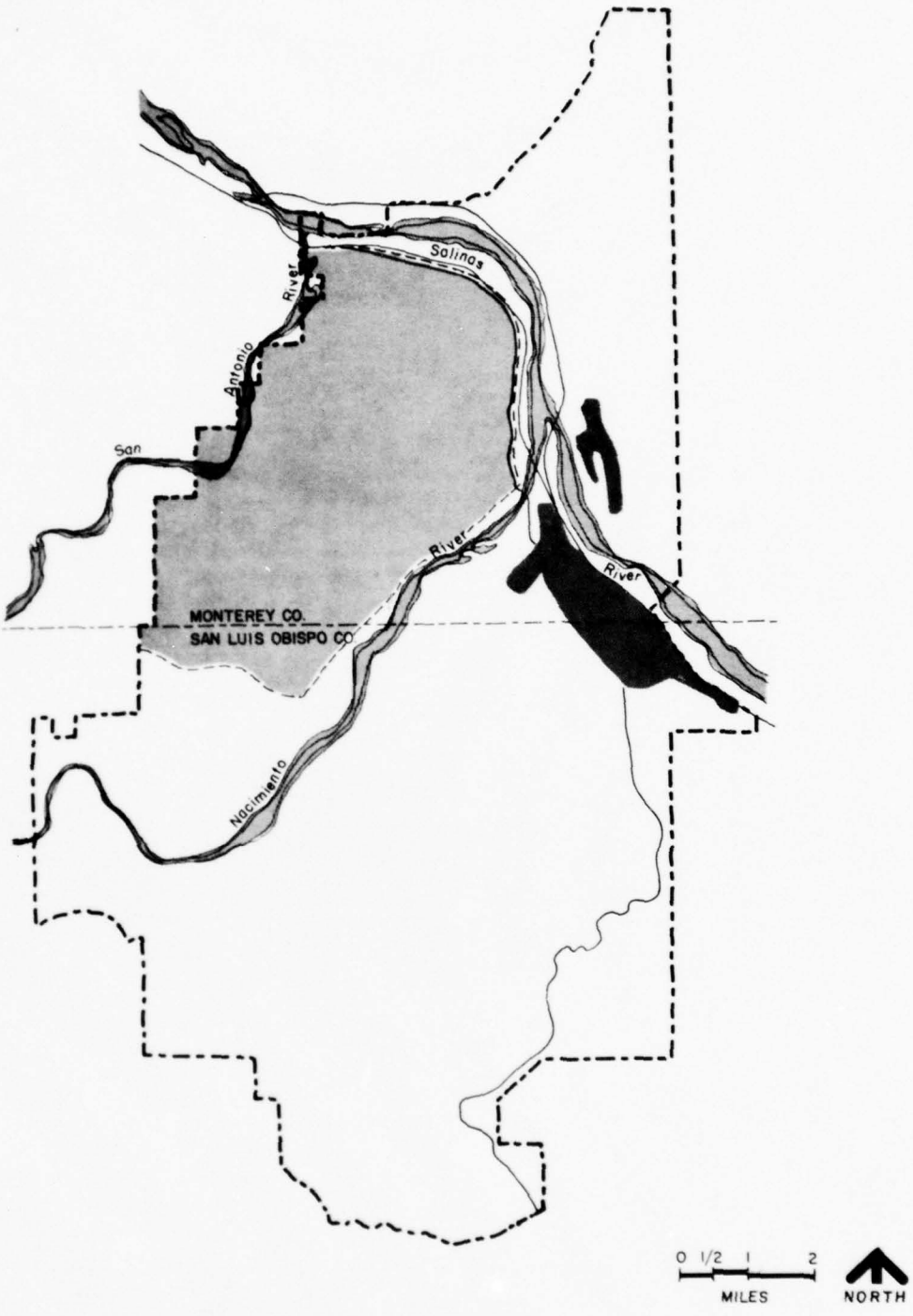



FIGURE 9
MILITARY LAND USE ON CAMP ROBERTS


FIGURE 10
VEGETATIVE COVER TYPES OF CAMP ROBERTS
(Source: Fairchild Aerial Survey Map (1964) & US Dept. of the Army Aerial Photos (1963))

## Fauna

Camp Roberts, with vegetative species composition similar to Hunter Liggett Military Reservation, also supports a similar diversity of nongame and game species of wildlife. See Appendix B for species list. A single den site of the rare and endangered San Joaquin kit fox has been located on the reservation. The rare and endangered peregrine falcon and southern bald eagle have also been observed on Camp Roberts.

The Salinas, San Antonio and Nacimiento Rivers crossing military property support rainbow trout, green sunfish and Sacramento suckers (Catostomus occidentalis) as well as other game and nongame fishes (California Department of Fish and Game, 1955) (see Appendix B for species list).

A limited amount of hunting and fishing is permitted on Camp Roberts during regular seasons. A cooperative catchable rainbow trout program with California Department of Fish and Game provides sport fishing to the public along the lower Nacimiento River within military property (Johnson, 1965).

The distribution of several reptiles and amphibians may include Camp Roberts. Among these are the California newt, bull frog (Rana catesbeiana), the California alligator lizard (Gerrhonotus multicarinatus) and the Pacific gopher snake (Pituophis melanoleucus) (Appendix B).

## Soils

The predominant soil series in upland areas of Camp Roberts are similar to those at Hunter Liggett. In areas of lower elevations Nacimiento, Arroyo Seco, Chualar, Garey, Gaviota, Los Osos, Placentia, Plaskett, and Santa Lucia series soils are present.

Cantonment areas of Camp Roberts are situated on well-drained Garey sand loam and Chualar loam soils. Garey soils are formed on gently sloping (5 percent) dune-like terraces. Runoff is medium and erosion hazard is moderate. They are mostly used for annual pasture.

Chualar soils are formed on fans and terraces. Slopes are 0 to 9 percent. They are used mostly for irrigated row crops and field crops.

Psamments and fluvents soils are subject to occasional flooding. These soils are found along the banks of the Arroyo Seco, perennial and intermittent streams, and San Antonio, Nacimiento, and Salinas Rivers. Drainage is excessive and permeability is rapid. These soils have very little agricultural value. They are used for recreation and some grazing.

Other areas on Camp Roberts consist of smaller isolated areas of different soil series and larger areas previously described. (The soils of San Luis Obispo County are in the process of being mapped. For the present study the soils of Camp Roberts which lie within San Luis Obispo County will represent an extrapolation of data based on regional geology, topography and vegetation from Monterey County.)

## Ground Squirrels

### Life History - General

Distribution of the beechey ground squirrel (Spermophilus beecheyi) is limited primarily to the State of California, with the subspecies (Spermophilus beecheyi beecheyi) extending along the coast from the Golden Gate and Carquinez Strait south nearly to San Diego. The closely related subspecies (Spermophilus beecheyi fisheri) is most abundant on the plains of the San Joaquin and lower Sierra foothills. The ground squirrel's preferences of habitat are not closely constrained in the valleys, except that it avoids wetlands, dense chaparral and thick woods. It frequently inhabits grain fields, grazing lands, meadows, orchards, rock outcrops on the top of ridges, sparsely tree-covered slopes and granite talus slopes (Grinnell and Dixon, 1918). They also inhabit road banks, dams, airports, picnic areas and other areas disturbed by man.

Ground squirrels naturally feed on most plants, fruit, seeds, bird eggs and some animal matter. Vegetation becomes available to squirrels with the start of fall rains; broadleaf filaree, brome and fescue grasses are the staples of diet. During the early stages of growth, entire plants are taken. Later in the season as the plants mature, the tender leaves and fruits are selected. Large quantities of immature fruits are consumed during the spring, and after the seeds ripen these comprise most of the food (Horn and Fitch, 1942).

All ground squirrels are diurnal. During spring and summer they come out of their burrows soon after sun-up. During those seasons, ground squirrels are most active during the middle of the morning and again during the late afternoon, avoiding the intense heat of midday. During midwinter those

squirrels which do not hibernate and remain underground altogether, appear only late in the forenoon of bright sunny days (Grinnel and Dixon, 1918).

The most conspicuous signs of ground squirrel activity are their burrow systems and runways. Observations by Storer (1942) and confirmed by Jones & Stokes Associates, Inc. (1976) personnel during field studies, indicate that burrows average about 4 inches in diameter. Large mounds of soil are excavated from the burrows during the spring. This soil is commonly dispersed in a fan-shaped pile in front of, and to the sides of the burrow entrance (Figure 11). An average area of 2.0 square feet of displaced soil was found to cover the vegetation around burrow openings on Hunter Liggett and Camp Roberts (Jones & Stokes Associates, Inc., field observations, 1976). Burrows are used for hibernation, safety retreats and shelter during very hot or rainy weather, storage of food, and for rearing young. Runways are formed on the soil surface between areas frequented by ground squirrels. Linsdale (1946) states that runways are essential for rapid progress by animals which travel close to the ground and are not especially fitted to leap over obstacels. He further states that a fairly heavy population of squirrels seems to be required for the formation of runways. Runways usually appear between the burrows and extend out to foraging sites. The width of runways varies, but is rarely greater than 6 inches (Linsdale, 1946) (Figure 12).

Ground squirrels produce one litter a year. Litter sizes vary according to location and population density. The average litter size is 7 to 8, and ranges from 1 to 15. The gestation period is 25 to 30 days and the young generally remain underground about 6 weeks. As young squirrels mature some of them move away from the area of the parental burrows into new territory, but usually occupy old burrows.

> The rate of reproduction in ground squirrels is such that unless 90 percent are eliminated in a given year there will be no general reduction in numbers. Theoretically, it would require 8 to 9 years of control at this rate to rid a given piece of land of squirrels entirely. (Storer and Jameson, 1965)

Neither the proposed nor alternate action discussed in the report are intended to eliminate or eradicate the ground squirrels, but rather to suppress their populations. The statement of Storer and Jameson (1965) does, however, point out that to effectively reduce the overall population from one year to the next a high degree of control (approximately 90 percent) must be achieved. Rapid population recovery following the control of many rodent species has been well documented in the literature.

These facts show that persistent and intensive efforts are needed to keep the squirrel populations at levels necessary to minimize conflicts.

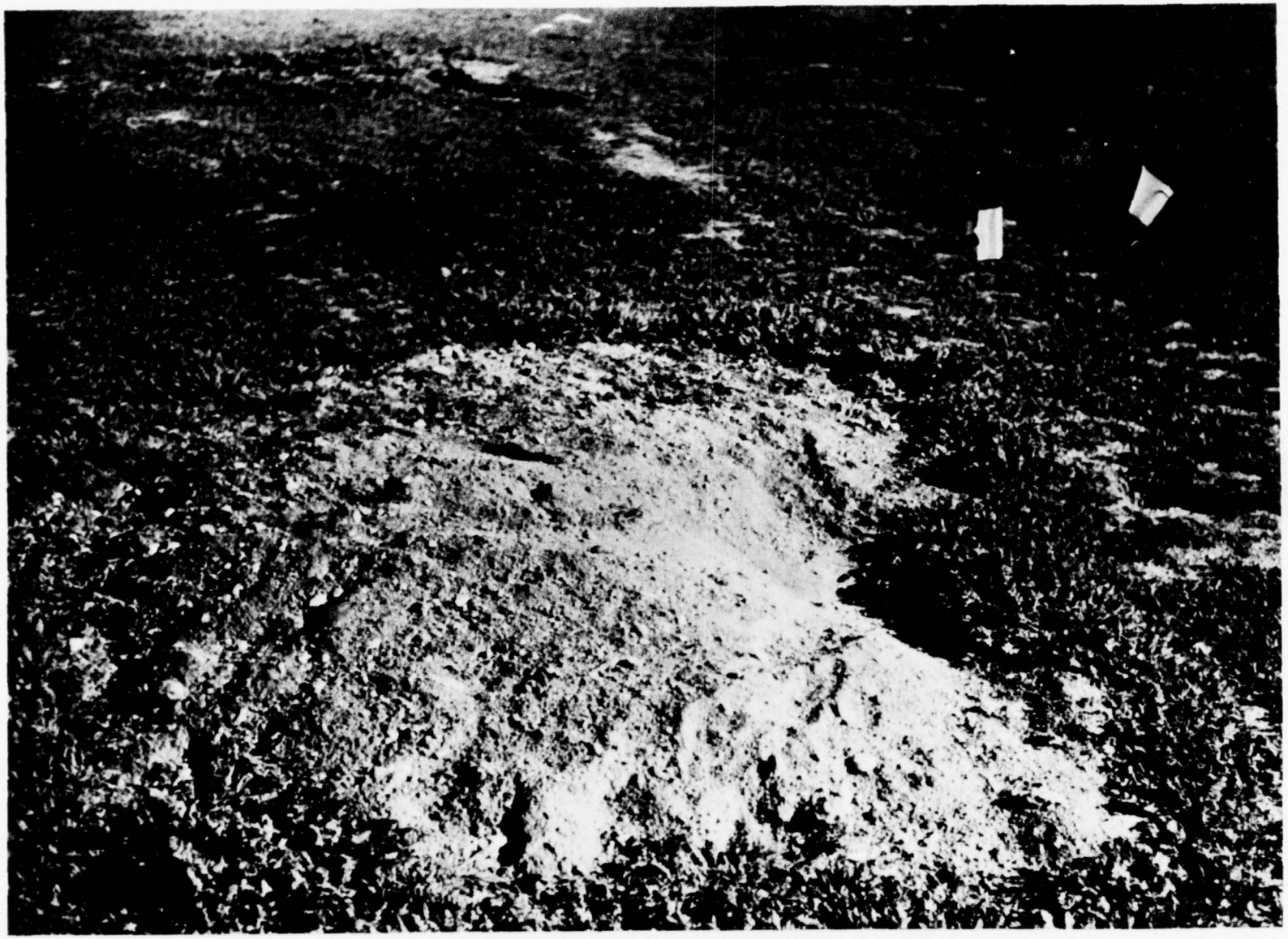


Figure 11. Soil Displacement Resulting From Burrow Excavations at Camp Roberts

Figure 12. A Runway Made by Ground Squirrels at Camp Roberts

Ground squirrels may live 5 years or more in the wild. Outbreaks of epizootic sylvatic plague and other diseases periodically reduce ground squirrel numbers in some areas. Among the natural enemies which prey on ground squirrels are coyotes, badgers, weasels, bobcats, red-tailed hawks, golden eagles, rattlesnakes and gopher snakes. A list of these species as well as others that frequent similar habitat can be found in Appendix B. Other factors undoubtedly contribute to the mortality of ground squirrels, but they are difficult to appraise.

California ground squirrels living at high altitudes and most of the population at lower elevations (especially the adults), hiberate for a part of each year. Before this period of inactivity, each animal accumulates excess body fat. After going below ground the squirrel plugs up to 3 feet of tunnel near the nest with earth and curls up in its nest behind the tunnel plug. While the squirrel hibernates, the rate of heartbeat and respiration is greatly reduced, and body temperature drops nearly to that of ambient air temperature in the burrow.

Emergence from hibernation occurs in late winter or early spring. Immediately following hibernation, males are usually more active than females, though activity tends to become more equalized as the breeding season approaches (Fitch, 1948). Breeding takes place mainly during early spring, and young are born in April and May with nearly all emerged from their burrows by mid-June (Holdenried, et.al., 1951). Field observations indicate that males and females older than one year of age begin breeding in early spring and terminate in late spring while the younger animals breed from early spring to early summer thus extending the overall season from early spring to early summer (Dana, 1967).

A common habit of ground squirrels is aestivation. ("summer sleep") during the warm months of the year. In California, ground squirrel aestivation has been observed to begin as early as mid-May in the hills of east Livermore, and by late June in the hills of eastern Kern County, whereas, it does not commence until early August in Siskiyou County. In areas of low elevation aestivation may extend up to true hibernation. In mild climates the young-of-the-year may not aestivate or hibernate, and may be seen above ground during suitable weather throughout the winter (California Department of Food and Agriculture, 1975).

## Populations

Numerous ground squirrel population studies have been conducted in California in the past (Evans and Holdenried, 1943; Linsdale, 1946; Fitch, 1948; Fitch and Bentley, 1949; and Tomich, 1962). The highest populations of ground squirrels are associated with areas of open grasslands scattered with rock outcropping, trees or other surface features which serve to provide protection of burrows (Dixon, 1918; Fitch, 1948). Squirrel colonies and populations are rarely distributed evenly over the landscape, but rather are concentrated in areas where food supply and shelter are available and soil conditions are correct (Fitch, 1948). Ground squirrels are rarely seen living in areas of heavy tree and brush growth or on ungrazed land where dense stands of grasses are present (Evans and Holdenried, 1943).

Because ground squirrels occur in colonies with a number of animals living close together rather than being uniformly distributed in any habitat, population estimates of squirrels or burrows per square acre are oftentimes deceiving. According to Fitch (1948), the number of squirrels per colony often varies significantly from one year to the next. Fitch and Horn (1942) found that on the San Joaquin Experimental Range ground squirrel colonies contained from 10 to 50 burrow holes with an average population of 2 to 3 squirrels per colony, but at times a maximum of 10 squirrels per colony.

Squirrel populations there varied from 3.2 squirrels per acre (43.6 burrows/acre) in 1940 to 2.0 squirrels/acre (40.8 burrows/acre) in 1946, while field observations during 1934 had indicated from 12 to 15 squirrels/acre on favorable sites. According to Marsh (pers. comm.), a concentration of greater than 50 burrows per acre is an indicator of a very dense ground squirrel population.

In addition to grasslands, ground squirrels are known to occur on sites disturbed by grazing and by human activities such as construction, grading, firebreaks, fills etc. (Balbach, 1976; Jones & Stokes Associates, Inc., field observations, 1976). Linsdale (1946) observed that ground squirrel populations on the Hastings Reservation tended to decrease after grazing was removed from the land, while Horn and Fitch (1942) found no significant differences in squirrel population on areas lightly (2.7 squirrels/acre), moderately (2.3 squirrels/acre) or closely (4.1 squirrels/acre) grazed. There was, however, a significant difference on natural sites where grazing was completely excluded (0.8 squirrels/acre). Howard (1953) confirmed that regardless of whether grazing is light or close, alteration of plant species and density of forage cover by grazing of California annual plant type leads to an increase in the ground squirrel population.

Field Observations - November 8-19, 1976
by Jones & Stokes Associates, Inc.

General. Due to the season of the field investigation, mid-fall, squirrel densities were based primarily on the presence of burrows. Some squirrels were active above ground but there was no way to relate their numbers with existing total populations.

Squirrels were found to have strong habitat preferences related to vegetation, terrain exposure, soil types, man-made structures and land use. A combination of factors often contributed to the presence of preferred habitat. Some vegetative types support no significant squirrel populations.

The vegetative types supporting squirrels are grassland and oak-grassland, but many differences were found between habitats falling under these broad definitions. Squirrel burrows were nowhere evenly distributed over large areas, but tend to be in colonies and their distribution often relating to habitat factors other than vegetation.

Fort Ord. Squirrels were found in the grasslands and to a lesser extent in open oak-grassland. South-facing exposures were favored in the hilly grasslands with the possible exception of areas relatively near the ocean. Several colonies were found taking advantage of concrete slabs, junk piles and the airfield runways where their burrows would provide protection from digging predators. The face of a dirt fill dam in the grasslands was extensively burrowed. Squirrel colonies occur adjacent to the golf course fairways and in several parks within the main post.

Fort Hunter Liggett. Squirrel colonies were found throughout the grassland and oak grass areas. Chaparral and woodland types do not support significant populations.

In the grassland type there are some extensive (2 or more acres) colonies with fairly uniform burrow densities, but typically the colonies are based on some anomaly such as a lone tree, rocky outcrops, dry stream banks or mounds of earth pushed up by past military operations.

The oak-grassland areas are generally hilly and the squirrel colonies tend to be discrete. The favored locations are at the base of hills or on the upper slopes and tops. Northern exposures are the least used. Many burrows go under oak trees, especially when there are large valley oaks present. Steep, bare slopes along stream channels seem to be favored sites.

Squirrel colonies occupy artificial sites such as earth dam faces, roads and embankments and abandoned military structures.

Camp Roberts. Most of this post is either grassland or oak grass. There is a mixture of woodland, scrub and chaparral along the western boundary that is not squirrel habitat. In the East Garrison area the grassland and oak-grassland habitats do not contain as many squirrel colonies as at Hunter-Liggett. There are steep, wooded slopes with northern exposures that are hardly used. In the main camp area the woodland grass habitat is similar to that of Hunter Liggett and squirrel colony densities are about the same. In the interior of the main camp there are extensive flats and gently rolling hills that are treeless. Squirrel colonies here are numerous along road cuts and embankments, dry stream banks and abandoned military objects such as old tanks.

A number of squirrel colonies occur within the main base building area. A very dense colony was found in an athletic field and in a small park area. Squirrels frequently establish burrows beneath concrete slabs.

Burrow Counts. During November 1976, Jones & Stokes Associates, Inc. personnel conducted field investigations of Fort Ord, Hunter Liggett and Camp Roberts. The investigations were oriented toward obtaining data on the density and numbers of ground squirrel burrows. One-square-acre plots were marked off in representative habitats on Hunter Liggett reservation and at Camp Roberts. Several plots of less than one acre on earthen dam faces and in cantonment areas were also selected on the three installations (Figures 6, 8 and 10).

Ground squirrel burrows within the square-acre plots were marked with colored flags and counted. In addition, notes were made of habitat type, burrow opening size and area of dirt coverage per burrow. Colored slides and black and white photographs were taken of each site.

Ground squirrel burrows were generally found to be scattered in dense colonies throughout Hunter Liggett and Camp Roberts. The Fort Ord squirrel colonies were dense, but not as widespread as on the other two military reservations.

Based on general field observations and burrow counts, the squirrel populations at Hunter Liggett and Camp Roberts were judged to be the highest ever seen by the Jones & Stokes Associates, Inc. investigator (with 35 years of California field experience). Except for localized areas such as earthen dam faces, the Fort Ord populations, however, seem to be typical, medium high California densities.

Table 6 depicts the results of burrow counts on the three military areas. Because many squirrels had begun hibernation when these field studies were conducted, no accurate counts of squirrels per acre could be made. However, the number of burrows per acre does represent an indicator of relative abundance, assuming that 50 burrows/acre is considered to represent a "dense" ground squirrel population.

Very few previous estimates of ground squirrel populations have been made on any of the military reservations. On Camp Roberts, Sanger, et.al. (1974) estimated 16.7, 7.8 and 12.1 squirrels per acre on three study plots; however, no estimates were made of the number of burrows per squirrel.

Predators. A badger was observed excavating a squirrel burrow on Hunter Liggett. Red-tailed hawks and golden eagles were common at Hunter Liggett and Camp Roberts. One red-tailed hawk was seen with a freshly-killed squirrel. No coyotes or bobcats were seen or heard.

## Ground Squirrel Damage

Ground squirrel populations, large or small, coupled with their foraging and burrowing habits, often conflict with man's use of the land. Through their burrowing action they damage man-made structures such as earthen dams, road surfaces and underground wiring, as well as landscaping and recreational facilities. Their foraging habits may damage croplands or rangeland, thereby resulting in competition with livestock or affect populations of other desirable wildlife (Figures 13, 14 and 15).

Army personnel have reported that ground squirrels have damaged many man-made structures on all three installations. The airstrip apron of Fort Ord has been continually undermined by ground squirrels and must be repaired periodically to prevent hazards to aircraft (Figure 16). Radar station mounds on Fort Ord have also been similarly damaged with the possibility that extensive undermining could cause tipping and malfunction of the radar tower (Figure 17). Ground squirrel burrowing, as observed by Jones & Stokes personnel, has resulted in widespread damage to earthen dams on Forts Ord and Hunter

Table 6

RESULTS OF GROUND SQUIRREL BURROW COUNTS MADE BY
JONES & STOKES ASSOCIATES, INC. PERSONNEL, NOVEMBER 1976

| Installation | | | Location | | | |
|---|---|---|---|---|---|---|
| Fort Ord | Hunter Liggett | Camp Roberts | Inhabited Areas | Open Areas | Habitat Type | Number of Burrows Per Acre |
| X | | | | X | Earthen dam face | 49* (.33 acre) |
| X | | | | X | Grazed slope | 72* (.15 acre) |
| | X | | | X | Grazed grassland, adjacent to creek | 50 |
| | X | | | X | Oak woodland | 192 |
| | X | | | X | Open grassland | 51 |
| | X | | | X | Del Venturi dam face | 82* (.75 acre) |
| | X | | X | | Mowed grass, Hacienda | 164 |
| | X | | | X | Blue oak/grass slope | 173 |
| | X | | | X | Grassland/grain interface | 155 |
| | X | | | X | Grazed grassland/oak | 82 |
| | | X | X | | Tree/grass strip | 92* (.83 acre) |
| | | X | X | | Baseball field | 329 |
| | | X | | X | Grassland/blue oak | 111 |
| | | X | | X | Grassland/grain interface | 137 |
| | | X | | X | Grassland/grain interface | 111 |
| | | X | | X | Grazed grassland/river cut bank | 198 |
| | | X | | X | Open grassland | 7 |
| | | X | | X | Grassland-oak/grain interface | 80 |
| | | X | | X | Road berm | 30* (.02 acre) |

* Less than one acre plot. Area indicated as a fraction of an acre.


FIGURE 13
GROUND SQUIRREL DAMAGE – FORT ORD

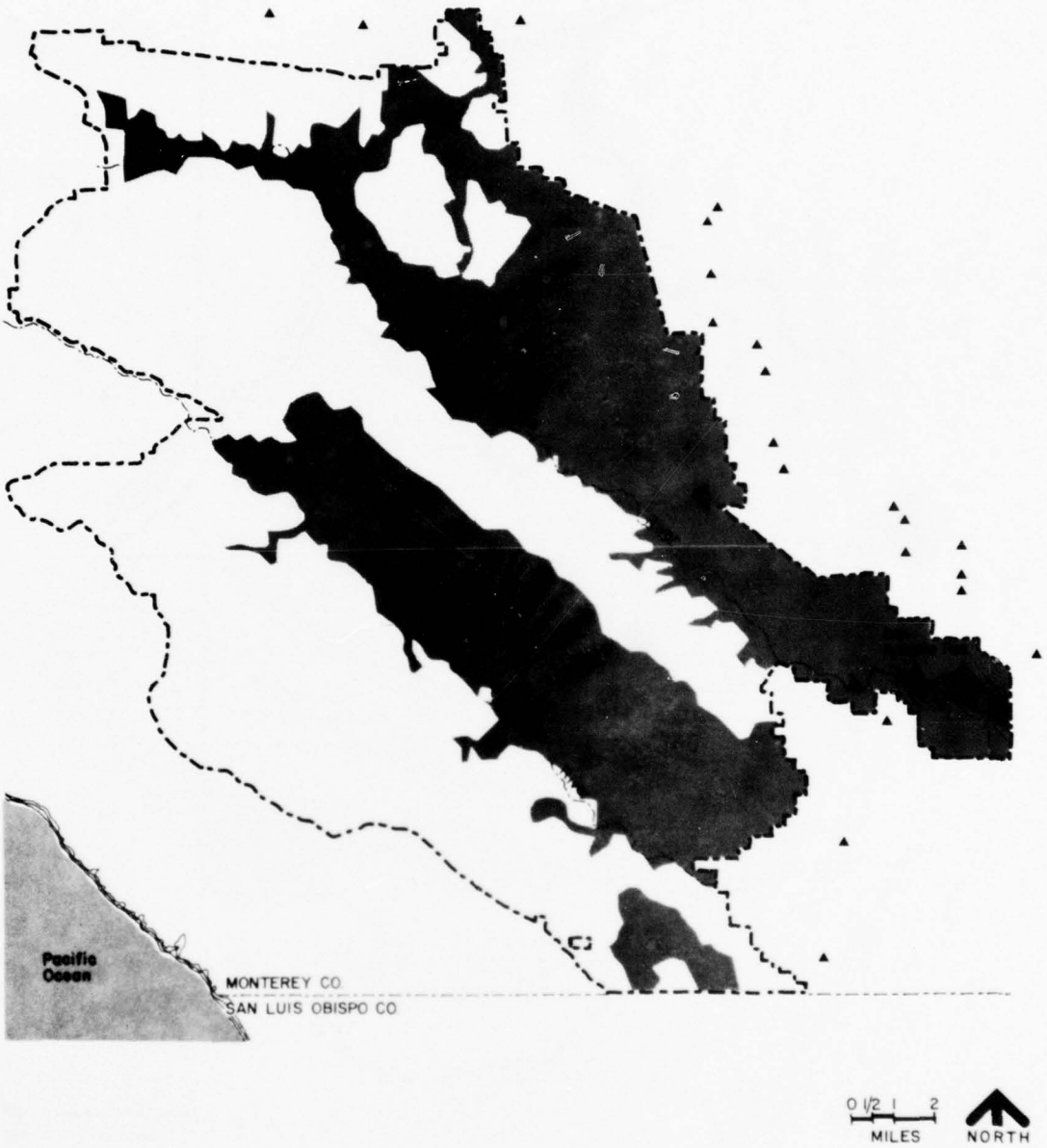



FIGURE 14
GROUND SQUIRREL DAMAGE AREAS ON MILITARY LAND AND ADJACENT PRIVATE LAND – FORT HUNTER LIGGETT

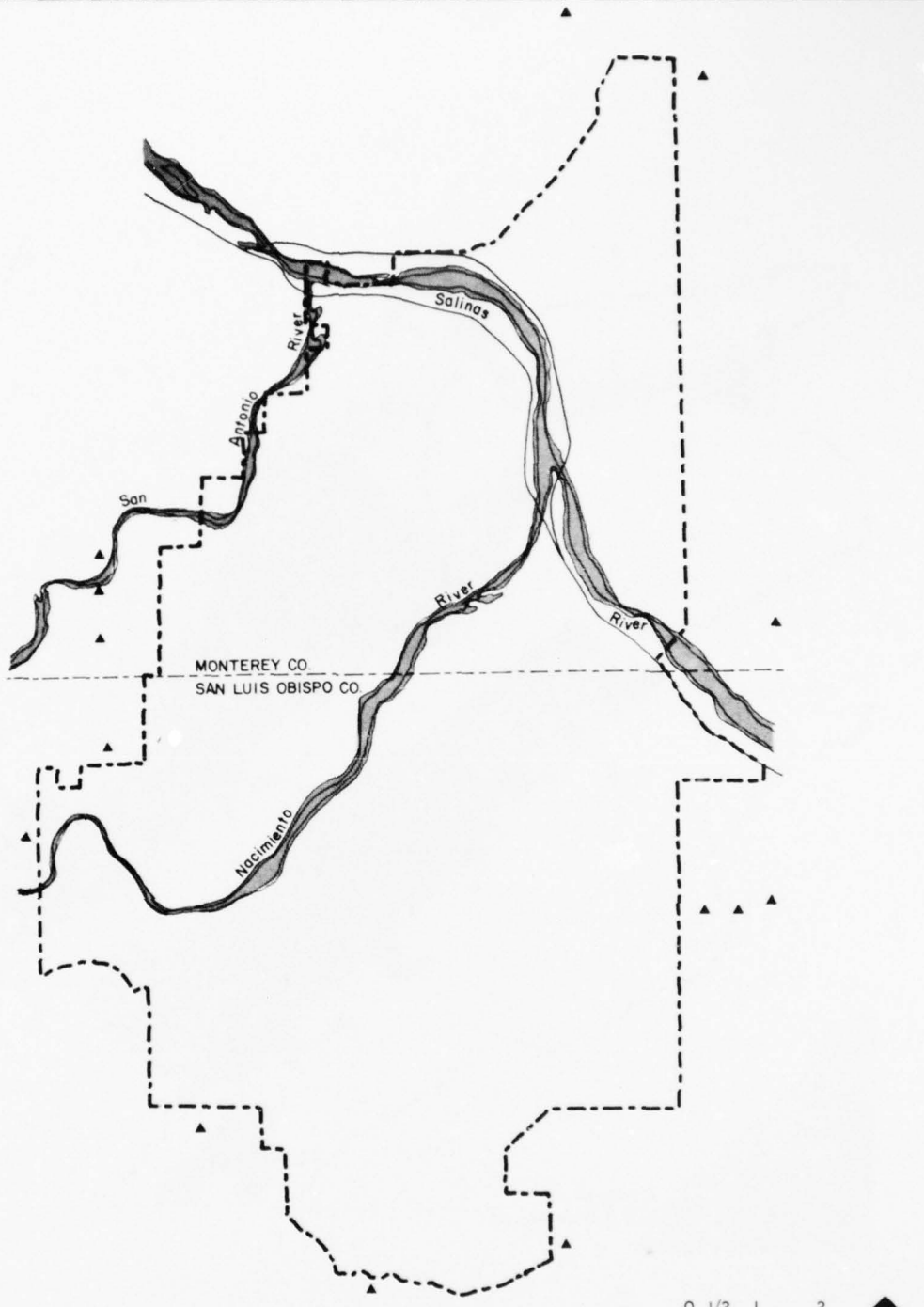



FIGURE 15
GROUND SQUIRREL DAMAGE AREAS ON ADJACENT PRIVATE LAND—
CAMP ROBERTS (Ground squirrel damage-entire military area.)

Figure 16. Ground Squirrel Burrows Next to Air Strip Apron at Fort Ord

Figure 17. Ground Squirrel Burrows at the Base of a Radar Tower on Fort Ord

Liggett (Figure 18). Burrowing on both sides of the dam face during dry periods has caused a seepage loss of approximately 6 surface feet of water from one damaged dam on Fort Hunter Liggett (Walkley, pers. comm.). The cost to rebuild one dam reportedly washed out due to ground squirrel burrowing has been estimated at $20,000 (Figure 19). Earth-covered ammunition bunkers on Fort Hunter Liggett have also been excavated by ground squirrels (Figure 20) with an estimated cost of $54,000 to completely repair all damaged bunkers. Reinfestations by ground squirrels require continuous repair, which costs approximately $1,000 annually. Jones & Stokes Associates personnel have observed damage to road banks and surfaces as well as footpaths and sidewalks on all three installations (Figure 21). The estimated cost for continual repair of these surfaces is $2,000 annually on Fort Hunter Liggett. Ground squirrels have also extensively undermined concrete foundations around cantonment and bivouac buildings (Figure 22).

Ground squirrel burrowing and gnawing has caused considerable damage to the wiring and mechanisms of automated rifle firing ranges on Fort Hunter Liggett. The firing range was inoperative for 90 days during 1976 and the cost of range repair totaled $21,000. Similar damage also occurred on Fort Ord to underground wiring next to the airstrip. The estimated cost of repair and replacement of damaged wiring was $20,300. Damage to wiring at the sewage treatment plant on Fort Hunter Liggett has also been reported (Griffey, pers. comm.).

Recreational playing fields on Fort Ord and Camp Roberts which are continually mowed and thus provide excellent ground squirrel habitat are heavily infested. Jones & Stokes personnel observed an extremely high number of burrows (329/acre) on the baseball field at Camp Roberts. The resulting large holes and mounds of earth over twelve inches above ground level prevent most recreational use of this field (Figures 23 and 24). Other mowed areas around buildings and intersections of all three installations reportedly harbor squirrel populations and their burrows create hazards to pedestrians and horseback riders. Continued efforts to eliminate ground squirrels and repair their damage in their improved areas has cost $2,500 annually on Fort Hunter Liggett.

Marsh and Salmon (pers. comm.) have reported extensive damage to out-buildings and other structures on the San Antonio Mission grounds, which lie within Fort Hunter Liggett. Ground squirrel burrowing has damaged the adobe and stone wall which surrounds the Indian Cemetery (Figure 25). The grinding mill has also been extensively undermined (Figure 26). Other damage to stone walls and aqueducts on the mission has also occurred.

Ground squirrels reportedly damage a wide variety of crops including all kinds of grain, apples, apricots, peaches, prunes, oranges, tomatoes, nuts, dry beans, sugar beets, and alfalfa (Shaw, 1920; Tomich, 1962; California Department of Food and Agriculture, 1975). According to Dana (1967) damage to crops in California has been estimated at $8,000,000 annually. In Monterey and San Luis Obispo Counties combined, over $44,000 was spent in 1975 on poison baits to control these rodents on private land.

Many private landowners adjacent to Fort Hunter Liggett and Camp Roberts claim that ground squirrels coming from military lands have damaged their crops and pasture (Nutter, 1976; Kalar, 1976). Ground squirrels are known to shift with the availability of food wherever rangeland meets cropland (Horn and Fitch, 1942), and may travel on rangeland upwards of one quarter mile from their burrow systems to forage (Marsh, pers. comm.), possibly crossing from military to private cropland. Newbold (pers. comm.) recorded back and forth movements of approximately one quarter mile for tagged ground squirrels on Fort Hunter Liggett. Young squirrels that commonly disperse from the parent burrow system in the fall (Grinnell and Dixon, 1918) may travel from military land to private land and reinfest vacant burrow systems or occasionally establish new systems. Storer and Jameson (1965) indicate that some squirrels migrate 1 to 5 miles into new areas.

A survey on crop damage on lands adjacent to military property was conducted by the Monterey and San Luis Obispo County Departments of Agriculture in 1976 covering the period between 1972 and 1976 when no effective ground squirrel control program was conducted on military land. Land owners in Monterey County adjacent to Fort Hunter Liggett and Camp Roberts reported an estimated pasture and grain crop loss for the years 1972-75 of over $697,000 (Appendix C). Landowners adjacent to Camp Roberts in San Luis Obispo County claimed over $36,000 in crop damage between 1973 and 1976 chiefly to wheat, barley and pasture. These landowners also reported an extra expenditure of over $41,000 during the same years to control ground squirrel reinfestations from military lands (Appendix D).

Field observations by Jones & Stokes Associates personnel did not substantiate reported damage to adjacent crops or pasture because of the time of year (November). Crops had been harvested and most ground squirrels were inactive. However, ground squirrel colonies were present along the border between military land and adjacent cropland in many areas of Fort Hunter Liggett and Camp Roberts (Figure 27).

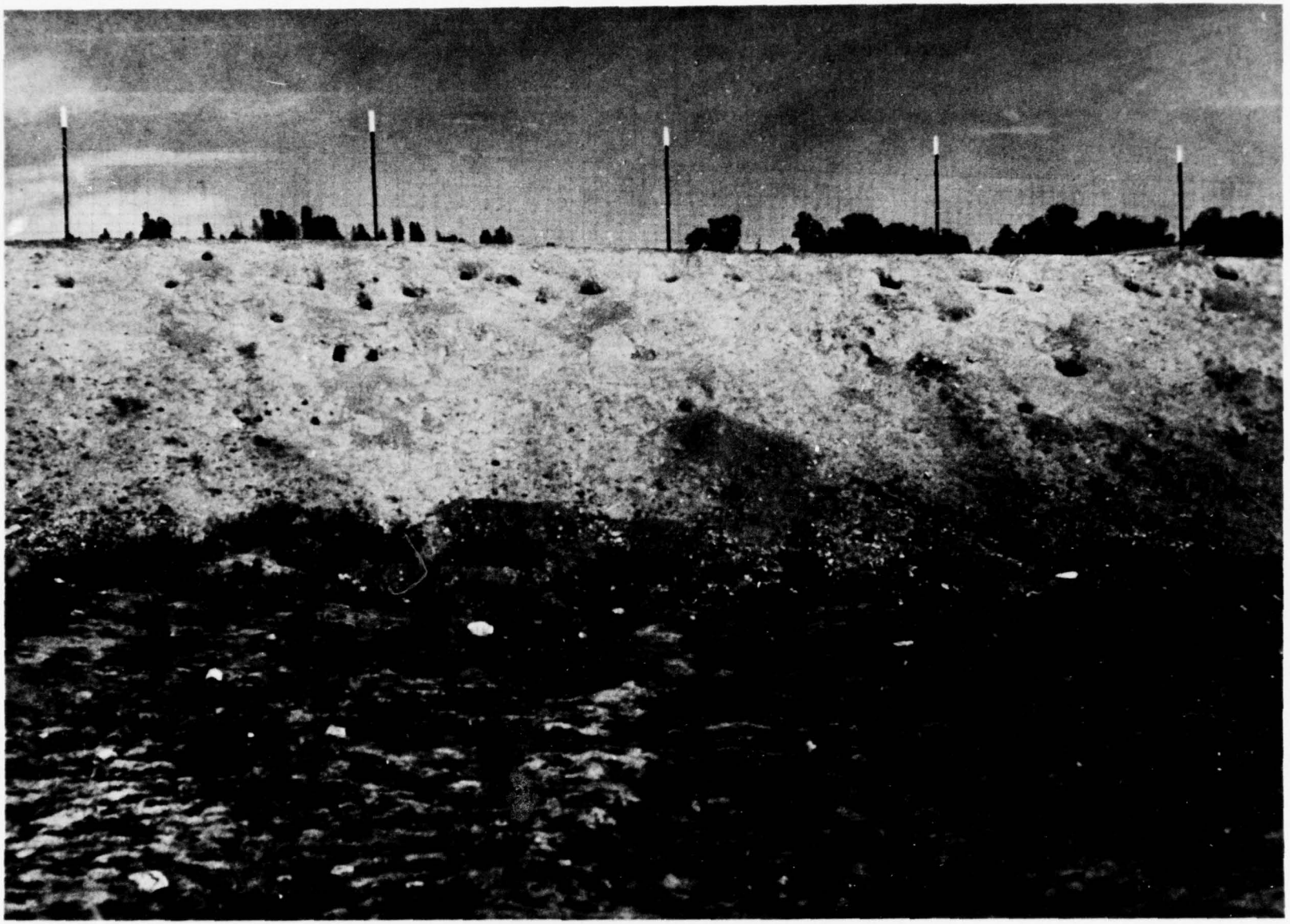


Figure 18. Ground Squirrel Burrows on an Earthen Dam Face at Fort Hunter Liggett

Figure 19. Earthen Dam With Washed Out Area at Fort Hunter Liggett

Figure 20. Ground Squirrel Burrows on an Ammunition Storage Bunker at Fort Hunter Liggett

Figure 21. Flagged Ground Squirrel Burrows on a Road Bank at Camp Roberts. NOTE: Repaired Pavement on Roadway.

Figure 22. Ground Squirrel Burrows Under a Bivouac Building at Fort Hunter Liggett

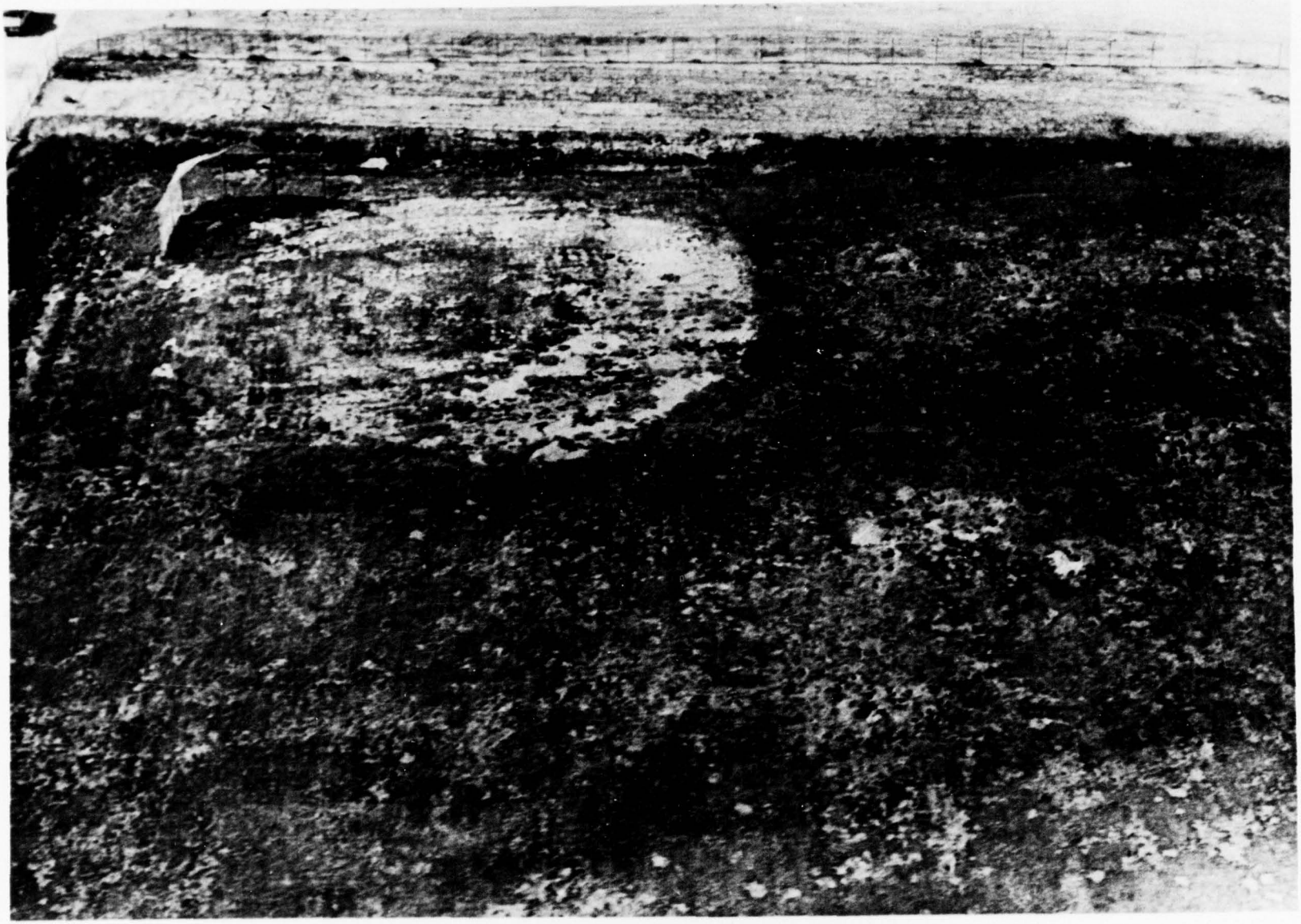


Figure 23. Aerial Photograph of Ground Squirrel Burrows on the Baseball Field at Camp Roberts

Figure 24. Close-up View of Ground Squirrel Burrows on the Baseball Field at Camp Roberts

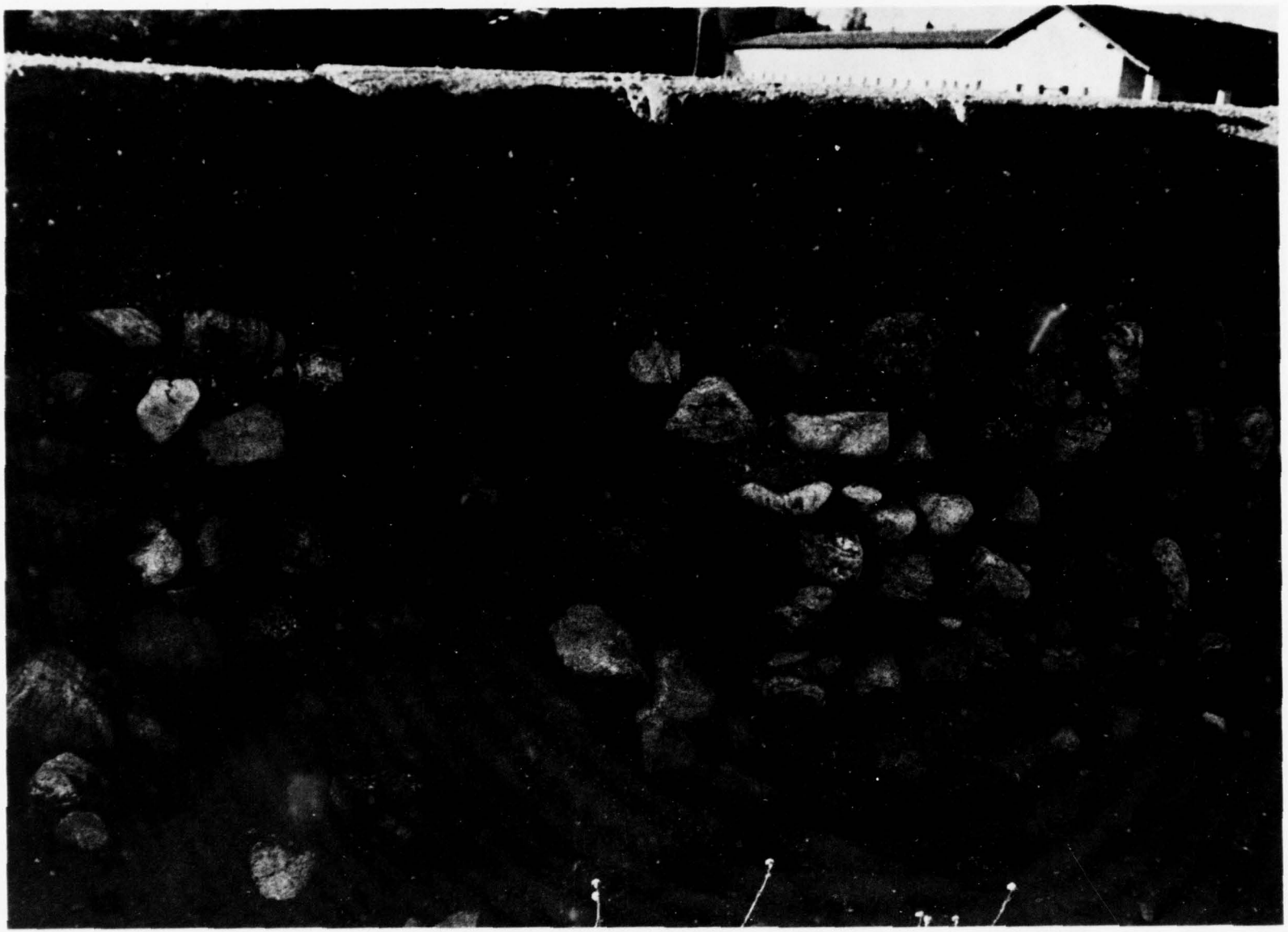


Figure 25. Ground Squirrel Burrows in the Adobe and Stone Wall Surrounding the Indian Cemetery, San Antonio Mission

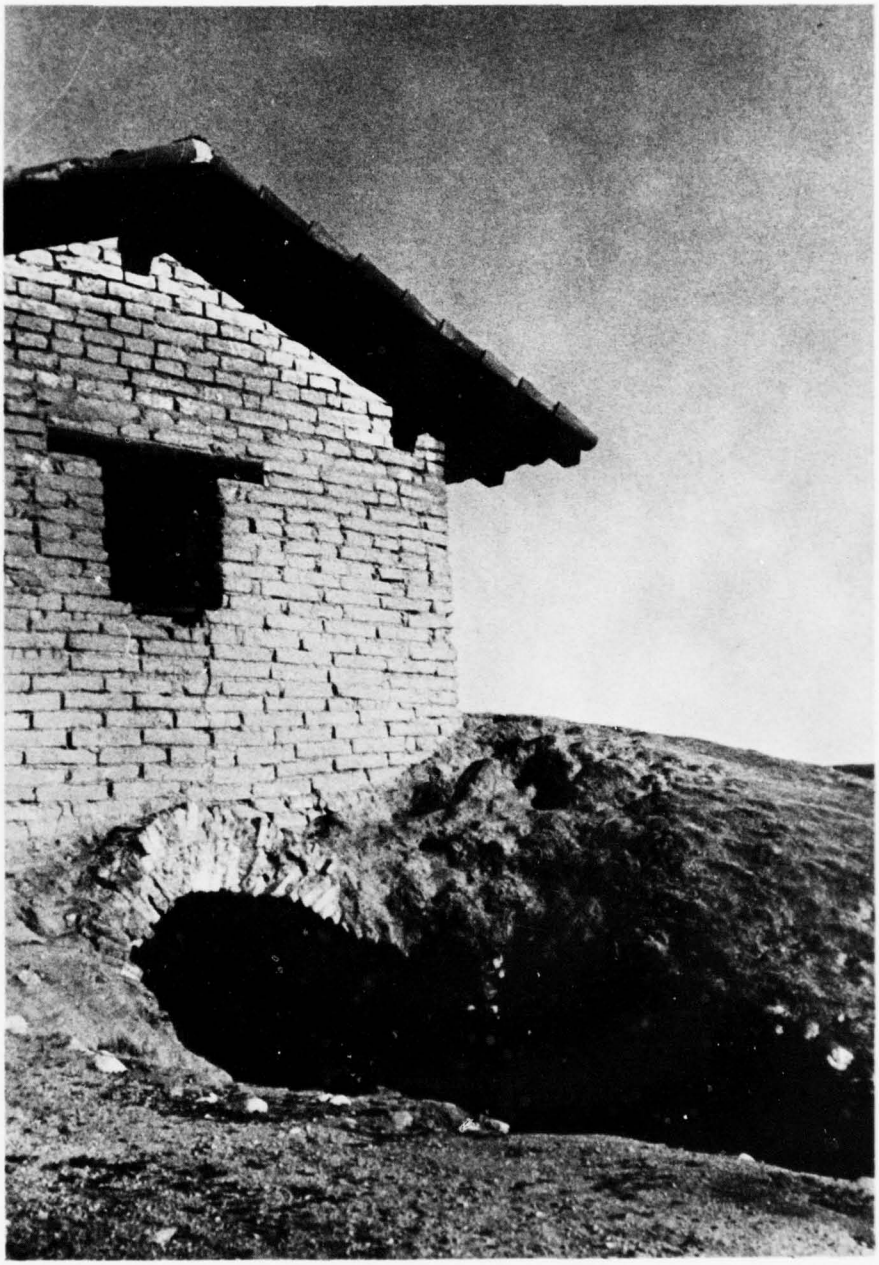


Figure 26. Ground Squirrel Burrows Next to the Grinding Mill at the San Antonio Mission on Fort Hunter Liggett

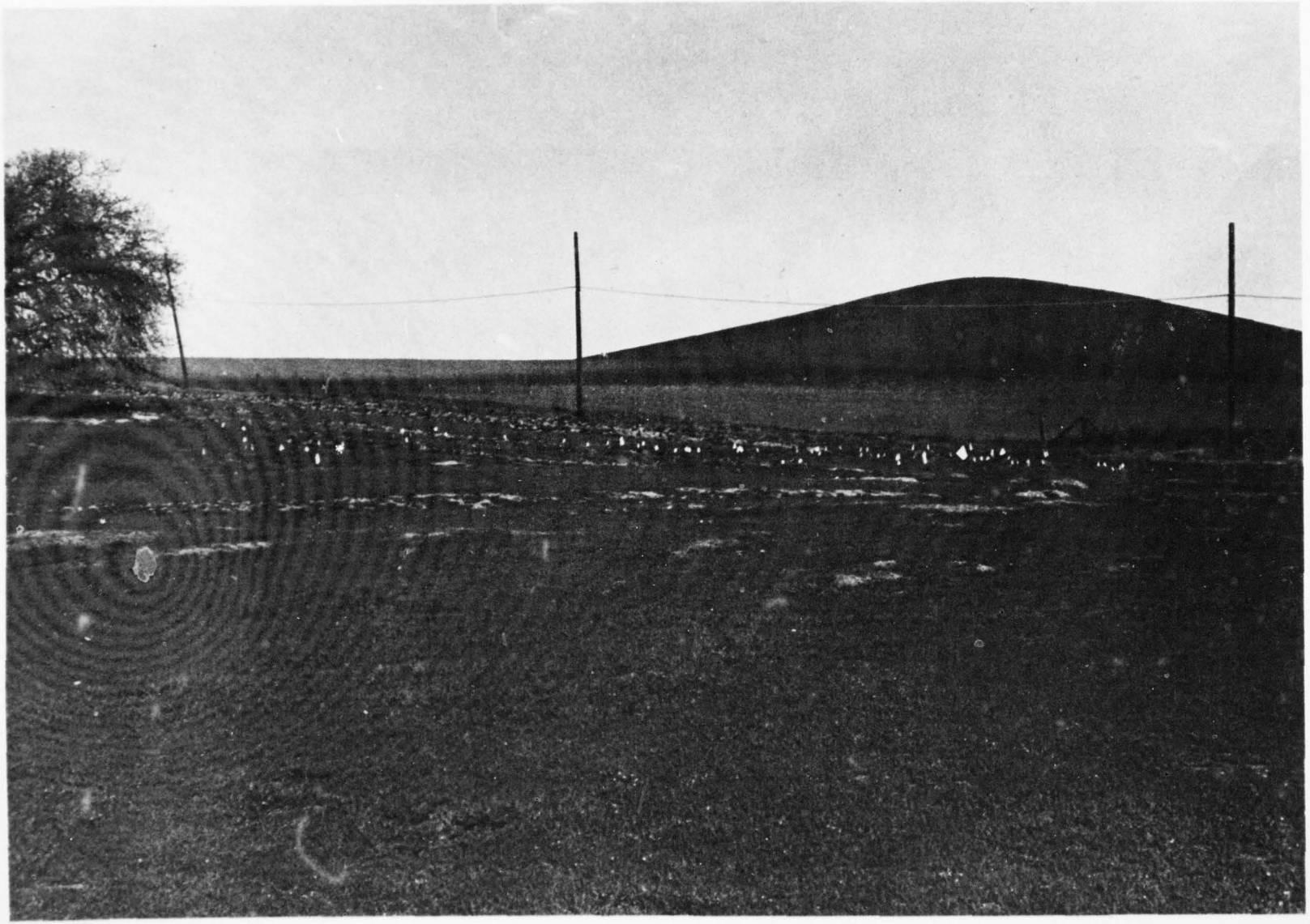


Figure 27. Flagged Ground Squirrel Burrows on Camp Roberts Adjacent to Private Grain Fields.
NOTE: White Spots Depict Flagged Area.

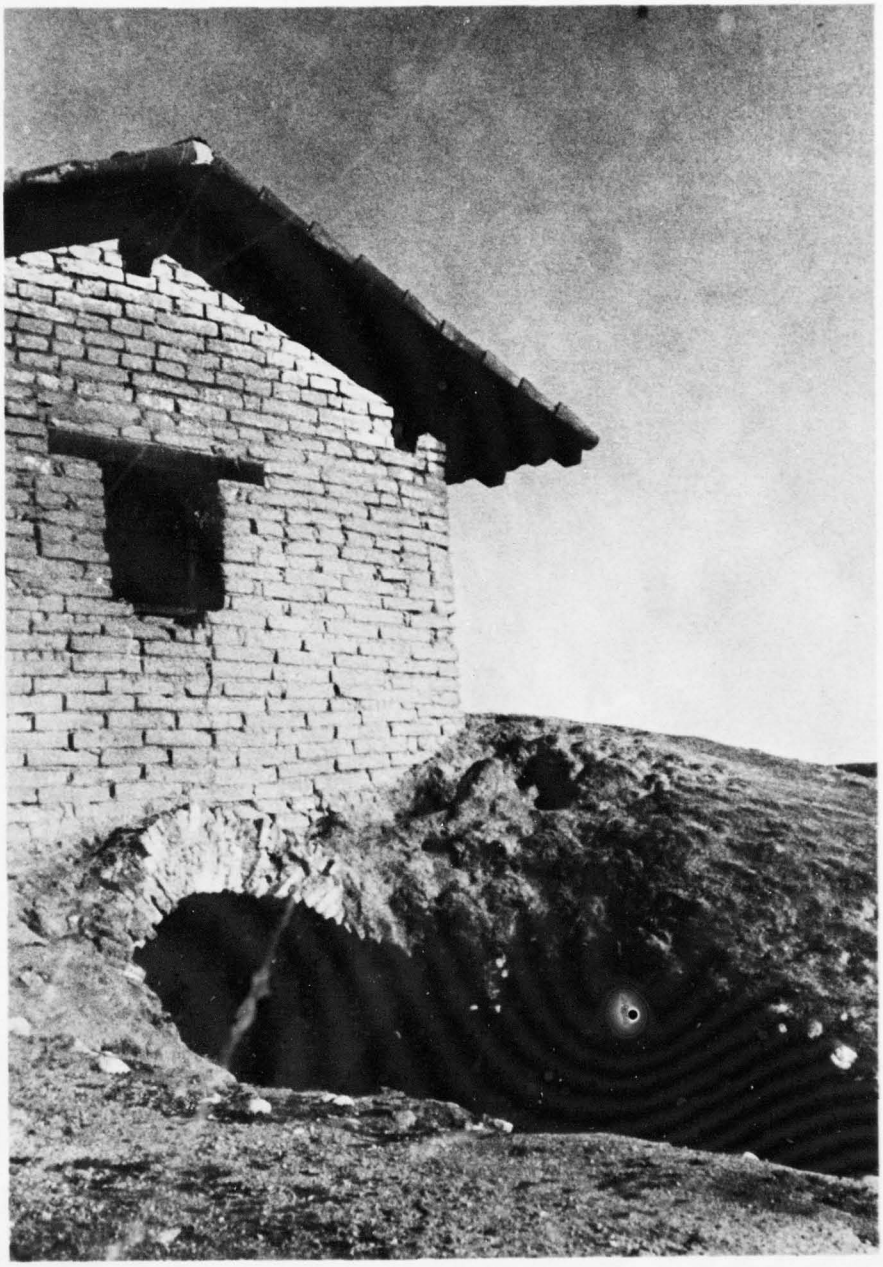


Figure 26. Ground Squirrel Burrows Next to the Grinding Mill at the San Antonio Mission on Fort Hunter Liggett

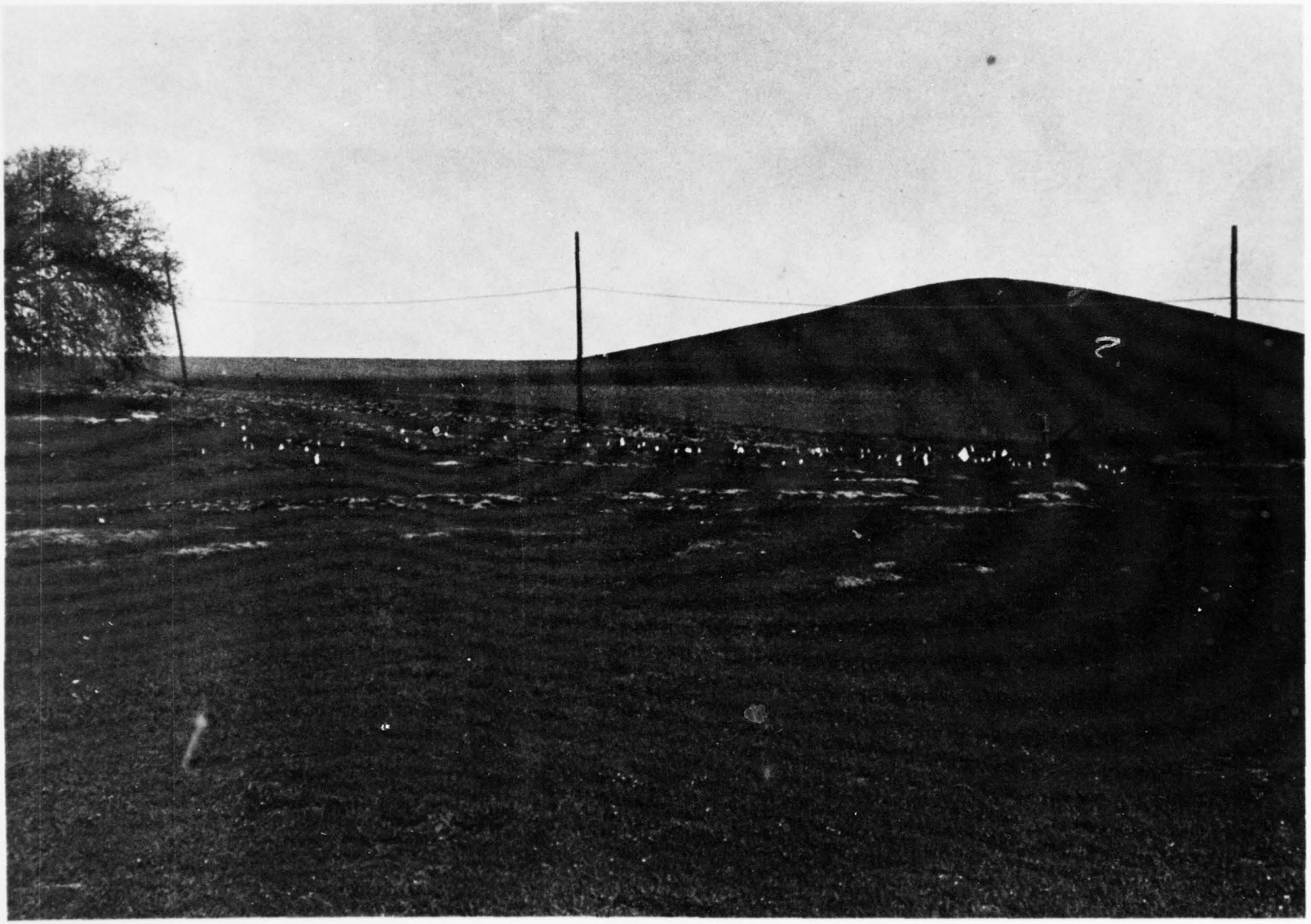


Figure 27. Flagged Ground Squirrel Burrows on Camp Roberts Adjacent to Private Grain Fields.
NOTE: White Spots Depict Flagged Area.

The grazed rangeland (grassland and oak woodland) of Forts Ord, Hunter Liggett and Camp Roberts are prime habitat for ground squirrels (Grinnel and Dixon, 1918). Wherever large populations of ground squirrels occur on these rangelands the potential for damage to vegetation and competition between these rodents and livestock exists.

Ground squirrels damage the rangeland by cutting and discarding vegetation, trampling it, using it for nesting material, and covering it with soil from their burrow systems. Fitch (1948) found that ground squirrels could destroy up to 38 percent of rangeland yield in this manner. Their foraging activities in winter may also stunt the vegetation, thereby decreasing overall range production (Howard, 1953).

In addition to the forage ground squirrels destroy, they also compete with livestock for forage, especially for filaree and bur clover, both valuable range species. Grinnell and Dixon (1918) estimated that two hundred squirrels would eat as much as one steer and twenty squirrels as much as one sheep. Howard, et.al. (1959) showed that heifers grazing on pasture devoid of ground squirrels averaged a greater daily gain of 1.03 pounds than heifers grazed on squirrel-infested pasture.

Competition is most severe in fall, winter and early spring when forage growth is inadequate (Howard, et.al., 1959). In years of above average rainfall, however, competition between squirrels and cattle may be minimal (California Department of Food and Agriculture, 1975). Conversely, in dry years competition may be extreme throughout the livestock grazing season.

The foraging activities of ground squirrels may also promote the dissemination of seeds of noxious weeds (De Vos, 1969). Their selectivity in feeding may also result in the elimination or encouragement of certain valuable rangeland species (Fitch & Bentley, 1949). Ground squirrels also reportedly damage young orchards by gnawing on the bark. Jones & Stokes personnel observed numerous trees on Camp Roberts that may have died due to girdling of the tree base by ground squirrels (Figure 28). Bushes and other landscaping may also be damaged by their gnawing and burrowing habits. There have also been claims of damage to oak trees from extensive ground squirrel burrowing around their root systems. However, no direct evidence is available to substantiate this claim.

Figure 28. Girdled Tree on Camp Roberts

Another potential problem aggravated by ground squirrel burrowing is excessive erosion (Fitch, 1948; Longhurst, 1957). Surface runoff running down burrow systems accelerates erosion and may result in extensive subsurface erosion, cave-ins, and gullies (Howard, 1953). According to De Vos (1969) burrowing on open rangeland is not the primary cause of erosion, but instead is caused by a combination of factors.

No claims of erosion damage on open rangeland have been reported by the Army and Jones & Stokes personnel found no evidence of excessive erosion during field observations of each installation. Erosion of one dam face due to squirrel burrowing has been reported and the potential exists for pavement slippage or cave-ins wherever squirrels burrow into road banks.

The foraging activities of ground squirrels may affect other desirable wildlife species that share the same habitat. Ground squirrels are known to eat gopher snake eggs, young cottontails, and prey on the nests of killdeer, mourning doves and quail (Fitch, 1948 and California Department of Food and Agriculture, 1975). Glading (1938) found that the highest percentage of California valley quail nest loss (31 percent) was attributable to ground squirrels. Quail population levels have been high on Camp Roberts and Fort Hunter Liggett since 1972, but declined in the winter and spring of 1975 (Dedrick, 1976). This decline, however, was reportedly due to dry weather conditions and not to predation by ground squirrels. Under normal environmental conditions, field studies have shown that ground squirrels are not highly detrimental to quail populations (Dedrick, 1976). There seems to be conflicting evidence on the effects of squirrels on quail populations and thus other factors may also be implicated.

## Plague-Ground Squirrel Relationship

### Plague

The following discussion is modified and abbreviated from the Manual for the Control of Communicable Diseases, 1971, compiled by the California Department of Public Health.

Plague is a highly infectious disease characterized by a number of symptoms, including acutely inflamed and painful swelling of lymph nodes, septicemia, and petechial hemorrhages, often with high fever, shock, mental confusion, delirium and coma.

Bubonic plague is the most common. Primary septicemic plague is rare, and primary pneumonic plague is the most serious. Untreated bubonic plague has a case fatality rate of 25 to 50 percent, untreated septicemic and pneumonic plague are usually fatal. Results are good if modern therapy is begun within 24 hours of onset, but are poor thereafter.

Sylvatic (wild rodent) plague is known to exist in the western third of the United States in addition to large areas in South America, Africa and Central and Southeast Asia.

Plague in man in the United States is limited to rare instances of exposure to wild rodents and their fleas.

Plague has been identified in California since 1900, and from 1900 to 1970, 413 human cases of plague with 28 deaths had been recorded from 21 counties. From 1940 to 1970, 13 cases with 5 deaths have been recorded (one a laboratory infection). All of them have been the bubonic form. Three cases of human plague have been reported in California, 1974-1976, and plague has been found in rodents (Table 9).

The infectious agent of plague is Yersina pestis (Pasturella pestis), the plague bacillus. The chief natural reservoirs of the plague are wild rodents, which are subject to periodic epizootics throughout the world. Certain kinds of mice (Microtus, Peromyscus) may serve as enzootic reservoirs. Bubonic plague is transmitted by the bite of an infective (blocked) flea, e.g., Xenopsylla cheopsis (rat flea), Diamanus montanus (common with ground squirrels), etc., or by contact with pus or tissues of an infected animal. The incubation period may be from 2 to 6 days.

Bubonic plague is not directly transmitted from person to person except through terminal plague pneumonia. Fleas may remain infected for days, months or even years under suitable conditions of temperature and humidity, or may clear themselves of infection (WHO, 1970). Certain infective (blocked) fleas are generally short-lived (3 to 4 days) (State Department of Public Health, 1971); however, according to Pollitzer (1954, pages 345 and 353), some infective fleas may live 10 to 52 days.

Preventative measures include: a) active immunization which is justifiable for persons traveling or living in areas of high incidence and which may confer some protection for several months but is not relied upon as the principal preventative measure; b) periodic surveys in endemic and potentially endemic areas to determine prevalence of rats and fleas, institute suppression methods, continue inspection and survey of wild rodents and their ectoparasites in areas of known sylvatic plague. Where plague is present or threatening, a systematic search for infected fleas and serologic surveys of rodents can further delineate the extent of the problem; c) other measures include rat-proofing buildings and reduction of breeding places and harborages, together with education of the public in endemic areas on mode of transmission and protective measures against fleas and rats. Additional discussion may be found in Kartman (1975).

In addition to control of patients, there should be a search for infected rodents and fleas or persons exposed to plague pneumonia. Elimination of fleas should precede anti-rat measures. Rat populations should be suppressed by energetic campaigns of poisoning or trapping.

## General Background

Plague infection in wild rodents and their fleas has been demonstrated widely in California. Prominent areas have been: coastal counties from San Francisco Bay southward; San Bernardino Mountains; Siskiyou, Modoc, Plumas, Shasta and Lassen Counties; Sierra Nevada and Tehachapi Mountains. Most plague epizootics involve species of ground squirrels (Citellus), now called Spermophilus, or chipmunks (Eutamias). Sporadic human cases of sylvatic origin usually are a consequence of epizootics in these animals (California State Department of Health, 1971).

> Epizootics of plague among wild rodents move silently and are frequently not apparent in nocturnal, solitary species. They are more easily recognized in susceptible diurnal, colonial species, especially when these are in proximity to areas of human activity. Epizootics may be recognized by the presence of sick or dead rodents from which Y. pestis can be demonstrated. These organisms also may be present in fleas from carcasses or from abandoned rodent burrows and nests. In spite of often heavy mortality, carcasses may not be readily evident owing to predation and cannibalism. Consequently, epizootics of plague sometimes may only be demonstrated by serological methods (antibody titers) and by observation of decreased rodent activity substantiated by trap-capture data in a given area.

> Serological procedures are essential in detecting plague activity in enzootic rodent reservoirs, in rodents that show heterogeneity in their resistance to plague, and in individuals of a susceptible species that occasionally may survive the infection....Monitoring of activity and inactivity of various rodent species is important in assessing the extent of an epizootic in a given area. Detailed knowledge of the rodents involved is necessary to read and interpret sign accurately. (Nelson and Smith, 1976).

The Fort Ord complex is located in an area of California in which sylvatic plague has been found.

Eskey and Haas (1940) stated that the ground squirrels constituted one of the great primary reservoirs of plague in the western United States. Subsequent workers, however, have found that the primary reservoirs appear to be in Microtus spp. and Peromyscus spp., and that the ground squirrel becomes infected through contact with infected populations of deer mice, meadow voles, etc. (Olson, 1970; Nelson and Smith, 1976; and Kartman, 1958).

Murray (1963) has listed ecological conditions necessary for the occurrence and persistence of plague.

1. Persistent reservoirs of plague are not those species involved in violent epizootics, but relatively resistant species in which the disease organism is adapted. Much of the infection may remain in a latent state.

2. Enzootic plague persists in foci or pockets. These pockets are relatively small and persist where suitable climate (characteristically in cold mountains, high plateaus, or coastal fog belts), suitable flea vectors, and suitable rodent hosts occur.

3. Epizootics occur when infection transfers to susceptible species of relatively high density. Such epizootics may be brief and limited or may follow an ever-shifting path for years.

4. High density of susceptible populations is a prerequisite for epizootics; physiological stress from overcrowding may be important in activating latent enzootic infections.

The following brief statements are taken from Pollitzer (1954).

The low incidence of human infection derived directly from the wild rodents or through their fleas is in striking contrast to the large area comprising 131 counties in 15 states, where evidence of plague among these animals has been found. (Page 52).

While...the danger of a spread of plague to man through direct contact with wild rodents or through their fleas is slight, secondary involvement of the rats or other rodent species living near man might greatly enhance the chances for human infection. (Page 53).

...Lobo and Silvetti (1941) [state that]...the fundamental differences between rat-caused and wild rodent plague is that the presence of the infection among the rats is apt to lead to the appearance of collective human cases in settlements, whereas wild rodent plague in the strict sense is, as a rule, responsible merely for the occurrence of sporadic cases in persons who have entered the haunts of the species concerned. Nevertheless, in view of the often enormous extent of the wild rodent plague foci, the aggregate number of human infections contracted in them may be considerable, and the case-mortality is apt to be high since the patients often receive no adequate treatment, either because they live away from centers of civilization, or because, owing to its sporadic incidence, the presence of the disease is not recognized. (Page 499).

According to Meyer (1942) epizootics among the ground squirrels, which led to the appearance of sporadic plague cases in man, began early in spring, rose in intensity during the summer months, and slowly declined during autumn to disappear entirely during the winter in regions where the animals hibernated. However, in some localities, young ground squirrels, which were apt neither to aestivate nor to hibernate, could be found plague-infected in December and January. (Page 489).

## Observations at Fort Hunter Liggett

A team from the Letterman Army Institute of Research, headed by Dr. M. A. Moussa of the Department of Tropical Medicine, studied the ecology and control of sylvatic plague at Fort Hunter Liggett from November 1974 to September 1976. Fort Ord and Camp Roberts were visited, but no studies were conducted.

Ground squirrels at two sites on Fort Hunter Liggett (Figure 29) were trapped and released on a regular schedule for one year to determine ground squirrel population dynamics and make flea counts (Figure 30). Short-term collections of ground squirrels and other rodents were conducted in other areas, and counts were made of hosts and fleas (Table 7).

Table 7

FLEA-HOST ASSOCIATIONS AT FORT HUNTER LIGGETT
(November 1974 - August 1976)

| Animal Host | Number Examined | Diamanus montanus | Hoplopsyllus anomalus | Malaraeus telchinus | Atyphloceras multidentatus | Monopsyllus wagneri | Peromyscopsylla ravalliensis | Orchopeas sexdentatus | Pulex simulans | Cediopsylla inaequalis |
|---|---|---|---|---|---|---|---|---|---|---|
| California ground squirrel *Spermophilus beecheyi* | 1,732 | x | x | | | | | | x | |
| Brush mouse *Peromyscus boylei* | 30 | | x | x | x | x | x | | | |
| Deer mouse *Peromyscus maniculatus* | 25 | x | | x | | x | | | | |
| California vole *Microtus californicus* | 9 | | x | x | | x | | | | |
| California pocket mouse *Perognathus californicus* | 17 | | x | | | | x | | | |
| Desert wood rat *Neotoma lepida* | 4 | | | | | | | x | | |
| Desert cottontail *Sylvilagus auduboni* | 3 | | x | | | | | x | | x |
| Kangaroo rat *Dipodomys venustus* | 23 | | | | | | | | | |

Source: Lt. Col. M. A. Moussa, Ph. D.

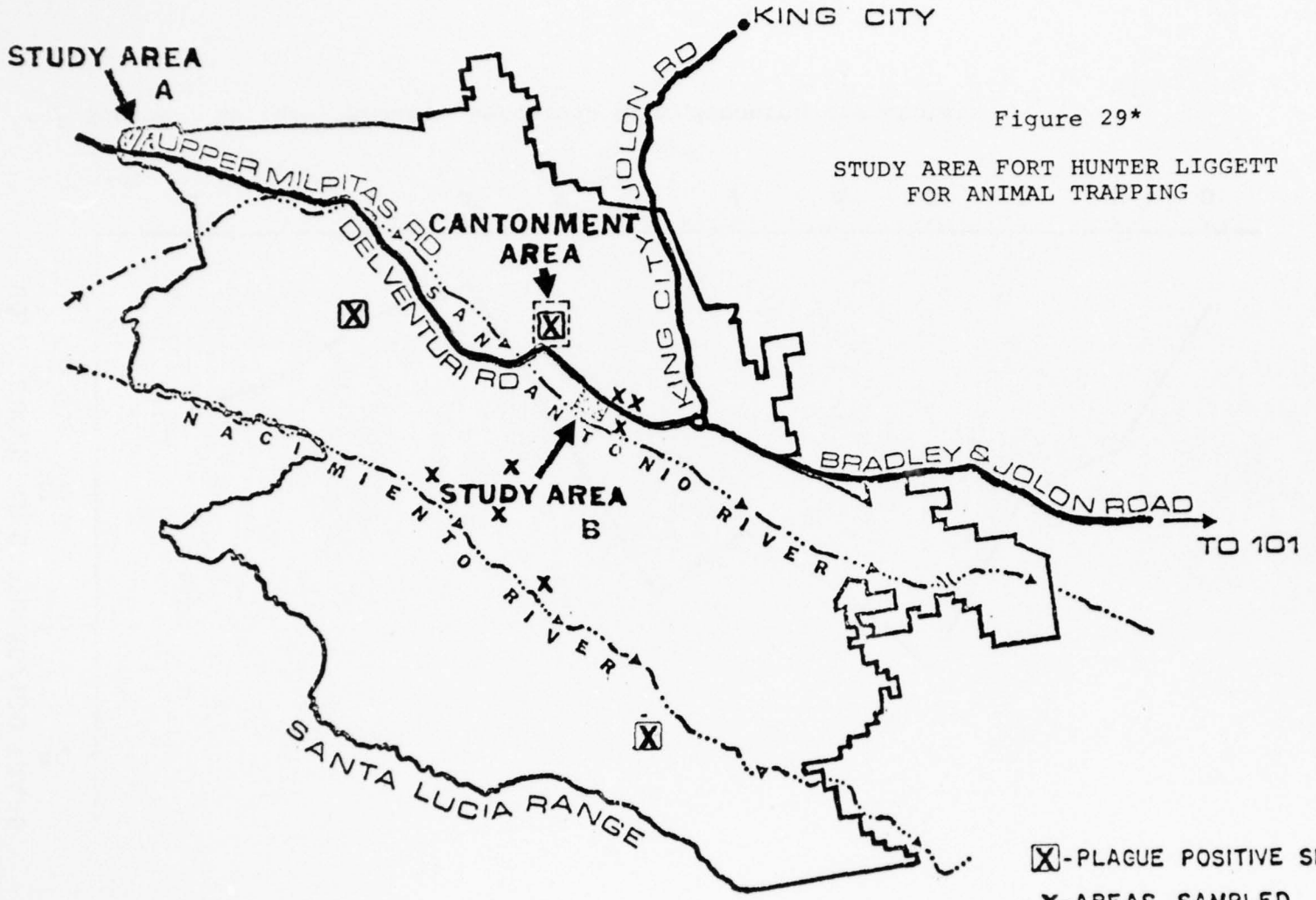



Figure 29*

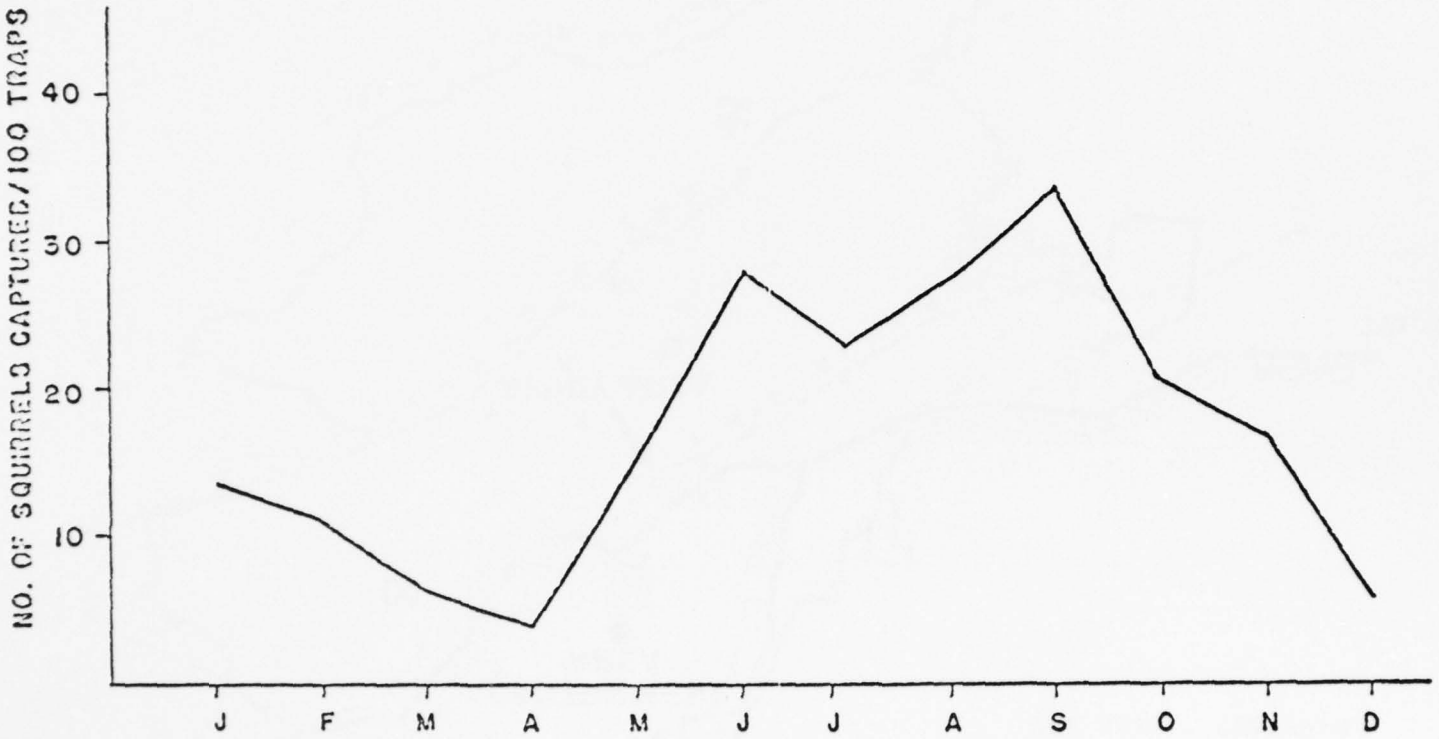
STUDY AREA FORT HUNTER LIGGETT
FOR ANIMAL TRAPPING

**FORT HUNTER LIGGETT, CA.**

* Source: Lt. Col. Moussa, Letterman Army Research Institute.

Figure 30*

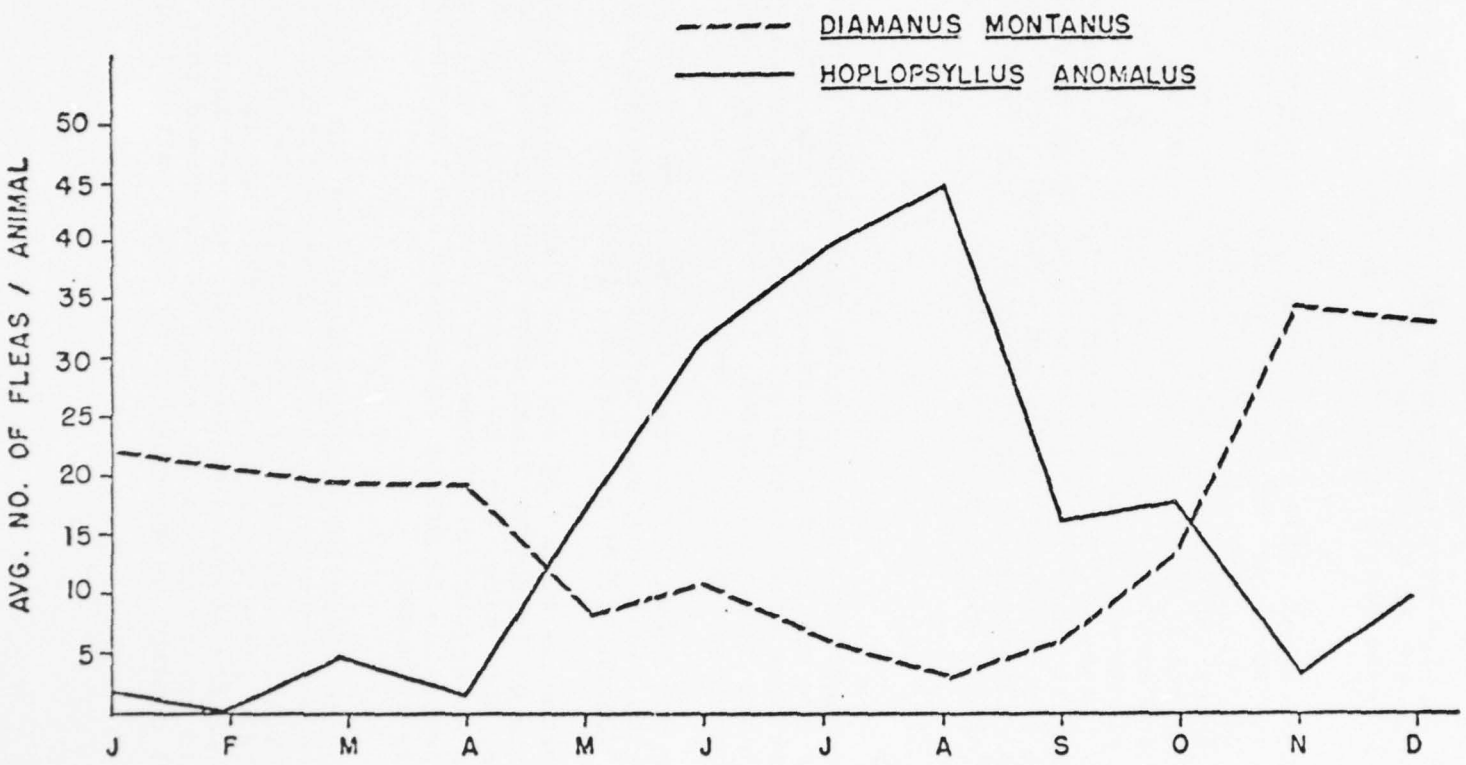
SEASONAL OCCURRENCE OF THE CALIFORNIA GROUND SQUIRREL
AT FORT HUNTER LIGGETT, CALIFORNIA -- 1975




* Source: Lt. Col. Moussa, Letterman Army Research Institute.

Figure 31*

FLEA POPULATIONS ON THE CALIFORNIA GROUND SQUIRREL
AT FORT HUNTER LIGGETT, CALIFORNIA -- 1975




* Source Lt. Col. Moussa, Letterman Army Research Institute.

Blood samples were taken from all those ground squirrels captured and sent to Walter Reed Army Research Institute to determine if sera showed evidence of plague. Fleas were also sent.

Carnivores and small rodents and lagomorphs were also collected and sera was sent to Walter Reed Army Research Institute for immunological tests for plague. Table 8 lists the preliminary serological (plague) findings made by Walter Reed Army Research Institute on sera taken from the animals collected and sampled at Fort Hunter Liggett. A positive titer for plague was found in the sera of a number of the carnivores tested and in one ground squirrel. No plague has been reported to date by Walter Reed Army Research Institute concerning the 31,000 fleas (pooled samples) tested (mostly taken from California ground squirrels). Sera from a number of other rodents all have been negative.

## Discussion

The recent literature suggests that ground squirrels in California are not a permanent reservoir of the plague, but rather that deer mice, meadow voles, etc. are probably the natural plague reservoirs (Olson, 1970; Nelson and Smith, 1976; and Kartman, 1958).

It is not known for certain whether some ground squirrels infected with plague can survive and thus maintain a plague reservoir (Olson, 1970; and Kartman, 1958).

The probable method of sylvatic plague transmission is transference of infective fleas from wild rodents, such as field mice, deer mice, etc. to ground squirrels, which then results in an epizootic. Generally the ground squirrel is highly susceptible to plague infections and the population is drastically reduced.

Infective fleas leave dead rodents and may infect available new hosts (Smith, et.al., 1968; Pollitzer, 1954, page 385; Westrum and Yescott, 1975, pages 97-103; Stark and Kinner, 1962, pages 249-251). Since this may lead to an expansion of the plague into new areas and new hosts, including man, public health officials generally recommend that rodent (squirrel) control be accompanied by flea control (Lackner, 1976).

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GROUND SQUIRREL CONTROL, FORT ORD COMPLEX FORT ORD, CALIFORNIA.(U)
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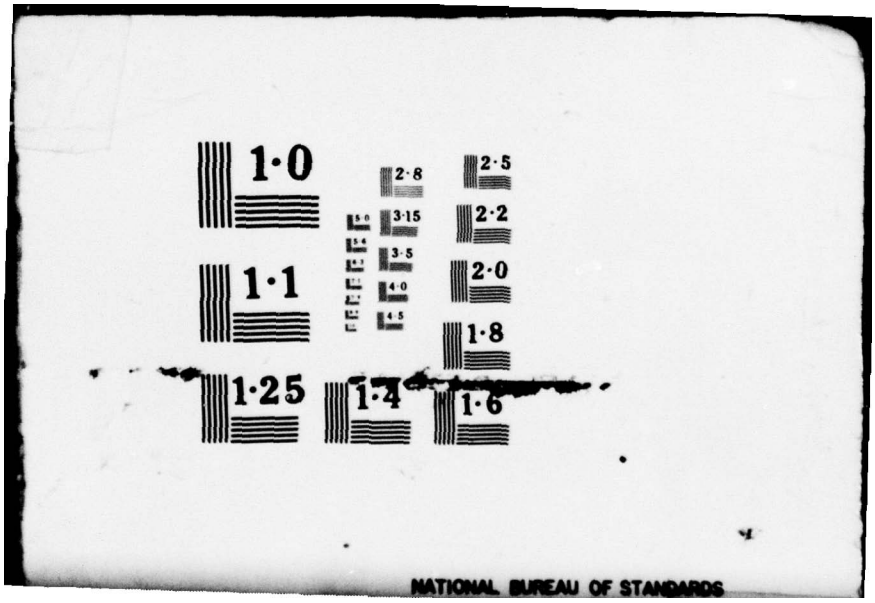
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NATIONAL BUREAU OF STANDARDS

Table 8

SEROLOGICAL FINDINGS OF PLAGUE IN MAMMALS AT FORT HUNTER LIGGETT (1975-1976)

| Common Name<br>Scientific Name | No. Sera Collected | No. Sera Tested | No. Sera Positive | Titer |
|---|---|---|---|---|
| Bobcat<br>*Lynx rufus* | 16 | 12 | 1 | 1:8 |
| Coyote<br>*Canis latrans* | 11 | 11 | 2 | 1:256<br>1:28* |
| Dog<br>*Canis familiaris* | 32 | 32 | 9 | 1:16(5)<br>1:8(3)<br>1:64(1) |
| Gray fox<br>*Urocyon cinereoargenteus* | 7 | 4 | 0 | N/A |
| House cat<br>*Felis domestica* | 14 | 14 | 1 | 1:16 |
| Mountain lion<br>*Felis concolor* | 4 | 3 | 0 | N/A |
| Striped skunk<br>*Mephitis mephitis* | 1 | 1 | 0 | N/A |
| California ground squirrel<br>*Spermophilus beecheyi* | 971 | 871 | 1 | 1:8** |
| Other small rodents | 83 | 81 | 0 | N/A |
| Total | 1,139 | 1,029 | 14 | N/A |

* Probably 1:128.

** Probably not positive according to criteria of California Department of Health or Plague Laboratory CDC, Ft. Collins (comment added).

Source: Lt. Col. M. A. Moussa, Ph.D., Department of Tropical Medicine, Herman Army Institute of Research, Presidio, San Francisco, California.

> In general, measures taken to reduce the human plague potential in an area should be directed against the flea vectors as well as the vertebrate hosts; flea control itself has become an important technique in combating plague by interfering with or breaking the normal rodent-flea-rodent transmission chain. If rodent control alone is practiced, the situation may be made worse since large numbers of hungry fleas remain, which could shift from their normal hosts to man or would attack new rodent hosts as soon as they entered the area; under conditions of high population pressure this might be an immediate influx. (Olson, 1970, page 210).

The plague will still remain in other rodents even though the ground squirrels are all killed.

There are very high populations of ground squirrels on the Fort Ord complex with large numbers of fleas, particularly Diamanus montanus and Holopsyllus anomalus, which are known to carry the plague organism. Specimens are found on ground squirrels at all times of the year in varying numbers (Figure 31).

Much of the Fort Ord complex is open to the public. Public use is high, and if ground squirrels succumb to plague, there will be a large number of fleas which may transfer to humans in certain field situations, such as recreation.

At Fort Hunter Liggett all of the factors appear to be present which may lead to a plague outbreak.

As summarized by the Surgeon General's office (August 17, 1976 meeting), the present circumstances include:

1. A highly abundant, susceptible host species overrunning the areas in which people live, train, work and play.

2. High flea counts on the rodent hosts.

3. A marked increase this year in the occurrence of epizootic plague and human cases throughout the western states, including California.

4. Evidence by carnivore serology of the existence, right now, of plague foci at the Fort Ord complex or in the vicinity.

A summary (Table 9) by Walter Reed Army Research Institute shows that the overall incidence of plague cases has increased in recent years in the United States. The problem, therefore, may be much broader than at the Fort Ord complex (August 17, 1976 meeting).

The California State Department of Health has expressed its concern about the Fort Hunter Liggett situation in a letter to the office of the Surgeon General as follows:

Table 9

INCIDENCE OF PLAGUE CASES IN UNITED STATES

HUMAN PLAGUE, U.S.A. 1974-1976

| Year | Cases | Pneumonia |
|---|---|---|
| 1974 | 8 | |
| 1975 | 22 | 3 |
| 1976* | 13 | 4 |
| N | 43 | 7 (16% = 3 X Normal) |

* Incomplete

HUMAN AND RODENT PLAGUE, U.S.A. 1974-1976*

| State | Cases | Rodent Plague |
|---|---|---|
| Arizona | 7 | + |
| California | 3 | + |
| Colorado | 2 | + |
| New Mexico | 29 | + |
| Texas | -- | + |
| Utah | 2 | - |
| Oregon | -- | + |
| Idaho | -- | + |
| N | 43 | |

* Incomplete

Source: Walter Reed Army Research Institute.

With plague circulating in the area of Hunter Liggett, as evidenced by carnivore serology, it appears that the disease at some time in the future will enter into the highly susceptible ground squirrel population. Plague epizootics and human exposure have occurred in this area in the past. Plague occurrence has not been documented at Camp Roberts, but epizootics in past years may have occurred there undetected. (Lackner, 1976).

Summary

1. Plague is a serious disease which is endemic in populations of wild rodents in California and worldwide.

2. Human cases of plague of probable sylvatic origin have been reported in California since 1920.

3. Sylvatic plague is present in some hosts in or near the Fort Ord complex as demonstrated by positive serology of carnivores collected and tested in the area.

4. All the factors necessary for a plague outbreak are present in the Fort Ord complex area.

5. Plague is known to infect ground squirrels and to drastically reduce population.

6. Flea control should precede or accompany ground squirrel control in order to minimize further spread of plague infection.

The following paragraphs reflect the position of the State Department of Public Health with respect to ground squirrel and flea control in plague-related situations. The discussion is based upon communications with Dr. Bernard Nelson and material which was presented by Dr. Nelson to Army personnel at a meeting at Fort Hunter Liggett in April 1976.

The policy of the Vector Control Section of the California Department of Health toward control of ground squirrels is as follows: ground squirrel control is not supported on lands where proposed reasons for control are based upon actual or threatened crop damage or grazing competition with livestock. This is an agricultural problem to be handled through decisions made by agricultural officials. Likewise, control of ground squirrels that cause structural damage to levees, earthen dams, bunkers, etc., is a decision to be made by persons involved in maintenance of these structures.

The California Department of Public Health is mandated by law and international agreements to monitor the occurrence of plague throughout California. The beechey ground squirrel is highly susceptible to plague organisms and undergoes violent epizootics, often killing most or all members of a colony. The ground squirrels make good sentinel animals since the presence of sick animals or carcasses of these rodents is usually a good indication of a current epizootic of plague. These episodes are usually observed by the general public and reported to the State Department of Public Health, whereas a plague epizootic among forest rodents goes unnoticed and is more time-consuming and difficult to monitor. The work of the Public Health Department is made easier if ground squirrels are not poisoned.

When the State Department of Public Health officially states that a population of ground squirrels is a public health problem, the program to prevent human infection is basically as follows:

1. Recommendations are made to officially or unofficially quarantine the designated area. Unofficial quarantine is suggesting that ranchers keep their men, family and pets out of the area. Official quarantine is closure of campground, parks, etc., that are under county, state or federal control.

2. Surveys are (or have already been) performed to establish the limits of the problem area.

3. Flea control measures are undertaken, followed 7 to 14 days later by a post-treatment evaluation of the control.

4. If ground squirrels are above the carrying capacity of the area, and the number still poses a direct public health problem, then ground squirrel control measures are undertaken.

The Public Health Department does not support or participate in large areawide flea and rodent control. The Department deals with the problem in that area where, in their opinion, there is sufficient and frequent enough human contact with ground squirrels and their fleas to be a human health hazard.* Flea and rodent control take place at the interface between the ground squirrel and humans; this includes areas such as campgrounds, recreational areas, bivouacs, some ranches, etc. The Department stipulates that flea control and evaluation of

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* The Fort Ord complex offers an excellent example of this type of interface where human contact with ground squirrels and fleas will occur.

control must precede rodent control. It is unnecessary to control a large area where human-ground squirrel contact is low or absent.

The Department of Health has experienced problems with flea control using Carbaryl. Formerly several effective insecticides were available, namely DDT, dieldrin, aldrin, malathion, benzene hexachloride and heptachlor. These are no longer available for use against fleas in plague control.

Krishna Murthy, et.al. (1965), Miller, et.al. (1970) and Barnes, et.al. (1972) have indicated that Carbaryl was effective when applied directly to the den, nest or burrow.

Public Health flea control efforts at the Lava Beds National Monument in March 1973 and at Lake Davis (Plumas County) (1975) were not effective.

Subsequent studies by Stegmiller and Hawthorne (1975) indicated the crucial role that pH occupies in the efficacy of Carbaryl -- an acid condition apparently is necessary for effective residue life. Later studies by the State Department of Public Health at Lake Davis indicated that the acid formulation appeared to give adequate control, but was not effective in preventing the spread of plague within the ground squirrel population.

There is therefore, only one insecticide available for flea control -- Carbaryl (Sevin). It is the only one registered with EPA and with a label. It must be dusted directly into burrows with hand dusters and in order to be effective, one ounce of 5 percent Carbaryl must be dispensed <u>into</u> each burrow to achieve control.

Three insecticides show promise under experimental conditions -- Phoxim and trichlorofon (Dipterex) as systemics (Moussa, 1976) and dichlorvos as a vapor toxicant. These materials are at least a year away in respect to registration and may have limited applications.

The plague laboratory of the Communicable Disease Control Center in Denver and the California Department of Public Health have found that Carbaryl is not always effective. Carbaryl must then be regarded as suspect as to its effectiveness against fleas during sylvatic plague epizootics.

In the summer of 1976, the State Department of Public Health treated several campgrounds in California with DDT (under emergency exemption) to control fleas during observed plague epizootics among chipmunks, in which two human cases were reported. Excellent control was achieved and the program was effective.

## Grazing

Each of the three military reservations has an outlease grazing program as an element of the natural resource conservation program. Fort Ord has one sheep lease and one apiary lease; Fort Hunter Liggett has four cattle leases and Camp Roberts has 2 sheep and one cattle leases. Present leases were issued in 1975 and 1976 as summarized in Table 10. Figures 6, 8 and 10 indicate the lease areas on each of the three installations.

Each lease is operated under land use regulations (see Appendix E for an example) which are intended to:

1. Provide for the multiple purpose use of these lands for military purposes, grazing by domestic livestock, public recreation, water conservation and wildlife habitat.

2. Protect the ecological balance to ensure the continued productivity of the land while permitting economic returns to the lessee.

### Fort Hunter Liggett

The Army acquired Hunter Liggett Military Reservation in 1941, and the original area was outleased in 1942 to three different parties. No management plan or conservation practices were stipulated. Subsequent leases in 1954 incorporated conservation and range management practices that were designed to improve rangelands along with proper utilization following multiple use concepts.

Four areas are under cattle leases at present. Area A, comprised of 7,150 acres, is limited to 1,600 Animal Units Per Month (AUM); Area B has 86,000 acres limited to 45,000 AUMs; Area C has 4,420 acres limited to 1,500 AUMs; and Area D has 8,820 acres limited to 2,500 AUMs. Table 10 indicates the four lease areas. Because of the present drought and consequent low-range productivity, the cattle stocking at the present time (December 1976) on Fort Hunter Liggett is approximately one third of that authorized under the leases (Wheeler, pers. comm.).

Extensive fencing is not used because of the nature of military operations. Herding and salt locations are used to distribute livestock.

Table 10

STATUS OF GRAZING LEASES ON FORTS ORD AND HUNTER LIGGETT AND CAMP ROBERTS

| Installation | AUMs[1] | Area | Lease Number | Lessee | Acreage | Term | Amount |
|---|---|---|---|---|---|---|---|
| Fort Hunter Liggett | ( 1,600) | A | DACHO5-1-77-507 | Joe Paesano | 7,150 | 11/1/76 - 10/31/81 | $25,000 |
| Fort Hunter Liggett | (45,000) | B | DACHO5-1-76-512 | La Panza Cattle Company | 86,000 | 11/1/75 - 10/31/80 | $315,000 |
| Fort Hunter Liggett | ( 1,500) | C | DACHO5-1-77-508 | Joe Paesano | 4,420 | 11/1/76 - 10/31/80 | $18,253 |
| Fort Hunter Liggett | ( 2,500) | D | DACHO5-1-77-509 | Joe Paesano | 8,820 | 11/1/76 - 10/31/79 | $24,502 |
| Fort Ord | | | DACHO5-1-74-559 | Mouren Farming[2] | 6,031 | 12/14/73 - 9/13/78 | $17,415 |
| Fort Ord | | | DACHO5-1-75-694 | Heinz Michels[3] | 1 | 3/17/75 - 8/16/79 | $340 |
| Camp Roberts | ( 2,000) | A | DACHO5-1-77-510 | Jaureguy and Mouren | 5,854 | 11/1/76 - 10/31/81 | $47,101 |
| Camp Roberts | ( 3,500) | B | DACHO5-1-74-517 | Zubeldia[2] | 9,146 | 10/1/73 - 9/30/78 | $47,073 |
| Camp Roberts | ( 5,400) | C | DACHO5-1-74-518 | Zubeldia[2] | 22,091 | 10/1/73 - 9/30/78 | $60,849 |

[1] Animal Unit Month (AUM) = One (1) Animal Unit grazing for an entire month. Animal Unit (AU) = Five (5) ewes with lamb, or rams or weaned lambs or older sheep; one (1) horse; one (1) cow, heifer, steer or bull; one (1) weaned calf.

[2] Sheep grazing lease.

[3] Apiary lease (1-acre - 2½ acre-parcels).

Source: Sacramento District, U. S. Army Corps of Engineers.

Water is provided by springs, wells and dams, which with intermittent streams provide a good distribution of water throughout the leased areas during late fall, winter and early spring seasons. During late spring, summer and early fall, the water supply is reduced to water taken from springs, wells, some dams and scattered potholes along the Nacimiento and San Antonio streambeds.

Monthly and yearly rainfall totals are extremely variable, from 7 inches in 1966 to 40 inches in 1969. The average annual rainfall for the grazing areas is 15 inches.

Range evaluations have been made at Fort Hunter Liggett since 1953, when the U. S. Soil Conservation Service conducted a soil and range survey. In their June 30, 1953 report, the statement was made that:

> The range over much of the Reservation is in good condition indicating that management has been good. However, we found some overgrazed, eroded and fair to poor condition areas. One of the most damaging factors found on the range was the teeming population of squirrels. The squirrels have denuded quite a few areas and unless checked, will harm more areas and lessen production of the forage on the entire range.

A number of range management suggestions were made, including fertilizing, controlled burning, fencing, leaving vegetation on ground at end of grazing period and moderate grazing to bring about most desirable forb/grass mixture.

Dillard, in January 1971, indicates that range management appears to be good, but that parts of the area are losing density due to failure of proper use by livestock, which otherwise are expected to scatter seed and trample it underground where it can grow.

Biswell, in October and December 1971, indicated that the blue oak woodland-grass ranges were generally moderately utilized. He suggests burning mixed chamise and chaparral to encourage deer. He estimates that the entire reservation may support 54,000 to 60,000 AUMs, with possible supplemental feeding November 15 to February 15. He states that the reservation (October 1971) is considerably overstocked. Range condition for most of the reservation is good; however, could be over-utilized by February.

In December the same areas were looked at by Biswell. Precipitation had been light and weather cold. Biswell states that there was little plant growth, that cattle are in weak condition, obviously not getting enough to eat and recommended 20 pounds per day per head of good quality hay to hold animals in feeding area and prevent excessive soil trampling. He estimates carrying capacity will be 30,000 to 40,000 AUMs because of late rains, cold weather and close grazing.

In January 1973 Dr. Leopold reported in a letter to General Moore that the Hunter Liggett Reservation rangelands were severely overgrazed and that this depleted range could not support much wildlife.

In March 1973 Dr. Longhurst discussed a number of range management possibilities on Hunter Liggett. These included fertilization, brush management (herbicides, burning) and reseeding. His opinion was that cattle and deer do not have severe competition on this type of range. "Cattle would have to be stocked extremely heavily, virtually to the point of starvation, before significant detrimental effects would be produced on the deer population." He states that deer and quail are benefited by moderate cattle grazing, which tends to promote species of grasses and herbaceous plants at lower successional levels. These species, such as filaree, are preferred.

He also states that doves thrive best when grassland is held at a low successional stage through moderately heavy livestock grazing. The degree of grazing needed to support turkey mullein, however, would not be favorable for cattle or other wildlife. Turkey mullein abundance is down, possibly because of increased levels of cattle grazing.

In November 1973 Stroud gave a speech concerning the management and utilization of natural resources on the Hunter Liggett range in which he discussed grazing and land use and management studies, but did not mention ground squirrels as a problem.

In May 1976 Dr. Menke prepared a range report in which he indicated that the grassland and woodland grass range types had sufficient live ground cover to prevent raindrop soil compaction and surface erosion. However, with some exceptions, standing-dead herbaceous plant residues, litter and mulch were in very short supply. These factors indicate heavy utilization of forage but not soil degradation.

Dr. Menke predicted unavoidable local overutilization during the summer and fall of 1976 on the grassland and woodland-grass range types, based upon the April livestock stocking rate, the planned reduction in livestock numbers and the low rainfall. He further states that local over-utilization and loss of ground cover will occur seasonally, generally on nearly level land, pointing out that riparian habitats may suffer some degradation in the process if not managed carefully.

Menke reports that the species composition of the grass-land ranges were not significantly different than that of a moderately grazed annual rangeland. Filaree (Erodium spp.) and brome grasses (Bromus spp.) dominate the open grasslands while wild oat (Avena spp.) is more abundant on steeper slopes and areas less susceptible to livestock.

Livestock grazing has affected the species composition by reducing taller grasses and promoting lower prostrate forbs such as filaree, trefoil and bur clover. Wildlife (especially quail and deer) prefer these forbs, which are more nutritious than grasses.

Yellow-star thistle and tarweed have infested some areas. Except for these weedy sites, the mixture of annual grasses and annual forbs was considered to be acceptable and desirable for sustained production of wildlife and livestock grazing.

The plant production, however, is highly dependent upon rainfall and other factors.

Ground squirrels have removed a significant ground surface area from production and consume a significant amount of forage that could be more productively consumed by other wildlife and livestock.

Ground squirrels may be associated with both nonutilized as well as heavily utilized land, and at Hunter Liggett are certainly associated with heavy utilization by livestock.

Menke points out that with reduction in forage utilization and reduction in squirrel numbers, more net forage would be available for livestock grazing in a few years, thus the same number of livestock could be supported with a lower utilization.

Menke also refers to Dr. Harold Heady who has pointed out (Heady, 1975) that the amount of herbaceous plant residue (mulch) at the end of the grazing season may be related to plant productivity, and that approximately 500 pounds/acre seems to be optimal for sustained yield. Quantitative measure-ments should be instituted to monitor utilization.

Based upon qualitative inspection, Menke rates the Fort Hunter Liggett general range conditions as fair on a scale of poor, fair, good and excellent.

The Sacramento district Corps of Engineers expects to shortly award a contract for the preparation of a range and related resource inventory and condition report with management recommendations for Fort Hunter Liggett.

The study will include detailed information on soil and vegetation types, range condition and trend, carrying capacities for wild and domestic animals and recommendations for range improvement practices. Additional information on threatened and endangered species, both plant and animal, and critical habitats will be included.

The study will also report on:

1. Average annual carrying capacities for each of the range types for domestic livestock in terms of animal unit months as defined in the existing outlease documents. The carrying capacities should reflect the maximum stocking rates possible without inducing damage to the range or related resources (i.e., wildlife, soils, etc.). Summations of carrying capacities for range types shall be made for each of the existing grazing outlease areas as well as for those areas (primarily brushlands) not presently outleased for grazing.

2. Recommended grazing strategies for each of the existing outleased areas, including seasonal variation of actual stocking rates and distribution of livestock. These recommendations will be based on existing range improvements and controls, such as present locations of fences and water developments.

3. Suggested range improvements for each area, such as cross-fencing, rehabilitation and/or development of watering facilities, salt distribution, range type conversion through burning and reseeding, fertilization, range rodent and wood control, etc. Along with each recommendation shall be included a cost analysis and resulting change in grazing strategy for the area.

Fort Ord

One sheep lease for 6,031 acres at a stocking rate of 13,500 AUMs is in effect at Fort Ord. The carrying capacity at Fort Ord was established by range management personnel employed by the Fort Ord complex and the district engineers office, Corps of Engineers (Wheeler, pers. comm.).

Camp Roberts

One cattle lease for 5,854 acres at a stocking rate of 13,500 AUMs and two sheep leases -- one for 9,146 acres and 3,500 AUMs, the other for 22,091 acres and 5,400 AUMs are in effect at Camp Roberts. The carrying capacity at Camp Roberts was established by range management personnel employed by the Fort Ord complex and the district engineers office (Wheeler, pers. comm.).

Field Observations -- November 8-19, 1976
by Jones & Stokes Associates, Inc.

Jones & Stokes Associates, Inc. personnel traveled over some of the rangelands of Forts Ord and Hunter Liggett and Camp Roberts and made several observations concerning range appearance.

Generally, grazing on Fort Ord appeared to be of medium intensity and grass was being maintained. Some undesirable species such as Medusa head (Elymus capert medusa) are invading, probably due to seed introduction.

Grazing on Fort Hunter Liggett and Camp Roberts appeared to be very intense. There was a great reduction of dry litter on the area's surface in the dry season.

There was no observed evidence of erosion related to grazing on any of these areas.

# LAND USE RELATIONSHIPS

## LEGAL, POLICY AND INSTITUTIONAL CONSTRAINTS

This section provides a checklist of laws and regulations of various governmental agencies that have either regulatory or planning responsibility that affects the planning and implementation of the proposed ground squirrel control program -- either directly or indirectly. It describes those land use plans, policies and controls which may act as constraints at the federal, state or local level. Any conflicts or inconsistencies between these and the proposed action will be addressed in the Proposed Action and Alternatives-Impacts and Mitigation section.

Federal installations and federal activities are generally not subject to non-federal laws and regulations. The state and local laws and regulations listed in this section do not apply to the federal government, and the proposed activity is not subject to their provisions. However, the federal decision makers will fully consider these local laws and regulations insofar as they provide sound environmental policy and standards.

### Environmental Requirements

#### National Environmental Policy Act

The National Environmental Policy Act of 1969 (NEPA) establishes policy regarding environmental quality. NEPA directs that proposals for major federal actions that significantly affect the quality of the environment include a a detailed statement on the environmental impact of the proposed action. Alternatives to the proposed action must be circulated for comment to other federal agencies, to state and local governments and to the public.

#### Council on Environmental Quality NEPA Guidelines

The Council on Environmental Quality (CEQ) is responsible for coordinating the development of the impact statement process. Their published guidelines apply to the obligation of all federal agencies under section 102(2)(c) of NEPA. Under these guidelines each federal agency is required to adopt procedures for the implementation of the Act and the CEQ guidelines.

## Department of Defense Directive and Army Regulations

Department of Defense Directive 5100.50 and Army Regulation 200-1 together with the Department of Army Pamphlet 200-1 -- Handbook for Environmental Impact Analysis -- are the military's procedures for implementing the CEQ's guidelines.

## California Environmental Quality Act (CEQA)

The CEQA requires the preparation of environmental impact reports by public agencies on any project they propose to carry out or approve which may have a significant effect on the environment. The California Resources Agency is responsible for the preparation and issuance of regulations to implement the Act.

## Land Use Constraints

Certain Federal legislation and regulations provide direction and guidance to the management of military lands.

## Sikes Act - Public Law 86-797 (1960)

This act authorizes the Secretary of Defense to carry out a program of planning, development, maintenance and coordination of wildlife, fish and game conservation and rehabilitation in military reservations in accordance with a cooperative plan mutually agreed upon by the Secretary of Defense, Interior and the appropriate state agency.

## Department of Defense Directive #5500-5 (1965)

This directive prescribes DOD policies and establishes an integrated multiple-use program for renewable natural resources in forests, woodlands, fish and wildlife, soil, water, grasslands, outdoor recreation and natural beauty. This directive references DOD directive 5154.12 which establishes an Armed Forces Pest Control Board which functions as the coordinating activity in the DOD for pest control and is the principal advisory board to all DOD agencies and activities on all matters relating to pesticide use, including those pertaining to the problems of resource conservation and management.

Natural Resources - Land, Forest and Wildlife Management
AR 420-74

This regulation establishes natural resource management objectives and principles, requires the preparation of various land and resource management plans, and requires the preparation of annual natural resources reports for each installation.

Cooperative Agreement for the Conservation and Development of Fish and Wildlife for the Fort Ord Complex consisting of Fort Ord, Camp Roberts and Hunter Liggett Military Reservation, California. (May, 1963)

This agreement between the California Department of Fish and Game, the U.S. Fish and Wildlife Service and the Commanding General, Fort Ord was consummated to carry out the Sikes Act and to implement the directive and regulations indicated above.

American Antiquities Act of 1906

This act provides for the protection of historic and prehistoric ruins, monuments, or objects of antiquity on federal land.

National Historic Preservation Act of 1966

This act provides for a National Register of Historic Places. It is the basis for Executive Order No. 11593.

Executive Order No. 11593

This Executive Order directs federal agencies to ensure the preservation of cultural resources on federal ownership.

## Endangered Species

Federal Endangered Species Act of 1973, PL 93-205

Section 7 of the Endangered Species Act directs that all Federal agencies shall utilize their authorities in furthering the purposes of the act, shall not authorize, fund, or carry out actions that will result in jeopardizing the continued existence of listed species or action which will result in the destruction or adverse modification of the habitats of listed species.

## California Endangered Species Act of 1970

The California Endangered Species Act of 1970 gives authority to the Fish and Game Commission to declare birds, mammals, fish, reptiles, and amphibians as endangered or rare and to prohibit with limited exceptions and importation, taking, possession and sale of rare and endangered wildlife.

## Pest Control

### California Authority

Basic authority for pest control in California is vested in the Department of Food and Agriculture through various sections of the California Agriculture Code. The County Agricultural Commissioners act as enforcing officers of pest control laws and regulations and generally direct the pest control programs. Relevant agriculture code sections are:

Section 403: The Department shall prevent the introduction and spread of injurious insect or animal pest, plant diseases, and noxious weeds.

Section 482: The Director may enter into cooperative agreements with individuals, associations, boards of supervisors, and with departments, bureaus, boards, or commissions of this state or of the United States for the purposes of eradicating, controlling or destroying any infectious disease or pest within this state. He may enter into cooperative agreements with boards of supervisors for the purpose of administering and enforcing this code.

Section 5101: Each commissioner is an enforcing officer of all laws and regulations which relate to the prevention of the introduction into, or the spread within the state of pests. He is, as to such activities, under the supervision of the Director.

Section 6021: If the director receives a report from the State Director of Public Health which states that field rodents in a certain area carry, or are likely to carry, any disease, insect, or other vector of any disease which is transmissible and injurious to humans, he shall forthwith advise the commissioner of the county in which such rodents exist.

Section 6022: The commissioner shall cooperate in suppressing field rodents and insects, or other associated vectors of rodent-borne diseases transmissible and injurious to humans.

Section 6023: The director shall cooperate by entering into an agreement pursuant to Section 482 for the purpose of suppressing the field rodents and insects or other associated vectors in the reported areas and in neighboring areas, to prevent the spread of the rodents and insects, or other associated vectors.

Section 6024: In order to carry out the purposes of this article, the director or commissioner may enter upon any and all premises within any reported areas or neighboring area to bait, trap, expose chemically treated baits, or perform any act which he deems necessary for the purpose of suppressing, destroying, or repelling the rodents and insects, or other associated vectors.

California government code section 25842 provides that County Boards of Supervisors may provide for the control or destruction of gophers, squirrels or other wild animals.

Several sections in the California Fish and Game Code and Title 14 of the Administrative Code address the subject of pest control. Extracts of relevant sections follow.

* Section 4152: Taking Nongame Mammals, Jackrabbits, Muskrats, and Red Fox Squirrels. Nongame mammals and black-tailed jackrabbits, muskrats, and red fox squirrels which are found to be injuring growing crops or other property may be taken at any time or in any manner by the owner or tenant of the premises or employees thereof, except that if leg-hold steel-jawed traps are used to take such mammals, the traps and the use thereof shall be in accordance with the provisions of subdivisions (a) and (b) of Section 4004. They may also be taken by officers or employees of the California Department of Food and Agriculture or by federal, or county officers or employees when acting in their official capacities pursuant to the provisions of the Food and Agricultural Code pertaining to pests, or pursuant to the provisions of Article 6 (commencing with Section 6021) of Chapter 9 of Part 1 of Division 4 of the Food and Agricultural Code. Persons taking mammals in accordance with this section are exempt from the requirements of Section 3007. (Exempt from requiring a hunting license or permit.)

Section 3005: Taking by Poisons. It is unlawful to take birds or mammals with any net, pound, cage, trap, set line or wire, or poisonous substance, or to possess birds or mammals so taken, whether taken within or without this State.

Proof of possession of any bird or mammal which does not show evidence of having been taken by means other than a net, pound, cage, trap, set line or wire, or poisonous substance, is prima facie evidence that the birds or mammals were taken in violation of the provisions of this section.

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* Note: The ground squirrel is a non-game mammal.

This section does not apply to the lawful taking of furbearing mammals, nongame birds, nongame mammals, or mammals found to be injuring crops or property, nor to the taking of birds or mammals under depredation permits, nor to the taking by employees of the Department acting in official capacity or holders of a scientific or propagation permit acting in accordance with the conditions of the permit.

Policy Statement - Rare and Endangered Species - California Department of Food and Agriculture, Fish and Game and the California Agricultural Commissioner's Association

The 1976 joint policy statement recognizes there may be hazards with certain applications of toxicants for the control of vertebrate pest animals in specific areas inhabited by rare and endangered species.

The policy provides that each county or the state's proposed vertebrate pest animal control program within the range of rare or endangered species shall be reviewed annually by the Department of Fish and Game to ascertain the threat to any of these species. The Department will identify any problems to rare and endangered species and so advise the Department of Food and Agriculture and the agricultural commissioners of the affected counties.

## Use and Control of Pesticides

### Federal

General. In 1947 the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) was enacted. Its primary objective was to license pesticides to regulate interstate shipment. This act was amended by the Federal Environmental Pesticide Control Act of 1972, (FEPCA) which is administered by EPA. It requires federal registration by EPA, with only a few exceptions, for all pesticides used in the United States. The Act establishes registration and permit procedure, classifies pesticides, provides for the certification of applicators to apply restricted use pesticides and provides for supervision, cancellation, indemnification and judicial review.

The effective dates of provisions of the act vary, based on the 1972 act and amendments since that time. The final date for re-registration of previously registered pesticides (i.e., by states) has been extended to October 1977 due to the 1975 amendments of the act.

Rebuttable Presumption List. Compound 1080 has not yet been registered by EPA for ground squirrel control although state registration exists. Compound 1080, 1081 and strychnine were placed by EPA on their rebuttable presumption list based on EPA regulations (40 CFR 162). Section 162.11 provides that a rebuttable presumption against registration shall arise if it is determined that a pesticide meets or exceeds any of the criteria for risks set forth in 162.11(a)(3).

Rebuttable Presumption Notice. On December 1, 1976 EPA filed notice in the Federal Register (Vol. 41, No. 232) indicating that a rebuttable presumption against registration of all pesticide products containing strychnine, strychnine sulphate or compounds 1080 and 1081 does exist. Under these regulations, all registrants and applicants for registration are notified and given 45 days to submit evidence in rebuttal of the presumptions listed which indicate the strychnine products or compound 1080 and 1081 meet or exceed the risk criteria set forth in 40 CFR 162.11(a)(3). All information, including public comments, will be considered by EPA before it is determined whether a notice shall be issued in accordance with 40 CFR 162.11(a)(5)(ii).

The risk criteria referenced in the rebuttable presumption notice are as follows.

A. Acute Toxicity. Hazard to wildlife Sections 162.11(a)(3)(i)(B)(1) and (2) provide that a rebuttable presumption shall be issued if the pesticide as formulated occurs as a residue immediately following application in or on the feed of a mammalian or avian species representative of species likely to be exposed to such feed in amounts equivalent to the average daily intake, at levels equal to or greater than (1) the acute oral $LD_{50}$ for mammalian species and (2) the subacute dietary $LC_{50}$ for avian species.

B. Effects on Nontarget Organisms. 40 CFR 162.11(a)(3)(ii)(C) provides: "A rebuttable presumption shall arise if a pesticide's ingredient(s) * * * [c]an reasonably be anticipated to result in significant local, regional or national population reductions in nontarget organisms, or fatality to members of endangered species".

C. Lack of Emergency Treatment. 40 CFR 162.11(a)(3)(iii) provides: "A rebuttable presumption shall arise if a pesticide's ingredient(s) * * * [h]as no known antidotal, palliative, or first aid treatment for amelioration of toxic effects in man resulting from a single exposure".

(The EPA evidence which supports its position that these risk criteria have been exceeded is provided in the Proposed Action and Alternatives-Impacts and Mitigations section.

## Exemptions of Federal and State Agencies

FIFRA as amended provides for certain exemptions by federal and state agencies when an emergency exists. The two types of exemptions that are relevant are the "specific exemption" and the "crisis exemption".

An emergency will be deemed to exist when (a) a pest outbreak exists or is about to occur and no registered pesticide or alternate method of control is available to eradicate or control the pest, (b) significant economic or health problems will occur without the use of pesticide, and (c) the time available from discovery or prediction of the pest outbreak is insufficient for registration of pesticide. Permits will be granted for specific exemption, quarantine-public health exemption and crisis exemption.

Exemptions shall be applied for in writing by the head of the federal agency or governor of the state involved, to the EPA administrator. Applications shall include a list of the pesticides proposed for use, whether a registered pesticide is available for the proposed use, the scope and nature of the situation demanding exemption, description of the proposed pest control or public health program, and statements of possible effects on man and the environment. If an EIS has been prepared, it should be submitted.

When a specific exemption has been approved, the agency involved shall immediately inform the EPA of the time and place of pesticide application; record quantity, location and extent of use of pesticide, and inform EPA within 10 days of end of application; monitor effects as required by EPA and report results; provide a summary report within 1 year.

When a federal or state agency uses a crisis exemption, the agency head or state governor shall notify the EPA by telegram within 36 hours after the pesticide has been used. Within 10 days, a written report shall be filed with EPA stating nature and scope or emergency; pest involved; unavailability of appropriate registered pesticide; critical nature of time element which did not allow request for specific or quarantine-public health exemption; application information (location, quantity, method, duration, personnel); steps being taken to reduce possible adverse effects on man and environment. If crisis treatment is expected to last more than 15 days total, the report should be accompanied by a specific exemption application.

On 13 August 1976, Fort Ord, U.S. Army notified EPA of a crisis exemption declaration to control plague vector fleas. The notification stated:

On 11 August 1976, Fort Ord, U. S. Army, exercised crisis exemption under Section 18 under the Federal Insecticide, fungicide and Rodenticide Act as amended because of an imminent plague hazard which required that Carbaryl be evaluated to control plague vector fleas.

Three hundred (300) pounds of Carbaryl Dust, 10 percent, EPA Registration #7001-179-AA, EPA Establishment #7001-CA-1, Occidental Chemical Company, was applied to control plague vector fleas on approximately 20 acres at Fort Hunter Liggett, California, because a registered 10 percent Carbaryl Dust product was not readily available. Approximately 2 ounces of Carbaryl Dust was placed into each California Ground Squirrel (Spermophilus Beecheyi) burrow.

The time element prohibited Fort Ord from requesting a specific exemption or waiting until a registered product could be shipped from Thompson-Hayward Chemical Company in New Orleans, Louisiana.

Executive Order Regarding Federal Lands. On February 9, 1972, the President issued Executive Order 11643, titled Environmental Safeguards on Activities for Animal Damage Control on Federal Lands. This order was rewritten and issued by the President July 18, 1975 as Executive Order 11870. The order was further revised by Executive Order 11917, May 28, 1976. The order prevents on federal lands "field use of any chemical toxicant for the purpose of killing predators, and the field use of any chemical toxicant which causes any secondary poisoning for the purpose of killing mammals, birds, or reptiles".

Section 3b of Executive Order 11870 states:

Notwithstanding the provisions of Subsection (a) of this section, the head of any agency may authorize the emergency use on Federal Lands under his jurisdiction of a chemical toxicant for the purpose of killing other mammals, birds, or reptiles, but only if in each specific case he makes a written finding, following consultation with the Secretaries of the Interior, Agriculture, and Health, Education and Welfare, and the administrator of the Environmental Protection Agency, that an emergency exists that cannot be dealt with by means which do not involve use of chemical toxicants, and that such use is essential.

On 17 August 1976 the Army held a meeting under Section 3b with the Departments of Agriculture, Interior, HEW, EPA, and the Council on Environmental Quality on the threat to human health associated with large populations of ground squirrels on military installations in the State of California and to determine measures necessary to mitigate the threat of human infection from plague. Excerpts from the Army Memorandum of Record (August 19, 1976) state:

The objective of the meeting was to present evidence that a threat to human health exists and to solicit the opinions of the agencies represented as to whether we have a basis to seek exception to the Executive Order for the use of a toxicant having secondary effects for rodent control.

Significant points from the meeting are:

1. The Surgeon General's Office presented the rationale for the Army Surgeon General's determination that a threat to human health exists (Incl 2). The factors contributing to this determination are: a highly abundant, plague-susceptible host species (Spermophilus beecheyi); high flea counts on the rodent hosts; a marked increase this year in the occurrence of epizootic plague and human cases throughout the Western states, including California; and evidence by carnivore serology of the existence of plague foci at the Fort Ord complex or in the vicinity. The California State Department of Health and the DHEW agreed with TSG's appraisal of the existence of a serious threat to human health.

2. Walter Reed Army Institute of Research presented data on the incidence of human plague in the Western United States from 1920-1976 (Incl 3). These data show that the overall incidence of plague cases has increased in recent years in the U.S., and suggest that the problem is a great deal broader in scope, involving other Federal lands in the West, than the immediate problem at Fort Ord.

3. Letterman Army Institute of Research presented findings on the prevalence of rodents and fleas at Fort Ord, and on research studies being conducted at Fort Ord on flea and rodent control measures (Incl 4). The data indicate that, in areas of human habitation, carbaryl for flea control and diphacinone for rodent control are adequate. For large scale controls (i.e., in open range areas) the materials of choice would appear to be carbaryl and 1080. The data on carbaryl are preliminary; however, studies just initiated with this compound show good flea control in 48 hours. If carbaryl is shown to have persistent effects, carbaryl will be the insecticide of choice. Controls will be required on a continuing basis. Rodenticide 1080 can be applied annually to achieve adequate results. Other rodenticides would require more frequent application, and are not amenable to aerial dispersal. The DHEW indicated that continuing evaluations of the effects of control measures would be warranted.

4. Flea and rodent control will be initiated in areas of human habitation, using carbaryl and diphacinone. An environmental assessment of this operation will be made and publicized.

6. Department of Agriculture, Interior, HEW, EPA and CEQ will present their written opinions within two weeks as to whether we have due cause to seek exception to Executive Order 11870 for use of a secondary effects toxicant for rodent control for reason of protection of health and safety of human life.

7. Based on the opinions and recommendations received (6 above), a plan for control and an EIS will be prepared for actions required for eradication on open range land. All feasible alternatives will be considered in the EIS review process.

8. We can expect to do range controls no sooner than the Spring of 1977, considering the procedural requirements to be met and the fact that squirrels will be hibernating during the winter months, when controls would be of minimal value. The month of September would normally be a time that controls could be expected to be reasonably effective, but it would not be possible to meet the procedural requirements in time for controls to be exercised in this time frame.

*Consultation Responses*. On September 2, 1976, Mr. Richard Feltner, Assistant Secretary, U. S. Department of Agriculture memo to the Army stated:

This is in response to your August 20 letter about Executive Order 11870 and the use of "1080" (Sodium monofluoroacetate) to control ground squirrel in California because of a likelihood of plague.

Our review of your information on the subject indicates that a threat does now exist to human health. Therefore, this Department concurs that (1) an emergency exists and (2) that an emergency exists which cannot be dealt with by means which do not involve the use of chemical toxicants and that such use is essential according to the provisions of the Executive Order.

Mr. John Ritch, Director, Registration Division, the Environmental Protection Agency (EPA), indicated at the August 17 meeting that EPA has two State "1080" registrations labeled for ground squirrel control in California. If used according to their registered label directions for use, we believe that adverse effects on the environment are not likely to occur.

On August 24, 1976, Mr. Russell W. Peterson, Chairman of the Council of Environmental Quality memo excerpts to the Army stated:

The Council is concerned about the effects of such a proposal and the proper integration of a Section 3(b) determination under the Executive Order with the policies and procedures of the National Environmental Policy Act (NEPA). We are also anxious to insure the best possible coordination of the actions of federal agencies that have jurisdiction and expertise in determining the need for and effects of ground squirrel control measures as that control may be necessary because of the squirrel's infestation with fleas, the potential carriers of bubonic plague.

It appears that, based on the information presented by the office of the Army Surgeon General at a meeting of federal agencies on August 17, 1976, there may be a public health problem requiring an immediate flea control program in certain California military installations. We understand that the Army proposes to take such steps, involving the use of Carbaryl, based on an adequate environmental review that will be widely circulated among the public and other federal, state and local agencies. We hope that after full evaluation of their effectiveness by the Army and other federal agencies these immediate flea control measures will have reduced the public health risks posed by present squirrel and flea populations to acceptable levels.

It is the Council's view, however, that there is no present emergency justification for the use of 1080 or DDT to control fleas and ground squirrel populations in military installations in California. Justification for the use of such chemical toxicants and for the declaration of an emergency under Section 3(b) of the Executive Order can and should be determined only after completion of the environmental impact statement process.

The consultation that has already begun pursuant to Section 3(b) of the Executive Order should be a part of that impact statement process. We recommend to the Department of the Army that in the course of this consultation process it work closely with HEW and the Fish and Wildlife Service of the Department of the Interior in order to determine their respective expertise and responsibilities in helping to prepare the impact statement. It will also be necessary to obtain the expertise and assistance of EPA in order to decide whether any chemical toxicant, such as 1080, might pose more serious threats to public health and the environment than would be posed without control program. The Council is, of course, ready to assist the federal agencies in determining the scope of the impact statement and the individual agency responsibilities for its preparation.

On October 22, 1976, Mr. John Quarles, Deputy Administrator, EPA, for Russell E. Train memo excerpts to the Army stated:

It has been recommended by the Office of Pesticide Programs, and I concur, that I advise the Army to use ground application of the anticoagulant bait diphacinone and zinc phosphide grain for ground squirrel control in areas of human activity, and aerially applied zinc phosphide in remote areas. Zinc phosphide is not currently registered for ground squirrel control. However, the U.S. Department of Interior does have a pending application for zinc phosphide. Certain data must still be submitted but we do not anticipate problems with the submission of the requisite data. Zinc phosphide for ground squirrel control on rangelands should be registered in time for use in a spring program. It is the Agency's position that the Army has amply demonstrated that an emergency health risk exists to warrant a request for an exemption from the Executive Order to allow them to use a chemical toxicant, but it is felt that 1080 (sodium fluoroacetate) should be avoided unless other means of control are shown to be ineffective. In this way, we can take all steps necessary to avoid secondary poisoning and allow the Army to prepare an Environmental Impact Statement for a spring program, if 1080 proves necessary.

A diphacinone and zinc phosphide program is expected to result in reliable reduction of ground squirrels, and to reduce the hazard of an epizootic, and subsequently, a plague threat to humans. Also, since the ground squirrel population will not be completely exterminated, we would advise the continuation of the carbaryl dusting program which has been shown to be effective in destroying the ground squirrel fleas, the carriers of the plague.

In the process of contacting the various State and Federal authorities, including the California Department of Health, the Army Surgeon General, and the Center for Disease Control (CDC), and with the agreed upon recommendation that the ground squirrel population should be reduced by at least 85 percent, one particularly important aspect of the ground squirrel population explosion was noted: the increase appears to have resulted from the overgrazing of the Federal lands involved. This point was particularly stressed by Dr. Allan Barnes of the CDC,* and he urged that the Army take steps to correct this problem. Although this Agency has not fully examined this allegation, we believe it would benefit the Army to examine this possibility in order to avoid future control programs that could possibly result in secondary poisoning to endangered species.

* In a letter of December 2, 1976 to the office of the client engineers, Dr. Barnes wrote that he did not state that the increase of ground squirrels appears to have resulted from overgrazing of the federal lands involved. He wrote that he did state the belief, essentially in agreement with EPA, that the Army would benefit from a consideration of environmental factors found to affect squirrel populations -- negatively or positively in future land use planning.

I am hopeful that this correspondence will aid the Army in determining the methods it will apply to control the ground squirrel population. I would add that any field use of zinc phosphide must be closely monitored by representatives of the California Fish and Game Department, and/or the U.S. Fish and Wildlife Service, to ensure that provisions of the Endangered Species Act are followed and that non-target species are minimally affected. If I may be of any further service, please feel free to contact me.

On September 10, 1976, Mr. David Mathews, Secretary of the U. S. Department of Health, Education and Welfare memo to the Army stated:

Thank you for your letter of August 20 requesting an opinion on the need to seek an exemption to Executive Order in order to use toxicants having secondary effects for the purpose of rodent control on military installations in California.

It is our understanding from the data presented at your meeting on August 17 with Department representatives that the potential for the occurrence of bubonic plague exists at the Fort Ord military complex in California. The evidence of a possible health threat included an abundant and susceptible rodent population, a consistently high flea count on rodent hosts, and positive serological findings in carnivores. With this indication of a plague focus in the vicinity of human activity, and the known endemicity of epizootic plague in several Western States, we agree that a potential hazard to human health does exist. The reduction or elimination of such a health hazard is consistent with good preventive health policies.

We, therefore, concur with your findings and support your need to use the appropriate chemical toxicants which will effectively control the flea and rodent populations. We feel assured that toxicants will be used with concern for human safety and the vested interests of all State and Federal agencies.

On September 9, 1976, Mr. Nathaniel Reed, Assistant Secretary for Fish and Wildlife and Parks, U. S. Department of Interior memo excerpt to the Army stated:

Determination of an "emergency" in this instance appears to rest within the sphere of expertise of public health authorities, epidemiologists, or physicians, and is therefore beyond the scope of professional knowledge in this Department. However, there may be some question as to the immediacy of the emergency since the Memorandum of Record attached to your August 20 letter indicates that broadcast application of 1080 rodenticide is not anticipated before spring of 1977. While this delay is attributed to procedural requirements occasioned by restrictions on the toxicant of choice,

1080, by provisions of Executive Order 11917, it seems inconsistent with an "emergency" situation to delay several months when another rodenticide, zinc phosphide, may be available for immediate use. Zinc phosphide to our knowledge does not have secondary poisoning characteristics and its use would therefore not be prohibited as a field rodenticide by the Executive Order.

It should also be noted that as prerequisite to implementing the emergency provisions of Section 3(b) of the Executive Order, consideration must be given to Section 1(5) which states as the policy of the Federal Government to "assure that where chemical toxicants or devices are used pursuant to Section 3(b), only those combinations of toxicants and techniques will be used which best serve human health and safety and which minimize the use of toxicants and best protect nontarget wildlife species and those individual predatory animals and birds which do not cause damage..." (emphasis added). The choice of 1080 as the preferred rodenticide in this circumstance should be weighed carefully against the policy stated in Section 1(5) of the Executive Order.

Again referring to the Memorandum of Record attached to your August 20 letter, it is inferred therein that annual use of rodenticide 1080 is contemplated. Before this practice is adopted as a permanent procedure, a better understanding is needed of the dynamics of the ground squirrel population at the Fort Ord complex. Numerous studies of ground squirrels and other range rodent populations suggest that a number of environmental factors other than the absence of toxicant control are responsible for population eruptions or unusually high population densities sustained over a period of time. By identifying these factors, it is possible to develop management plans which are cost effective and environmentally safe with minimal need for toxicant use or other control techniques. I recommend that appropriate studies be conducted to determine what these management plans should be.

U. S. Department of Interior guidelines for use of poisons in Nonpredatory Animal Damage Control (May 23, 1972).

The purpose of this guideline is to specify chemicals permitted and conditions under which they may be used when controlling damage caused by nonpredatory mammals, birds and reptiles on Interior Department lands or in programs under Interior Department jurisdiction in compliance with Executive Order No. 11643.

The stated policy of Executive Order No. 11643, "Environmental Safeguards on Activities for Animal Damage Control on Federal Lands," provides specific restrictions on the use "...of chemical toxicants which cause any secondary poisoning effects for the purpose of killing... mammals, birds, or reptiles...." Further, the policy clearly states that all mammal and bird damage control programs "...shall be conducted in a manner which contributes to the maintenance of environmental quality, and to the conservation and protection, to the greatest degree possible, of the Nation's wildlife resource...."

## Secondary Poisoning Effect Resulting From Field Use

By Executive Order definition, a "secondary poisoning effect" occurs when a chemical toxicant is retained in a target animal in such a manner and quantity that its chemical action will cause significant bodily malfunction, injury, illness or death to non-target animals or to man when the body part retaining the chemical in question is ingested.

It is clear that the degree of toxicity of a chemical varies in accordance with its respective chemical and physical properties and with the amount and manner of its use. The degree of secondary poisoning effect caused by such toxicants will vary similarly. It is evident that some toxicants will have a "secondary poisoning effect" only as a result of gross application and consequent accumulation in the target species. Accordingly, if these toxicants are not used in such gross amounts, it is permissible to use them for the control of non-predatory, depredating mammals and birds. Thus, it is within the intent of Executive Order No. 11643 that determination of a "secondary poisoning effect" must allow for consideration of amounts and methods of actual field use as well as the toxicological properties of the chemicals in question (CF, 50 Am. Jr. Statutes, 378, 382).

In summary, toxicants which have a theoretical secondary poisoning effect may be used if, in practical application, toxic concentration, bait materials, and methods of application are so controlled as to prevent adverse secondary effects to man and non-target populations.

## Authorization Procedure

Since this interpretation of Executive Order No. 11643 relies heavily upon applying practical secondary poisoning effect data to field situations, it is necessary to consider use of permitted toxicants in the light of specific patterns of use and to base decisions for using these materials on sound ecological knowledge of specific habitats. Standard dose-weight pharmacology toxicity estimates should be considered as they relate to the target organism as well as to carrion feeders that can be expected to share its habitat. Since secondary poisoning hazard will vary with specific field conditions, agency directors will be responsible for assuring that adverse secondary effects to man and non-target populations will not result from field patterns of use, that such uses comply with federal and state pesticide use regulations, and that programs proposing use of chemical toxicants are submitted as appropriate for review and approval by the Federal Working Group on Pest Management.

Toxicants Permitted for Non-Predatory Mammal and Bird Control (partial)

Only the following chemical toxicants may be used within the context of these guidelines:

1) Non-predatory mammal control baits -- baits treated with strychnine alkaloid or zinc phosphide may be used for controlling non-predatory mammal damage. Potential for secondary poisoning effects from normal uses of these toxicants are related to remnant amounts of the toxicant not degraded in the gastro-intestinal tract prior to death of the target individual and are not associated with other body parts. Since baits are treated at the lowest concentration effective against target animals, the possibility of secondary poisoning effects" occurring under field conditions is remote. However, if there is reasonable doubt as to secondary poisoning hazard, use will not be made.

3) Burrow fumigants -- These fumigants include cyanide compounds, carbon bisulfide, methyl bromide and chloropicrin. These chemicals are generally considered to have no secondary poisoning effect and since use is restricted to underground situations, the likelihood of contact with carrion feeders is remote.

4) Suffocating cartridges -- These devices, when ignited and inserted into closed burrows, remove available oxygen and result in suffocation of target species. Secondary poisoning effects are not possible under these conditions.

Non-Field Use

The Executive Order restrictions apply only to "field use" of chemical toxicants. "Field use" applies only to controlling damage caused by non-commensal mammals, birds and reptiles. The order does not apply to urban bird and rodent control programs for residential, industrial, and urban facilities, including garbage dumps, communication facilities, etc.; the order does not restrict the type of chemical toxicants that can be used in these situations.

## California Authority

The prime authority for control of pesticides in California is vested in the California Department of Food and Agriculture. Various pesticide laws are found in the California Food and Agriculture Code. Rules and regulations are found in Title 3, California Administrative Code.

The various laws and regulations define economic poisons, regulate their manufacture, labelling, and distribution, designate those which are restricted, require permits for their use and establish regulations covering pest control operators, advisors and dealers -- all designed to carefully control the uses of pesticides in California.

The rodenticide sodium monofluoracetate (compound 1080) is a restricted material and a permit is required for its possession and use. Its sale, use and possession is covered in Article 22, Sections 2470-2472 of the California Agriculture Code. Section 2471 controls the sales, records, possession, storage, containers, handling and waste disposal. Section 2472 covers the use for pest control purposes including baits, bait boxes and containers, prohibited uses, indoor and outdoor placement. The rodenticide strychnine and zinc phosphide are also restricted materials and when used for agricultural purposes a permit is required for their use.

Section 6021, Food and Agriculture Code, states:

> Report of rodents carrying diseases transmissible to humans. If the director receives a report from the State Director of Public Health which states that field rodents in a certain area carry, or are likely to carry, any disease, insect, or other vector of any disease which is transmissible and injurious to humans, he shall forthwith advise the commissioner of the county in which such rodents exist.

## Local Regulation and Policy

Monterey County Ordinance. Monterey County Ordinance 328 states:

> An Ordinance to enforce the extermination of ground squirrels in the County of Monterey, State of California, and punish the violation of the same by fine or imprisonment, or both.
>
> The Board of Supervisors of the County of Monterey do ordain as follows:

Section 1. Every person, firm or corporation, owning, leasing, possessing or occupying any land in the County of Monterey, State of California, in and upon which there are any ground squirrels, shall, upon the discovery or knowledge of such presence of ground squirrels, immediately proceed in good faith to endeavor to exterminate, kill and destroy the same by placing, spreading and distributing poisoned grain upon said lands to be taken, eaten or carried away by said ground squirrels, or by placing in the holes or underground runways of said ground squirrels carbon-bisulphide.

Section 2. Any person, firm or corporation that shall violate any of the provisions of this ordinance shall be deemed guilty of a misdemeanor and upon a conviction thereof shall be punished by a fine of not less than $25.00, and not more than $100.00 or by imprisonment in the county jail for a term not exceeding one hundred days, or by both such fine and imprisonment; one half of said fine to be paid to the informant.

Section 3. All ordinances and parts of ordinances in conflict with the provisions of this ordinance are hereby repealed.

Section 4. This ordinance shall take effect and be in force from and after the 2nd day of November, 1908.

Monterey County Resolution. Resolution #76-197 (April 20, 1976) states:

WHEREAS, by reason of the lack of control of ground squirrels on Fort Hunter Liggett and Camp Roberts, the squirrel population on said reservations has reached such proportions as to create a serious health hazard as well as a serious economic loss, and

WHEREAS, the use of 1080 poison is presently prohibited by Executive Order, and

WHEREAS, this Board desires that effective ground squirrel control be undertaken on Fort Hunter Liggett and Camp Roberts by the U. S. Army;

NOW, THEREFORE, BE IT RESOLVED that the Board of Supervisors of the County of Monterey supports the actions of the U. S. Army in obtaining through channels approval of the use of 1080 poison to control ground squirrels on Fort Hunter Liggett and Camp Roberts and environs.

San Luis Obispo County Resolution. Resolution #76-426 (June 7, 1976) states:

WHEREAS, the Federal enclave known as Camp Roberts, located in the northern portion of San Luis Obispo County has, since 1973, become the site of an evergrowing infestation of specifically the California Digger Ground Squirrel, such that said infestation now covers the entire camp consisting of approximately 42,000 acres; and

WHEREAS, the indigenous plant life of Camp Roberts has never been sufficient to sustain this evergrowing population of ground squirrel, and because this condition has become even more aggravated due to this year's drought, vast migration of ground squirrel may be reasonably anticipated to begin in the early summer of this year; and

WHEREAS, since 1973 said infestation has caused thousands of dollars of damage to surrounding property owners' crops and pasture, and said infestation is expected to cause even greater damage this year; and

WHEREAS, Kern County, which is contiguous to San Luis Obispo County, has just reported its first death from pneumonic plague in 36 years; said disease from bites of fleas carried by infected ground squirrel, the cause of death being listed as pneumonic plague, the most virulent and dangerous form of plague; and

WHEREAS, the San Luis Obispo County Health Department has characterized the potential for plague transmission by the infestation of ground squirrel at Camp Roberts as a clear and present danger to all persons living in the vicinity of said camp, and

WHEREAS, local government lacks the necessary authority to properly control such health hazards occurring in federal enclaves; and

WHEREAS, the Secretary of Defense of the United States of America has authority to order the eradication of these pests.

NOW, THEREFORE, BE IT RESOLVED by the Board of Supervisors of San Luis Obispo County that:

1. The Secretary of Defense be notified immediately that the infestation of ground squirrel at Camp Roberts poses a clear and present danger to the health and safety of residents of the County of San Luis Obispo, State of California; and

2. That the Secretary of Defense is hereby requested to take immediate action to eradicate these pests.

San Luis Obispo County Vertebrate Pest Control Policy. The Vertebrate Pest Control Policy adopted February 3, 1969, states:

1. Purpose: The purpose of this policy is to establish a uniform and equable procedure for providing assistance in vertebrate pest control to landholders in San Luis Obispo County.

2. Responsibility: The Agricultural Commissioner of San Luis Obispo County has the responsibility for implementing this policy.

3. Definitions:

a. "Vertebrate Pests" includes ground squirrels, meadow mice, jack rabbits, or any other nonprotected vertebrate pest of farm crops or of public health significance.

b. "Poison" means any economic poison used for vertebrate pest control.

c. "Bait" means materials used for rodent control which consists of a rodent food material treated with a poison.

d. "Plague areas" means those areas designated by the State Department of Public Health, in accordance with Sections 6021-6024, California Agricultural Code.

4. Authorization: Subject to applicable State laws, the Agricultural Commissioner is hereby authorized to:

a. Prepare and sell poisons and baits at cost. Sale to irresponsible persons shall be refused and quantities sold may be limited to actual needs.

b. Prescribe and enforce conditions for the safe and effective use and storage of poisons and baits as may be deemed necessary.

c. Conduct vertebrate pest control operations when feasible and necessary for the protection of public health and agriculture within the County.

d. Establish a schedule of charges for poisons and baits for sale.

5. Preference: The order of preference for conducting County Vertebrate pest control operations shall be as follows:

a. Plague areas.

b. Areas where owners of contiguous properties have requested assistance and are willing to cooperate in an area-wide vertebrate pest control program.

c. Individual properties outside of the above categories, upon request from the landholders thereof.

The primary responsibility for controlling all vertebrate pests (including ground squirrels) lies with the landholder except where specifically directed by State law.

Safety to man, domestic animals, and non-target wildlife must be stressed in all programs of vertebrate pest control.

## Public Health/Plague

### Federal Responsibilities

Army Regulation 40-5 (September 25, 1974) prescribes a comprehensive disease prevention and environmental enhancement program for the U. S. Army and areas under its control. The program encompasses communicable and chronic disease control, public health, environmental engineering, environmental physiology, health nursing, medical entomology, nutrition, radiological hygiene, occupational health, aviation medicine and health standards. It establishes policy and delineates areas of responsibility for commanders, medical authorities and the Surgeon General.

Army Regulation 420-76 (November 24, 1971) defines responsibilities, prescribes procedures, and in accordance with DOD Instruction 4150.7 establishes standards for:

1. The safe and efficient control of animal reservoirs and disease vectors and of pests which impair morale and efficiency of personnel and damage or destroy real property and stored supplies at Army installations.

2. The prevention of excessive pesticide contamination of installations and/or adjacent areas.

It delineates the responsibilities of the facilities engineer, engineer entomologist and installation surgeon.

Letter of the Surgeon General, August 5, 1976 to Commander U. S. Army Health Services Command, subject: Flea Control at the Fort Ord Military Complex states:

1. The Surgeon General has determined that the large ground squirrel population at the Fort Ord military complex (Fort Ord, Fort Hunter Liggett and Camp Roberts) represents a significant public health threat. Pending the results of actions to obtain an exemption to use the toxicant, "1080", for ground squirrel control, it is planned to initiate controls in areas of human habitation by trapping or the use of diphacinone. Flea control will be initiated prior to squirrel control.

2. The State of California has reported that carbaryl does not give consistent results, and recommends DDT for flea control. To be able to use DDT, a "crisis" or "specific" exemption must be sought from the Administrator of the Environmental Protection Agency. To support such a request, information must be presented to show that the currently registered product, carbaryl, is not effective.

3. Request that the necessary field tests be conducted at the Fort Ord complex to determine the efficacy of carbaryl in the control of fleas on ground squirrels, and that these tests be conducted at the earliest practical date. The results should be forwarded to HQDA, DASG-HCH-E, as soon as possible.

Excerpts from U. S. Department of Army Office of Adjutant General letter of December 3, 1976 addressed to various military commands, subject: Plague Surveillance Program states:

1. Reference Executive Order 11643, Environmental Safeguards on Activities for Animal Damage Control on Federal Lands, February 1972. (Rewritten as Executive Order 11870, July 1975, and amended by Executive Order 11917, May 1976).

2. Background:

a. Sylvatic plague is endemic in the western third of the United States. Within recent years, the incidence of both epizootic plague and human plague cases in this section of the country has increased markedly. During 1976, plague activity in animal populations was identified at four U. S. Army installations, and 13,000 acres were treated with insecticide to control the flea vectors.

b. Referenced Executive Order prohibits the use on Federal lands of rodenticides that cause secondary poisoning effects. This prohibition, which has been in effect since 1972, has inhibited rodent control programs at some installations to such an extent that the resulting excessive rodent populations now

constitute a significant threat to human health. The Surgeon General has determined that such a threat to health from plague definitely exists at Fort Ord, Fort Hunter Liggett and Camp Roberts, California.

c. Following this determination by the Army Surgeon General in July 1976, Department of the Army was designated as the DOD lead component to develop a plan to control ground squirrels and other plague-susceptible rodents at applicable DOD installations. The first required action is the development and implementation of a plague surveillance program to determine the DOD installations where rodent control programs should be instituted. The Army position with respect to control measures is that a threat to human health is the only reason to use toxicants having secondary effects.

d. This letter outlines responsibilities and provides detailed instructions for the conduct of the Army's plague surveillance program.

3. Concept of Operations:

4. This plan will be implemented at all identified installations effective 1 January 1977.

The following was an attachment to the above letter:

US ARMY INSTALLATIONS INCLUDED IN SURVEILLANCE PROGRAM AND REQUIRED SURVEILLANCE

1. The following installations are sufficiently at risk to warrant major surveillance:

a. Installations

| | |
|---|---|
| Fort Ord, CA | Fort Hunter Liggett, CA |
| Camp Roberts, CA | Fort Carson, CO |
| Rocky Mountain Arsenal, CO | Navajo Army Depot, AZ |
| Fort Wingate Army Depot, NM | Fort Lewis, WA |

b. Surveillance Elements.

1) Carnivore Blood Serum. Collect and submit 25 to 30 carnivore (coyote, bobcat, fox, raccoon, etc.) blood serum samples during the period February, March, and April each year.

2) Rodent and Flea Population Characterization. Develop baseline data on species and densities of rodents and fleas potentially involved in plague transmission and determine the degree of human contact with such populations. Evaluate population densities at least annually, where highly susceptible rodent species (rock squirrel, beecheyi ground squirrel, and prairie dog) occur.

3) Rodent Population Observation. Where highly susceptible rodent species occur, observe rodent populations for unusual conditions (sick, sluggish or dead animals) that may signal disease activity. Observations should be accomplished at least twice monthly when rodents are active (i.e., when the mean temperature exceeds 40°F).

4) Liaison Activities. Establish and maintain liaison with local and state health authorities to ascertain any potential plague activity in proximal civilian areas.

5) Epizootic Investigation. When unusual activity or dead animals are observed in the rodent population, or when plague activity is determined by carnivore blood serum analysis, an epizootic investigation will be initiated (as a minimum, investigations should include the collection of dead animals, trapping rodents for sera and flea collections, and swabbing burrows for fleas).

California Responsibility

The responsibility for the control of communicable disease and the protection of the community is shared by the State Department of Public Health, the local health officer and the community itself.

This responsibility is defined and fixed in two types of legislation. In Division 4, Chapters 1-6, Section 3000 and following sections of the Health and Safety Code, the functions and duties of state and local health departments are stated as are those of certain individuals, i.e., those suffering from or exposed to contagious disease and those in the community having knowledge of such persons. These are broad statutory provisions concerning quarantine, isolation, reporting, etc., with provision for legal penalties for violation of the statutes.

Health and Safety Code:

3000. "Health officer", as used in this division, includes county, city, and district health officers, and city and district health boards, but does not include advisory health boards.

3053. Upon being informed by a health officer of any contagious, infectious, or communicable disease the state department may take such measures as are necessary to ascertain the nature of the disease and prevent its spread. To that end, the state department may, if it considers it proper, take possession or control of the body of any living person, or the corpse of any deceased person.

3110. Each health officer knowing or having reason to believe that any case of the diseases made reportable by regulation of the Board of Public Health, or any other contagious, infectious or communicable disease exists, or has recently existed, within the territory under his jurisdiction, shall take such measures as may be necessary to prevent the spread of the disease or occurrence of additional cases.

Regulations of the California State Board of Public Health:

2501. Reports by Local Health Officer to State Department of Public Health. (a) Individual case reports: Each local health officer shall report at least weekly, on the prescribed form, to the Director of the State Department of Public Health each individual case of those diseases or conditions in the above list (Section 2500) which have been reported to him in the last seven days.

Note: The list referred to above includes plague which requires an immediate report by telephone or telegraph.

Letter from Surgeon General, June 11, 1976, to Jerome Lackner, Director, California Department of Public Health states:

I know you are familiar with the problems posed by the ground squirrels at the several installations in the Fort Ord military complex since the termination of control measures in 1971. Of concern to me, and I am sure also to the State of California, is the potential public health threat engendered by their excessive numbers.

The research project entitled, "Ecology and Control of Sylvatic Plague at Hunter Liggett Military Reservation", being conducted by Letterman Army Institute of Research, has yielded over 1,200 rodents during the last 16 months, none of which has been found positive for plague organisms. More recently, the trapping area has been extended

and predatory animals have been included. Serological evidence of plague infection has been found in one coyote, one feral house cat, eight dogs and one ground squirrel. This suggests that there are, or were, active plague foci on the reservation or in the vicinity. The existing surveillance evidently has not been extensive enough to locate these foci.

Aside from the surveillance aspects of the research, two of the main thrusts have been to evaluate the effects of the oral systemic insecticides, Trichlorfon and Phoxim, in controlling fleas on wild rodents, and the effectiveness of the anticoagulant rodenticide, Diphacinone, in controlling ground squirrels. While the initial results of these studies are encouraging, it seems possible that a control program might have to be initiated before the value of newer measures can be demonstrated unequivocally.

One of the possible exemptions to the Executive Order against the use of toxicants with secondary effects, including 1080, is the demonstration that a hazard to human health exists. It would appear that neither the Army nor the State can affort to wait until the threat is manifested by a case of human plague. Therefore, pending the completion of the research effort to demonstrate the effectiveness of control methods that would appear not to fall under the constraints of the Executive Order, I should appreciate having the state's position on the following issues:

1. What evidence would be appropriate to declare that the excessive number of ground squirrels constitutes a hazard to human health?

2. In the event the surveillance program results in the isolation of Pasteurella pestis from ground squirrels or other rodents, or the identification of a rodent die-off due to plague, what control measures should be instituted?

3. Would a rodent die-off in one area constitute the basis for initiating control measures in other, as yet unaffected areas?

Your timely assistance in this matter is greatly appreciated.

Response of Director Lackner, June 30, 1976, to Surgeon General states:

Thank you for your letter of June 11, 1976, routed by Major General Robert W. Green, M. D., concerning ground squirrel problems at Hunter Liggett Military Reservation and Camp Roberts.

As you know, we have been well briefed in this matter. Members of our staff participated at the hearings held at Hunter Liggett in April and have undertaken surveillance to assess the economic impact

and the epizootiological potential for plague in these areas. Through our Vector Control Section we have continued to maintain effective liaison with Army personnel at Fort Ord, and at Fitzsimmons Army Medical Center in Denver.

Responding directly to the three questions from your letter, we offer the following comments:

1. Ground squirrels that occur in areas of substantial human activity are a hazard when they or their fleas show evidence of zoonotic disease, in particular, bubonic plague. They also become a matter of concern when population levels exceed the ecological carrying capacity of the area, thereby increasing the epizootic potential should disease, such as plague, be introduced into the population. This Department has recommended that ground squirrels be sharply reduced in number at Camp Roberts in areas of significant human exposure. Ground squirrel control should be preceded by or accompanied by flea control. This includes both the central Camp area as well as the bivouac areas where maneuvers are performed. Population levels are high at Hunter Liggett, although not to the extent observed at Camp Roberts. We believe, therefore, that control should also be undertaken in areas of substantial human activity at Hunter Liggett. The consensus of specialists at the April meetings at Hunter Liggett indicated 1080 to be the rodenticide of choice, provided authorization for its use can be obtained.

2. Flea control should be initiated at the site of a plague epizootic in a locality occupied by humans and prophylactically in surrounding areas of continuous ground squirrel occurrence. The only effective method to kill fleas is to dust the insecticide directly into the burrows. Area-wide and aerial applications are ineffective and uncalled for. In our experience, DDT is the only proven effective insecticide for use against plague-infective fleas. Carbaryl, the only insecticide registered for this specific use, has performed inconsistently. Our Department and the Colorado Department of Health have set precedents this year by using DDT under the "crisis exemption" clause provided under EPA authorization.

   Because the high ground squirrel population is more or less continuous throughout the valleys at Hunter Liggett, the logistics of dusting burrows over hundreds or thousands of acres subject to use may be impracticable. Consideration might well be given to quarantining certain areas against training or other general use where flea control would have to be delayed for periods of three to six months. We do not know precisely how long plague-infected ground squirrel fleas may live away from their hosts, but three to six months should provide an ample margin of safety.

3. A determination of control measures appropriate for areas peripheral to an epizootic where rodents appear healthy and are present in moderate numbers, calls for carefully weighed judgments tailored to the situation at hand. These would consider the topography of the land, the continuity of the susceptible rodent populations, the dimensions of potential human exposure, and the extent and intensity of the epizootic. A judgment can usually best be made by medical entomologists who have had an opportunity to examine these and other relevant matters carefully.

With plague circulating in the area of Hunter Liggett, as evidenced by carnivore serology, it appears inevitable that the disease at some time in the future will enter into the highly susceptible ground squirrel population. Plague epizootics and human exposure have occurred in this area in the past. Plague occurrence has not been documented at Camp Roberts, but epizootics in past years may have occurred there undetected.

It would be our hope that the Executive Order can be waived and that effective ground squirrel control can be undertaken in the critical areas specified.

# PROPOSED ACTION AND ALTERNATIVES: IMPACTS AND MITIGATIONS

## Introduction

This section describes in detail the proposed action, the viable alternatives and discusses the impacts and mitigations of each. Earlier sections of the report have discussed the proposed action in general terms, described the relevant environmental features of the region and of each of the military installations -- Fort Ord, Fort Hunter Liggett and Camp Roberts. Detailed environmental information is provided on the ground squirrel life history and populations, damage by ground squirrels, grazing use and the flea/plague interrelationships -- because each of these are key factors in considering the environmental impacts of the proposed ground squirrel control programs.

The impacts of the proposed action and of the various viable alternatives are being considered together in one section because this combination seemed to be the most logical way to present a large amount of interrelated data, consider numerous alternative control measures, narrow these to a few viable alternatives and discuss the impacts in a manner that is understandable and yet minimizes repetition. The section first lists the many agencies, individuals, and citizens groups who have demonstrated an interest in the program and describes what appear to be their major interests and objectives. Since their objectives may differ so may their opinions of the identified impacts.

Next, this section identifies generally the type of and areas for ground squirrel control necessary to solve the three stated problems of high ground squirrel populations: 1) threat to human health; 2) damage to military facilities; and 3) damage to adjacent crop lands.

All of the possible ground squirrel control methods are then described by categories: (1) chemical controls, (2) mechanical controls and (3) biological controls. The proposed action is then described in detail and organized on the basis of control measures: (1) an open range land, (2) in heavy human use areas and (3) in special situations. Major environmental impacts and possible mitigations are listed.

The alternative section then describes a limited number of viable alternatives which should still be considered for a short-range solution to the identified problems caused by ground squirrels. These will be limited to 3 alternatives: (1) alternative chemicals for use on open range lands, (2) changes in open range land areas to be treated, and (3) no action alternative. All other control alternatives will have been discussed and evaluated earlier in this section and dismissed for a variety of reasons, i.e., not being viable or because certain features of proposed action appear to be the most attractive option available.

A summary of impacts of the various alternatives is presented and finally, the section will discuss long-range considerations and suggest recommendations for monitoring and surveillance programs and possible testing programs.

## Objectives of Various Interests Regarding the Proposed Action

The control of the ground squirrel population at the Fort Ord complex has aroused the interests of many. They include governmental agencies at the federal, state and local level, individual citizens (both locally and nationally), and a number of local and national citizen organizations. Their concerns about this project differ -- primarily because as a governmental agency, they have certain assigned responsibilities; or, if a citizen's organization, their organization has a specific set of goals or objectives.

This section lists what appear to be the major interests and objectives of the key groups. A consideration of these various objectives has value in evaluating the impacts and to assist in selecting the proper course of action to take in ground squirrel control at the Fort Ord complex.

Army

The Army as land manager of the three military reservations has the major responsibility for the areas. The primary use of these areas is to further the military mission, in addition, Army Regulation 200-1, Environmental Protection and Enhancement, lists additional environmental objectives:

> It is the continuing policy of the Department of the Army, as a trustee of the environment, to demonstrate leadership and carry out its mission of national security in a manner consistent with national environmental standards, laws and policies. All practical means and measures will be used to minimize or avoid adverse environmental consequences and in attaining the objectives of --
>
> (1) Providing a safe, healthful, productive, and esthetically and culturally pleasing surrounding.
>
> (2) Attaining the widest range of beneficial uses of the environment without degradation, risk to health or safety or other undesirable and unintended consequences.
>
> (3) Preserving important historic, cultural, and national aspects of our national heritage and maintaining where possible an environment which supports diversity and variety of individual choice.
>
> (4) Achieving a balance between resources use and development within the sustained carrying capacity of the ecosystem involved.
>
> (5) Enhancing the quality of renewable natural resources and approaching the maximum attainable recycling of depletable resources.

The land use relationship section of the report lists numerous other laws and regulations which provide guidance or constraints on the use of these lands (i.e. Endangered Species Act, Historic Preservation Act, etc.). In addition, certain programs are implemented on the areas by the army to satisfy or support one or more of the objectives (i.e. grazing use of the installations assists in fire control -- a necessity in furthering the military mission).

Local Landowners

The major interest of many landowners adjacent to the three installations or the local ranchers who lease grazing rights on the reservations is to earn their living by grazing cattle or sheep or growing crops. High ground squirrel populations affect these objectives.

## Public Health Officials

The public health officials at the federal, state and local government level are interested primarily in protecting public health and preventing a plague epidemic due to fleas on ground squirrels. The higher the ground squirrel/flea populations the greater is the threat of plague incidence.

## Fish and Wildlife Officials

Both federal and state fish and wildlife agencies are responsible for the protection of important fish and wildlife populations and are particularly concerned with the potential impact of ground squirrel control programs on endangered and threatened species.

## Citizen Environmental/Conservation Organizations

Although specific areas of interest of the different groups vary, most are interested in the maintenance and long-term protection of natural resource values including fish and wildlife.

## Humane Groups

Most humane group's key objectives are the maintenance of all animal populations. Some are opposed to the killing of animals by any means. Others oppose what they consider indiscriminate killing or killing by inhumane methods.

# Approaches Regarding Ground Squirrel Control

The army has proposed a ground squirrel control program at Fort Ord, Fort Hunter Liggett and Camp Roberts to solve three types of problems caused by high ground squirrel populations: 1) threat to human health; 2) damage to adjacent crop lands; and 3) damage to military facilities. While each of these types of problems all relate to large populations of ground squirrels, the possible action which may be taken to solve them does vary, particularly as it relates to areas on which ground squirrels are controlled. The basic approach, therefore, in considering both the proposed action and in establishing alternatives for reducing ground squirrel populations is indicated in the following table.

| Action on Ground Squirrel Control | Effectiveness in Minimizing Threats to Human Health | Effectiveness in Minimizing Damage to Adjacent Crops | Effectiveness in Minimizing Damage to Military Facilities |
|---|---|---|---|
| Reduction of all moderate or high populations on the 3 military establishments | X | X | X |
| Reduction of populations only in high human use areas | X | XXX | XX |
| Reduction of populations only on the perimeter of the military property | XXX | X | XXX |
| No action | XXX | XXX | XXX |

X Best overall solution based on present information and proven technology
XX Helpful, but generally considered inadequate
XXX Doubtful value

## Methods of Ground Squirrel Control

### Timing of Squirrel Control

Timing is a most critical part of effective ground squirrel control. Without adequate attention to the proper timing, control may be totally ineffective, resulting in wasted pesticides and potential environmental contamination without benefit.

Timing is important because unlike commensal rodents such as rats and house mice which are active year around, ground squirrels are unique because many go into hibernation in the winter and aestivation in the summer. At these periods control methods are ineffective.

Bait is most effective when the maximum number of the existing squirrels are active daily above ground and are foraging for seeds as opposed to vegetative portions of the plant. There are essentially three periods when activity is at its best: 1) the breeding period which occurs a few weeks following emergence from hibernation. Depending on the areas, this peak breeding period may last, roughly, from 3 to 6 weeks. By collecting and autopsying a random sample of the squirrels, the breeding period and progression of gestation in the female population can be ascertained quite precisely.

This breeding period of high activity often cannot be used for baiting because the squirrels, although active, are feeding principally on green forage and not on seeds, hence baits consisting of grain are normally avoided except in relatively rare situations. The use of green forage as a bait has been explored; however, it is not recommended for the California ground squirrel for reasons of potential hazard to non-target species, efficacy, costs and practicability.

As the season progresses and the young are born, daily feeding patterns of adults above ground may be varied and inconsistent which would influence the success of any type baiting program with acute toxicants. The lack of efficacy, for all practical purposes, eliminates baiting from the time litters are being dropped until the young are above ground readily consuming seeds.

2) Another period of high squirrel activity occurs when the majority of young squirrels have been born and are above ground foraging for and eating seed. Most of the California ground squirrel control is conducted at this period. It is an optimum time because of the high squirrel activity above ground and because they are accustomed to eating on seeds, which means they will usually take grain bait. A determination of grain acceptance should always precede baiting programs. This optimum period for squirrel control is roughly 6 to 8 weeks long, and in Monterey and San Luis Obispo counties it generally falls in the months of May and June. Weather conditions and habitat may influence the exact dates of this period. This ideal control period is of a relatively short duration, for it abruptly stops when adult squirrels go into aestivation (summer sleep), which is frequently brought about by high daytime temperatures.

Fumigants (i.e. methyl bromide, carbon bisulphide, or gas cartridges) are useful from the breeding period through the time aestivation commences (roughly February through June). Fumigants tend to become less effective as the soil moisture decreases, hence in Monterey and San Luis Obispo counties of California they are most effective in the Winter and Spring when seasonal rains keep the soil moist. The use of fumigants diminishes as the soil dries.

3) The third period of high activity may occur in the Fall of the year as the daytime temperatures subside. When this occurs many of the aestivating squirrels become active and are again feeding on seed and on acorns if present. Full or nearly full activity may not occur each year at this period; this is believed to be linked to the weather conditions. Because of this uncertainty, major squirrel control operations cannot be geared to this period; however, this period can be used for controlling squirrels missed during the Spring control. Squirrels are often hoarding grain at this time of the year and gather seeds and grain in their cheek pouches to carry into their burrows. If strychnine baits are to be used they are most effective when hoarding is occurring because strychnine is absorbed more rapidly through the cheek pouches than the intestinal tract. Anticoagulant baits may also be effectively used around buildings and other structures at this time of year. Grain bait of any type may not be sufficiently acceptable for control once the squirrels are feeding regularly on acorns, almonds or the like, and hence baiting may have to be delayed until the next year. This period of Fall activity stops with the onset of hibernation.

It is easy to be fooled on periods of activity, especially if the population trends have not been followed throughout the year or if existing squirrels are not examined closely. The tendency is to not recognize diminishing activity; this is brought about by the fact that squirrels born in the Spring may neither aestivate or hibernate. Thus, sub-adults may be active throughout the Summer, Fall and Winter, but it must be remembered that they represent only a fraction of the total population. Control conducted when the adults are aestivating or hibernating is superficial and short-lived and can seldom be justified based on cost/benefits.

## Chemical Control

All information on characteristics, pharmacology and toxicity of the following rodenticides, where not otherwise referenced, is taken from the California Department of Food and Agriculture Vertebrate Pest Control Handbook (1975). Additional information on $LD_{50}$'s, symptomatology and antidotes can be found in the same publication.

Toxicants.

*Sodium monofluoroacetate*. Sodium monofluoroacetate (compound 1080) is a white, stable, water soluble, practically tasteless, crystalline powder.

Compound 1080 is a rapidly absorbed toxicant. Death usually results in one half to two hours (Howard, 1959) from cardiac or nervous system failure. Monacetin, acetamide, procainamide, and acetate plus ethanol show some antidotal effects (Atzert, 1971).

Compound 1080 has an extremely wide variation in susceptibility among different animals. Rodents such as ground squirrels and pocket gophers are highly susceptible. Fish are very tolerant to 1080 (King and Penfound, 1946). Birds are generally quite tolerant; however, waterfowl have been found to be susceptible under situations of high competition for food (Koehler, 1962). Livestock may be susceptible (Jensen et.al., 1948). There were 37 known domestic animal poisonings between 1959 and 1969 (Atzert, 1971). However, most of these were related to the animals gaining direct access to bait containers rather than to bait exposed in the field for control. No human fatality from 1080 has ever occurred in California despite its long history of use (Marsh, pers. comm.).

Compound 1080 is absorbed in the muscles and tissues of poisoned animals and therefore increases the potential of becoming a secondary poison. Members of the dog and cat family are very susceptible (Hagen, 1972; Schitoskey, 1975). Raptors and scavenging birds apparently are seldom affected (Koford, 1953; Atzert, 1971).

Poisoned animals may metabolize 1080 to non-toxic metabolites and/or excrete in the urine large quantities of a dose prior to death, thus decreasing the hazard of true secondary poisoning (Gal, et.al., 1961 In: Atzert, 1971). However, according to Swick (1973) rodents may consume or pouch several times the lethal dose creating a greater potential secondary poisoning hazard. It has also been shown that carcasses of rats poisoned with 1080 remained toxic 8-10 weeks (Pattison, 1959).

The efficacy of 1080 poison depends on many variables. In the laboratory, marked resistance to 1080 can be artificially produced in Norway rats within 4-5 generations (Howard, et.al., 1973). Rodents receiving sublethal doses may develop bait shyness (Tull Chemical Company, n.d.). However, field studies using aerial 1080 to control ground squirrels have resulted in 90 percent population reductions after treatment (Marsh, 1967).

David & Gardiner (1966) found that 1080 was not mobile or persistent in the soil and was rapidly degraded to non-toxic compounds by soil bacteria. They found no measurable toxicity in the soil after two weeks. Compound 1080 is also adsorbed by plant roots and other cellulose material, with 5-10 percent transported to the leaves (Hilton, et.al., 1969, In: Atzert, 1971). Compound 1080 was also found to be absorbed by plant leaves (Hilton, et.al., 1969, In: Atzert, 1971). Saito, et.al. (1966 in Atzert, 1971) analyzed streams over a 5-month period and found no trace of 1080. Marsh (1967) found no trace of 1080 oat groat bait after the winter rainy season. There is also no evidence that hazardous amounts of 1080 can accumulate in the meat of carcasses used for human consumption (Peters, 1975).

Compound 1080 is registered for ground squirrel control by the state. EPA placed it on a rebuttal presumption list and on December 1, 1976 issued notice that a rebuttal presumption exists against registration and continued registration. Crimped oat groats is the most commonly recommended bait. Compound 1080 can be applied by hand or aerially with a poison concentration of 0.05 or 0.08 percent respectively. For aerial treatment, pilot and plane costs are approximately $90.00 - $150 per hour (Nutter, pers. comm. and Marsh, pers. comm.). Depending on squirrel densities, pilots generally can cover approximately 2,000 to 3,000 acres per hour, spot-treating the squirrel colonies. Prepared bait costs approximately $0.20 per pound. The total cost of aerial 1080 application in Tulare County (1975) was estimated at $0.14 to $0.16 per acre (Clark, pers. comm.). Ground application of 1080 was estimated to cost $1.63 per acre in Fresno County in 1975 (Clark, pers. comm.) (Table 11).

Compound 1080 is an effective rodenticide. It is the most commonly used rodenticide for control of ground squirrels in California (Clark, pers. comm.). Because of 1080's toxicity, its use for ground squirrel control in close proximity to humans and their pets is not recommended (Jenkins and Koehler, 1948), but because of its efficacy, 1080 is considered a viable method for large-scale control of ground squirrels on the Fort Ord complex.

*Zinc phosphide*. Zinc phosphide ($Zn_3P_2$) is a gray-black powder that is practically insoluble in water or alcohol. When exposed to moisture, a breakdown slowly occurs, releasing small amounts of phosphine gas. Containerized dry baits remain toxic almost indefinitely and exposed baits are known to maintain toxicity for several months under field conditions (Keith and O'Neill, 1964).

Zinc phosphide baits have a strong phosphorus-like odor. This garlic-like odor characteristic is attractive to some rodents, such as rats, but is often unattractive to other animals. Bait acceptance by ground squirrels has been poor in some areas (California Department of Food and Agriculture, 1974).

Zinc phosphide is poisonous in some degree to all animals. There is no specific antidote. Gallinaceous birds and waterfowl are highly susceptible to poisoning (Hood, 1972). Some species of fish may be susceptible to high concentrations of phosphine gas (California State Water Resources Control Board, 1971). It is a relatively slow acting rodenticide taking from 30 minutes to 2 hours for death to occur (Dana, 1962).

Zinc phosphide does not accumulate in the muscles or other tissues of poisoned animals, reducing some of its secondary poisoning potential. However, complete breakdown of zinc phosphide in the stomach may require several days and thus, secondary poisoning can occur if an animal eats enough gut contents of a recently poisoned animal (Rudd and Genelly, 1956).

According to Hood (1972), zinc phosphide does not seriously contaminate the environment. Zinc phosphide is absorbed by the soil and breakdown is rapid. It is also absorbed by roots and leaves of plants, but appears to be transformed to non-toxic chemicals. Breakdown in water occurs relatively slowly (Robinson and Hilton, 1971, In: Hood, 1972).

Zinc phosphide is registered in California for ground squirrel control and is currently being considered for registration by the Environmental Protection Agency (EPA). Crimped oat groats is most often the recommended bait. Zinc phosphide can be applied by hand or by aircraft. The recommended poison concentration for hand baiting is .8 percent and 1.69 percent for aerial baiting. Mixed grain bait costs approximately 30 cents per pound (Nutter, pers. comm.). Aircraft and pilot costs would be similar to those stated for 1080 treatment. The total cost of aerial application of zinc phosphide in Fresno and San Benito Counties was estimated at $0.09 to $0.17 per acre in 1975 (Clark, pers. comm.; Schilling, 1976). Hand application of zinc phosphide in Fresno County in 1975 cost approximately $0.52 per acre (Shilling, 1976) (Table 11).

Zinc phosphide bait is considered a moderately effective poison for ground squirrels, often giving erratic control that is good at times, but fair to poor generally (Marsh, pers. comm.). The expected percent of control of the Beechey ground squirrel, using zinc phosphide baits, can reasonably be placed at approximately 60 percent, on an average, based on general information in the literature and the consensus of those individuals in California knowledgeable of the subject (Marsh, pers. comm.)., including those who have evaluated zinc phosphide in San Luis Obispo (Kalar, pers. comm.) and Monterey Counties (Nutter, pers. comm.).

*Strychnine*. Strychnine is a white crystalline powder with a characteristic bitter taste. It is available in an alkaloid or sulfate form. The alkaloid form is practically insoluble in water and very stable. However, when transformed to an acid-salt compound it becomes water soluble and is subject to leaching in acid soils. The sulfate form is slightly soluble in water.

Strychnine is a fast-acting rodenticide usually taking from 5 to 30 minutes for death to occur. The poison is absorbed most rapidly through the cheek pouches in ground squirrels, taking one fifth of the quantity of strychnine to kill as is required through the stomach (Dana, 1962). In one field study, approximately 20 percent of poisoned ground squirrels died above ground and thus were available to scavengers or predators (California Department of Food and Agriculture, 1974).

According to Hood (1972) strychnine baits are poorly accepted by ground squirrels. However, this depends on the species and sometimes the subspecies. One study showed a bait acceptance of only 11.4 percent (California Department of Food and Agriculture, 1974). Because of its fast-acting nature, strychnine baits must be exposed in sufficient amounts to ensure that each squirrel will find enough bait within a few minutes to obtain a lethal dose. Otherwise, a sublethal dose might be taken resulting in bait or poison shyness (Howard, 1959).

Strychnine is extremely poisonous in various degrees to most birds and mammals. It is somewhat less toxic to gallinaceous birds than other birds. Waterfowl and some domestic animals readily accept lethal amounts of strychnine bait. Antidotes are available and can be effective if treatment is initiated very soon after poisoning.

Strychnine is not absorbed into muscles or tissues of a poisoned animal. However, residues in the stomach of a lethally poisoned animal are known to be potentially hazardous to susceptible predators or scavengers that might consume the stomach contents. Secondary poisoning of raptors is thought to be unlikely. According to Hagen (1972) condors are believed highly susceptible to strychnine poisoning, although there are no reports of condors being killed as a result of strychnine use for ground squirrel control.

Strychnine is registered by the state for control of ground squirrels. It is on EPA's rebuttal presumption list and on December 1, 1976, EPA issued notice that a rebuttal presumption exists against registration and continued registration. Whole barley is often the recommended bait with a strychnine concentration of 0.2 percent. Bait should be hand placed; aerial baiting is not recommended for squirrel control. Mixed grain bait costs approximately $0.80 per pound. The total cost of hand application of strychnine in Sacramento County was estimated at $2.00 per acre in 1976 (Miller, pers. comm) (Table 11).

The subspecies of ground squirrel, Spermophilus beecheyi beecheyi, occurring in Monterey and San Luis Obispo Counties, is less susceptible to strychnine and is more apt to reject strychnine, hence such baits are presently used infrequently for control of ground squirrels in that region of California (Marsh, pers. comm.). Unless toxic shyness or resistance to other acute toxicants occurs, strychnine should not be considered a very viable alternative for ground squirrel control on the Ford Ord complex.

Anticoagulants. Anticoagulant compounds used in rodent control belong to two groups: the hydroxycoumarins (e.g., warfarin and Fumarin) and the indandiones (e.g., diphacinone, Pival and chorophacinone). Most anticoagulants are stable compounds. Their sodium salts are soluble in water and often are used as lethal water baits.

Anticoagulants, which cause death by reducing the clotting ability of the blood, have the same effect on all warm-blooded animals. Relatively low doses of anticoagulants are poisonous to ground squirrels and many other rodents if consumed by multiple feedings over a period of several days. The same amount of poison bait if consumed in one feeding might have no poisonous effect. Antidotes are transfusion of whole blood and oral doses of vitamin K.

All mammals and birds are susceptible to anticoagulant baits but not to the same degree. Birds apparently are less susceptible than other animals. Pets would have to consume a quantity of bait over several days to be poisoned. However, some poisonings in dogs and cats have been reported. There is little danger to livestock unless exposed to large quantities of stored poison bait.

The potential of secondary poisoning from anticoagulants has been reported because they accumulate in the liver of a poisoned animal. Gopher snakes fed poisoned meadow mice were not adversely affected.

Some resistance to anticoagulants through genetic mutation has been shown in rats. In addition, the effects of anticoagulants may be nullified in rodents that consume larger quantities of green feed containing vitamin K (Howard, 1959).

In Monterey and San Luis Obispo Counties the most commonly used anticoagulant is diphacinone. It is registered in California, but not with EPA for control of ground squirrels. Oat groats are recommended with a poison concentration of 0.005 percent when used in bait boxes or 0.01 percent when spot-baited. Because of the lack of adequate research data, aerial application is not recommended. Mixed bait costs approximately $0.30 to $1.00 per pound figuring approximately one pound per 20 burrows plus a follow up treatment in two days (Nutter, pers. comm.). Hand baiting of diphacinone has been estimated to cost approximately $2.00 per acre (Clark, pers. comm.) (Table 11).

Diphacinone has been used safely and effectively around homes and farms and in small-scale field situations, but because large quantities of bait must be exposed in multiple doses, large-scale field use is prohibitively expensive (Hagen, 1972). Therefore diphacinone or other anticoagulants should be considered a feasible control method only for small-scale use on the Fort Ord complex.

Fumigants. Three fumigants have historically been used for small-scale ground squirrel control in California. These are methyl bromide, carbon bisulphide and gas cartridges.

None of these fumigants are effective on hibernating or aestivating squirrels because toxic amounts of their vapors cannot readily penetrate the soil plug built by the squirrel. Ground squirrels may also plug their burrow against poisonous vapors making slowly diffusing gases less effective (Dana, 1962).

*Methyl Bromide*. Methyl bromide ($CH_3Br$) is a colorless, nonflammable liquid. It has a burning taste and for all practical purposes is odorless. Often 2 percent chloropicrin gas is combined as a warning agent to give it an identifiable odor. Methyl bromide vapors are 3.5 times heavier than air and will flow to the lowest parts of a burrow system.

Vapors of methyl bromide are poisonous to all animals and to all stages of fleas or other ectoparasites. Death occurs relatively rapidly from respiratory or nervous system failure. Injury may also occur from contact of the liquid with the skin.

Methyl bromide is registered by the state but apparently not by EPA for use in ground squirrel control (Fitzwater, 1972). It is usually packaged in one-pound pressurized containers or larger metal cylinders. Methyl bromide is effective when injected at a rate of 10 cc per burrow. To prevent the gas from escaping, the burrow is then immediately plugged with soil. It can be used in dry or moist soil, but not wherever rocks or other obstacles prevent sealing of the burrow with dirt (Dana, 1962). The gas costs approximately $0.86 per pound. The total cost of methyl bromide use in Alameda County in 1975 was approximately $21.60 per acre (Clark, pers. comm.) (Table 11). Therefore, the cost and considerable labor requirements, prohibits its use in large-scale ground squirrel control especially in rugged terrain (Hagen, 1972).

*Carbon Bisulphide*. Carbon bisulphide or disulphide ($CS_2$) is a clear, colorless volatile liquid. It is extremely inflammable, which creates operational and storage hazards, and is slightly soluble in water. The commercial grade carbon bisulphide has a strong sulfur odor. Its vapors are 2.5 times heavier than air.

Carbon bisulphide vapors are poisonous to all animals. When the liquid vaporizes slowly, it may have a slow physiological effect on the target species (Dana, 1962). Prolonged or repeated contact with the skin or oral intake is also harmful. Acute poisoning in man is rare. However, chronic poisoning may occur resulting in injury to the nervous system. Carbon bisulphide vapors at high concentrations can be harmful to tree roots and other plant life (Marsh, 1964).

Carbon bisulphide is registered by the state and by EPA for use in ground squirrel control. It is normally applied in one of two ways: with a special pump (i.e., Demon Rodent Gun) to force 2-4 ounces of liquid gas into the burrow or by

Table 11

ESTIMATED COSTS OF GROUND SQUIRREL RODENTICIDE USE

| Rodenticide (Bait) | Approximate Dollar Cost Per Pound | Estimated Dollar Cost Per Acre[1] | Method of Application |
|---|---|---|---|
| Compound 1080 | 0.20 | 0.14-0.16 | Air |
| Compound 1080 | 0.20 | 1.63 | Hand |
| Zinc phosphide | 0.30 | 0.09-0.17 | Air |
| Zinc phosphide | 0.30 | 0.52 | Hand |
| Strychnine | 0.80 | 1.80-2.00 | Hand |
| Diphacinone | 0.30-1.00 | 2.00 | Hand |
| Methyl bromide | 0.86 | 21.50 | Applicator |
| Carbon bisulphide | 1.60[2] | 5.12-7.04 | Waste ball |

[1] Based on estimates or actual field use in Sacramento, Fresno, Tulare, Alameda and San Benito Counties in 1975-1976. Clark, pers. comm.; Miller, pers. comm. Cost per acre may vary considerably depending on squirrel density, terrain, etc.

[2] Cost is per gallon.

soaking waste balls (absorbent fibers) in the liquid and then placing them 15 to 18 inches down into each burrow (Dana, 1962). In both methods, the burrow is then plugged with soil. Carbon bisulphide vaporizes more quickly when using a pump and is thus more effective than the waste ball method (Dana, 1962). Carbon bisulphide costs approximately $1.60 per gallon. The estimated total cost of carbon bisulphide use in Fresno and Tulare Counties in 1975 ranged from $5.12 to $7.04 per acre (Clark, pers. comm.) (Table 11). Therefore, the cost and labor requirements of carbon bisulphide use make this method of ground squirrel control too costly for extensive field use.

*Gas Cartridges*. Gas cartridges, also referred to as pyrotechnic or smoke cartridges, are cardboard cylinders filled with sulphur (10.84 percent), charcoal (17.34 percent), red phosphorus (3.2 percent), mineral oil (14.09 percent), sodium nitrate (43.36 percent), sawdust (3.52 percent) and other inert ingredients. These contents are ignited with a fuse.

The cartridges release smoke and toxic gases. Carbon monoxide is the major product, which if inhaled in sufficient quantities, is toxic to all animal life.

Gas cartridges manufactured by the U. S. Fish and Wildlife Service are registered by the state and by EPA. One or two gas cartridges per burrow are effective followed by plugging with soil. They should be used when soils are moist. Gas cartridges cost approximately $0.15 each. Because of the expense and labor requirements, large-scale use of gas cartridges would be prohibitively expensive.

Other Fumigants. A wide selection of fumigants including, but not limited to, carbon monoxide (CO), sulfur dioxide ($SO_2$), hydrocyanic acid gas (HCN), calcium cyanide (CaCN), chloropicrin ($CCl_3NO_2$) and tetrachloroethane ($C_2H_2Cl_4$) have been tried over the years with varying efficacy for the control of ground squirrels (Storer and Jameson, 1965). The fumes of gasoline have also been used as a fumigant, but it is not generally accepted and probably never will be unless other fumigants become unavailable. The EPA compendium also lists the seldom used fumigants: ethylene dichloride and paradichlorobenzene, as registered for ground squirrels (Fitzwater, 1972). The most recent fumigant to be tested for ground squirrels appears to have been phostoxin, but it is not registered for use.

The above-mentioned fumigants seem at this time to offer insufficient advantages, considering human safety, efficacy to target species, hazards to nontarget species, and cost and ease of application, over fumigants such as methyl bromide ($CH_3Br$) or carbon bisulphide ($CS_2$) to warrant their use. The question of registration at both the state and federal level must be addressed before their use could be considered and therefore, should not be considered as alternative methods of ground squirrel control on the Fort Ord complex.

*Chemosterilants.* Chemosterilants have been studied with considerable intensity in the past few years, particularly for the control of rats (Rattus sp.) and to a lesser extent some other pest rodent species (Marsh and Howard, 1973). Mestranol, a potent synthetic estrogen, has been experimentally evaluated on the Richardson's ground squirrel with some promise (Alsager, 1972; Goulet and Sadleir, 1974). The application of chemosterilants in integrated control programs appears to offer the greatest hope. The use of chemosterilants as a follow-up to the use of toxic baits or other conventional methods of direct reductional control could provide the maximum benefits by slowing down the potential for population recovery (Marsh and Howard, 1973). However, chemosterilants cannot be considered a feasible alternative to the immediate ground squirrel problem of the Fort Ord complex because none is presently registered for rodent control in California or by EPA.

*Chemical Repellents.* There are no known effective chemical repellents which can be used to move or displace ground squirrels from a site. Naphthalene granules are listed as an EPA registered repellent for tree squirrels, Sciurus sp., (Fitzwater, 1972). This material has been suggested for ridding attics of tree squirrels (Eadie and Hamilton, 1962). The efficacy of naphthalene as a repellent has not been proven for the California ground squirrel. Present technology seems to rule out the possibility of area chemical repellents for the control of ground squirrels (Marsh, pers. comm.). Therefore, chemical repellents cannot be considered a feasible alternative to the immediate ground squirrel problem at the Fort Ord complex.

*New Rodenticides.* A number of potential rodenticides have been evaluated on commensal rats and mice over the past 10 years, however, few of these have been evaluated on the California ground squirrel. The newest rodenticide registered by the California State Department of Food and Agriculture for ground squirrels is the anticoagulant, chlorophacinone. The experimental acute toxicant Silatrane was evaluated for ground squirrel control, but effectiveness was below that achieved with present rodenticides. This proprietary compound

was never developed as a rodenticide. Gophacide was also explored for ground squirrel control, but without good results. Fluoroacetamide (1081) would possibly be effective for squirrel control, although no known studies exist (Marsh, pers. comm.). One of the most promising potential rodenticides for ground squirrels was recently reported by Marsh and Howard (1975). This experimental toxicant is coded RH-908 by Rohm and Haas Company.

The Federal Pesticide Law and EPA's regulations concerning existing rodenticides establish a rather adverse climate for the development of new rodenticides for use on field rodents of limited distribution. Because of the high costs involved in registration and the relatively small market, private industry, for the most part, seems uninterested in the development of new rodenticides for limited uses. The U. S. Fish and Wildlife Service, the leading federal agency responsible for the development of field rodent control measures, has not developed an effective ground squirrel toxicant since they developed 1080 for ground squirrel and prairie dog control. The prospects of new acute rodenticides for ground squirrel control appear remote.

See Appendix F for examples of rodenticide specimen labels currently used in California.

## Mechanical Control

Trapping. According to the California Department of Food and Agriculture Vertebrate Pest Control Handbook (1975) trapping can be a "practical means of control for ground squirrels where other methods are unsatisfactory or undesirable." A trap that kills quickly can be constructed by modifying a wooden box-type gopher trap (California 44 trap) (Becker, 1940; Marsh and Pleese, 1964). Grain, walnuts, citrus, and melon rinds are effective baits, depending on the area. A dozen such traps can be used effectively to remove a small population of squirrels. The traps are quite selective, depending on where set and what bait is used. They kill instantly and probably do not leave trap-wise squirrels (Storer and Jameson, 1965).

Live catch traps (such as the National or Havahart traps) are also used to take squirrels but are generally less effective and require more attention than modified box-type pocket gopher traps. They also present the problem of live squirrel disposition.

Field use of trapping to control ground squirrels has met with varying success. Horn and Fitch (1946) found little success with live traps because of trap shyness, but were successful with steel traps and wire box traps. Dana (1962) described a live catch trap and steel trap that was effective against ground squirrels. However, Hagen (1972) found trapping an ineffective and expensive means of ground squirrel control in California, while Weinburgh (1964) stated that trapping was effective, but only for removal of small local populations or for cleaning up of those escaping poisoning. Because of the expense and manpower that would be needed as well as the non-selectivity of some types of traps, trapping would not be practical for large-scale ground squirrel control on the Fort Ord complex, but could be beneficial in human use areas where other small-scale control methods might be undesirable.

Shooting. Shooting with a .22 caliber rifle equipped with a scope is a very selective method of controlling small numbers of ground squirrels (Weinburgh, 1964). If used with discretion, there is no hazard to humans or other non-target species.

Shooting is particularly useful for the relatively rapid collection of random squirrel specimens for determining flea indexes, breeding condition, littering dates, litter sizes, sex ratios and diets, all of which may be helpful in planning ground squirrel management.

Because shooting is labor-intensive and restricted to relatively uninhabited areas, it has limited application as a general control method. Therefore, shooting cannot be considered as an important alternative in control of ground squirrels on the Fort Ord complex.

Exclusion. Squirrel-proof fences extending 30 to 36 inches underground, either electric or equipped with a horizontal top flange, have been used to confine or exclude ground squirrel populations (Fitch and Bentley, 1949; Ryckman, et.al., 1953); but because of the animal's ability for climbing and digging, the construction of these fences is very expensive. Except for the protection of a vital structure involving a relatively small area of a few acres, fencing cannot be considered a practical or feasible alternative in ground squirrel control on the Fort Ord complex.

Burrow Destruction. The destruction of burrow systems as a means of reducing reinfestations by ground squirrels on occasion has been suggested and is currently being evaluated for the control of European rabbits (Oryctolagus cuniculus) in Australia (Parker et.al., 1976). Linsdale (1946) stated that periodic destruction of burrows or permanent blockage of entrances was an effective means of retarding or preventing reinfestation. It has also generally been observed that land which has been routinely disced and cultivated for a number of years has fewer squirrels occupying that area than adjacent uncultivated land (Marsh, pers. comm.). However, both of these control methods are predicated on initial elimination of occupants of the colony by some other means. Manual destruction of burrow systems would require considerable manpower and money, and discing would involve major land-use changes, making these approaches impractical for control of ground squirrels on the Fort Ord complex.

Flooding. Flooding can be an effective way to control ground squirrels and prevent reinfestation. Grinnell and Dixon (1918) found that repeated irrigation of an alfalfa field "drowned out" many ground squirrels and prevented their reinfestation. However, use of flooding to control ground squirrels is limited to infestations occurring in crops normally flood irrigated. Considering the hydrology and topography of the area, flooding would not be a feasible alternative in ground squirrel control.

Repelling Devices. At least two magnetic field devices (ERGON, The Frontier House, Spokane, Washington and AMIGO, The VRP Corporation, Los Alamitos, California) have appeared on the market within the last few years. The manufacturers and/or distributors claim the devices will rid an area of ground squirrels, but these claims are unsupported by scientific evidence of efficacy. Until something other than testimonials become available to support their efficacy, these devices cannot be seriously considered as a method of ground squirrel control.

Other types of repellent devices operating on various principles, including ultrasonic sounds, are available for rodent control; however, none of these have been proven effective for ground squirrels or any other rodent species. Therefore, repelling devices cannot be considered a viable alternative in ground squirrel control on the Fort Ord complex.

## Biological Control

Modifications of Grazing. Modifications of livestock grazing have been suggested as a method of reducing ground squirrel numbers (Linsdale, 1946). However, it has been shown that any amount of grazing of California grasslands will encourage ground squirrels to become more abundant (Howard, 1953). Linsdale (1946) found that when grazing was excluded from one small area on the Hastings Natural History Reservation (Carmel Valley, California) ground squirrels tended to decline as the vegetation changed and became rank. According to Fitch and Bentley (1949) and Horn and Fitch (1942) significant reduction of ground squirrels on grazed land would require almost complete exclusion of grazing, which would significantly increase the fire hazard on open range. Furthermore, complete exclusion of grazing at the USFS San Joaquin Experimental Range in Madera County did not eliminate ground squirrels (Howard, pers. comm.). In any event, grazing modification as a tool in reducing the density of ground squirrels should be considered a long-range control measure for open rangeland and will be discussed as such in a later section. Elimination of grazing would not be a feasible alternative, either, for immediate or long-range control of ground squirrels in human use areas or where squirrels damage man-made structures on the Fort Ord complex.

Introduced Diseases. Indirect population reduction through deliberate introduction of fatal or debilitating pathogens is one means of biological control. While biological control has been successful for the control of certain insects and weed pests, it has met with little success in vertebrate pest control. One example frequently cited as evidence of the value of biological control was the introduction of myxoma virus to control European rabbits in Australia in 1950. Once the disease took hold some remarkable reductions in rabbit numbers occurred in the initial years. However, this did not last due to the development of resistance by the host (Cherrett, et.al., 1971) and attenuation of strains of the virus (Marshall and Fenner, 1960).

Disease organisms which have the potential for adequately reducing populations of vertebrate pests to very low levels unfortunately are rarely host specific and those that are host specific lack effectiveness (Jacobsen, 1962). Once a disease has been released into an ecosystem, man has little if any control over its future effect on the biota. Introduced diseases which are not host specific might severely affect populations of valuable or rare wildlife while having little if any long-range detrimental effect on pest species for which they were introduced.

Since vertebrate pests represent higher animals, man himself might fall victim to an introduced disease intended for pest control. When Salmonella bacteria was introduced many years ago to control rats (Rattus sp.) in the United States, rodent droppings carrying the bacteria then contaminated human food, resulting in food poisoning and human deaths (Storer, 1958).

While the introduction of diseases for control of ground squirrels has been suggested as a natural approach to reducing their density, introduction of the most promising of the known diseases, plague, would be temporary in effectiveness and probably affect only local populations. Of course, the introduction of plague would unquestionably be an unacceptable alternative control method for the ground squirrel problem of the Fort Ord complex, because of the susceptibility of man and other wildlife to this disease.

Introduced predators. The encouragement of natural predators has been suggested as a method for keeping pest rodents at a low level (Craighead and Craighead, 1956; Storer and Jameson, 1965), based on the theory that predators reduce their prey to acceptable levels. Errington (1946 and 1956) provides strong evidence to support the theory that the number of prey determine the number of predators and not vice versa. Howard (1974) theorizes that predators may in fact keep certain prey at higher levels than would persist over long periods of time if predators were not present, even though such prey populations would initially increase following removal of any predators. Depending on the species involved and the situation, all theories may be valid. Insofar as ground squirrel populations are concerned, no definite evidence exists that predators, native or introduced, are capable of keeping squirrel populations at or below levels considered acceptable on the basis of public health or economic damage. Howard (1953) stated that coyotes take only a fraction of the annual increase in ground squirrels and that the combined influence of all predators could not keep squirrel populations at low levels. Current knowledge does not support the practicality or feasibility of either introducing additional predators or attempting, by artificial means, to increase the density of the existing population and therefore should not be considered a practical alternative for ground squirrel control in the Fort Ord complex.

## Summary

Of the methods of ground squirrel control described on the previous pages, many were deemed impractical for immediate control of ground squirrels on the Fort Ord complex, either in large-scale or limited use. Table 12 analyzes some of these methods as to their efficacy, adverse environmental effects, cost, and feasibility in large-scale or limited use. Those methods of ground squirrel control that were judged to be practical for large-scale or limited use on the Fort Ord complex are summarized in Figure 32 and will be further discussed in following sections.

## Methods of Flea Control

### Carbaryl (Sevin)

Carbaryl (Sevin) is a white crystalline carbamate poison. It is slightly soluble in water. Carbaryl is used primarily to control insect pests on fruit, vegetables, forage crops, field crops, lawns, ornamentals, and other crops as well as on poultry and humans. It is available in the form of 5 or 10 percent dust, 5 or 10 percent granules, wettable powder, oil dispersion, and water dispersible.

Carbaryl is a relatively fast-acting contact or stomach poison. A wide number of insects are susceptible. Bees are highly susceptible (Thomson, 1976). In field studies carbaryl has been shown to be highly toxic to aquatic invertebrates and some molluscs (California State Water Resources Control Board, 1971; U. S. Office of Science and Technology, 1971). Carbaryl may also lower natural resistance in fish to parasites (U. S. Office of Science and Technology, 1971). Mammals and birds show low toxicity to Carbaryl (Tucker and Crabtree, 1970; California State Water Resources Control Board, 1971).

Carbaryl reportedly has no effect on plants (U. S. Office of Science and Technology, 1971). However, it may cause retarded germination of grasses or injury to young foliage (Thomson, 1976). According to the 1975 Farm Chemicals Handbook (Meister Publishing Company, 1975) use of Carbaryl in the field does not result in excessive residues. Residues have been found to dissipate rapidly (U. S. Office of Science and Technology, 1971).

Table 12

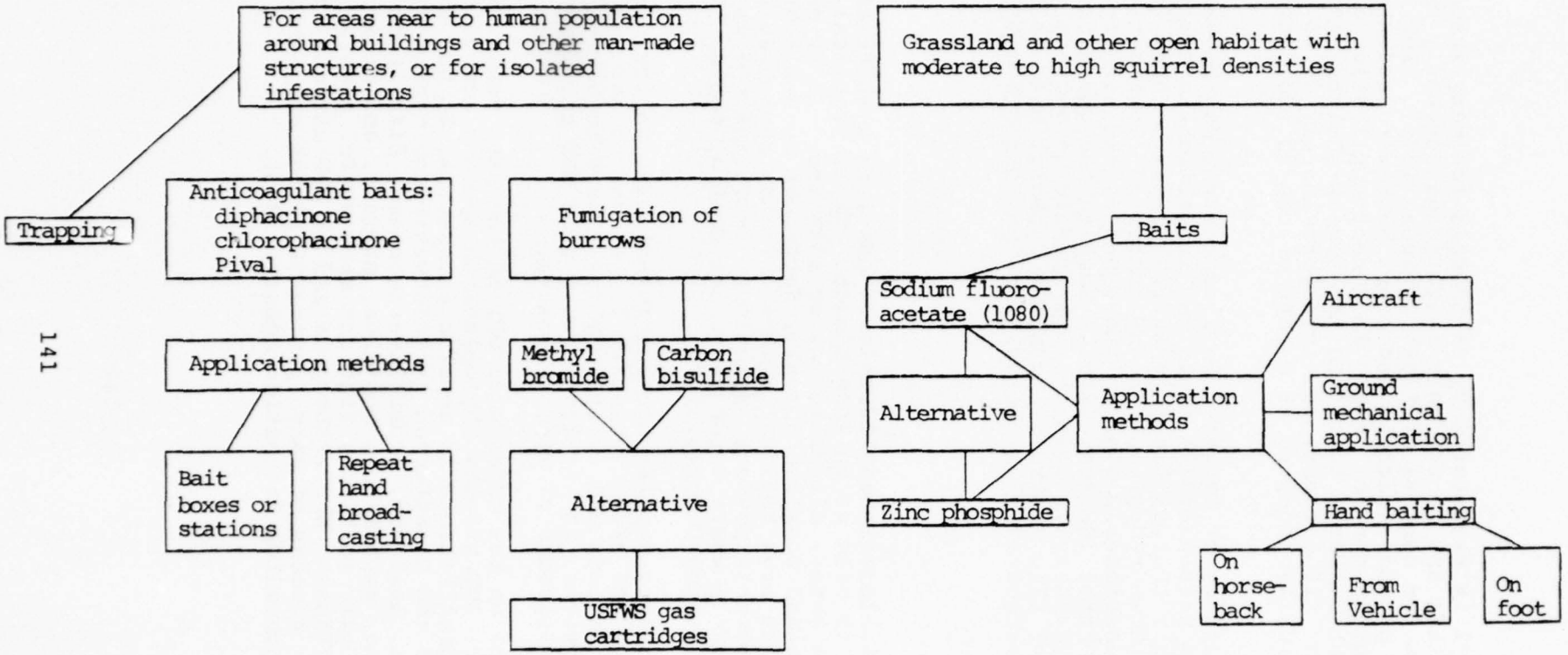
Analysis of Some Alternative Methods of Ground Squirrel Control

| Methods | Effectiveness in alleviating the problem | Adverse environmental effects | Cost | Feasibility | |
|---|---|---|---|---|---|
| | | | | Large-scale use | Limited use |
| Trapping | H | L | H | L | H |
| Shooting | H | L | H | L | M |
| Exclusion | H | L | H | L | L |
| Chemical repellents | U | U | H | L | L |
| Repelling devices | U | U | H | L | L |
| Other fumigants | L to H | L | H | L | M |
| Chemosterilants | U | U | U | U | U |
| New rodenticides | U | U | U | U | U |
| Introduced predators | U | U | U | U | U |
| Introduced diseases | U | U | U | U | U |
| Modification of grazing | U | L | U | U | U |
| Burrow destruction (cultivation) | M | U | H | L | M |
| Flooding | M | L | H | L | M |

L = low, M = medium, H = high, U = unknown.

Figure 32

PRACTICAL METHODS OF SHORT-TERM GROUND SQUIRREL CONTROL ON THE FORT ORD COMPLEX*






* All suggested methods are subject to various limitations (i.e., safety, efficacy, timing, cost, etc.)

Carbaryl is registered by California for many insects including fleas and is the only insecticide currently registered by EPA for control of fleas (Nelson, 1976). For control of fleas of ground squirrels and other burrowing rodents, the most efficacious control method is direct application of 5 or 10 percent Carbaryl dust into the burrow (Nelson, 1976). Carbaryl dust (10 percent) costing approximately $0.50 per pound is normally injected at a rate of one to two ounces per burrow.

The efficacy of Carbaryl in flea control may be variable. According to Nelson (1976) field use in California has failed to effectively control fleas in several cases. Other field tests have shown reductions in the number of fleas per squirrel, but it is questionable whether these reductions signify effective control (Nelson, 1976). Despite the questionable efficacy of Carbaryl, it is the only pesticide currently available for flea control, therefore Carbaryl must be considered a feasible method of flea control for the Fort Ord complex.

DDT

DDT (dichlorodiphenyltrichloroethane) is a white amorphous powder that is used as an insecticide. It is practically insoluble in water, dilute acids, or alkalies. It is extremely non-volatile and does not normally decompose in sunlight which results in its high residual powers. It has been used as aerosols, wettable powders, solutions, emulsions and as a dust (California State Water Resources Control Board, 1971; Meister Publishing Company, 1975).

DDT became a popular contact insecticide in the United States during and after World War II because of its high toxicity to insects and relatively low hazard to warm-blooded animals. However, it was later found that DDT could accumulate in the fatty tissues of many organisms.

Research on the effects of DDT in the past years has shown that 1) DDT affects phytoplankton species composition and the natural balance in aquatic ecosystems, 2) DDT can be concentrated and transferred in freshwater and marine plankton, insects, molluscs, other invertebrates, fish, terrestrial invertebrates, amphibians, reptiles, mammals, and birds, 3) DDT can be toxic to birds, fish and many useful aquatic invertebrates, molluscs, and arthropods and 4) DDT affects the reproductive success of many species of fishes and birds (U. S. Environmental Protection Agency, 1975).

As a result of this extensive research into DDT's residual effects, general use of DDT in the United States was cancelled by the Environmental Protection Agency in 1973. Even though DDT is still used in this country in emergency public health cases or in other situations permitted on a case basis (U. S. Environmental Protection Agency, 1975), under the present circumstances, DDT cannot be considered a viable method of flea control for the Fort Ord Complex.

### Other Insecticides

Other insecticides that are effective in flea control include phoxim, trichlorfon (Dipterex), dichlorvos, dieldrin, malathion, and diazinon. Phoxim and trichlorfon are organic phosphate insecticides with systemic properties. Dichlorvos, also an organic phosphate, is a vapor toxicant (fumigant). However, all three insecticides are still under experimentation and are not currently registered with EPA for flea control (Nelson, 1976). Dieldrin, a chlorinated hydrocarbon insecticide similar to DDT has also shown long residual effects and is no longer sold or used in the United States (Thomson, 1976). Malathion and diazinon are organic phosphate insecticide-acaricides that are primarily used in California for mosquito control (California State Department of Health, 1976).

## The Proposed Action

### Objective

The objective of the proposed action is to reduce ground squirrels and their fleas to acceptable levels, which in turn will reduce 1) the human health hazards, 2) crop and range depredation, 3) damage to military structures and interference with military activities.

### Categories of Areas to be Treated

The Army's proposed ground squirrel and flea control program can be divided into three categories: 1) control in open rangeland, 2) control in areas of human use and 3) control in special areas (i.e., dam faces, around water supplies and in the vicinity of any known San Joaquin kit fox den sites) (Figures 5 through 10).

## Description of Treatment and Application Methods

Open Range. The proposed action for control of ground squirrels in open rangeland of the Fort Ord complex involves the use of sodium monofluoroacetate (1080) and zinc phosphide grain bait. Compound 1080 will be used in 1977 on Fort Hunter Liggett and Camp Roberts and zinc phosphide will be used on Fort Ord. Direct flea control with insecticides is not being considered for the open range, since flea control is ultimately achieved through squirrel reduction.

Sodium monofluoroacetate, purchased from the County Agricultural Commissioner, will be used in the form of grain bait (crimped oat groats) with a 1080 concentration of 0.08 percent. The bait will contain a yellow dye (Auramine O concentrate 130 percent) to repel seed-eating birds. Prior to application of poison bait, bait acceptance will be tested in several squirrel colonies using untreated crimped oat groats.

Application of 1080-treated grain bait will be by aircraft only. The Monterey and San Luis Obispo County Departments of Agriculture will be contracted for application of the poison bait. All procedures concerning proper conditions for application, notification of adjacent landowners, pilot safety, handling, cleanup and disposal of poison and its containers will be governed by California Department of Food and Agriculture laws and regulations and supervised by officials authorized by the county agricultural commissioners.

On squirrel-infested rangeland bait will be applied by spot broadcasting from aircraft over isolated colonies at a rate of 6 pounds/swath acre. Grazing lessees on both installations will be notified prior to the aerial application of 1080 bait. Retreatment with aerially-applied 1080 bait may be required every 2-3 years, wherever the ground squirrel populations increase again to a high density.

Approximately 89,500 acres of the total of 166,535 acres on Fort Hunter Liggett can be assumed to be potential open range ground squirrel habitat (i.e., grassland and oak grassland vegetative cover types). Of the 89,500 acres, it is estimated that only about 5 percent* of this acreage (4,475 acres) will actually be treated with 1080 bait. Therefore, the estimated pounds of 1080 bait spot broadcasted at a rate of 6 pounds per acre (i.e., 6 pounds/swath acre), where

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* Figures of 2.4 and 3.7 percent have been reported from Monterey and San Luis Obispo Counties and cited earlier. Five percent is used as a conservative estimate because of the high squirrel density.

applied, totals 26,850 pounds. At $0.20 per pound, the 1080-treated bait will cost $5,370. Assuming that a pilot can fly an average of 1,500 acres per hour (Marsh, 1968), approximately 60 hours of flying time will be needed to cover all of the potential ground squirrel habitat. At a maximum of $150 per hour of flying, the total cost of the pilot and aircraft will be $9,000. Excluding any supervisory costs, the estimated total cost of aerial application with 1080 bait on Fort Hunter Liggett will be $14,370 or $0.16 per acre.

Approximately 39,000 acres of the total of 43,745 acres on Camp Roberts are potential ground squirrel habitat. Of these acres, however, only approximately 1,950 acres will be treated. The estimated pounds of 1080 bait needed at 6 pounds per swath acre is 11,700, which at $0.20 per pound will cost $2,340. Twenty-six hours of flying time will be needed to fly all potential ground squirrel habitat and will cost $3,900. Excluding any supervisory costs, the total cost of 1080 aerial application on Camp Roberts will be approximately $6,240 or $0.16 per acre.

Post-treatment manpower for retrieval of squirrel carcasses above ground will be supplied by army personnel. Handling and disposal of carcasses will follow California Departments of Food and Agriculture and Public Health recommendations. Military operations will be notified wherever aerial application of 1080 bait is being conducted.

Zinc phosphide grain bait with a poison concentration of 0.8 percent will be purchased from the County Agricultural Commissioners office. The bait will contain a bird repellent dye. Bait acceptance will be tested prior to application of poison bait.

Army personnel will apply the poison bait on Fort Ord by hand wherever squirrel colonies exist on the open rangeland. Distribution of the bait by hand will follow label instructions (one level tablespoon scattered around each burrow to cover 2 to 3 square feet). All handling and cleanup of poison bait and its containers will follow California Department of Food and Agriculture recommendations. The grazing lessee will be notified before application of poison bait.

Approximately 11,000 acres of Fort Ord is potential ground squirrel habitat. The estimated amount of zinc phosphide needed to hand treat the isolated squirrel colonies within this acreage is 2,310 pounds. Depending on the density of squirrels and number of burrows per acre, when hand baiting, a maximum of 1 pound of zinc phosphide-treated bait may be

needed per acre. At $0.30 per pound, the zinc phosphide grain bait will cost approximately $693. An estimated 19 man days will be needed to hand treat squirrel-infested areas, but because labor will be supplied by Army personnel, no estimates of labor costs have been prepared.

Zinc phosphide is also projected for use as a long-range control measure on all three installations. After aerial application of 1080, it will be used whenever needed throughout the year on Fort Hunter Liggett and Camp Roberts, and in other untreated areas that have squirrel damage, such as road banks and culverts.

Areas of Human Activity. The proposed ground squirrel and flea control program for areas of human activity on all three installations (i.e., cantonments, bivouacs, recreational areas) may involve use of several rodenticides: diphacinone, methyl bromide, carbon bisulphide, gas cartridges, and zinc phosphide. In addition, Carbaryl will be used to control fleas within human use areas.

Squirrel Control. Diphacinone grain bait will be the most extensively used rodenticide within human use areas. It will be purchased from the County Agricultural Commissioner and have a poison concentration of 0.005 percent. Bait will be distributed by Army personnel in 30-inch long PVC pipe bait boxes with an estimate of one bait box per 50 ground squirrel burrows with the bait boxes no further apart than about 200 feet in infested areas. Approximately 15 pounds of bait will be used per bait box. Diphacinone grain bait will cost $1.00/pound. The cost of construction of each bait box is estimated to be $5.00. Bait boxes will be maintained for a period of 21 days or until consumption ceases. The bait will be replenished as needed which, initially, will be every 2 to 3 days.

On Fort Ord there are an estimated 1,500 ground squirrel burrows within 500 acres to be treated. Approximately 750 pounds of diphacinone and 50 bait boxes will be needed. The total cost will be $1,000 or $2.00 per acre excluding Army personnel labor costs.

On Camp Roberts, 3,000 acres with an estimated 10,000 burrows will be treated. A total of 6,000 pounds of diphacinone bait and 400 bait boxes will be needed. The total cost will be $8,000 or $2.67 per acre excluding labor costs.

Safety precautions for handling, cleanup, and disposal of bait-contaminated containers and carcass disposal will follow the recommendations of the California Departments of Food and Agriculture and Public Health. Army personnel and civilians will be notified when treatment begins.

Fumigants, such as methyl bromide, carbon bisulphide and gas cartridges will be used by Army personnel in conjunction with diphacinone in human use areas of each installation. All fumigants will be applied following recommended rates and procedures on the rodenticide label. Army personnel will follow California Department of Food and Agriculture regulations when handling or disposing of poison containers. There will be limited use of fumigants and costs will be minimal.

A limited amount of zinc phosphide grain bait will be used within city limits of Fort Ord on the athletic field or in vacant lots. It will not be used near family housing or other inhabited buildings.

*Flea Control*. As per Health Department recommendations, fleas of ground squirrels will be controlled in the cantonments or other human use areas. Ten percent Carbaryl dust purchased from the manufacturer will be applied by Army personnel using appropriate dusters. Two ounces of dust will be injected into each burrow. Safety precautions, handling and disposal of poison containers will follow label instructions.

Acreages and burrows to be treated on all three installations are equivalent to those estimated for diphacinone treatment. Five hand dusters at $125 each and 200 pounds of Carbaryl at $0.50 per pound will be needed for treatment on Fort Ord. The total cost will be $725. Fifteen hand dusters and 1,500 pounds will be needed on Fort Hunter Liggett. The total cost will be $2,625. Fourteen hand dusters and 1,250 pounds of Carbaryl will be used on Camp Roberts. The total cost will be $2,375.

Areas of Special Concern. Ground squirrel control in areas of special concern such as den sites of San Joaquin kit fox, water supplies, and dam faces will be more restrictive. Prior to open rangeland treatment an inspection will be made on each installation for den sites of the San Joaquin kit fox in conjunction with the California Department of Fish and Game. If den sites are found, 1080 bait will not be distributed within a one-mile radius; only zinc phosphide will be used in the vicinity of kit fox dens. In other sensitive areas such as dam faces or water supplies, infestations will be treated with diphacinone or the previously mentioned fumigants. Use of rodenticides in these special situations will be limited and costs will be minimal. Carbaryl will be used if there is significant human use of any of these areas.

Since the so called "open-range" may contain any one or several of the areas of human use or of special concern, applications of specific squirrel or flea control chemicals may be necessary at specific sites within this open range area. From the viewpoint of the Surgeon General's office, if ground squirrel control in any area is conducted without preceding or concurrent flea control, there should be a quarantine upon activities of the military or the public (including pets) within the treated areas.

## Impacts and Mitigations of Chemicals and Control Methods

In the discussion of impact and mitigation measures this report has proceeded on the assumption that the proposed action and alternatives will be conducted according to the laws, regulations, policies and permit constraints which will be imposed by the appropriate federal, state and local government agencies. See Appendix G for selected guidelines and constraints extracted from the California Administrative Code, the California Food and Agriculture Code, and the Vertebrate Pest Control Handbook.

Rodenticide bait will be formulated and used in accordance with the recommendations of the California Department of Food and Agriculture. All materials will be used following the most recently approved label instructions.

Time-proven policies and procedures have been assembled for conducting squirrel control. These incorporate many working details aimed at maximum efficacy on the target species and a minimum of undesirable effects under California field conditions (California Department of Food and Agriculture, 1975).

Insecticides for flea control will be used in accordance with label instructions and following the recommendations provided by health officials for maximum efficacy and a minimum of undesirable effects.

### Open Range

Water Resources. There is little possibility of 1080 (sodium monofluoroacetate) entering the aquatic environment from watershed runoff, leaching to the groundwater or accidental application onto water bodies. According to Saito, et.al. (1966), Hilton, et.al. (1969) and Peters (1975), sodium monofluoroacetate leached from baits is not likely to

be carried far, but rather to remain adsorbed in the upper soil (Atzert, 1971). Saito, et.al. (1966) analyzed water for a 5-month period from streams in an area treated with 1080 and did not detect a trace of the chemical. As a standard operating procedure, 1080 applied aerially or by hand will not be applied closer than 100 feet from streams or reservoirs. Any aerially-applied 1080 on Hunter Liggett and Camp Roberts will be at the rate of 6 pounds of baited grain per acre. The 1080 will be mixed at the rate of 0.015 ounce (0.425 grams) per pound of grain. Assuming the application of 1080 on one acre of watershed in the amounts previously mentioned, it is possible to project the potential contamination of a water resource with 1080. For the purposes of this example, it was assumed that: (1) 2.6 grams of 1080 was distributed evenly over one acre, (2) that rainfall equalled one inch, all of which ran off, (3) the entire toxic load is translocated (leached) from the grain baits into an impoundment or other water body. Given those assumptions, there would be 0.025 mg of 1080 per liter leached into the water body (Peters, 1975). Such an event is unlikely due to the tendency of 1080 to remain adsorbed in the soil layer and plant cellular material, and because the aerial application will be conducted in May or June, a time when the majority of precipitation has ceased. The lethal dose ($LD_{100}$) of 1080 for man is 2 mg/kg of body weight. Assuming a body weight of 70 kg (154 pounds), it would be necessary for a man to drink 5,600 liters (6,000 quarts) of the contaminated water within half a day to receive a lethal dose (140 mg/l).

The expected life of 1080 in water is unknown; however, there is evidence that sodium monofluoroacetate would degrade into non-toxic components at the soil/water interface due to the activities of soil micro-organisms (Peters, 1975).

While there is always the possibility of an accidental spill of 1080-baited grain into a water body, it would take a concentration of >370 mg/l to have an effect on fish life (King and Penfound, 1946).

Zinc phosphide ($Zn_3P_2$) is insoluble in water, and therefore is not expected to provide any significant impact per se upon water quality in the proposed treatment area. Zinc phosphide breaks down by hydrolysis in damp, acid situations releasing zinc ions and phosphine gas ($PH_3$), both of which may affect water quality. Phosphine gas is converted rapidly to phosphates in the soil, and in water solution would be utilized by living organisms.

Zinc has no known adverse physiological effects upon man except at very high concentrations, and is an essential and beneficial element in human nutrition (discussed and referenced in California State Water Resources Control Board, 1971). As

discussed in this publication, it would appear that the USPHS and World Health Organization (WHO) limits of 5 mg/l of zinc in drinking water are conservative. The normal human intake of zinc is estimated to be 10-15 mg/day with numerous reports of families and communities using drinking water containing up to 50 mg/l. 30 mg/l of zinc may cause a milky appearance in water and an unpleasant taste may be present as low as 2 mg/l.

In the unlikely event that all of the zinc phosphide bait added to one acre were to become hydrolyzed and all of the zinc washed into an impoundment by 1 inch of rain (102,790 liters), the resulting concentration of zinc due to this addition would be 0.34 mg/l. (Based upon the rate of 6 pounds of zinc phosphide-treated bait per acre using a 1.69 percent formulation, this would result in 0.1014 pounds of zinc phosphide per acre. Of this $\frac{3(65.4)}{258.1}$ x 0.1014 pounds or 0.0771 pounds would be as zinc ions. 0.0771 pounds = 35 grams of zinc. $\frac{35 \text{ grams}}{102{,}790 \text{ liters}}$ = 0.34 mg/l.)

Even if no further dilution occurred, which is unlikely -- either through removal of the zinc ion by chemical or biological processes (there is evidence that zinc ions are adsorbed strongly and permanently on silt with a resultant inactivation of zinc [Jacobs, 1955, In: California State Water Resources Control Board, 1971]), or by addition of more water -- this concentration remains far below the recommended upper limit for zinc in livestock waters of 25 mg/l.

Fauna - Sodium Monofluoroacetate (1080).

*Primary Poisoning - Target Species*. Sodium monofluoroacetate (1080) as a rodenticide has had a long, effective and relatively hazard-free history in squirrel control in California. It is the most efficacious, acute rodenticide known for squirrel control (Dana, 1962; Marsh, pers. comm.; Howard, pers. comm.), but 1080, like all toxicants, has some undesirable characteristics which may result in some degree of unfavorable impact.

The spot-broadcast application of compound 1080 by aircraft on Fort Hunter Liggett and Camp Roberts will result in relatively high mortality (approximately 90 percent) of the Beechey ground squirrels. The degree of control (mortality) may depend on several factors: (1) the timing of the control operation in relation to the above-ground activity of the squirrels (discussed earlier), (2) bait acceptance as may be influenced by feeding habits and the availability of more preferred natural food, (3) the density of organic litter or range forage on areas where bait is applied, which influences the squirrels' ability to locate a lethal amount of bait (applied at about 2.5 kernels of grain per square feet, i.e., 6 pounds per swath acre), (4) the ability of the pilot to place bait in close proximity to squirrel burrows.

If 1080 bait prepared on crimped oat groats at the concentration of 0.08 percent (1.5 ounce per 100 pounds of grain) is applied by spot broadcasting from the air at a rate of 6 pounds of grain per swath acre treated, the percent mortality will probably be approximately 90 percent. Figures of 85 to 98 percent have been mentioned (Marsh, 1968; Kalar, pers. comm.). The actual effectiveness of control will have to be determined through pre- and post-treatment censuses of representative areas.

The effect of the control operation will be an immediate reduction of the squirrel populations receiving treatment on Fort Hunter Liggett and Camp Roberts. Populations in areas not treated will continue to exist and may act as a source of reinfestation of the voids created by control, and they may also move into new areas previously unoccupied by squirrels if favorable habitat has been created.

After the initial treatment, ground squirrel populations will remain low until production of young the following spring. The rapidity with which the population recovers depends on the initial degree of control. Ninety percent mortality initially may keep the population suppressed for 2 or more years before retreatment may be necessary. Subsequent control with 1080 can be used to maintain a depressed population.

*Primary Poisoning - Nontarget Species.* Primary poisoning can be defined as poisoning which may result when the toxic bait is ingested directly by nontarget species. Whether this, in fact, takes place under field conditions depends on many factors.

The timing of squirrel control is relatively critical for maximum efficacy. Squirrel control conducted at the optimum time of year with the most efficacious rodenticide will then reduce the need for frequent rebaiting, reducing the overall amount of 1080 placed in the environment and, hence, reducing the degree of potential exposure to nontarget species.

The relatively limited optimum baiting period (discussed earlier) assists in anticipating potential problems which may arise as the result of baiting. Baits for aerial and hand baiting are formulated with the minimal concentration of rodenticide effective for the target species, and this markedly reduces the potential hazard to many nontarget species, especially those less susceptible to 1080 than are squirrels. Ground squirrels are among the most susceptible of all species to 1080, with an $LD_{50}$ of about 0.3 mg/kg (Table 13), and this is probably the key factor that has kept impacts on the environment resulting from ground squirrel control at such a relatively minor level.

Table 13

$LD_{50}$ OF SODIUM MONOFLUOROACETATE (1080) FOR WILD AND DOMESTIC VERTEBRATE SPECIES

| Species | $LD_{50}$ mg/kg | Average Weight, kg | Median Lethal Dose Required, mg $LD_{50}$ |
|---|---|---|---|
| MARSUPIALS: | | | |
| Opossum | <1.2 | 3 | 3.6 |
| UNGULATES: | | | |
| Cow, adult | 0.393 | 500.0 | 196.5 |
| Cow, juvenile | 0.221 | -- | -- |
| Goat | 0.6 | 50.0 | 30.0 |
| Horse | 0.35-0.55 | -- | -- |
| Mule | 0.22-0.44 | -- | -- |
| Sheep | 0.25-0.50 | 50.0 | 12.5-25.0 |
| Pig, adult | <1.0 | 50.0 | 50.0 |
| Pig, juvenile | 0.4 | -- | -- |
| Mule deer | 0.30-1.0 | 68.0 | 20.4-68 |
| CARNIVORES: | | | |
| Bear | 0.5-1.0 | 136.0 | 68.0-136.0 |
| Bobcat | <0.66 | 10.0 | <6.6 |
| Domestic cat | <0.20 | 1.4 | <0.3 |
| Mountain lion | ----------Unknown---------- | | |
| Coyote | 0.10 | 13.6 | 1.4 |
| Gray fox | <0.3 | 5.4 | <1.6 |
| Desert kit fox | 0.22 | 1.7 | 0.4 |
| Dog | 0.1 | 25 | 2.5 |
| Badger | 1.0 | 8.6 | 8.6 |
| Marten | ~1.0 | 1.4 | ~1.4 |
| Mink | ~1.0 | 1.4 | ~1.4 |
| RODENTS: | | | |
| Columbia ground squirrel | 0.1 | 0.5 | 0.1 |
| Fisher's ground squirrel | 0.3 | 0.9 | 0.3 |
| Breviceps pocket gopher | <0.05 | 0.3 | 0.02 |
| Southeastern pocket gopher | 0.25 | 0.3 | 0.08 |
| Merriam kangaroo rat | <0.2 | 0.04 | 0.008 |
| Fresno kangaroo rat | -- | 0.04 | -- |
| Norway rat | 4.0 | 0.3 | 1.2 |
| Wood rat | 1.5 | 0.4 | 0.6 |
| Black rat | 0.5 | 0.2 | 0.1 |
| Deer mouse | 4.0 | 0.02 | 0.08 |
| House mouse | 8.0 | 0.01 | 0.08 |
| Pocket mouse | -- | 0.02 | -- |
| Meadow vole | 0.92 | 0.04 | 0.04 |
| Porcupine | <1.0 | 5.4 | <5.4 |
| LAGOMORPHS: | | | |
| Black-tailed jackrabbit | 5.55 | 2.3 | 12.8 |
| BIRDS: | | | |
| Domestic pigeon | 4.24 | 0.3 | 1.3 |
| Mourning dove | 7.8 | 0.2 | 1.6 |
| Mallard | 6.1 | 1.2 | 7.3 |
| Pintail | 8.0 | 1.0 | 8.0 |
| Widgeon | 7.5 | 0.8 | 6.0 |
| Snow geese | 3.5 | 2.7 | 9.5 |
| White-fronted geese | 5.9 | 2.8 | 16.5 |
| Chicken | 7.5 | 1.0 | 7.5 |
| Chukar | 3.51 | 0.5 | 1.8 |
| Gambel's quail | 20.0 | 0.3 | 6.0 |
| Japanese quail | 17.7 | 0.2 | 3.5 |
| Ring-necked pheasant | 6.46 | 2.5 | 16.2 |
| Turkey | 4.0 | 3.0 | 12.0 |
| California quail | 2.6 | 0.2 | 0.5 |
| Brewer's blackbird | 2.0-3.0 | 0.2 | 0.4-0.6 |
| English sparrow | 3.0 | 0.1 | 0.3 |
| Golden eagle | 1.25-5.0 | 3.2 | 4.0-16.0 |
| Rough-legged hawk | ~10.0 | 1.1 | ~11.0 |
| Marsh hawk | ~10.0 | 1.1 | ~11.0 |
| Great horned owl | ~10.0 | 1.6 | ~16.0 |
| Turkey vulture | <20.0 | 2.7 | <54.0 |
| Magpie | 0.67 | 0.23 | 0.15 |
| California condor | ----------Unknown---------- | | |
| Man | 2 | 68.0 | 136.0 |

Source: Atzert, 1971; Peters, 1975; California Department of Food and Agriculture, 1975.

The potential of primary poisoning of nontarget species depends on (1) whether such animals find and consume the bait, (2) the susceptibility of the species to 1080, and (3) the ability of the species to detect early symptoms and stop feeding prior to ingesting a lethal dose (aversive conditioning).

To reduce the potential hazards to nontarget species, baits are prepared with recleaned crimped (slighted rolled) hulled oat groats which, according to Marsh (pers. comm.) and Howard (pers. comm.), are selected for a number of reasons:

1. Oats are highly preferred by squirrels, but are less acceptable to small seed-eating birds than are other grains such as wheat (Gabrielson, 1932) or milo.

2. Rolling of the oat groat kernel distorts its shape, which is believed to cause additional rejection by birds.

3. Rolling increases the surface areas, making them relatively consistent in size, permitting even distribution of the toxicant on the grain, thus decreasing the chance that some kernels might have much greater concentrations of toxicant than others.

4. Oat groats are consumed at a faster rate than oats with hulls because the squirrels do not have to stop to hull the oats. This increases the efficacy of the bait, permitting a lower application rate.

5. Biological and climatic degradation of the rolled oat groats is much more rapid than with unhulled oats or oat groats which are not rolled.

6. Baits using hulled oats can be prepared at slightly reduced rodenticide concentrations without affecting efficacy because no toxicant will be lost in the squirrel's hulling process. Hulls discarded by squirrels contain small amounts of toxic residue.

7. Rolled oat groats will not germinate, eliminating any chance of toxic seedlings.

Laboratory studies have indicated that most seed-eating birds are less susceptible to 1080 than are ground squirrels or canids (Rudd and Genelly, 1956; Tull Chemical Company, n.d.; Atzert, 1971; Peters, 1975; California Department of Fish and Game, 1962)(Table 13). Under certain circumstances 1080 bait

can be a potential hazard to individual seed-eating birds, and, in fact, an occasional seed-eating bird has been killed, although no evidence exists that any significant losses to even very localized populations has ever occurred except with waterfowl (Marsh, pers. comm.).

The dyeing or coloring of grain bait has long been recognized as an aid in repelling many seed-eating birds (Kalmbach, 1943). It is also known, however, that some species such as waterfowl are not particularly repelled by colored bait. For example, waterfowl deaths occurred in the vicinity of the Tule Lake National Wildlife Refuge from eating dyed baits applied at high rates for an eruption of meadow mice which reached reported population levels of 3,000 per acre (Federal Cooperative Extension Service, 1959). Some dyes also tend to fade with time under field conditions (Rudd and Genelly, 1956), and, hence, their effectiveness as repellents may be reduced.

All 1080 bait used on Fort Hunter Liggett and Camp Roberts will be dyed to reduce the possibility of birds eating the bait, recognizing, however, that this safeguard is not infallible. Since rodents are essentially colorblind, color additives in baits do not cause visual rejection by squirrels. Color additives have the following additional benefits:

1. Prevent possible accidental human consumption of the dyed bait and reduce the hazard of the bait being accidentally used for livestock feed.

2. Aid in bait preparation. Uniformity of color distribution in the finished product assures that thorough mixing has been achieved.

At the application rate of 6 pounds per swath acre (approximately 2.5 kernels/square foot), varying amounts of bait may remain a few days following application; however, residual bait was found to be lowest when the squirrel populations were high (Marsh, 1967).

The effect of 1080 baiting on terrestrial invertebrates at Fort Hunter Liggett and Camp Roberts is not known; however, Marsh (1968) did report his findings on 1080 bait concerning harvester ants and darkling ground beetles. Harvester ants were killed by 1080 bait, and, thus, some impact on this species may occur very locally. Darkling ground beetles were capable of feeding on the treated bait without apparent harm. Marsh (1968) also reported that invertebrates apparently removed or consumed over 30 percent of the bait which was placed on the ground and protected by wire mesh caps. Biodegradation by invertebrates seems likely.

The direct poisoning of nontarget species in 1080 ground squirrel operations has been reported. Deer mice, kangaroo rats and pocket mice are believed to have been killed as the result of 1080 squirrel control programs, based on carcasses found or local populations censused (Marsh, 1968; California Department of Agriculture, 1973). Marsh (pers. comm.) and Howard (pers. comm.) believe that deer mice are probably the most affected of the nontarget rodent species because this nocturnal species is most apt to be found in close association with ground squirrels, which are diurnal, and because they are excellent foragers with a relatively high preference for oats. This close association with ground squirrels may be a factor in why they are suspected of being potential reservoirs of plague. In all likelihood, a local reduction in the deer mouse populations, and possibly other seed eating rodents, i.e., those inhabiting areas where the squirrels are to be controlled, can be anticipated in the 1080 treatment of Fort Hunter Liggett and Camp Roberts. That 1080 may be lethal to deer mice is supported by the fact that the U. S. Fish and Wildlife used to recommend and use baits (containing 0.55 percent 1080) for aerial broadcasting to control forest rodents (Fitzwater, 1972). However, this is seven times the dosage of 1080 that is to be used on the ground squirrels. Also, it was only applied at 0.5 pounds per acre, and was uniformally broadcast over the entire forest area instead of by spot treatment as with squirrel control.

Pocket gopher populations, which frequently occupy the same rangeland as ground squirrels, are not significantly affected by 1080 baiting because of their fossorial habits.

Those nontarget rodent species which are locally affected will have a tendency to recover more rapidly than squirrels because they have several litters a year as opposed to ground squirrels which have only one. Each subsequent baiting of ground squirrels will have about the same effect on the susceptible small rodent population.

Occasionally small numbers of cottontails may be killed (Marsh, pers. comm.), although there is no current evidence that local populations are drastically reduced. Jackrabbits are generally less vulnerable because of their greater tolerance to 1080 and by the fact that it is difficult for this species to pick up lethal amounts of widely scattered grain. Grey squirrels will not be affected because they are not common in ground squirrel areas and are also quite tolerant to 1080.

The effect the relatively rapid reduction of a ground squirrel population would have on the food base of bird, mammal and reptile predators is not known for the areas in question. When ground squirrels are in high numbers, they undoubtedly play some role in the diets of diurnal predators that are large enough to kill ground squirrels. Snakes and other predators mostly take young squirrels. Since the activity of ground squirrels varies seasonally, they are more available as food for predators at specific times of the year. During the hotter periods of the summer the adult squirrels frequently go into aestivation, and hibernation in the winter months drastically reduces the number of squirrels available to predators at that time of year. Where high densities of squirrels exist, some mostly young-of-the-year, are active almost daily all year when the weather is favorable (Howard, pers. comm.; Marsh, pers. comm.).

Since the above ground activity of ground squirrels fluctuates rather dramatically from season to season, they cannot be a staple of the diet of predatory species throughout the year. Since predators are, for the most part, opportunistic, selecting from what is available to them, any substantial artificial reduction in the density of ground squirrels would probably only cause a shift in the diet of those predators which were currently utilizing ground squirrels. However, other species such as jackrabbits, meadow mice, pocket gophers and others not affected significantly by the control of ground squirrels would still be available to the predators.

*Secondary Poisoning - Nontarget Species*. Secondary poisoning is defined as the poisoning of a nontarget species as the result of consuming another animal which has died from 1080 bait. Secondary poisoning is the unfavorable characteristic most often expressed with regard to the use of 1080. The extent that secondary poisoning occurs from 1080 generally relates to how it is used. The way it is used in squirrel control is one of the least hazardous applications. The only time the hazard is present is in pocket gopher control. Considering that several million gross acres are treated annually with 1080 bait in California for ground squirrel control, relatively few instances of secondary poisoning can be cited. The Canidae (dogs, coyotes and foxes) are very susceptible to 1080 and, hence, potential secondary hazards are of a greater concern with this group than with most other species, although members of the cat family, Felidae, are also quite susceptible. Most avian predators or carrion feeders are quite resistant to 1080 (Table 13). The potential for secondary poisoning relates to a number of factors concerning the carnivore's susceptibility and feeding behavior.

(1) What is the feeding behavior of the carnivore? Do they commonly feed on the target species (i.e. ground squirrels) or other rodent species which may be incidentally killed?

(2) Is the carnivore a carrion-feeder or does it take only live prey?

(3) Is the carnivore sufficiently susceptible to 1080 to cause its death through the consumption of dead rodents?

(4) The size of the carnivore compared to its prey may be an important factor (i.e. dilution factor).

(5) What percentage of the carnivore's daily total diet is made up of 1080-killed rodents?

(6) For how long will a squirrel carcass be acceptable, since flesh decomposition is relatively rapid in California's warm, dry weather.

(7) Will the carnivore feed on the intestinal tract or will it tend to eviscerate the squirrel? Larger amounts of 1080 may be found in the intestinal tract than in the animal tissues.

(8) Will they eat the entire squirrel including the contents of the cheek pouches, which may contain unconsumed 1080 treated grain?

(9) Is the carnivore capable of detecting early symptoms from 1080 and thus stop feeding on poisoned squirrels prior to receiving a fatal dose?

(10) Does the carnivore tend to regurgitate its prey when early poisoning symptoms occur, reducing the potential for fatal poisoning?

(11) Will the carnivore feed on material regurgitated by other carnivores or refeed on their own regurgitate?

The significance of any one of these factors depends on the species of carnivore or carrion-feeding mammal, bird or snake. There are still other factors concerning the prey or carrion which are equally important in determining any adverse impact on the carnivores. These include the following:

(1) How many squirrel carcasses will be available to the carnivores within their normal feeding range?

(2) What percentage of the squirrels will consume quantities of toxic bait greatly in excess of a lethal dose as opposed to those consuming just slightly over a lethal dose (Howard, 1959)?

(3) At the time of control are most of the squirrels pouching the grain bait, thereby increasing the potential for secondary hazards?

*Field monitoring of the effects of 1080 grain baits on nontarget wildlife species has been conducted in the past by the California Department of Fish and Game (California Department of Agriculture, 1973; Swick, 1973; Griffith, 1976 memo; California Department of Fish and Game progress reports, 1958-1976; Hagan, 1972). No cases of secondary poisoning by 1080 were documented during those studies. The studies cited do not preclude the possibility that some losses, particularly to the canids, did occur; however, it is doubtful that significant losses could have gone undetected considering the man hours spent in the field. Circumstantial and other actual evidence indicates that occasionally dogs, coyotes or other highly susceptible mammals are indeed killed in squirrel control operations. Rudd and Genelly (1956) stated, "...ground squirrel control in California has assisted considerably in reducing coyote populations", although no evidence was provided to justify this contention. Earlier, Kalmbach (1945) estimated "that rodent control may effect a 30 percent reduction in the coyote population of treated areas"; however, this estimate occurred only shortly after the introduction of 1080 by the U. S. Fish and Wildlife Service, and the concentration of 1080 used on the baits, the types of bait used, and techniques of application were not refined to reduce secondary hazards to the degree they are today (Howard, pers. comm.). Coyote populations naturally fluctuate, and during the past several decades in California there has been no evidence presented indicating that controlling ground squirrels has altered the density of coyotes (other than possibly locally) either by secondary poisoning or by reducing their food base.

Squirrel control, which is conducted on a regular basis every second or third year, is biologically sound for reasons other than effective reduction of squirrel populations. Evidence suggests that aversion or bait shyness in rodents, brought about by sublethal doses, occurs more commonly when acute rodenticides are used too frequently, and such averted

animals may well be protected for the rest of their lives. The same kind of induced aversion to prey has been studied in coyotes and in some avian species (Gustavson, et.al., 1976; Rusiniak, et.al., 1976; and Brett, et.al., 1976). The fact that substantial populations of foxes, coyotes, badgers, and other carnivores do exist in areas that have been consistently poisoned with 1080 or other acute rodenticides for over 25 years, may in part be explained by aversive conditioning.

The number of poisoned squirrels available to predators has been suggested as one significant factor in possible secondary poisoning. According to previous post-treatment field analyses, 4 to 6 percent of poisoned Beechey ground squirrels were estimated to die above ground (U. S. Department of Army, 1968 memo). Of those squirrels dying above ground, many may have consumed or "pouched" much more than a lethal dose of bait, thereby increasing the hazards of secondary poisoning (U. S. Department of Army, 1968 memo; Swick, 1973).

In the process of hoarding food, the amount that will be pouched will depend on factors such as the season of the year, density of bait applied, availability of natural food, age of the squirrel, etc. Less pouching is believed to occur in areas of dense populations because fewer kernels are available to each squirrel (U. S. Army, 1968; Griffith, pers. comm.). Aerial baiting distributes the bait sparsely (i.e., approximately 2.5 kernels per sq.ft.) so that the squirrels are believed less capable of ingesting much more than one lethal dose and are also less capable of pouching large amounts of bait, thus reducing the potential for secondary poisoning of predators. These same factors also reduce the potential of primary poisoning by nontarget seed-eating species.

Aerial baiting has several other safety advantages over hand baiting. 1 It drastically reduces the number of people coming into direct contact with the toxic bait, hence reducing potential human-related accidents. 2 The use of aerial baiting has virtually eliminated the accidental loss of domestic livestock because of the reduced chance, when compared with hand baiting, of animals gaining direct access to containers of bait during the baiting operation or of someone spilling bait in the field. 3 Livestock cannot eat a lethal amount of sparsely distributed aerial-broadcast bait.

*Rare and Endangered Species*. The San Joaquin kit fox and the California condor are the two rare and endangered species which must be considered under the proposed action and associated impacts.

A condor has been reported sighted on Fort Hunter Liggett, although these sightings apparently are extremely rare. No evidence exists that condors have been feeding on any portion of the Fort Ord Complex; however, the possibility cannot be ruled out because the study area is within the California condor's range (Wilbur et.al., 1972).

Joseph Keyes and others of the Fish and Wildlife Service watched for effects of 1080 on condors and other birds during trial applications in Kern County in 1945. Neither condors nor turkey vultures was found to be killed by eating squirrels poisoned with 1080.

Experiments on the toxicity of 1080 have been carried out (National Research Council, 1948). Koford (1953) reported that the results of these experiments on the feeding of Compound 1080 to vultures were as follows: 20.0 mg/kg was required to kill 71 percent of 7 turkey vultures, and 50 percent of the 10 black vultures were killed at a dosage of 15.0 mg/kg. Judging by these results, a turkey vulture would have to eat as much as 40 times its own weight in poisoned squirrels before it would probably be killed. The amount would be less if the contents of the cheek pouches and stomach were eaten or if the squirrel had ingested more than the minimum lethal dose (Koford, 1953). According to Hagen (1972), the California condor appears to be relatively immune to 1080. Turkey vultures, a near relative of the condor, have for years followed squirrel-poisoning crews, feeding on the carcasses of dead squirrels; however, secondary poisoning from 1080 in turkey vultures is unrecorded. Populations of turkey vultures seem to flourish in the areas where ground squirrels are routinely controlled with 1080. Presently there is no evidence that condors have ever been killed as the result of 1080 used for ground squirrel control.

San Joaquin kit fox have been reportedly observed on both Fort Hunter Liggett and Camp Roberts. Only one den, however, has been reported and this was on Camp Roberts. Both of these military properties lie on the western margin of the kit fox's apparently expanding distribution range. Laughrin (1970) reported that between 1,000 and 3,000 San Joaquin kit fox were believed to exist in California. His distribution map did not even closely include the areas as far west as Camp Roberts or Fort Hunter Liggett. Since then Morrell (1975) completed an extensive study on the San Joaquin kit fox

and found its distribution extended into areas where historically it had not previously existed. He also now estimates the population at a minimum of 5,066 and a maximum of 14,800 adults with a mean figure of 10,000. As the result of this study the San Joaquin Kit Fox Recovery Team, appointed by the Secretary of Interior, has recently met and recommended that this kit fox now be downgraded from Endangered to Threatened. In either case, every possible effort must be taken to protect this species. Therefore, as a special added precaution of this proposed action, and in part based on the findings of Schitoskey (1975), no 1080 bait will be used within 1 mile of any known kit fox dens. Special efforts will be made to locate kit fox dens prior to the control of ground squirrels. Zinc phosphide bait will be used within that 1-mile radius of dens.

Recent evaluation made by the California Department of Fish and Game (1976) concluded that "the aerial application of compound 1080-treated grain bait for the control of ground squirrels in the vicinity of active San Joaquin kit fox dens (sic) has not caused any observable detrimental effect to kit fox in the areas surveyed." The present average densities of kit foxes in areas where ground squirrels have been controlled for over 25 years with 1080 is consistent with the aforementioned study (Morrell, 1975).

The mitigation of possible adverse impacts of 1080 on nontarget species is incorporated as part of the above section on fauna. To minimize hazards to humans and pets, 1080 baits will not be applied in close proximity to inhabited areas.

Well-trained personnel is an essential key in minimizing the impact of baiting programs on the environment. Supervisors and their employees must be knowledgeable in the characteristics of the rodenticide used and of the fauna in the ecosystem to be treated (Marsh, pers. comm.).

Arrangements for possible emergency medical attention should be made in advance of control efforts. Poison centers should be made aware of the toxicants in use, and local veterinarians should be kept apprised of the kind of rodenticides used so they can better diagnose and treat suspected or actual poisonings which may occur in pets or domestic livestock.

With the exception of the target species (ground squirrels), potential impacts on the fauna will be of a relatively minor nature.

*Aquatic Fauna*. Aquatic life is considered to have a very low susceptibility to 1080. Studies by King and Penfound (1946) indicated that fingerling bream and bass experienced no apparent distress in concentrations of 1080 as great as 370 mg/l. It is judged that there will be no adverse impact on aquatic fauna from the proposed action.

*Cumulative Effects on Biological Resources*. Repeated sublethal doses of Compound 1080 under laboratory conditions have slightly increased the tolerance of some wildlife species (i.e., golden eagles, rats and mice) while in other species repeated sublethal doses over a very short period of a few hours accumulated to lethal levels (i.e., dogs, rabbits, and mallards); however, sublethal doses at longer intervals can be excreted as 1080 or metabolized to nontoxic metabolites by some mammal species (In: Atzert, 1971). Cumulative effects were experienced only when sodium monofluoroacetate was administered over a very short time interval (12 hours) (Rowley, 1963). Compound 1080 is not considered a cumulative poison.

Based on research results from Horiuchi (1960), Rowley (1963), Hilton, et.al. (1969), Preuss and Weinstein (1969) and others, the persistence of 1080 in the environment will be short, with little likelihood of persistence and cumulative features.

Fauna - Zinc Phosphide.

*Primary Poisoning - Target Species*. Zinc phosphide baits prepared on crimped oat groats will be used for both hand baiting and aerial application. A 0.8 percent concentration is used for hand baiting applied at an estimated rate of approximately 1 pound per acre (60 bait placements per pound). The amount per acre will vary with the squirrel density. For aerial application a bait concentration of 1.7 percent is used and spot broadcast on squirrel-infested area at 6 pounds per swath acre (i.e., approximately 2.5 kernels/sq.ft.). The acceptance of zinc phosphide bait by ground squirrels is considered to be less than that obtainable with 1080 (Hood, 1972). Whether applied by hand or aircraft the expected percentage of control of the beechey ground squirrel, using zinc phosphide baits can reasonably be placed at approximately 60 percent. Reference has already been made to the expected 60 percent efficacy of zinc phosphide under the section on methods. The initial efficacy of zinc phosphide upon the military lands in question may be somewhat higher since the area has not been treated for 6-7 years. However, subsequent treatments as bait shyness develops will probably result in an efficacy of approximately 60 percent. Few published reports

have been made on the efficacy of zinc phosphide in ground squirrel control -- one, a progress report in 1975 by the Denver Wildlife Research Center of the USFWS to the Mid-Pacific Regional office of the U. S. Bureau of Reclamation (Memorandum of understanding, Contract #14-06-200-7231A) indicates ground squirrel control of 79 percent to 92 percent -- however, corrections for control results ranging from 20 percent to 41 percent were apparently not considered. Applying correction for controls, the results would be significantly lower. Marsh (pers. comm.) and others who have evaluated zinc phosphide in San Luis Obispo County (Kalar, pers. comm.) and in Monterey County (Nutter, pers. comm.) generally support the 60 percent control factor. The erratic results of zinc phosphide for squirrel control have been mentioned earlier.

Hand baiting with zinc phosphide will be conducted on Fort Ord on rangeland and other select areas, and at Fort Hunter Liggett and Camp Roberts in areas where 1080 may be inappropriate (i.e., along streamways and water impoundments, etc.). Zinc phosphide bait will be applied by aircraft within one-mile radius of active kit fox dens found on either Fort Hunter Liggett or Camp Roberts.

The effect of treatment of ground squirrels with zinc phosphide will be a reduction of the treated populations within a few days. Since the program will not result in the total elimination of ground squirrels, the rate which the various populations will increase during the next breeding season will depend upon the number of survivors (and their reproductive potential). The greater the density of a squirrel population, the higher the percentage mortality must be before the operation can be considered efficacious (e.g., a 50 percent reduction of a squirrel colony containing only two squirrels will leave the same number of survivors as 93.5 percent reduction of a colony containing 15 squirrels) (Howard, pers. comm.). Subsequent control with zinc phosphide may have to be as often as every year. In no instance is it recommended that zinc phosphide be used more frequently than once a year because of creating a serious problem of bait shyness in the surviving squirrels.

Since the use of zinc phosphide bait will likely give results inferior to 1080 bait regardless of the method of application, it can be anticipated that the squirrel populations will have to be retreated much more frequently than with the use of 1080 bait. Bait shyness or poor initial bait acceptance may make subsequent control efforts less successful. The maintenance of suppressed squirrel populations with zinc phosphide bait may be less than desirable.

*Primary Poisoning - Nontarget Species*. The factors for minimizing potential hazards which were discussed for 1080 (i.e., minimum effective doses, minimum rates of application, proper timing of control, type of grain used for bait, the dyeing of bait, etc.) are the same for zinc phosphide baits.

The characteristics of zinc phosphide make it somewhat less hazardous to some nontarget rodents because of its reduced efficacy on many rodent species primarily because the toxicant is poorly accepted. Because of its relatively strong odor which may be attractive initially to some rodents, the odor also can serve to create an aversion following a sublethal dose (Marsh, pers. comm.).

Based on past history of its use, zinc phosphide bait might be expected to be slightly more hazardous than 1080 to some bird species since most birds are more susceptible to zinc phosphide than are ground squirrels.

Geese have been killed as the result of ingesting zinc phosphide bait which was applied during a severe meadow mouse irruption in the area of Tule Lake (Keith and O'Neill, 1964); however, some rather unusual circumstances were involved. The rates of bait application for meadow mouse control were greater than those proposed in this action for ground squirrels.

At one time it was thought that zinc phosphide would degrade relatively rapidly in the environment (Crabtree, 1962); however, this has been shown not to be the case at least in some situations. In the Tule Lake incident, laboratory findings showed that about one-third of the original zinc phosphide remained on the bait after 3 months of exposure in the field (Keith and O'Neill, 1964). According to Hood (1972), zinc phosphide is considered relatively toxic to pheasants, ducks, geese and domestic fowl. The compound is considerably more toxic to meadow mice than squirrels (Table 14).

The application of zinc phosphide in the properly prescribed manner should reduce the incidence of mortality to nontarget wildlife. The possibility of incidental loss of a few seed-eating birds may occur; however, this would not be expected to have a measurable effect on the populations of such birds. Since waterfowl do not occupy the areas where squirrels are to be controlled, no potential hazard to them exists.

Even though some mortality of nontarget rodents may occur, the effect on the population will be short, as most rodent species which might be affected have several litters a year and populations will recover more rapidly than do ground squirrels.

Table 14

$LD_{50}$ OF ZINC PHOSPHIDE ON DOMESTIC AND WILD VERTEBRATE SPECIES

| Species | $LD_{50}$ mg/kg | Average Weight, kg | Median Lethal Dose Required mg, $LD_{50}$ |
|---|---|---|---|
| Cow | 50.00 | 500 | 25,000 |
| Desert kit fox | 93.00 | 1.7 | 158.1 |
| Dog | 40.00 | 25 | 1,000 |
| Cat | 40.00 | 1.4 | 56 |
| California ground squirrel | 33.1 | 0.5 | 16.6 |
| Northern pocket gopher | 6.80 | 0.3 | 2.0 |
| Bannertailed kangaroo rat | 8.00 | 0.04 | 0.3 |
| Deer mouse | 40.50 | 0.02 | 0.8 |
| Meadow vole | 18.00 | 0.04 | 0.7 |
| California meadow mouse | 15.70 | 0.04 | 0.6 |
| Muskrat | 29.90 | 1.4 | 40.6 |
| Wood rat | 25.00 | 0.4 | 10.0 |
| Black rat | 21.00 | 0.2 | 4.2 |
| Norway rat | 27.00 | 0.3 | 8.1 |
| Roof rat | 43.40 | 0.2 | 8.7 |
| Black-tailed jackrabbit | 8.25 | 2.3 | 19.0 |
| Mallard | 13.00 | 1.2 | 15.6 |
| Snowgoose | 8.80 | 2.7 | 23.8 |
| White-fronted goose | 7.50 | 2.8 | 21.0 |
| California quail | 13.50 | 0.2 | 2.7 |
| Mourning dove | 34.20 | 0.2 | 6.9 |
| Pheasant | 26.70 | 2.5 | 66.8 |
| Red-winged blackbird | 23.70 | 0.2 | 4.8 |
| Chicken | 20.00-30.00 | 1.0 | 20.0-30.0 |

Source: Vertebrate Pest Control Handbook, California Department of Agriculture, 1975; Pittman-Robertson Report, California Department of Fish and Game, 1962.

Generally, much less is known on the effects of zinc phosphide than 1080 on the nontarget fauna because it has not been used nearly as extensively for ground squirrel control and hence has not been studied as thoroughly.

*Secondary Poisoning - Nontarget Species.* The major threat of secondary poisoning is from the toxic kernels which may be in the cheek pouches of poisoned squirrels and the viscera of poisoned squirrels, since zinc phosphide is not assimilated into tissues and bones (Hood, 1972). Storer and Jameson (1965), Przygodda (1961), and Evans (1970) indicated that dogs and cats are most susceptible to secondary poisoning and that in laboratory tests, golden eagles, vultures, great horned owls, other raptors, and coyotes receiving multiple feedings of zinc phosphide-poisoned jackrabbits showed no intoxication symptoms.

It has been shown that zinc phosphide is a relatively strong emetic to some members of the canid group (Schitoskey, 1975); therefore, this undoubtedly serves as a protective measure against secondary poisoning of dogs, fox and coyotes. As with 1080, zinc phosphide probably causes an aversive reaction which then protects predators once they have experienced the symptoms of a sublethal dose. Experimental feeding of poisoned prairie voles (Microtus ochrogaster) for 3 days to red and gray foxes and to great horned owls did not kill any of the test animals; however, changes in patterns of behavior were noted (Bell and Dimmick, 1975).

According to Rudd and Genelly (1956), poisoned ground squirrels remain toxic for several days after death until acid conditions of the stomach render the zinc phosphide less toxic.

Schitoskey (1975) found that the desert kit fox (Vulpes macrotis arsipus) was atypical in its response to doses of zinc phosphide and has an $LD_{50}$ of 93 mg/kg of body weight, nearly 3 times more resistant than ground squirrels. Under laboratory conditions, kit foxes survived repeated feedings of kangaroo rats, each killed by 480 mg of zinc phosphide, equivalent to 3 times the $LD_{50}$ for a fox. Because of this tolerance in the related subspecies of kit fox, ground squirrel control within a mile of an active San Joaquin kit fox den will be conducted with zinc phosphide rather than with 1080.

On studies conducted at Camp Roberts (California Department of Food and Agriculture, 1974), 9 percent of the zinc phosphide-poisoned squirrel population died on the surface, approximately 5 percent more than the average mortality

remaining above ground with 1080. While it appears that a large percentage of the poisoned squirrels die underground, the number remaining above ground has to be recognized as a potential source of secondary poison. However, this hazard is considered minimal to most nontarget species.

*Rare and Endangered Species*. Although the use of zinc phosphide for rodent control is generally considered slightly more hazardous than 1080 to birds, there is no evidence that bird populations are significantly affected by its limited use in ground squirrel control in Monterey and San Luis Obispo Counties. Based on this, there appears to be little danger to condors through its use.

According to Schitoskey (1975), zinc phosphide is the safest to kit fox of the three acute rodenticides tested. The potential hazards to kit fox are believed minor, although a slightly greater percentage of squirrels will die above ground rather than in their burrows. Kangaroo rats and the smaller rodents make up the greater portion of the San Joaquin kit fox diet (Laughrin, 1970). The small size of the kit fox relative to the size of ground squirrels may preclude its use as a significant prey item. The extent to which kit fox feed on squirrels as carrion is unknown.

The possibility of a potential adverse impact on rare and endangered fauna is remote.

*Aquatic Fauna*. If the level of 0.34 mg/l of zinc were to be maintained in waters containing freshwater aquatic life, some adverse effects may be experienced; however, the sensitivity of fish to zinc varies with species, age and condition of the fish, as well as with the physical and chemical characteristics of the water. Other ions may have a synergistic effect on the toxicity of zinc (McKee and Wolf, 1971). Jones (1938), as reported in McKee and Wolf, reported that for mature fish, the lethal limit for zinc in water containing 1 mg/l of calcium is only 0.3 mg/l, but in water with 50 mg/l of calcium, as much as 2.0 mg/l of zinc is not toxic.

Mitigation of possible adverse impacts upon aquatic life will be based upon avoiding the placement of zinc phosphide treated bait within the vicinity of any water impoundment or stream.

*Cumulative Effects on Biological Resources*. There is no reported evidence of cumulative toxic effects or of persistence as zinc phosphide in the environment.

Flora. Sodium monofluoracetate in the form of monofluoroacetic acid, has been noted to adsorb to a high degree on plant root tissues and other cellular materials (Hilton, et.al., 1969), while David and Gardiner (1951) found plants to be much less sensitive to sodium monofluoroacetate than are animals. Given the low dosage of 1080 per acre (2.6 grams), it is unlikely that plants would have the opportunity to utilize sodium monofluoroacetate in the form of monofluoroacetic acid ($FCH_2COOH$) prior to its decomposition by Pseudomonas and Nocardia species of soil microorganisms (Peters, 1975; Atzert, 1971).

The amount of zinc phosphide used will not affect flora when applied at the contemplated rate of 2.5 kernels of seed per square foot. Zinc ion is a normally-occurring essential trace element in soils at levels 10-250 ppm of surface soil (Buchman and Brady, 1969). Phosphine gas from the zinc phosphide will be converted to phosphate in the soil. There will be no adverse impact upon flora.

Public Health. There will be no significant adverse impact upon public health if chemicals are applied as required by state laws and recommendations, and the guidelines in the vertebrate pest control handbook. There will be a beneficial impact resulting from control of ground squirrels, since the population of this species which act as hosts for plague-infected fleas will be diminished.

Economics. The costs of treating the open range on Fort Hunter Liggett and Camp Roberts with 1080-treated grain will be $7,710 plus $150 per hour of flying time. (86 hours x $150 = $12,900, or a cost of $20,610). No significant impact upon the local economy should result, since no additional personnel will be hired. Other than the pilot, presently employed county and military personnel will be used.

The costs of ground squirrel treatment by hand on open range on Fort Ord with zinc phosphide will be $693 excluding labor costs of any personnel. Thus, the total cost of treating open range areas of the Fort Ord Complex will be approximately $21,303. Approximately $175,000 annually in crop and pasture damages will be saved by adjacent land owners.

Land Use. The application of 1080 and zinc phosphide to military lands would have no effects upon land use except as follows:

*Military Mission*. Rescheduling of military activities in treated areas would be of minor significance if adequate notice is given so that no military personnel would be in the area being treated for the brief time any given area is being overflown (1,500 acres covered per hour).

*Recreation*. Similar to above.

*Grazing*. Uniform application of bait at the low rate of 2.5 kernels of bait per square foot in squirrel-infested areas would not have significant impact upon grazing. The noise and movement of the airplane at low levels may cause some disturbance to stock. The use of a low-flying airplane over concentrations of stock probably should be avoided as a mitigation measure.

Transportation. The only effect which this operation may have on transportation may be the very brief periods during which traffic on military roads may be stopped or diverted during the actual aerial application of the bait. There is, therefore, no significant impact to be expected upon transportation (circulation).

Noise. The airplane used to apply toxic bait may typically be propeller-driven by a single 400-500 horsepower piston engine. The noise which will be apparent will be during takeoff, landing and the aerial application of the bait. The airplane may be expected to produce a sound level of 81 dB at a distance of 1,000 feet. This sound will be noticeable for a relatively brief time from any given point, since the entire flying operation should not exceed 86 hours. There will therefore be no significant impact resulting from the airplane noise. There will be few, if any, humans in or near the areas being treated, and the sound level will produce at most a very brief irritation. The sound of this airplane will be negligible in view of the ambient noise resulting from military helicopter, other aircraft operations, the use of small arms firing ranges, and heavy artillery up to 155 mm. Mitigation will consist of avoiding maneuvers near occupied dwellings or concentrations of humans.

Air Quality. The use of zinc phosphide or 1080 in a solid bait form would not cause changes directly in air quality over any significant area. Very minute amounts of bait chaff would add temporary particulate matter to air while mixing. The use of zinc phosphide and 1080 upon grain entails certain handling and mixing operations during the preparation of the bait, therefore site-specific changes in air quality may occur due to the presence of toxic particulate matter or liberated volatiles.

Low levels of phosphine gas may be released to the air during mixing of zinc phosphide and cause poisoning by inhalation. Mitigation consists of appropriate respirators and exhaust fans to remove 1080, phosphine gas and particulate zinc phosphide from the area where the mixing and handling of zinc phosphide is conducted. Care must be taken to exhaust

this air in such a manner that adequate dilution of the 1080, phosphine gas and zinc phosphide will occur, and thus eliminate a hazard.

Air quality may be affected by the exhaust products resulting from the combustion of aviation fuel (aerial applicators) or regular gasoline (vehicle application) over the area to be treated. One hour of flying time may consume up to 20 gallons of aviation fuel.

One estimate of uncontrolled emission rate from an airplane piston engine (EPA) is as follows (averaged for idling, take-off, flying and landing) per pound of fuel per hour: 0.886 pounds of carbon monoxide; 0.056 pounds of total hydrocarbons; and 5.3 pounds of $NO_x$ (as $NO_2$). Since one gallon of gasoline weighs approximately 6.3 pounds, the emission to be expected from 20 gallons (126 pounds) of gasoline during a one-hour period would, therefore, be 111.6 pounds of CO; 7.1 pounds of THC; 651 pounds of $NO_x$ (as $NO_2$). Based upon 1,500 acres flown per hour, the 128,500 acres of Hunter Liggett and Camp Roberts would require about 86 hours flying time for treatment.

This amount of emissions would not have a significant impact upon air quality. Emissions due to transport of materials by ground vehicles are also insignificant.

Soils.

*1080*. Sodium monofluoroacetate leached into the soil has been shown to adsorb on the soil and to be held there (Peters, 1975; David and Gardiner, 1966). The carbon-fluorine (C-F) bond of compound 1080 can be ruptured by enzyme systems in Pseudomonas and Nocardia species of soil microorganisms (Peters, 1975). Studies by Horiuchi (1960) indicated that sodium monofluoroacetate exhibited no measurable toxicity within 2 weeks when applied at the rate of 10 ppm; and no measurable toxicity within 11 weeks when applied to soils at 50 ppm.

*Zinc Phosphide*. Zinc phosphide when leached into the soil rapidly breaks down into zinc ions and phosphine gas, which in turn is converted into phosphates. There is therefore no significant impact upon soils since the contemplated rate of application of 5 kernels of seed per square foot leads to less than 1 mg of zinc ions per square foot, which is far below the normal level of 10-250 ppm of zinc in surface soils.

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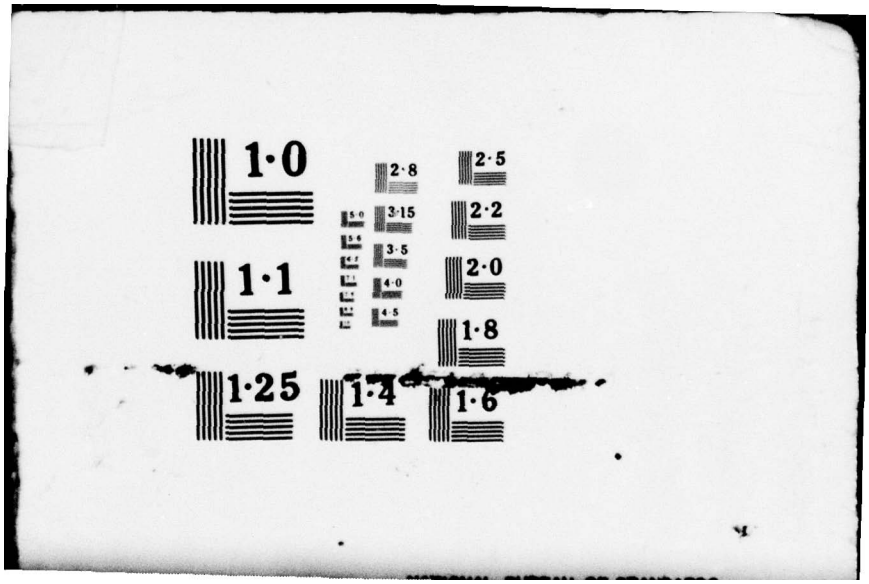
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Energy. Based upon the assumption that the 128,500 acres of Hunter Liggett and Camp Roberts will be flown at the rate of 1,500 acres per hour, there would be 86 hours flying time. At the rate of 20 gallons of aviation gasoline per hour, 1,720 gallons of gasoline would be consumed. This is an irretrievable use of energy.

Other energy consumption would be concerned with the production of 1080 and zinc phosphide, and the growing, harvesting and processing of the oats required for bait. These have not been calculated, but are not significant.

Areas of Human Activity

Zinc phosphide use will be minimal in areas of human activity and restricted to Fort Ord. Therefore, any impact on the environment will probably be insignificant. For details on the possible impacts of zinc phosphide use, see the impact section under Open Range above.

Water Resources. Anticoagulants (e.g. diphacinone) will be used around inhabited areas and in special cases (bivouac areas) in open range away from cantonments. Most anticoagulants are considered to be stable compounds (California Department of Food and Agriculture, 1975); however because of the small amount and the localized nature of application of anticoagulants, it is judged that there will be no significant impact resulting from the application of that rodenticide.

Fumigants applied in minimal amounts in areas of human use will probably have no significant effect on water or other resources.

Carbaryl (Sevin) dust will be used prior to the application of zinc phosphide or anticoagulant rodenticides in areas of human activity. Because the 10 percent concentration will be used only in association with squirrel control in and immediately adjacent to inhabited areas (i.e. cantonment and bivouacs), there is little possibility of adverse impact on water resources.

Fauna.

*Direct Poisoning - Target Species by Anticoagulants*. The ingestion of an anticoagulant compound by ground squirrels will result in the reduction of a localized population. The effects of the control program will only be localized in nature because anticoagulants will only be used in specific situations -- around cantonments and in bivouac areas rather than on a broad scale.

The efficacy of anticoagulants in reducing local ground squirrel problems will be dependent upon 1) acceptance of the bait and 2) the availability of bait. Because of the nature of the action of anticoagulants, they must be fed upon several times over a period of days, and a large amount of bait per squirrel is necessary to achieve effective control (California Department of Food and Agriculture, 1975).

The reduction of the ground squirrel population using anticoagulants will have a minor effect on the total area-wide population.

*Direct Poisoning - Nontarget Species by Anticoagulants.* The major nontarget species to be affected by anticoagulants will be rodents other than ground squirrels, which may consume baited grain. Those species are deer mice, house mice, Norway and roof rats, kangaroo rats and meadow mice. Toxicity information for specific animals is not known for diphacinone. Because the anticoagulants will be set out in bait boxes there will be little chance of poisoning to any larger species. Any bait brought out of the bait boxes could be ingested by birds or larger mammals; however, it is unlikely that a lethal dosage could be consumed in this manner. The use of bait boxes will prevent feeding on baited grain by dogs and cats, which have been known to be poisoned in the past by directly consuming bait.

*Secondary Poisoning - Nontarget Species by Anticoagulants.* The likelihood of secondary poisoning with anticoagulants is slight. There have been relatively few demonstrated cases of secondary poisoning from anticoagulants under field conditions. Prier and Derse (1965) conducted lab analyses of secondary poisoning on dogs. Results showed that dogs were killed by a continuous primary intake of warfarin but were unaffected by continuous ingestion of mice which had eaten warfarin bait.

Because the use of anticoagulants will be limited to areas around cantonments and in outlying bivouac areas, those animals most likely to come in contact with poisoned squirrels will be cats and dogs.

As a precautionary measure, dead squirrels should be picked up and disposed of. Such practices should significantly remove any secondary exposure.

*Aquatic Fauna.* There are few data available relating the toxicity of anticoagulants to aquatic life; however, due to the small quantities to be used and the controlled conditions (use of bait boxes) under which anticoagulants will be used, there is little likelihood of any effect on aquatic organisms.

*Cumulative Effects on Biological Resources*. Anticoagulants are known to have a cumulative effect on the target species (i.e., successive feeding on bait is necessary to achieve control) but anticoagulants are not likely to cause any major impact. However, no specific data are available to confirm this.

*Direct Poisoning - Target Species by Fumigants*. Application of fumigants to ground squirrel burrows may result in elimination of most ground squirrels inhabiting the treated burrow system.

The efficacy of fumigants on active ground squirrels will depend on: 1) the amount of soil moisture; 2) the ability of the user to seal all burrow entrances; and 3) the speed at which the fumigants move through the burrow system.

The reduction of the ground squirrel population using fumigants will have a minor effect on the total areawide population.

*Direct Poisoning - Nontarget Species by Fumigants*. Other vertebrates, such as lizards, snakes, toads, burrowing owls, and other rodents, which often occupy ground squirrel burrows (Linsdale, 1946; Thomsen, 1971), may incidentally be killed by fumigants. However, use of fumigants (or any other rodenticide) will result in many more unoccupied squirrel burrows, which will then be available for these other species. Data are generally lacking on specific hazards to nontarget species. In practice, relatively few nontarget species will probably be involved because fumigant use will be minimal.

Because actively-used ground squirrel burrows are used relatively infrequently by other species, losses of nontarget species can be avoided by gassing only active squirrel burrows. Bird droppings, recently enlarged burrow openings, fresh snake trails in the soil, etc. provide evidence that a burrow may be occupied by some species other than ground squirrels and thus should not be treated. Den sites of foxes, badgers, skunks, etc. should be identified as such and not treated. Animals only temporarily occupying squirrel burrows will most often be driven out of the burrow on first detection of fumigant odors.

Fumigants, such as methyl bromide, may also be hazardous to terrestrial invertebrates inhabiting ground squirrel burrows, and to ectoparasites of ground squirrels.

*Aquatic Fauna*. Fumigants, when dissolved in water, may have detrimental effects on aquatic life. Carbon bisulphide at concentrations of 100 to 127 mg/l was lethal to one species of sunfish (Shelford, 1917, In: California State Water Resources Control Board, 1971). The threshold of toxicity for perch has been reported at 35 mg/l (Meinck, et.al., 1956, In: California State Water Resources Control Board, 1971). However, use of fumigants will be minimal and applied under moist ground conditions, so that the gas will be confined to the treated burrow system. Therefore, a significant impact on aquatic life is unlikely.

*Cumulative Effects on Biological Resources*. Fumigants in their gaseous state dissipate rapidly in open air and therefore would probably not persist in the environment in significant amounts.

*Direct Poisoning - Target Species by Carbaryl*. The efficacy of control of fleas using Carbaryl will be highly variable. Under certain conditions, the success of flea control using Carbaryl has been found to be low, while in other situations control has been satisfactory.

*Direct Poisoning - Nontarget Species by Carbaryl*. Carbaryl is considered to have a low toxicity to mammalian and avian fauna (California State Water Resources Control Board, 1971) (i.e., $LD_{50}$s for some wildlife are: young mallards, 2,180 mg/kg; Canada geese, 1,790 mg/kg; Norway rats, 540 mg/kg). Given the low concentration (10 percent) and the limited use of Carbaryl, it is judged that the impact on mammalian and avian species will be nonexistent.

Carbaryl is considered highly toxic to honeybees and earthworms (at 0.1 percent concentration) (U.S. Executive Office, 1971); therefore, the application of Carbaryl on the military reservations may cause mortality in local populations of earthworms and may be injurious to a number of beneficial insect species. Because of the localized use of the insecticide, the impact will be minor.

*Aquatic Fauna*. Carbaryl is known to be toxic to aquatic vertebrate and invertebrate species (California State Water Resources Control Board, 1971; U. S. Executive Office, 1971). Toxicity values for fish in terms of $LC_{50}$'s (lethal concentrations in parts per million) range from 0.764 ppm for coho salmon to 20.0 ppm for black bullheads (California State Water Resources Control Board, 1971).

Aquatic insects are also very susceptible to Carbaryl ($LC_{50}$ for: stonefly - 0.015 ppm; waterflea - 0.0006 ppm; amphipods - 0.040 ppm).

In the unlikely event that Carbaryl comes in contact with a water body containing aquatic fauna, there would be a possibility of localized aquatic insect dieoffs.

Any effects on aquatic life would be highly unlikely because of the limited use of Carbaryl.

*Cumulative Effects on Biological Resources*. Carbaryl is nonpersistent and is known to break down rapidly following initial application. Barrett (1968) found that Carbaryl applied at the rate of 2 pounds per acre resulted in initial residues of 35 ppm on plants but after 16 days residues amounted to 0.37 ppm.

Flora. There will be no significant impact upon flora by zinc phosphide, diphacinone or by Carbaryl. Barrett (1968) determined that there was no effect upon millet when Carbaryl was applied at the rate of 2 pounds per acre.

Carbon bisulphide and methyl bromide may have an effect on plant life. Therefore neither methyl bromide nor carbon bisulphide gas should be used to treat ground squirrel burrow systems located under or near trees.

Public Health. There will be no significant adverse impact upon public health if chemicals are applied according to the proposed procedures following recommendations of the Vertebrate Pest Control Handbook.

Air Quality. Diphacinone bait will have no significant effect on air quality. Fumigants used in minimal amounts will dissipate rapidly in the open air and should have no significant impact on air quality. The application of Carbaryl dust into ground squirrel burrow systems will be accomplished by using a hand grinder dust applicator. Minor amounts of Carbaryl dust will be dispensed into the air during application but will dissipate quickly.

Economics. There will be no significant adverse economic impacts. Costs of anticoagulants will be approximately $1,000 for Fort Ord, $8,600 for Fort Hunter Liggett and $8,000 for Camp Roberts. The cost of fumigants will be minimal. Costs of Carbaryl will be $725 for Fort Ord, $2,625 for Fort Hunter Liggett, and $2,375 for Camp Roberts, excluding labor costs, which will be primarily military personnel. No additional personnel will be employed. Thus the total cost of treating human use areas of the Fort Ord complex will be approximately $23,325.

Land Use. The use of these chemicals will have no significant impact upon land use within the areas of human activity.

Energy. There will be a minor use of fuel for transport and distribution of anticoagulants and bait boxes.

Transportation. No impact upon transportation.

Soils. No impact upon soils.

## Special Areas of Concern

Impacts in these areas will be insignificant, and will be similar to areas of human activity (above).

Costs of applying treatment will be dependent upon the actual number and size of areas treated. Areas such as dam faces, 1-mile proximity to kit fox dens, etc., will be treated as needed. Cost of diphacinone will run about $2.00 to $2.66 per acre excluding personnel costs. Fumigant costs will be minimal.

## Alternative Actions

Generally, alternative actions warranting consideration are those that can meet the same objective as the proposed action -- in this report, that of reducing high ground squirrel populations to minimize the threat to public health or damage to military installations or surrounding private lands.

There are many potential methods for ground squirrel control. The major methods are chemical, mechanical and biological control. Each of these were discussed in detail in the section "Methods of Ground Squirrel Control". Table 12 analyzes the feasibility of many of the methods discussed, both for large scale control and limited use.

Generally, the methods listed in this table were determined to be infeasible for large scale use for a variety of reasons discussed in that section. Certain of the methods had some practical application for limited control. Those methods determined as infeasible are not considered viable alternatives and therefore not considered further.

The control methods described in the proposed action were divided into control on "open range" and control in areas with high human habitation or activity. The impacts of each have already been discussed. Since control in areas of human use is severely constrained by the limited number of significantly different chemicals and methods, the feasible alternatives of each were essentially covered in the proposed action section and will not be discussed further as alternative actions.

Therefore, the viable alternative methods of ground squirrel control included in this section will concentrate upon feasible choices in the application of ground squirrel control methods on open range or extensive land areas at Fort Hunter Liggett and Camp Roberts (Fort Ord ground squirrel problems are minimal on open range). In addition, the "no action" alternative is discussed.

Alternative 1

In this alternative the use of 1080 will be avoided and zinc phosphide will be substituted for the same areas in which 1080 was proposed. In all other respects, treatment (and impacts) would remain the same as the proposed action; e.g., Diphacinone, fumigants, etc., together with Carbaryl, would be used in areas of human use and in special situations as needed, such as dams, near streams or reservoirs, etc.

The change from 1080 to zinc phosphide will apply only to the "open range" of Fort Hunter Liggett and Camp Roberts. No compound 1080 was proposed to be used at Fort Ord.

The areas in question, as described in the proposed project, total 128,500 acres and will be treated aerially with zinc phosphide bait applied only to squirrel burrow concentrations (an estimated 6,425 acres) as with 1080 bait described in the Proposed Action section.

Zinc phosphide applied aerially at the rate of 6 pounds of bait per treated acre, would represent $1.38 \times 10^{-4}$ pounds of bait per square foot (.0625 grams/square foot). (Based upon a bait formula of 1.69 percent, this represents $2.3 \times 10^{-6}$ pounds of zinc phosphide per square foot [0.00106 grams/square foot] per treated acre.)

Impacts. Zinc phosphide in the proposed concentration added to the environment in the form of treated grain would be expected to have minor impacts upon environmental elements, with the exception that non-target species such as seed-eating birds may be adversely affected (see Proposed Action Impacts).

Zinc phosphide may have approximately 60 percent effectiveness (as compared with 90 percent effectiveness for 1080) as has been discussed earlier -- probably related to lack of bait acceptance.

There will be an impact with respect to cost; e.g. aerial treatment with 1080 bait will cost $0.16 per treated acre ($20,610) and treatment with zinc phosphide will cost $0.19 per acre ($24,465). The costs of treating human use areas on all three installations as well as the open range on Fort Ord will remain the same. Thus the total cost of Alternative 1 in comparison to the proposed action (total cost $44,628) will be approximately $48,483.

However, the relatively low effectiveness of zinc phosphide may require additional treatment for ground squirrels, with corresponding proportionately higher costs.

## Alternative 2

Alternative 2 is directed to only Fort Hunter Liggett and Camp Roberts. Under Alternative 2, ground squirrel control is not carried out on the large open range areas. The treatment methods for Alternative 2 remain the same as that described for human use areas and areas of special concern in the proposed action. Alternative 2, however, also includes the establishment of basically a one-mile buffer strip around the human use areas or adjacent to damaged private property within which either compound 1080 or zinc phosphide would be used for control. The areas outside the buffer zone would receive no treatment. The purpose of treatment in the buffer zone is to prevent re-infestation of ground squirrels in treated areas, i.e., human use areas or by ranchers on adjoining properties.

The objectives of this alternative would be to 1) satisfy the public health concerns in public use areas, 2) reduce ground squirrel populations on lands immediately adjacent to private agricultural lands thereby reducing squirrel-related crop damage, and 3) eliminate damage to military structures and facilities. This alternative would also reduce the total number of acres of land receiving ground squirrel control.

The selection of this alternative would mean that 3,125 fewer acres of open range land would be treated with poison bait at Fort Hunter Liggett, or 975 fewer acres at Camp Roberts than that acreage treated under the proposed action.

Under this alternative the width of the buffer strip would be one mile or the width of adjacent ground squirrel habitat, whichever is smaller.

Control Methods in Cantonment and Other Human Use Areas. The multiple control method concept presented in the proposed action also would be used with this alternative. A combination of anticoagulants (diphacinone), fumigants (carbon bisulfide, methyl bromide), or zinc phosphide would be used for squirrel control, in association with Carbaryl for flea control. The areas of selected use of these control methods would include all cantonment, bivouac, recreation (i.e., picnic areas) and physical structures (roadways, dam faces, radar towers, etc.) within Fort Hunter Liggett and Camp Roberts (see Figures 33 and 34). The zone of application of these compounds would extend 200 yards beyond the boundary of human use.

The estimated acreage of the cantonment and other human use areas mentioned above is as follows: Fort Hunter Liggett, 4,000 acres (cantonment areas will require 6,600 pounds of anticoagulants); and Camp Roberts, 3,000 acres (6,000 pounds of anticoagulants will be used for cantonment areas).

Control Methods in Buffer Zones. The method of treatment on these areas would be with 1080 or zinc phosphide.

The estimated acreage of these buffer areas would be: Fort Hunter Liggett, 22,000 acres of agricultural buffer and 5,000 acres of buffer around human use areas; Camp Roberts, 17,815 acres of agricultural buffer and 1,485 acres of buffer around human use areas (see Figures 33 and 34).

With this alternative, the rodenticides required to carry out the control program would amount to the following:

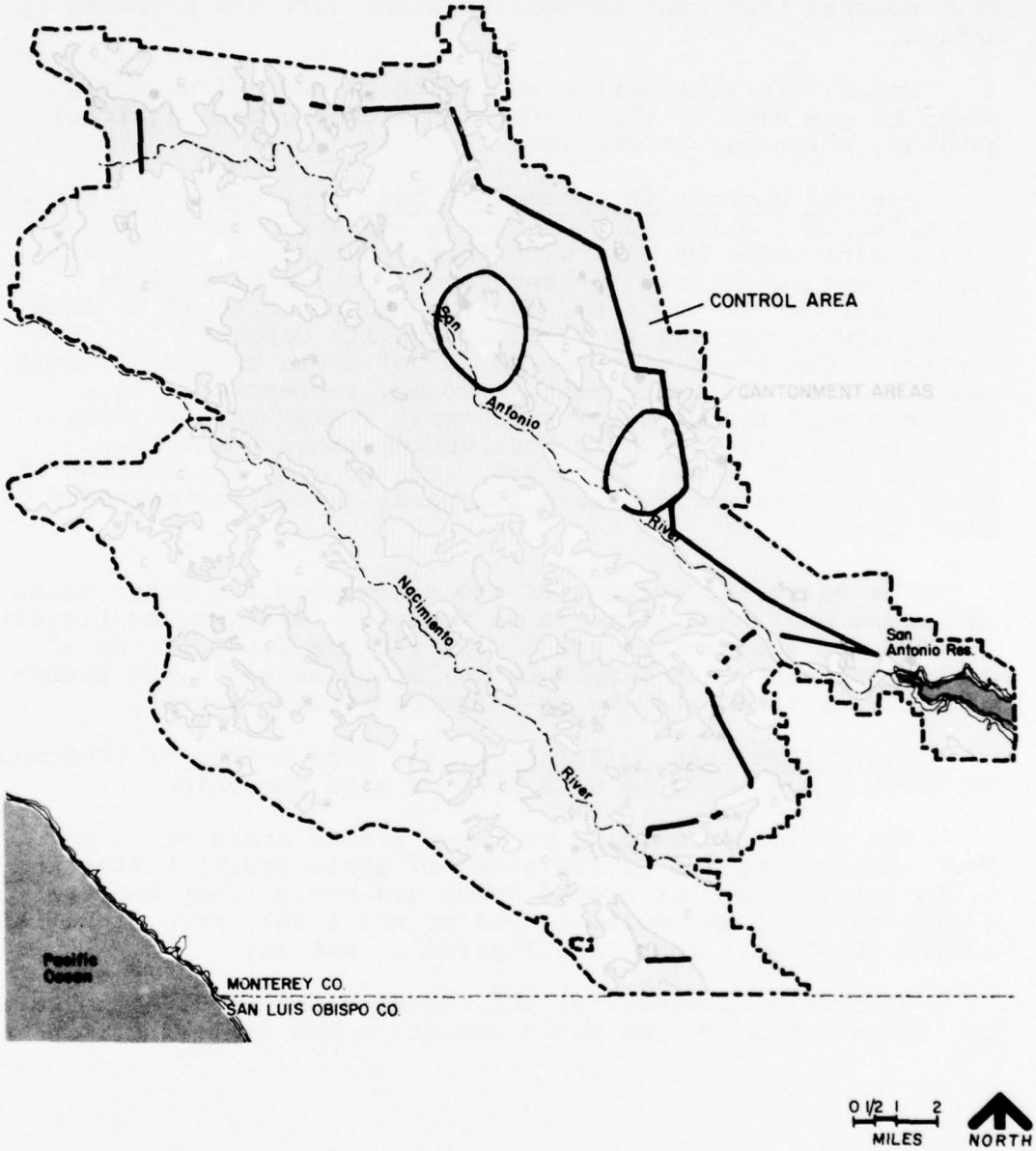


FIGURE 33
AREAS OF PROPOSED CONTROL UNDER ALTERNATIVE 2

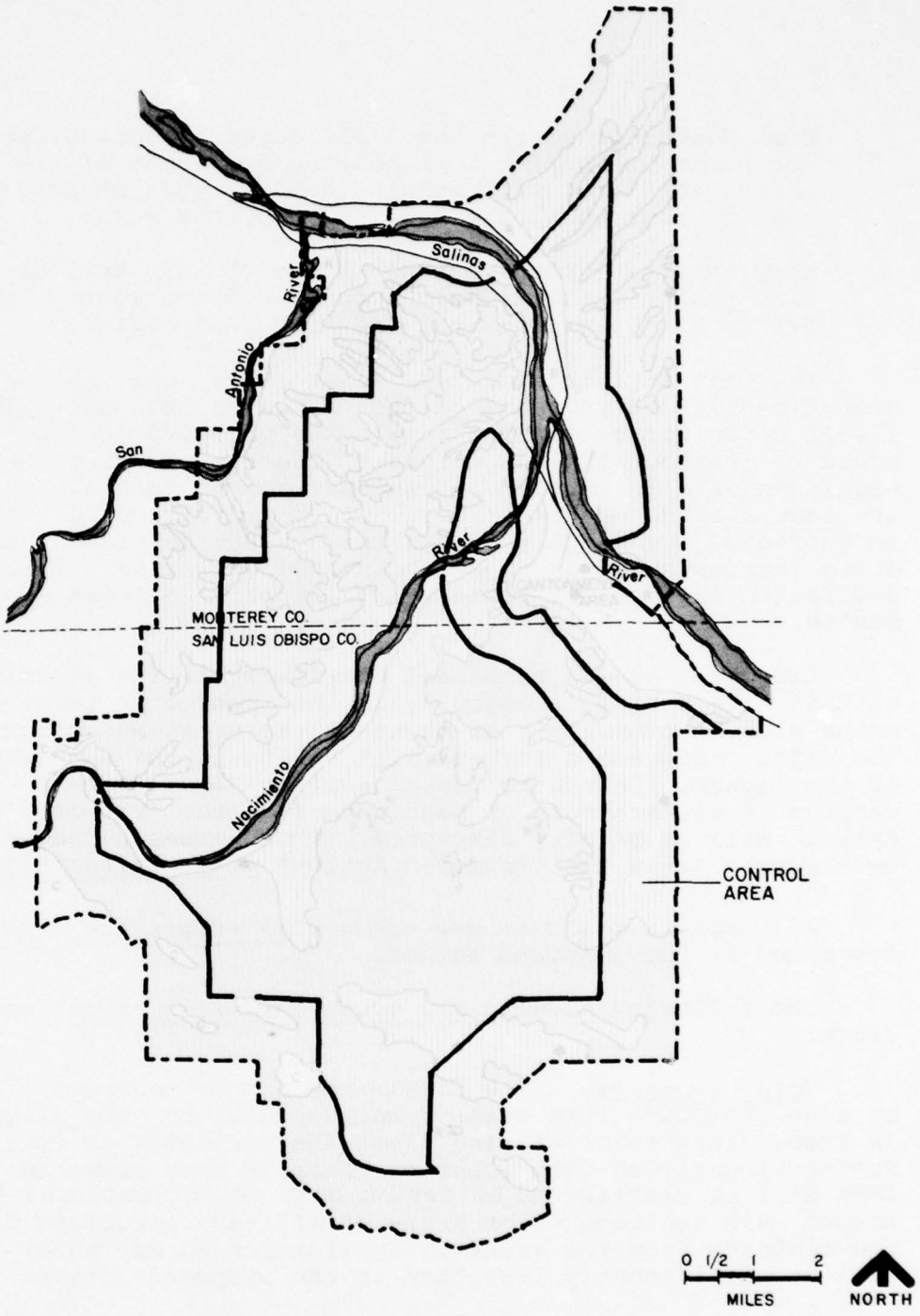


FIGURE 34
AREAS OF PROPOSED CONTROL UNDER ALTERNATIVE 2

Fort Hunter Liggett - the 1,350 acres of agricultural and human use buffer representing 5 percent of the total buffer zone area will require 8,100 pounds of 1080 bait or zinc phosphide bait (at 6 pounds/acre).

Camp Roberts - the required amount of 1080 bait or zinc phosphide bait would amount to 5,850 pounds for 975 acres of agricultural and human use buffer.

The main advantage of this alternative would be that significantly less acreage of open range on both installations (2,325 acres versus 6,425 acres in the proposed action) would be treated with rodenticides, thereby reducing the magnitude of some impacts. Disadvantages of this alternative are that a large reservoir of ground squirrels would remain in untreated areas, thereby providing a source of more immediate reinfestation on treated and adjacent areas. This high population would still represent a potential problem to public health.

Impacts. As was mentioned previously in the description of this alternative, a majority of the impacts in terms of scope will be comparable to those of the proposed action. The major differences instead will relate to the magnitude of the impact. In the following section those impacts varying in either scope or magnitude from the "Proposed Action" will be briefly discussed. Those impacts judged to be the same as in the "Proposed Action" will not be reiterated.

All impacts on human use areas will remain the same as described in the proposed action.

The following impacts may occur in buffer areas (open range):

*Water Resources*. The likelihood of any movement of 1080 or zinc phosphide into water resources will be very slight in those areas to be treated along the perimeter of Fort Hunter Liggett and Camp Roberts. Because zinc phosphide or 1080 will be distributed bordering only on agricultural land or around main cantonments or areas of military structure damage, the distance from the areas of application to any water body will be significantly less than in the proposed action.

*Air Quality*. Because less land will be aerially and hand treated, the amount of air pollutants from airplane and land vehicles will be significantly less. Air emissions for the Alternative 2 control program on Fort Hunter Liggett will be 75 percent less than under the proposed action and 54 percent less at Camp Roberts.

*Terrestrial Fauna: Direct Poisoning - Target Species.* Under Alternative 2, approximately 31 percent of the ground squirrel population will be controlled. High populations will continue to exist in grassland and woodland grass habitats away from the agricultural and human use areas. The eventual fate of this high population is unknown. It could continue to increase, with population dispersal into those areas treated, it could remain the same; or it could decrease as a result of natural causes, e.g., reduced fertility rate, disease (plague), etc. A more detailed discussion of population changes can be found under Alternative 3 - No Action.

In the area to be treated a greater percentage of the ground squirrel population is expected to survive the application of zinc phosphide as compared with the application of 1080 -- 60 percent as compared with 90-95 percent for 1080.

*Terrestrial Fauna: Direct Poisoning - Nontarget Species.* The magnitude of impact of Alternative 2 on nontarget species will be significantly less than that under the proposed action. Proportionately fewer individuals of the various nontarget species will be affected due to the smaller area of squirrel control.

A greater reduction in populations of seed-eating birds and small rodents within the 1 mile buffer zones may result from zinc phosphide than with 1080. A small percentage of rodent populations inhabiting the periphery of the treated areas will be reduced.

Populations of nontarget species in untreated open range areas will be unaffected.

*Terrestrial Fauna: Secondary Poisoning - Nontarget Species.* The smaller area of treatment will reduce the likelihood of secondary poisoning. Because most victims of secondary poisoning represent wide ranging species (coyotes, dogs, foxes, bobcats, etc.), there will continue to be some potential for nontarget poisoning. However, the fact that fewer ground squirrels will be available for consumption by predators may reduce the magnitude of the impact.

Economics. Costs of treating buffer zones will be: $2,790 for 1080 bait, and $4,650 for the pilot and airplane -- a total of $7,440. The grand total costs of treating Fort Hunter Liggett and Camp Roberts under Alternative 2 will be $29,040. The grand total costs of using zinc phosphide rather than 1080 would be $30,335. The costs of treating human use areas of all three installations as well as the open range of

Fort Ord will remain the same. Thus the total costs of Alternative 2 would be $31,458 (1080 bait) and $32,753 (zinc phosphide bait) as compared with $44,600 for the proposed action and $48,500 for Alternative 1. If control is effective, it is estimated that annual repair and maintenance costs of approximately $5,500 on Fort Hunter Liggett alone would be saved. Costs of damage to agricultural crops on neighboring lands, possibly exceeding $175,000 per year, would be saved. Otherwise there will be no significant economic impact, since personnel used will be existing county, contractor and military personnel.

Summary of Economic Impacts. The following table represents a summary of the approximate costs of rodenticide and insecticide use on the Fort Ord complex under the proposed action, Alternative 1 and Alternative 2.

| Installation | Open Range $ Cost | Human Use Areas Ground Squirrel Control | $ Cost Flea Control | Total $ Cost |
|---|---|---|---|---|
| PROPOSED ACTION: | | | | |
| Fort Ord | 693[1] | 1,000 | 725 | 2,418 |
| Fort Hunter Liggett | 14,370[2] | 8,600 | 2,625 | 25,595 |
| Camp Roberts | 6,240[2] | 8,000 | 2,375 | 16,615 |
| Total | 21,303 | 17,600 | 5,725 | 44,628 |
| ALTERNATIVE 1:[1] | | | | |
| Fort Ord | 693 | 1,000 | 725 | 2,418 |
| Fort Hunter Liggett | 17,055 | 8,600 | 2,625 | 28,280 |
| Camp Roberts | 7,410 | 8,000 | 2,375 | 17,785 |
| Total | 25,158 | 17,600 | 5,725 | 48,483 |
| ALTERNATIVE II:[2] | | | | |
| Fort Ord | 693[1] | 1,000 | 725 | 2,418 |
| Fort Hunter Liggett | 4,320 | 8,600 | 2,625 | 15,545 |
| Camp Roberts | 3,120 | 8,000 | 2,375 | 13,495 |
| Total | 8,133 | 17,600 | 5,725 | 31,458 |
| ALTERNATIVE II:[1] | | | | |
| Fort Ord | 693 | 1,000 | 725 | 2,418 |
| Fort Hunter Liggett | 5,130 | 8,600 | 2,625 | 16,355 |
| Camp Roberts | 3,705 | 8,000 | 2,375 | 14,080 |
| Total | 9,528 | 17,600 | 5,725 | 32,853 |

[1] Zinc phosphide

[2] 1080

Alternative 3

Description. This option assumes that "no action" will be taken to control ground squirrels. Other programs and land use activities both on the military installations and adjoining lands are assumed to continue as at present.

Dynamics of Wildlife Populations Generally. The major factor governing the distribution and density of wildlife populations is the suitability of the habitat -- the combination of vegetation, soil and other environmental factors which enable various species of animals to live in a particular locality. If the conditions of the habitat are improved, the species will increase in number, but not excessively or continuously. There is an upper density threshold which cannot be surpassed no matter how much the environment is improved for that species.

The main criteria for wildlife survival are the suitability of the habitat and the ability of a species to adapt to environmental changes, such as those man has brought about on these military lands (roads, dams, buildings, introduction of exotic forbs and grasses, grazing by livestock, etc.). Some species, such as commensal rodents, ground squirrels, coyotes, English sparrows, starlings, and others, often produce abnormally high densities in man-modified environments, while most species actually decline in density when their habitat is altered by man.

In general, however, the upper limits in density of animal populations vary within relatively narrow limits in any particular habitat, due to a number of regulatory mechanisms that are not well understood. Factors that probably interact to limit excessive population build-ups include emigration, shelter, food supply, predation, diseases, social interactions and other vicissitudes of life, all of which can operate as stress factors on populations. Without these involuntary, density-dependent, self-limitation powers, overpopulation would become so acute as to destroy the species. Ground squirrel populations always stop increasing when the equilibrium density, which is difficult to define precisely, is reached and triggers the various self-limiting population controls (Howard, 1965 and 1974; McLaren, 1971; and Krebs, et.al., 1973).

Population Dynamics of Ground Squirrels. Without control, there appears to be no question that the density of ground squirrels would continue to fluctuate from year to year. Since ground squirrels have but one litter a year, a fairly low reproductive potential compared to many other rodents and rabbits, their population fluctuations from year

to year would not be as dramatic as occur with voles, rats, mice and some other species. The most dramatic fluctuations observed with various ground squirrel populations in the past have been their periodic decline locally, in man-altered environments, following periods of high numbers. The reasons for the declines have been attributed to various factors including diseases (plague, tularemia, and perhaps others) and food shortages. But the reason that rodent diseases found in California cannot be considered as effective biological control forces with any of the various kinds of native rodent species is because the disease outbreaks do not occur on a regular basis and they are all short-lived. Also, they affect, for the most part, only local populations of rodents and then only temporarily.

If diseases that are lethal to ground squirrels and other rodents remained highly virulent for many years, and also occurred simultaneously over very large regions, the affected species would soon be eliminated. Instead, after a disease outbreak occurs in rodents, which generally is quite localized, the affected populations usually recover in only a year or two. This usually is not because the number of survivors provides sufficient breeding potential to permit the population to quickly recover, but rather is due in part to the rapid reinvasion by individuals from neighboring areas that were not affected by the disease. It is the same reason why checkerboard-type control, where squirrels are controlled on some ranches and not on others, will have no lasting effect on the populations.

It appears highly unlikely that those ground squirrel populations considered high in 1976 will increase much further in the future without some form of intraspecific or other self-limiting population regulatory factors operating to bring about a leveling off with periodic, marked decline. There is an upper density threshold which cannot be surpassed no matter how favorable the environment is for that species. Therefore, for purposes of considering the impacts of the no action alternative, it is assumed that the ground squirrel population densities will continue basically at present levels, recognizing that if a significant decline were to take place due to disease or other factors, the populations in such areas would recover in a matter of a few years.

Impacts. Since the population of ground squirrels is assumed to remain at the same level, the impacts which will result from "no action" will be essentially the same as discussed under the description of the ground squirrel damage problem in the present environment section. The main impact of "no control" will be the continued threat to human health because of the plague reservoir.

The effects of not controlling ground squirrels at Fort Ord would not be great, except along roads, the air strip, around buildings, and other areas where the soil and vegetation has been very much disturbed by man. The rest of Fort Ord has a lesser squirrel problem, and the impacts of no action on Fort Hunter Liggett and Camp Roberts would be quite similar on both bases. Therefore, the following discussion about the impacts of no action will apply primarily to both Fort Hunter Liggett and Camp Roberts.

*Water*. No action would have little effect on water except that the squirrel burrows may cause the stock pond dams to leak or to wash out.

*Fauna*. No action would mean that there would usually be very high populations of ground squirrels present. Such high populations would continue to compete with deer for acorns, forbs and grasses. The abundance of squirrels would increase the food base of predators, thus increasing the density of snakes, carnivores and hawks living in these areas that are known to feed on young squirrels. The density of predators is markedly affected by the availability of prey, even though the presence or absence of predators has much less effect on the population density of the prey species (Howard, 1974). Predation by squirrels, on the other hand, may have a detrimental effect on the nesting success of California valley quail, those mourning doves which build their nests on the ground, and perhaps other ground-nesting birds.

*Flora*. Most California range land forbs and grasses are such prolific seed producers that it is doubtful if the continued presence of uncontrolled ground squirrel populations would cause any plant species to become rare or endangered. But, due to the intensity of grazing from high squirrel populations, no action would probably cause changes in density composition of forbs and grasses. The vegetation would not revert to its pristine composition even if all livestock grazing was discontinued and the ground squirrels were vigorously controlled.

*Public health*. Without artificial reduction of the ground squirrel populations, many of which are unnaturally dense because of man's historic manipulation of the forage and his other land use practices, it seems inevitable that periodic outbreaks of disease will occur as one of the natural population-controlling factors. Disease outbreaks will probably occur more frequently than is normal for ground squirrels because the modified habitats permit such high densities of squirrels.

*Economics*. Without ground squirrel control, problems that will continue are competition with livestock for forage and the types of damage reported earlier to adjacent crops, roads, airport runways, dams, and electric wiring; gnawing and undermining of buildings, and related problems. For several more years, at least, it is likely that additional burrows will be dug by squirrels in and around roads, dams and buildings, and in any new areas where such soil disturbance occurs.

The approximate cost of ground squirrel control as discussed under the proposed action is $44,600; Alternative 1, $48,500; and Alternative 2, $31,500 (1080), and $32,800 (zinc phosphide), and these amounts would be saved if there were no action. However, of course, the costs of damage to structures ($115,300) or to agricultural crops ($774,000) and the costs of annual repair and maintenance ($5,500 Fort Hunter Liggett) will remain.

*Social Problems*. If the unusually high populations of squirrels are permitted to remain indefinitely, except for the natural fluctuations in density that will occur, the surrounding communities, especially the immediate landowners, will object to the military areas not being subjected to the same ground squirrel control regulations private citizens have to follow. There will be more hard feelings among neighbors who will find it much more complicated and expensive to keep their squirrels under control, since their lands will be quickly reinvaded by squirrels from military property. On the other hand, some persons may find that any increase in squirrel numbers actually makes these lands more interesting.

*Agricultural Crops*. If the ground squirrels are not controlled, they will continue to do damage to cereals and other crops grown on or adjacent to the military lands.

*Livestock grazing*. No action would perpetuate the economic loss to livestock operations due to the competitive grazing by ground squirrels and the reduction in carrying capacity for livestock.

*Military missions*. In addition to the many economic problems stated above, a no-action course may periodically jeopardize military use of much of the training grounds if plague occurs in dense populations of ground squirrels.

*Recreation*. The periodic hazard of plague resulting from no action would require frequent closure of portions of these lands now used for recreation purposes.

*Air*. No effect on air quality.

*Energy*. More fuel energy would probably be required to repair the damage caused by dense populations of squirrels than would be expended in controlling them every third year or so, but the difference cannot be very signficant.

*Transportation*. If no action were taken, less transportation (i.e. movement of control materials, etc.) would be required, but again this difference is of little significance.

*Soils*. No action would have little effect. Most erosion that occurs as a consequence of digging by squirrels is along roads, in dams and around buildings. Another type of erosion which occurs on some range lands is most severe where woody vegetation has been removed and when rainwater gets channeled from a road or a livestock trail down a burrow, causing subsurface erosion. Once the top caves in, a gulley is formed (Longhurst, 1957). This type of erosion, however, is not common on these military lands.

## Summary of Environmental Impacts

The following discussion represents a brief summary of: 1) the alternatives as they relate to the project objectives, 2) a comparative evaluation of the alternatives relative to the acreage to be treated, and 3) a short summary of the impacts for each alternative.

### Project Objectives

The project objectives have been mentioned often throughout this report. The following table shows how the proposed action and the three alternatives relate to the project objectives:

| Action on Ground Squirrel Control | Effectiveness in Minimizing Threats to Human Health | Effectiveness in Minimizing Damage to Adjacent Crops | Effectiveness in Minimizing Damage to Military Facilities |
|---|---|---|---|
| Proposed Action | x | x | x |
| Alternative 1 | xx | xx | xx |
| Alternative 2 | xxx | xxx | xxx |
| Alternative 3 (no action) | xxxx | xxxx | xxxx |

x Good overall solution based on present information and proven technology. Probable 90-95% effectiveness.
xx Less effective than the proposed action due to the probable lower efficacy (60%) of zinc phosphide.
xxx Effective, but with the major drawback of constant reinvasion of ground squirrels from untreated areas.
xxxx Doubtful value.

Acreage of Treatment

The following table summarizes the acreage of potential squirrel habitat (oak woodland and grassland) vs. the actual acreage to receive treatment under the various alternatives.

| | Aerial Treatment | | Hand Treatment | |
|---|---|---|---|---|
| | Potential Squirrel Habitat* | Actual Acreage Upon Which Bait Will be Placed | Potential Habitat | Actual Acreage to be Treated |
| PROPOSED ACTION: | | | | |
| Fort Ord | NC | NC | 11,500 | 2,800 |
| Fort Hunter Liggett | 89,500 | 4,475 | 4,000 | UK |
| Camp Roberts | 39,000 | 1,950 | 3,000 | UK |
| ALTERNATIVE 1: | | | | |
| Fort Ord | NC | NC | NC | NC |
| Fort Hunter Liggett | 89,500 | 4,475 | 4,000 | UK |
| Camp Roberts | 39,000 | 1,950 | 3,000 | UK |
| ALTERNATIVE 2: | | | | |
| Fort Ord | NC | NC | NC | NC |
| Fort Hunter Liggett | 27,000 | 1,350 | 4,000 | UK |
| Camp Roberts | 19,300 | 975 | 3,000 | UK |
| ALTERNATIVE 3: | | | | |
| No action | 0 | 0 | 0 | 0 |

* Also represents acreage to be flown.

NC Not considered in alternative.

UK Unknown.

## Environmental Impacts

This table briefly summarizes the impacts of the proposed action and various alternatives. Because this represents only a summary, it does not include a discussion of the magnitude of each impact relative to individual species of animals. The detailed discussion of these features appears in the main body of this impact chapter. The numbers assigned to represent the magnitude of the impact resulting from the proposed action and alternative should be considered on the basis of whether or not the impact affects man's environment.

Impacts resulting from pest control in human use areas (Alternatives 1 and 2) are the same as those in the proposed action. However, the effectiveness of pest control in human use areas may be considerably reduced because of reinvasion of ground squirrels from untreated or less effectively treated adjacent lands.

The numbers are for comparison purposes only and do not necessarily represent any absolute values, and therefore cannot be summed.

| | Proposed Action | | Alternative 1 | | Alternative 2 | | Alternative 3 | |
|---|---|---|---|---|---|---|---|---|
| Environmental Elements | Open Range | Human Use Area | Open Range | Human Use Area | Open Range | Human Use Area | Open Range | Human Use Area |
| Water resources | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Target species | +4 | +4 | +3 | +4 | +2 | +4 | 0 | 0 |
| Primary poisoning of nontarget species | -1 | -1 | -1 | -1 | 0 | -1 | 0 | 0 |
| Secondary poisoning of nontarget species | -1 | -1 | 0 | -1 | 0 | -1 | 0 | 0 |
| Rare and endangered species | -1 | 0 | -1 | 0 | -1 | 0 | 0 | 0 |
| Aquatic fauna | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cumulative effects | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Flora | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -2 |
| Public health: | | | | | | | | |
| a) Safety and health | -1 | -1 | -1 | -1 | -1 | -1 | -2 | 0 |
| b) Plague control | +4 | +4 | +3 | +4 | -1 | +4 | 0 | -4 |
| Economics: | | | | | | | | |
| a) Treatment costs | -2 | -3 | -2 | -3 | +2 | -3 | -4 | 0 |
| b) Damage costs | +3 | +4 | +2 | +4 | -1 | +4 | -4 | -4 |
| Land use | -1 | 0 | -1 | 0 | -1 | 0 | -1 | -2 |
| Transportation | -1 | 0 | -1 | 0 | -1 | 0 | 0 | 0 |
| Noise | -1 | 0 | -1 | 0 | -1 | 0 | 0 | 0 |
| Air quality | -1 | 0 | -1 | 0 | -1 | 0 | 0 | 0 |
| Soils | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Energy | -1 | 0 | -1 | 0 | -1 | 0 | 0 | 0 |

Key:

0 No impact
1 Minor impact
2 Low impact
3 Moderate impact
4 Major impact

\+ Beneficial to environmental element
\- Adverse to environmental element

## Consideration of Land Use Relationships in Reference to the Proposed Actions and Alternatives

The land use relationship section (Legal, Policy and Institutional Constraints) lists a number of laws, regulations and policies which may in some way act as a constraint on the proposed action. Many are important in assuring that the project, if carried out, will be done in an environmentally-sound manner. Several, however, warrant specific attention in consideration and selection of the ground squirrel control methods to be used.

Regarding the use of compound 1080, which is proposed for use in the proposed action and is also considered as one option under Alternative 2, the authority to use this chemical during 1977 is questionable -- and it is difficult to predict when a decision regarding its use may be made.

On December 1, 1976, EPA placed compound 1080 and 1081 on its rebuttal presumption list and provided 45 days for responses prior to making a determination whether continued use would be allowed. It is reported the response period has been extended 60 days and it is possible additional extensions may follow to allow further EPA investigations.

In addition, of course, the use of compound 1080, under the proposed action or as an option in Alternative 2, will require completion of action by the Army in obtaining an exemption from Executive Order 11870, which prohibits use of chemicals with secondary poisoning possibilities on federal lands.

Regarding public health, the Army Surgeon General, with support from the California Department of Public Health, has determined that the large ground squirrel population at the Fort Ord complex does represent a significant public health threat, and that ground squirrel control (coincident with flea control) should be undertaken in areas of substantial human activity. This situation should be given careful attention when considering Alternative 3 -- the alternative under which no action would be taken to control ground squirrels.

Finally, and perhaps not of serious concern in consideration of the alternatives, the Monterey County Ordinance 328 (November 2, 1908) would be in conflict with Alternative 3 -- no action. It provides for fines (with half of the fine to the informant) or imprisonment for failure to act in good faith to exterminate, kill or destroy any ground squirrels in Monterey County.

While many of the other laws, regulations and policies listed in this section place important constraints on the Army, none appear to be a major consideration in a decision regarding the selection of the proper course of action.

## Surveillance, Monitoring and Testing

If a ground squirrel control program is undertaken at the Fort Ord complex, a surveillance and monitoring plan should be prepared and implemented. The objective of the plan should be to collect information on the results of the control effort. It should be oriented toward the collection of data which could be used to improve future control efforts either at the Fort Ord complex or elsewhere.

The details of the surveillance and monitoring program will be dependent on the specific control methods implemented. The following are examples of the type of measurements which should be made:

1. The efficacy of the control method applied. What percent of the ground squirrels (and fleas) were killed?

2. The effects of the control method on nontarget species, with special emphasis on rare and endangered species.

3. The rate and timing of re-population (or reinfestation) by ground squirrels following control.

The Fort Ord complex has been designated in a memorandum from the Office of the Adjutant General, 3 December 1976, as an installation sufficiently at risk to warrant major (plague) surveillance. A number of surveillance elements are to be conducted including:

1. Carnivore Blood Serum. Collect and submit 25 to 30 carnivore (coyote, bobcat, fox, raccoon, etc.) blood serum samples during the period February, March and April each year.

2. Rodent and Flea Population Characterization. Develop baseline data on species and densities of rodents and fleas potentially involved in plague transmission and determine the degree of human contact with such populations. Evaluate population densities at least annually, where highly susceptible rodent species (rock squirrel, beecheyi ground squirrel, and prairie dog) occur.

3. Rodent Population Observation. Where highly susceptible rodent species occur, observe rodent populations for unusual conditions (sick, sluggish or dead animals) that may signal disease activity. Observations should be accomplished at least twice monthly when rodents are active (i.e., when the mean temperature exceeds 40°F).

4. Liaison Activities. Establish and maintain liaison with local and state health authorities to ascertain any potential plague activity in proximal civilian areas.

5. Epizootic Investigation. When unusual activity or dead animals are observed in the rodent population, or when plague activity is determined by carnivore blood serum analysis, an epizootic investigation will be initiated. (As a minimum, investigations should include the collection of dead animals, trapping rodents for sera and flea collections, and swabbing burrows for fleas).

Consideration should also be given to the testing of changes in existing land use practices to determine their long term benefits in controlling ground squirrel populations or reducing potential ground squirrel damage and, incidentally, to determine their contribution to improved management of the natural resources of the three military installations.

It would be desirable to establish one or more test areas on which the grazing intensity could be adjusted to determine the effect this would have on ground squirrel numbers. The literature is not conclusive on the relationship between grazing and ground squirrel populations. If a practical study of this nature were devised, it should be coordinated carefully with the study planned by the Sacramento District Corps of Engineers for the preparation of a range and related resource inventory and condition report for Fort Hunter Liggett.

Consideration should also be given to testing various habitat modification methods and their efficacy in minimizing or preventing damage. The possibility of establishing a buffer strip of land which is frequently disturbed by mechanical means on the perimeter of military lands to minimize ground squirrel damage to adjacent private landowners has been mentioned. The practicability of these or other approaches should be further considered. If any appear feasible, they should be tested at an appropriate site.

Regardless of what surveillance monitoring and testing is undertaken, it is essential that a system be developed and implemented for the collection and recording of ground squirrel damage and all of its associated costs -- both prevention and control.

# PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

In the event that the proposed action is implemented, a number of unavoidable adverse environmental impacts may occur. The use of rodenticides will result in approximately an 60-90 percent reduction in the beechey ground squirrel population of the Fort Ord Complex. In turn, this reduction in squirrel numbers will mean some reduction in available prey for carnivores, raptorial birds and some reptiles.

The proposed rodenticides may also result in some primary poisoning losses of nontarget wildlife, such as rodents, seed-eating birds, and wildlife that inhabit ground squirrel burrows (burrowing owls, snakes, lizards and toads). Several of the proposed rodenticides and Carbaryl may adversely affect some species of beneficial terrestrial invertebrates.

Some secondary poisoning losses to individuals of the cat family (i.e., bobcat) and dog family (i.e., coyote), including kit foxes, may occur due to consumption of ground squirrel carcasses that may be exposed above ground.

Fuel and some materials will be consumed to implement the ground squirrel control program.

Many unavoidable environmental impacts can be minimized by judiciously following the laws and regulations governing rodenticide use. By following recommended application rates and procedures, bait will be exposed in a manner least detrimental to nontarget species. Careful planning of the ground squirrel program will eliminate wastage of fuel, labor and materials.

# RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The proposed action would result in an immediate and efficient reduction in the number of ground squirrels now populating the Fort Ord military complex. The short-term gain would be: 1) a reduction in the public health hazard (plague) resulting from the ground squirrel's role as a flea host in the transmission of plague from wild rodent reservoirs to humans via the bites of infective fleas; 2) an increase in the productivity of the leased rangelands now being grazed by cattle and sheep; 3) a reduction in the damage now being done to military structures and facilities, which cost an estimated $5,500 per year to repair and maintain on Fort Hunter Liggett alone; and 4) a reduction in crop damage on neighboring ranches, damage which has been estimated to total $700,000+ during 1972-76.

The long-term environmental losses would be in the area of unavoidable adverse impacts upon nontarget species particularly other rodents, carnivores and birds.

Some domestic cats and dogs may be lost in those areas where uncontrolled pets are permitted to run loose in areas where dead rodents containing 1080 or zinc phosphide may be consumed. The kit fox may experience some loss for the same reason. Some coyotes may be lost in the areas treated. Some seed-eating nontarget rodents and possibly birds may be lost.

The losses of these species will be minimal, and in no case will result in a long-term effect upon the populations of species other than the target species.

The kit fox is the only rare or endangered species which may be affected. On Fort Hunter Liggett no kit fox dens have been identified. On Camp Roberts only one den has been identified, but the area within one mile of any identified den will not be treated with 1080; therefore, it is unlikely that the kit fox population will be significantly affected if at all.

To achieve long-term gains, a repeated control of the ground squirrel population may be necessary, probably every 2 to 3 years, with 1080 and every year or possibly every two if zinc phosphide is used, since the ground squirrel residual number will always be sufficient to repopulate the area within that period of time. There will be some reduction in the food base for mammalian and avian predators, resulting from reduced populations of the ground squirrel and nontarget rodents.

The most probable long-term effects will be those associated with a reduction in the competition for forage with other wildlife and with cattle and sheep.

A reduction in ground squirrel numbers will provide the opportunity to maintain at least the same number of grazing livestock on a given area, and to thereby provide an opportunity for range conditions to improve where overstocking or overutilization now exist.

In no case does it appear that any future options will be foreclosed since the proposed action will not eliminate any wildlife species (including the target species), and will not add any material to the environment, nor change the environment in a way which would prevent any future options from being implemented.

# IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Other than the consumption of fuel and materials, or the death of individual animals, there will be no irreversible or irretrievable commitment of resources.

# NATIONAL DEFENSE CONSIDERATIONS THAT MUST BE BALANCED AGAINST THE ADVERSE ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION

The benefits of the proposed action will be:

1. Reduced public health hazard (plague) existing on the Fort Ord military complex.

2. Reduced damage to crops on adjacent private land.

3. Reduced damage to military structures and facilities.

4. Reduced competition with grazing livestock, with consequent improvement in productivity.

The benefits of alternatives to the proposed action will be as follows:

Alternative 1. Similar to the proposed action, except that ground squirrel control method costs will be slightly greater ($3,900), and that the efficiency of zinc phosphide (60 percent) may be considerably less than that of 1080 (90 percent).

Alternative 2.

1. Reduced public health hazard (plague) existing on the Fort Ord military complex.

2. Reduced damage to crops on adjacent private land.

3. Reduced damage to military structures and facilities.

4. Somewhat lesser reduction of competition with grazing livestock than would be accomplished through the implementation of the proposed action -- due to the significantly fewer acres of grazing land which would be subject to ground squirrel control.

5. Fewer losses of nontarget species because of the reduced area treated.

6. Approximately $12,000 lower cost of ground squirrel control.

Alternative 3. No benefits will be obtained, except that no loss of nontarget species due to ground squirrel control will occur.

## GLOSSARY

ACRE-FOOT -- A water or sediment volume measurement term, equal to the amount of water which would cover an area of one acre to a depth of one foot, i.e., 43,560 cubic feet or 325,828 gallons.

ACUTE TOXICITY -- Rapid damage to an organism by the fastest acting mechanism of poisoning, fatal unless the organism escapes the toxic environment at an early stage.

AESTIVATION -- A period of dormancy during the summer.

ALLUVIUM -- Material, including clay, silt, sand, gravel and mud, deposited in riverbeds, lakes, alluvial fans, valleys and elsewhere by modern streams.

ANGLER DAY -- One angler day equals one fisherman fishing for any part of one day.

ANIMAL UNIT (AU) -- An animal unit is widely accepted as a mature cow with calf, or their equivalent, horses, sheep and goats commonly are converted to animal units at the rate of 1.25, 0.2, and 0.17, respectively.

ANIMAL UNIT MONTH (AUM) -- The amount of forage required by an animal unit for one month of grazing.

ANTICOAGULANTS -- Multiple dose rodenticides used widely for commensal and field rodent control. They reduce the clotting ability of the blood and cause damage to the capillaries. They may cause death if consumed in sufficient quantity over a period of days.

AQUIFER -- Water bearing, porous rock or sand and gravel formation yielding a usable quantity of water.

BUBONIC PLAGUE -- See plague.

CARRYING CAPACITY -- The number (or weight) of organisms of a given species and quality that can survive in, without causing deterioration of, a given ecosystem through the least favorable environmental conditions that occur within a stated interval of time.

CHEMICAL TOXICANT -- Any chemical substance which when ingested, inhaled, or absorbed, or when applied to or injected into the body, in relatively small amounts, by its chemical action may cause significant bodily malfunction, injury, illness, or death, to animals or to man.

CHRONIC TOXICITY -- May influence the ability of the organism to reproduce, grow, or behave normally, but probably is not often a direct cause of death in nature.

COMMENSAL -- Of or relating to those who habitually eat together.

COMMUNICABLE DISEASE -- An illness due to a specific infectious agent or its toxic products, which arises through transmission of that agent or its product from a reservoir to a susceptible host -- either directly, as from an infected person or animal, or indirectly, through the agency of an intermediate plant or animal host, vector, or the inanimate environment.

DORMANT -- Marked by a suspension of activity.

ECOSYSTEM -- The system formed by the interaction of a group of organisms and their environment.

EDGE EFFECT -- The effect upon wildlife occurring where the types of food and cover needed by wildlife come together, i.e., where habitat edges meet.

ENDEMIC -- A taxonomic category (e.g., genus, species) whose natural occurrence is confined to a certain region and whose distribution is relatively limited.

ENZOOTIC -- A disease present in the population at all times.

EPHEMERAL STREAM -- A stream or portion of a stream that flows only in direct response to precipitation. It receives little or no water from springs and no long-continued supply from snow or other sources.

EPIDEMIC -- Attacking many people in any region at the same time; widely diffused and rapidly spreading.

EPIZOOTIC -- High morbidity usually accompanied by high mortality spreading rapidly.

EROSION -- The group of processes whereby earthy or rock material is worn away. Loosened or dissolved and removed from any part of the earth's surface.

FEBRILE -- Of or relating to a fever.

FAULT, ACTIVE -- A linear break in the earth's surface that has undergone movement in recent geologic time (the last 10,000 years) and may be subject to future movement.

FAUNA -- The animal life of an area, "animal" being used in the broad sense to include birds, fish, reptiles, insects, molluscs, crustaceans, etc., in addition to mammals.

FEDERAL LANDS -- All real property owned by or leased to the federal government, excluding (1) lands administered by the Secretary of the Interior pursuant to his trust responsibilities for Indian affairs, and (2) real property located in metropolitan areas.

FLORA -- The plant life of an area.

FORAGE -- All browse and nonwoody plants that are available to livestock or game animals and used for grazing or harvested for feeding.

GESTATION PERIOD -- The period from fertilization to birth.

GROUNDWATER -- Water within the earth that supplies wells and springs. Specifically, water in the zone of saturation where all openings in soils and rocks are filled -- the upper surface of which forms the water table.

HABITAT -- The natural place of abode of a plant or other organism. The locality where the organism may generally be found, and where all essentials for its development and existence are present.

HIBERNATION -- A state of inactivity and torpidity during the winter. The body temperature falls until it is barely above that of the environment; the breathing rate decreases; the the heartbeat rate is reduced.

HUNTER DAY -- One hunter day equals one hunter hunting for any part of one day.

INTERMITTENT STREAM -- Streams which, in general, flow during wet seasons and are dry during dry seasons.

LETHAL DOSE ($LD_{100}$) -- The amount or concentration of a toxic substance which will result in the death of 100 percent of a group of test organisms upon exposure (by ingestion, application, injection or in their surrounding environment) for a specified period of time.

MEDIAN LETHAL DOSE ($LD_{50}$) -- The amount or concentration of a toxic substance which will result in the death of 50 percent of a group of test organisms upon exposure (by ingestion, application, injection or in their surrounding environment) for a specified period of time.

MORBIDITY -- The relative incidence of a disease.

MORTALITY -- The number of deaths in a given time or place.

OPEN RANGE -- All suitable range of an area upon which grazing is permitted.

PLAGUE -- An acute febrile disease caused by a bacillus yersinia (Pasteurella) pestis, with fleas as vectors. The term bubonic plague is sometimes used to designate a case contacted from wild (sylvatic) rodent or commensal (urban) rat sources.

RANGE CONDITION -- The state and health of the range based on what it is naturally capable of producing.

RANGELAND -- Land on which the (climax or natural potential) plant community is dominated by grasses, grass-like plants, forbs, or shrubs suitable for grazing or browsing and present in sufficient quantity to justify grazing or browsing use. Includes rangelands revegetated naturally or artificially to provide cover that is managed like native vegetation.

RANGE MANAGEMENT -- The art and science of planning and directing range use to obtain sustained maximum animal production, consistent with perpetuation of the natural resources.

RECHARGE -- The addition of water to an aquifer that occurs naturally from infiltration of rainfall and from water flowing over earth materials that allow water to infiltrate below the land surface.

RESERVOIR -- An organism in which a parasite that is pathogenic for some other species lives and multiplies without damage to its host.

RIPARIAN -- In loose usage, referring to the land bordering a stream, lake, or tidewater.

RODENTICIDE -- A chemical substance used for the destruction of rodents, generally through ingestion.

SECONDARY POISONING -- The result attributable to a chemical toxicant which, after being ingested, inhaled, or absorbed, or when applied to or injected into a mammal, bird, reptile or fish, is retained in its tissue, or otherwise retained in such a manner and quantity that the tissue itself or retaining part, if thereafter ingested by man, mammal, bird, reptile or fish, causes significant bodily malfunction, injury, illness, or death to animals or to man.

SOIL ASSOCIATION -- A group of defined and named soil taxonomic units occurring together in an individual and characteristic pattern over a geographic region.

SOIL SERIES -- Soils which have similar soil profile characteristics and which are derived from similar parent materials.

SURFACE WATER -- Water which remains on top of the land, such as a river or lake.

VECTOR -- An organism (as an insect) that transmits a pathogen.

ZOONOSIS -- Disease condition affecting both man and animal.

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APPENDIX A

FLORA OF THE STUDY AREA

| Common Name | Scientific Name | Fort Ord* | Fort Hunter Liggett, Camp Roberts** |
|---|---|---|---|
| TREES | | | |
| Arroyo willow | Salix lasiolepis | x | x |
| Big leaf maple | Acer macrophyllum | | x |
| Black cottonwood | Populus trichocarpa | x | x |
| Blue oak | Quercus douglasii | | x |
| Bluegum*** | Eucalyptus golbulus | | x |
| Bristlecone fir | Abies bracteata | | x |
| California bay | Umbellularia californica | | x |
| California buckeye | Aesculus californica | | x |
| California sycamore | Platanus racemosa | x | x |
| Canyon live oak | Quercus chrysolepsis | | x |
| Coast live oak | Quercus agrifolia | x | x |
| Coulter pine | Pinus coulteri | | x |
| Digger pine | Pinus sabiniana | | x |
| Fremont cottonwood | Salix fremontii | | x |
| Gowan cypress | Cupressus goveniana | | x |
| Incense cedar | Libocedrus decurrens | | x |
| Interior live oak | Quercus wislizenii | | x |
| Knobcone pine | Pinus attenuata | | x |
| Monterey pine | Pinus radiata | x | |
| Pacific bayberry | Myrica californica | | x |
| Pacific madrone | Arbutus menziesii | | x |
| Pacific willow | Salix lasiandro | | x |
| Ponderosa pine | Pinus ponderosa | | x |
| Red alder | Alnus rubra | | x |
| Red willow | Salix laevigata | | x |
| Tan oak | Lithocarpus densiflorus | | x |
| Valley oak | Quercus lobata | | x |
| Black sage | Salvia mellifera | x | x |
| Blue blossom | Ceanothus thyrsiflorus | x | x |
| Blue elderberry | Sambuscus caerulea | x | x |
| Blue witch | Solanum umbelliforum | | x |
| Brewer willow | Salix breweri | | x |
| Buck brush | Ceanothus cuncatus | | x |
| Bush poppy | Dendromecon rigida | | x |
| California blackberry | Rubus vitifolius | x | |
| California bush buckwheat | Eriogonum fasciculatum | | x |
| California coffeeberry | Rhamnus californica | | x |
| California sagebrush | Artemisia californica | x | x |
| California scrub oak | Quercus dumosa | | x |
| California wild rose | Rosa californica | x | x |
| Canyon gooseberry | Ribes menziesii | | x |
| Cascara sagrada | Rhamnus purshiana | | x |
| Chamise | Adenostoma fasciculatum | x | x |
| Chaparral currant | Ribes malvaceum | x | |
| Chaparral pea | Pickeringia montana | | x |
| Chaparral whitethorn | Ceanothus lencodermis | | x |
| Chinquapin | Castanopsis chrysophylla var. minor | | x |
| Coast silktassel | Garrya elliptica | x | |
| Coast whitethorn | Ceanothus incanus | x | |
| Common snowberry | Symphoricarsus albus | | x |
| Coyote brush | Baccharis pilularis ssp. consanguinea | x | x |
| Creeping sage | Salvia sonomensis | | |

| Common Name | Scientific Name | Fort Ord* | Fort Hunter Liggett, Camp Roberts** |
|---|---|---|---|
| Deer brush | Ceanothus integerrimus | | x |
| Deer weed | Lotus scoparius | x | x |
| Dwarf ceanothus | Ceanothus dentatus | x | |
| Eastwood manzanita | Arctostaphylos glandulosa | | x |
| Eastwood's ericamerica | Happlopappus eastwoodae | x | |
| Flannelbush | Fremontia californica | | x |
| Fuchsia flowered gooseberry | Ribes speciosum | | x |
| Golden yarrow | Eriophyllum confertiflorum | x | |
| Hillside gooseberry | Ribes californicum | | x |
| Hollyleaf redberry | Rhamnus crocea var. ilicifolia | | x |
| Mock heather | Happlopappus ericoides | x | |
| Monterey ceanothus | Ceanothus rigida | x | |
| Monterey manzanita | Arctostaphylos hookeri | x | |
| Pitcher sage | Lepechinia calycina | x | |
| Poison oak | Rhus diversiloba | | x |
| Purple sage | Salvia leucophylla | | x |
| Rabbit brush | Chrysothamus nauseasus | | x |
| Sandmat manzanita | Arctostaphylos pumila | x | |
| Shaggy bark manzanita | Arctostaphylos tomentosa | | |
| | var. crustacea | x | |
| | var. tomentosa | x | |
| | var. tomentosiformes | x | |
| | var. trichoclada | x | |
| | var. hebeclada | x | |
| Squaw bush | Rhus trilobato | | x |
| Tibinagua | Eriogonum nudum | x | |
| Toro manzanita | Arctostaphylos montereyensis | x | |
| Toyon | Heteromeles arbutifolia | x | x |
| Twinberry | Lonicera involucrata | | x |
| Valley willow | Salix hindsiana | | x |
| Wavyleaf ceanothus | Ceanothus foliosus | | x |
| Western chokecherry | Prunus virginia var. deniosa | | x |
| Western mountain mahogany | Cercocarpus betuloides | | x |
| Western service berry | Amlanchler alnifolia | | x |
| White sage | Salvia apiana | | x |
| Whiteleaf yerba santa | Eriodictyon crassifolium | | x |
| Yerba santa | Eriodictyon californicum | x | x |
| HERBACEOUS VEGETATION | | | |
| Annual bluegrass | Poa annua | | x |
| Annual foxtail barley | Hordeum laporinum | | x |
| Annual ryegrass | Lolium multiflorum | | x |
| Arenaria | Arenaria californica | | x |
| Baby blue eyes | Nemaphila menziesii | x | x |
| Beach aster | Corethrogyne leucophylla | x | |
| Beach-bur | Franseria chamissonis ssp. bipinnatisecta | x | |
| Beach burr | Ambrosia chamissonis | x | |
| Beach morning glory | Convolvulus soldanella | x | |
| Beach pea | Lathyrus littoralis | x | |
| Beach poppy | Eschscholtzia maritima | x | |
| Beach primrose | Oenothera cheiranthifolia | x | |
| Beach ryegrass | Elymus mollis | x | |
| Beach sagewort | Artemisia pycnocephala | x | |
| Bedstraw | Galium spp. | | x |
| Ben Lomond wallflower | Erysimum teretifolium | x | |
| Bermuda grass | Cynodon dactylon | | x |

| Common Name | Scientific Name | Fort Ord* | Fort Hunter Liggett, Camp Roberts** |
|---|---|---|---|
| Bindweed | Convolvulus arvensis | | x |
| Bitterroot | Lewisia rediviva | | x |
| Black mustard*** | Brassica nigra | x | |
| Bladder parsnip | Lomatium utriculatum | x | |
| Blow-wives | Archyracheena mollis | | x |
| Blue dicks | Brodiaea capitata | | x |
| Blue dicks | Brodiaea jolonensis | | x |
| Blue wild rye | Elymus glaucus | | x |
| Blue-eyed grass | Sisyrinchium bellum | x | x |
| Bluegrass | Poa bulbosa | | x |
| Bluegrass | Poa scabrella | | x |
| Branching phacelia | Phacelia ramosissima var. montereyensis | x | |
| Bracken fern | Pteridium aquilnum | x | |
| Buckwheat | Eriogonum spp. | | x |
| Bull thistle | Cirsium vulgare | x | x |
| Bulrush | Scirpus spp. | | x |
| Bush lupine (yellow) | Lupinus arboreus | x | |
| Bush lupine (purple) | Lupinus chamissonis | x | |
| Burclover | Medicago polymorpha | | x |
| Buttercup | Ranunculus spp. | | x |
| California brome | Bromus carinatus | | x |
| California buttercup | Ranunculus californicus | x | |
| California fescue | Festuca californica | | x |
| California poppy | Eschscholtzia californica | x | x |
| California water starwort | Callitriche marginata | x | |
| Canary grass | Phalaris tuberosa | | x |
| Carmel Valley bush-mallow | Malacothamnus palmeri var. involucratus | | x |
| Catchfly | Silene spp. | | x |
| Cattail | Typha latifolia | x | x |
| Centaury | Centaurium muhlenberaii | | x |
| Checkerbloom | Sidalcea malvaeflora | x | x |
| Chia | Salvia columbariae | x | |
| Chickweed | Cerastium viscosum | | x |
| Chinese houses | Collinsia heterophylla | x | |
| Climbing bedstraw | Galium nutallii | x | |
| Clover | Trifolium ciliolatum | | x |
| Clover | Trifolium variegatum | | x |
| Clover | Trifolium hirtum | | x |
| Clover | Trifolium depauperatum | | x |
| Clover | Trifolium microcephalum | | x |
| Clover | Trifolium albopurpureum | | x |
| Clover | Trifolium microdon | | x |
| Coast buckwheat | Eriogonum latifolium | x | |
| Coast figwort | Scrophularia californica | x | |
| Coast larkspur | Delphinium patens | x | |
| Coast parsnip | Lomatium parvifolium | x | |
| Coast wallflower | Erysimum ammophilum | x | |
| Cobweb thistle | Cirsium occidentale | x | |
| Common manroot | Marah fabaceus | x | |
| Common plantain*** | Plantago major | x | x |
| Cream cups | Platystemon californica | x | x |
| Curly leafed monardella | Monardella undulata | x | |
| Cut-leaf filaree | Erodium cicutarium | | x |
| Death camas | Zygadenus spp. | | x |
| Douglas iris | Iris douglasiana | x | |
| Dune bluegrass | Poa douglasii | x | |
| Dune buckwheat | Eriogonum parvifolium | x | |
| Euphorbia | Euphorbia ssp. | | x |
| European beach grass*** | Ammophila arenaria | x | |
| Fescue | Festuca reflexa | | x |
| Fescue | Festuca pacifica | | x |
| Fescue | Festuca dertonensis | | x |

| Common Name | Scientific Name | Fort Ord* | Fort Hunter Liggett, Camp Roberts** |
|---|---|---|---|
| Fiddleneck | Amsinckia spp. | | x |
| Fiesta flower | Pholistum auritum | x | |
| Filago | Filago californica | | x |
| Filaree | Erodium spp. | x | x |
| Foxtail barley | Hordeum jubatum | | x |
| Foxtail fescue | Festuca megalura | | x |
| Foxtail grass | Hordeum leporinum | x | |
| Gambleweed | Sanicula crassicaulis | x | |
| Geranium | Geranium spp. | | x |
| Giant ryegrass | Elymus condensatus | x | |
| Gilia | Gilia tricolor | | x |
| Goldback fern | Pityrogramma triangularis | x | |
| Goldenbrodiaea | Brodiaea lutea | x | |
| Goldfields | Bacria chrysostoma | x | x |
| Grindelia | Grindelia latifolia | x | |
| Hardham bedstraw | Galium hardhamae | | x |
| Hedge nettle | Stachys bullata | x | |
| Heliotrope | Phacelia douglasii | x | |
| Hickman sidalcea | Sidalcea hickmanii ssp. hickmanii | | x |
| Hill clarkia | Clarkia bottae | x | |
| Horsetail | Equisetum spp. | x | |
| Ice plant | Mesambryanthemum chilensis | x | |
| Ice plant*** | Mesambryanthemum edulis | x | |
| Indian Valley chorizanthe | Chorizanthe insignis | | x |
| Indian warrior | Pedicularis densiflora | x | |
| Italian ryegrass*** | Lolium multiflorum | x | |
| Johnny-jump-up violet | Viola pedunculata | x | |
| Junegrass | Koeleria cristata | | x |
| Kentucky bluegrass | Poa pratensis | | x |
| Large cut-leaf filaree | Erodium moschatum | | x |
| Large-flowered linanthus | Linanthus grandifiorus | x | x |
| Larkspur | Delphinium variegatum | | x |
| Little quakegrass | Eriza minor | | x |
| Lizardtail | Eriophyllum staechadifolium | x | |
| Locoweed | Astralagus spp. | | x |
| Lupine | Lupinus tricolor | | x |
| Lythrum | Lythrum hyssopifolia | x | |
| Mediterranean barley | Hordeum hystrix | | x |
| Melic grass | Melica imperfecta | | x |
| Milkmaids | Dentaria californica | x | |
| Milkweed | Ascelpias spp. | | x |
| Miner's lettuce | Montia perfoliata | x | x |
| Mint | Stachys spp. | | x |
| Monkey flower | Mimulus spp. | | x |
| Monterey spine flower | Chorizanthe pungens | x | |
| Mugwort | Artemisia douglasiana | x | |
| Mullein | Verbascum thapsis | | x |
| Narrow-leafed wooly mule ears | Wyethia angustifolia | x | |
| Navarretia | Navarretia spp. | | x |
| Neddlegrass | Stipa lepida | | x |
| Neddlegrass | Stipa cernua | | x |
| Oatgrass | Danthonia californica | | x |
| One-awned spine flower | Chorizanthe rectispina | | x |
| Orchard grass | Dactylis glomerata | | x |
| Owls clover | Orthocarpus densiflorus | x | |
| Pampas grass*** | Cortaderia atacamensis | x | |
| Pearly everlasting | Anaphalis margaritacea | x | |
| Pepper grass | Pipidium nitidum | | x |
| Pimpernel | Anagallis arvensis | | x |
| Popcorn flower | Plagiobothrys nothofulvus | | x |

| Common Name | Scientific Name | Fort Ord* | Fort Hunter Liggett, Camp Roberts** |
|---|---|---|---|
| Purple needlegrass | Stipa pulchra | x | x |
| Rabbitfoot grass | Polypogon monspeliensis | | x |
| Red brome | Bromus rubens | | x |
| Red-stem filaree | Erodium botrys | | x |
| River cinquefoil | Potentilla rivalis | x | |
| Ripgut brome | Bromus rigidus | | x |
| Ripgut grass*** | Bromus diandrus | x | |
| Rush | Juncus spp. | x | x |
| Ryegrass | Lolium perrene | | x |
| Sand lotus | Lotus heermanii | x | |
| Sand verbena (pink) | Abronia umbellata | x | |
| Sand verbena (yellow) | Abronia latifolia | x | |
| Sanicle | Sanicula spp. | | x |
| Santa Lucia pogogyne | Pogogyne clareana | | x |
| Sea lettuce | Dudleya caespitosa | x | |
| Sea rocket*** | Cakile maritima | x | |
| Seaside bird's beak | Cordylanthus littoralis | x | |
| Seaside painted cup | Castilleja latifolia | x | |
| Sedge | Carex spp. | x | x |
| Shepard's purse | Capsella bursa-pastoris | | x |
| Shooting star | Dedecatheon clevelandii var. patulum | | x |
| Short-lobed phacelia | Phacelia brachyloba | x | |
| Shower of Gilia | Linanthus androsacens | x | |
| Silver hairgrass | Aira caryophyllea | | x |
| Silver lupine | Lupinus albifrons | x | x |
| Sky lupine | Lupinus nanus | x | x |
| Slender flowered gilia | Gilia tenuiflora ssp. arenaria | x | |
| Slender oats*** | Avena barbata | x | x |
| Soap plant | Chlorogalum purpureum var. purpureum | | x |
| Soap root | Chlorogalum pomeridianum | x | x |
| Soft chess | Bromus mollis | x | x |
| Sorrel | Rumex spp. | | x |
| Spurge | Croton californica | x | |
| Squirrelgrass | Sitanion hystrix | | x |
| Star lily | Zigadenus fremontii | x | |
| Sticky monkey flower | Diplaucus aurantiacus | x | |
| Swamp knotweed | Polygonum coccineum | x | |
| Tarweed | Madia spp. | | x |
| Tarweed | Hemizonia spp. | | x |
| Tidy tips | Layia platyglossa | x | |
| Tocalote | Centaurea militensis | | x |
| Trefoil | Lotus subpinnatus | | x |
| Turkey mullien | Bremocarpus setigerus | | x |
| Umbrella sedge | Cyperus spp. | | x |
| Verbana | Verbana lasiostachys | x | |
| Verbena | Verbena bracteata | x | |
| Vetch | Vicia spp. | | x |
| Vinegar weed | Trichostema spp. | | x |
| Virgala eriastrum | Eriastrum virgatum | x | |
| Wedge-leaf horkelia | Horkelia cuneata | x | |
| Western dog violet | Viola adunca | x | |
| Western poppy | Papaver californicum | x | |
| White globe lily | Chalochortus albus | x | |
| White owls clover | Orthocarpus purpureus var. pallidus | x | x |
| Wild carrot | Daucus pusillus | | x |
| Wild geranium | Geranium dissectum | x | |
| Wild hyacinth | Brodiaea pulchella | x | x |
| Wild iris | Iris spp. | | x |
| Wild mustard | Brassica campestris | | x |
| Wild oats*** | Avena fatua | x | x |

| Common Name | Scientific Name | Fort Ord* | Fort Hunter Liggett, Camp Roberts** |
|---|---|---|---|
| Wild onion | Allium spp. | | x |
| Wild petunia | Petunia parviflora | x | |
| Wood rush | Luzula subsessilis | | x |
| Wood strawberry | Fragaria californica | x | |
| Woodland star | Lithophragma affine | x | |
| Yarrow | Achillea borealis spp. californica | x | x |
| Yellow mariposa lily | Chalochortus luteus | x | |
| Yellow star thistle | Centaurea solstitialis | | x |
| Yerba buena | Satureja douglasii | x | |

* Partial species list sources: Department of the Army, 1975; California Natural Areas Coordinating Council, 1975.

** Partial species list combining both installations: No separate species list is available for Camp Roberts. Source: Department of the Army, 1976; California Natural Areas Coordinating Council, 1975.

*** Introduced.

APPENDIX B

FAUNA OF THE STUDY AREA

| Common Name | Scientific Name | Fort Ord[1] | Fort Hunter Liggett[2] | Camp Roberts[3] |
|---|---|---|---|---|
| REPTILES AND AMPHIBIANS | | | | |
| California newt | Taricha torosa torosa | x | x | x |
| Yellow-eyed salamander | Ensatina eschscholtzi xanthoptica | | x | x |
| Santa Cruz long-toed salamander | Ambystoma macrodactylum var. eroceum | x | | |
| California slender salamander | Batrachoseps attenuatus | x | x | x |
| Arboreal salamander | Aneides lugubris | | x | |
| California tiger salamander | Ambystoma tigrinum | x | | x |
| California tree frog | Hyla cadaverina | | x | x |
| Pacific tree frog | Hyla regilla | x | | x |
| Red-legged frog | Rana aurora | x | | x |
| Foothill yellow-legged frog | Rana boylei | x | | x |
| Bull frog | Rana catesbeiana | x | x | x |
| California toad* | Bufo boreas halophilus | x | x | x |
| Western spadefoot* | Scaphiopus hammondi | x | | x |
| Western pond turtle | Clemmys marmorata | x | x | x |
| Western fence lizard* | Sceloporus occidentalis | x | x | x |
| California side-blotched lizard* | Uta stansburiana | | | x |
| Coast horned lizard | Phrynosoma coronatum | x | | x |
| Western skink | Eumeces skiltonianus | x | | x |
| California whiptail lizard* | Cnemidophorus tigris mundus | | | x |
| California alligator lizard* | Gerrhonotus multicarinatus | x | | x |
| California legless lizard* | Anniella pulchra | x | | x |
| Pacific rubber boa* | Charina bottae | x | | |
| California striped racer* | Masticophis lateralis | x | x | x |
| San Joaquin whipsnake* | Masticophis flagellum ruddocki | | | x |
| Western yellow-bellied racer* | Coluber constrictor | x | | x |
| Pacific gopher snake* | Pituophis melanoleucus | x | x | x |
| Common kingsnake* | Lampropeltis getulus | x | x | x |
| Coast mountain kingsnake* | Lampropeltis zonata | x | | |
| Coast garter snake* | Thamnophis elegans terrestris | | | x |
| Common garter snake* | Thamnophis sirtalis | x | x | x |
| Two-striped garter snake* | Thamnophis couchi hammondi | | | x |
| California night snake* | Hypsiglena torquata | | | x |
| Western rattlesnake* | Crotalus viridis | x | x | x |
| FISHES | | | | |
| White catfish | Ictalurus catus | | x | |
| Channel catfish | Ictalurus punctatus | x | x | |
| Brown bullhead | Ictalurus nebulosus | x | | |
| Sacramento sucker | Catostomus occidentalis | | x | x |
| Green sunfish | Lepomis cyanellus | | x | x |
| Bluegill | Lepomis macrochirus | x | x | |
| Redear sunfish | Lepomis microlophus | x | x | |
| Smallmouth bass | Micropterus dolomieui | | x | x |
| Largemouth bass | Micropterus salmoides | x | x | x |
| Rainbow trout | Salmo gairdneri | x | x | x |
| Brown trout | Salmo trutta | | | x |
| Surfperch | Amphistichus spp. | x | | |
| Starry flounder | Platichthys stellatus | x | | |
| Striped bass | Roccus saxatilis | x | | |
| Sacramento squawfish | Ptychocheilus grandis | | x | x |
| California roach | Hesperoleucus symmetricus | | x | x |
| Speckled dace | Rhinichthys osculus | | x | x |
| Lamprey | | | | x |

| Common Name | Scientific Name | Fort Ord[1] | Fort Hunter Liggett[2] | Camp Roberts[3] |
|---|---|---|---|---|
| BIRDS | | | | |
| Common loon | Gavia immer | x | x | |
| Arctic loon | Gavia arctica | x | | |
| Red-throated loon | Gavia stellata | x | | |
| Horned grebe | Podiceps auritus | x | x | |
| Western grebe | Aechmophorus occidentalis | x | x | |
| Eared grebe | Podiceps nigricollis | x | x | |
| Red-necked grebe | Podiceps grisegena | x | | |
| Pied-billed grebe | Podilymbus podiceps | x | x | |
| Northern fulmar | Fulmaris glacialis | x | | |
| Sooty shearwater | Puffinis griseus | x | | |
| Brown pelican | Pelecanus occidentalis | x | | |
| Brant's cormorant | Phalacrocorax penicillatus | x | | |
| Pelagic cormorant | Phalacrocorax pelagicus | x | | |
| Great blue heron | Ardea herodias | x | x | x |
| Green heron | Butorides virescens | x | x | x |
| Black-crowned night heron | Nycticorax nycticorax | x | | |
| Snowy egret | Leucophoyx thula | x | | |
| Great egret | Casmerodius albus | | x | |
| Whistling swan | Olor columbianus | | x | |
| Canada goose | Branta canadensis | | x | |
| White-fronted goose | Anser albifrons | | x | |
| Lesser snow goose | Chen caerulescens | | x | |
| Mallard | Anas platyrhynchos | x | x | x |
| Pintail | Anas acuta | x | x | |
| Green-winged teal | Anas crecca | x | x | x |
| Cinnamon teal | Anas cyanoptera | x | x | x |
| American wigeon | Anas americana | x | x | |
| Northern shoveler | Anas clypeata | | x | |
| Wood duck | Aix sponsa | x | x | x |
| Canvasback | Aythya valisineria | x | x | |
| Redhead | Aythya americana | | x | |
| Ring-necked duck | Aythya collaris | | x | |
| Lesser scaup | Aythya affinis | x | x | |
| Common goldeneye | Bucephala clangula | x | x | |
| Bufflehead | Bucephala albeola | x | x | |
| Oldsquaw | Clangula hyemalis | x | | |
| White-winged scoter | Melanitta deglandi | x | | |
| Surf scoter | Melanitta perspicillata | x | | |
| Ruddy duck | Oxyura jamaicensis | x | x | |
| Common merganser | Mergus merganser | x | x | |
| Red-breasted merganser | Mergus serrator | x | x | x |
| Hooded merganser | Lophodytes cucullatus | | x | |
| Turkey vulture* | Cathartes aura | x | x | x |
| California condor | Gymnogyps californianus | | x | |
| White-tailed kite* | Elanus leucurus | x | x | |
| Cooper's hawk* | Accipiter cooperii | x | x | x |
| Sharp-shinned hawk* | Accipiter striatus | x | x | |
| Goshawk | Accipiter gentilis | | x | |
| Red-shouldered hawk* | Buteo lineatus | x | x | x |
| Rough-legged hawk* | Buteo lagopus | | x | |
| Swainson's hawk* | Buteo swainsoni | | x | |
| Ferruginous hawk* | Buteo regalis | | x | |
| Red-tailed hawk* | Buteo jamaicensis | x | x | x |
| Golden eagle* | Aquila chrysaetos | x | x | x |
| Southern bald eagle | Haliaeetus leucocephalus | x | x | x |
| Marsh hawk* | Circus cyaneus | | x | |
| Osprey* | Pandion haliaetus | | x | x |
| Merlin* | Falco columbarius | | x | |
| Prairie falcon* | Falco mexicanus | | x | |
| Peregrine falcon* | Falco peregrinus | | | x |
| American kestrel* | Falco sparverius | x | x | x |
| California quail* | Lophortyx californicus | x | x | x |
| Mountain quail* | Oreortyx pictus | | x | |
| Turkey* | Meleagris gallopavo | | x | |
| American coot | Fulica americana | x | x | x |
| Virginia rail | Rallus limicola | x | | |
| Black oystercatcher | Haematopus bachmani | x | | |

| Common Name | Scientific Name | Fort Ord[1] | Fort Hunter Liggett[2] | Camp Roberts[3] |
|---|---|---|---|---|
| Snowy plover | Charadrius alexandrinus | x | | |
| Killdeer | Charadrius vociferus | x | x | x |
| Surfbird | Aphriza virgata | x | | |
| Black turnstone | Arenaria melanocephala | x | | |
| Common snipe | Capella gallinago | x | x | x |
| Whimbrel | Numenius phaeopys | x | | |
| Spotted sandpiper | Actitis macularis | | x | |
| Solitary sandpiper | Tringa solitaria | | x | |
| Wandering tattler | Heteroscelus incanus | x | | |
| Willet | Catoptrophorus semipalmatus | x | | |
| Greater yellowlegs | Totanus melanoleucus | x | x | x |
| Least sandpiper | Calidris minutilla | x | x | |
| Dunlin | Calidris alpina | | x | |
| Short-billed dowitcher | Limnodromus griseus | x | | |
| Long-billed dowitcher | Limnodromus scolopaceus | x | x | |
| Western sandpiper | Calidris mauri | x | x | x |
| Marbled godwit | Limosa fedoa | x | | |
| Sanderling | Calidris alba | x | | |
| American avocet | Recurvirostra americana | | x | x |
| Black-necked stilt | Himantopus mexicanus | | x | |
| Red phalarope | Phalaropus fulicarius | x | | |
| Northern phalarope | Lobipes lobatus | x | x | |
| Wilson's phalarope | Steganopus tricolor | | x | |
| Glaucous-winged gull | Larus glaucescens | x | | |
| Western gull | Larus occidentalis | x | | |
| Herring gull | Larus argentatus | x | | |
| California gull | Larus californicus | x | | |
| Ring-billed gull | Larus delanarensis | x | | |
| Bonaparte's gull | Larus philadelpha | x | | |
| Mew gull | Larus canus | x | | |
| Heermann's gull | Larus heermanni | x | | |
| Least tern | Sterna albitrons | x | | |
| Common murre | Uria aalge | x | | |
| Pigeon guillemot | Cepphus columba | x | | |
| Rhinoceros auklet | Cerorhinca manocerata | x | | |
| Band-tailed pigeon* | Columba fasciata | x | x | x |
| Mourning dove* | Zenaida macroura | x | x | x |
| Rock dove*(X) | Columba livia | x | | |
| Roadrunner | Geococcyx californianus | x | x | x |
| Barn owl | Tyto alba | x | x | x |
| Screech owl | Otus asio | x | x | |
| Great horned owl | Bubo virginianus | x | x | x |
| Pygmy owl | Glaucidium gnoma | x | x | |
| Burrowing owl | Speotyto cunicularia | x | x | |
| Spotted owl | Strix occidentalis | | x | |
| Long-eared owl | Asio otus | | x | x |
| Short-eared owl | Asio flammeus | | x | |
| Saw-whet owl | Aegolius acadicus | | x | |
| Poor-will | Phalaenoptilus nuttallii | | x | x |
| Lesser nighthawk | Chordeiles acutipennis | | x | |
| Black swift | Cypseloides niger | | x | |
| Vaux's swift | Chaetura vauxi | | x | |
| White-throated swift | Aeronautes saxatalis | x | x | x |
| Black-chinned hummingbird | Archilochus alexandri | | x | x |
| Costa's hummingbird | Calypte costae | | x | |
| Anna's hummingbird | Calypte anna | x | x | x |
| Rufous hummingbird | Selasphorus rufus | | x | x |
| Allen's hummingbird | Selasphorus sasin | x | x | x |
| Calliope hummingbird | Stellula calliope | | x | |
| Belted kingfisher | Megaceryle alcyon | x | x | x |
| Common flicker | Colaptes auratus | x | x | x |
| Acorn woodpecker | Melanerpes formicivorus | x | x | x |
| Lewis' woodpecker | Asyndesmus lewis | | x | |
| Hairy woodpecker | Dendrocopos villosus | x | x | x |
| Downy woodpecker | Dendrocopos pubescens | x | x | x |
| Nuttall's woodpecker | Dendrocopos nuttallii | x | x | x |
| Red-breasted sapsucker | Sphyrapicus varius | | x | |
| Cassin's kingbird | Tyrannus vociferans | | x | |
| Western kingbird | Tyrannus verticalis | | x | x |

| Common Name | Scientific Name | Fort Ord[1] | Fort Hunter Liggett[2] | Camp Roberts[3] |
|---|---|---|---|---|
| Ash-throated flycatcher | Myiarchus cinerascens | | x | x |
| Black phoebe | Sayornis nigricans | x | x | x |
| Say's phoebe | Sayornis saya | x | x | x |
| Willow flycatcher | Empidonax traillii | | x | |
| Western flycatcher | Empidonax difficilis | | x | x |
| Western wood pewee | Contopus sordidulus | | x | |
| Olive-sided flycatcher | Nuttallornis borealis | x | x | x |
| Horned lark | Eremophila alpestris | x | x | x |
| Violet green swallow | Tachycineta thalassina | | x | x |
| Tree swallow | Iridoprocne bicolor | x | x | x |
| Bank swallow | Riparia riparia | | x | |
| Rough-winged swallow | Stelgidopteryx ruficollis | | x | |
| Barn swallow | Hirundo rustica | x | x | x |
| Cliff swallow | Petrochelidon pyrrhonota | x | x | |
| Purple martin | Progne subis | | x | |
| Stellar's jay | Cyanocitta stelleri | x | x | x |
| Scrub jay* | Aphelocoma coerulescens | x | x | x |
| Yellow-billed magpie* | Pica nuttalli | x | x | x |
| Common raven* | Corvus corax | | x | x |
| Common crow* | Corvus brachyrhynchos | x | x | x |
| Plain titmouse | Parus inornatus | x | x | x |
| Chestnut-backed Chickadee | Parus rufescens | x | x | |
| Bushtit | Psaltriparus minimus | x | x | x |
| Dipper | Cinclus mexicanus | | x | |
| White-breasted nuthatch | Sitta carolinensis | | x | |
| Red-breasted nuthatch | Sitta canadensis | | x | |
| Pygmy nuthatch | Sitta pygmaea | | x | x |
| Brown creeper | Certhia familiaris | x | x | |
| Wrentit | Chamaea fasciata | x | x | |
| House wren | Troglodytes aedon | x | x | |
| Winter wren | Troglodytes troglodytes | | x | |
| Bewick's wren | Thryomanes bewickii | x | x | x |
| Long-billed marsh wren | Telmatodytes palustris | x | x | |
| Canyon wren | Catherpes mexicanus | | x | |
| Rock wren | Salpinctes obsoletus | | x | |
| Mockingbird | Mimus polyglottos | x | x | |
| California thrasher | Toxostoma redivivum | x | x | |
| American robin | Turdus migratorius | x | x | |
| Varied thrush | Ixoreus naevius | | x | |
| Townsend's solitaire | Myadestes townsendi | | x | |
| Hermit thrush | Catharus guttata | x | x | |
| Swainson's thrush | Catharus ustulata | x | x | |
| Western bluebird | Sialia mexicana | x | x | x |
| Mountain bluebird | Sialia currucoides | | x | |
| Blue-gray gnatcatcher | Polioptila caerulea | | x | x |
| Golden-crowned kinglet | Regulus satrapa | | x | |
| Ruby-crowned kinglet | Regulus calendula | x | x | x |
| Water pipit | Anthus spinoletta | x | x | x |
| Cedar waxwing | Bombycilla cedrorum | | x | x |
| Phainopepla | Phainopepla nitens | | x | |
| Loggerhead shrike* | Lanius ludovicianus | x | x | x |
| Starling* (x) | Sturnus vulgaris | x | x | x |
| Hutton's vireo | Vireo huttoni | x | x | x |
| Bell's vireo | Vireo bellii | | x | |
| Solitary vireo | Vireo solitarius | | x | |
| Warbling vireo | Vireo gilvus | x | x | |
| Orange-crowned warbler | Vermivora celata | x | x | |
| Nashville warbler | Vermivora ruficapilla | | x | |
| Yellow warbler | Dendroica petechia | x | x | x |
| Yellow-rumped warbler | Dendroica coronata auduboni | x | x | x |
| Townsend's warbler | Dendroica townsendi | x | x | x |
| Black-throated gray warbler | Dendroica virens | | x | |
| Hermit warbler | Dendroica occidentalis | | x | |
| MacGillivray's warbler | Oporornis tolmiei | | x | |
| Common yellowthroat | Geothlypis trichas | x | x | x |
| Yellow-breasted chat | Icteria virens | | x | |
| Wilson's warbler | Wilsonia pusilla | x | x | |
| House sparrow* (x) | Passer domesticus | x | x | |

| Common Name | Scientific Name | Fort Ord[1] | Fort Hunter Liggett[2] | Camp Roberts[3] |
|---|---|---|---|---|
| Ash-throated flycatcher | Myiarchus cinerascens | | x | x |
| Black phoebe | Sayornis nigricans | x | x | x |
| Say's phoebe | Sayornis saya | x | x | x |
| Willow flycatcher | Empidonax traillii | | x | |
| Western flycatcher | Empidonax difficilis | | x | x |
| Western wood pewee | Contopus sordidulus | | x | |
| Olive-sided flycatcher | Nuttallornis borealis | x | x | x |
| Horned lark | Eremophila alpestris | x | x | x |
| Violet green swallow | Tachycineta thalassina | | x | x |
| Tree swallow | Iridoprocne bicolor | x | x | x |
| Bank swallow | Riparia riparia | | x | |
| Rough-winged swallow | Stelgidopteryx ruficollis | | x | |
| Barn swallow | Hirundo rustica | x | x | x |
| Cliff swallow | Petrochelidon pyrrhonota | x | x | |
| Purple martin | Progne subis | | x | |
| Stellar's jay | Cyanocitta stelleri | x | x | x |
| Scrub jay* | Aphelocoma coerulescens | x | x | x |
| Yellow-billed magpie* | Pica nuttalli | x | x | x |
| Common raven* | Corvus corax | | x | x |
| Common crow* | Corvus brachyrhynchos | x | x | x |
| Plain titmouse | Parus inornatus | x | x | x |
| Chestnut-backed Chickadee | Parus rufescens | x | x | |
| Bushtit | Psaltriparus minimus | x | x | x |
| Dipper | Cinclus mexicanus | | x | |
| White-breasted nuthatch | Sitta carolinensis | | x | |
| Red-breasted nuthatch | Sitta canadensis | | x | |
| Pygmy nuthatch | Sitta pygmaea | | x | x |
| Brown creeper | Certhia familiaris | x | x | |
| Wrentit | Chamaea fasciata | x | x | |
| House wren | Troglodytes aedon | x | x | |
| Winter wren | Troglodytes troglodytes | | x | |
| Bewick's wren | Thryomanes bewickii | x | x | x |
| Long-billed marsh wren | Telmatodytes palustris | x | x | |
| Canyon wren | Catherpes mexicanus | | x | |
| Rock wren | Salpinctes obsoletus | | x | |
| Mockingbird | Mimus polyglottos | x | x | |
| California thrasher | Toxostoma redivivum | x | x | |
| American robin | Turdus migratorius | x | x | |
| Varied thrush | Ixoreus naevius | | x | |
| Townsend's solitaire | Myadestes townsendi | | x | |
| Hermit thrush | Catharus guttata | x | x | |
| Swainson's thrush | Catharus ustulata | x | x | |
| Western bluebird | Sialia mexicana | x | x | x |
| Mountain bluebird | Sialia currucoides | | x | |
| Blue-gray gnatcatcher | Polioptila caerulea | | x | x |
| Golden-crowned kinglet | Regulus satrapa | | x | |
| Ruby-crowned kinglet | Regulus calendula | x | x | x |
| Water pipit | Anthus spinoletta | x | x | x |
| Cedar waxwing | Bombycilla cedrorum | | x | x |
| Phainopepla | Phainopepla nitens | | x | |
| Loggerhead shrike* | Lanius ludovicianus | x | x | x |
| Starling* (x) | Sturnus vulgaris | x | x | x |
| Hutton's vireo | Vireo huttoni | x | x | x |
| Bell's vireo | Vireo bellii | | x | |
| Solitary vireo | Vireo solitarius | | x | |
| Warbling vireo | Vireo gilvus | x | x | |
| Orange-crowned warbler | Vermivora celata | x | x | |
| Nashville warbler | Vermivora ruficapilla | | x | |
| Yellow warbler | Dendroica petechia | x | x | x |
| Yellow-rumped warbler | Dendroica coronata auduboni | x | x | x |
| Townsend's warbler | Dendroica townsendi | x | x | x |
| Black-throated gray warbler | Dendroica virens | | x | |
| Hermit warbler | Dendroica occidentalis | | x | |
| MacGillivray's warbler | Oporornis tolmiei | | x | |
| Common yellowthroat | Geothlypis trichas | x | x | x |
| Yellow-breasted chat | Icteria virens | | x | |
| Wilson's warbler | Wilsonia pusilla | x | x | |
| House sparrow* (x) | Passer domesticus | x | x | |

| Common Name | Scientific Name | Fort Ord[1] | Fort Hunter Liggett[2] | Camp Roberts[3] |
|---|---|---|---|---|
| Western meadowlark* | Sturnella neglecta | x | x | x |
| Yellow-headed blackbird | Xanthocephalus xanthocephalus | | x | |
| Red-winged blackbird | Agelaius phoeniceus | x | x | x |
| Tricolored blackbird | Agelaius tricolor | | x | |
| Brewer's blackbird* | Euphagus cyanocephalus | x | x | x |
| Brown-headed cowbird* | Molothrus ater | x | x | x |
| Northern oriole | Icterus galbula bullockii | | x | x |
| Hooded oriole | Icterus cucullatus | | x | |
| Western tanager | Piranga ludoviciana | | x | |
| Black-headed grosbeak | Pheucticus melanocephalus | x | x | |
| Rose-breasted grosbeak | Pheucticus ludovicianus | | | x |
| Evening grosbeak | Hesperiphona vespertina | | x | |
| Lazuli bunting | Passerina amoena | | x | |
| Purple finch* | Carpodacus purpureus | x | x | x |
| House finch* | Carpodacus mexicanus | x | x | x |
| Pine siskin | Spinus pinus | | x | |
| American goldfinch* | Spinus tristis | x | x | |
| Lesser goldfinch* | Spinus psaltria | x | x | x |
| Lawrence's goldfinch* | Spinus lawrencei | | x | |
| Red crossbill | Loxia curvirostra | | x | |
| Rufous-sided towhee | Pipilo erythrophthalmus | x | x | x |
| Brown towhee | Pipilo fuscus | x | x | x |
| Savannah sparrow* | Passerculus sandwichensis | x | x | |
| Grasshopper sparrow* | Ammodramus savannarum | | x | |
| Vesper sparrow* | Pooecetes gramineus | | x | |
| Lark sparrow* | Chondestes grammacus | | x | |
| Rufous-crowned sparrow | Aimophila ruficeps | | x | |
| Sage sparrow | Amphispiza belli | | x | |
| Dark-eyed junco* | Juncus hyemalis oreganus | x | x | x |
| Chipping sparrow* | Spizella passerina | | x | |
| Black-chinned sparrow | Spizella atrogularis | | x | |
| White-crowned sparrow* | Zonotrichia leucophrys | x | x | x |
| Golden-crowned sparrow* | Zonotrichia atricapilla | x | x | x |
| White-throated sparrow | Zonotrichia albicollis | | x | |
| Fox sparrow | Passerella iliaca | x | x | |
| Lincoln's sparrow | Melospiza lincolnii | x | x | |
| Song sparrow | Melospiza melodia | x | x | x |
| **MAMMALS** | | | | |
| Big brown bat | Eptesicus fuscus | | x | |
| Fringed bat | Myotis thysanodes | | x | |
| California bat | Myotis californicus | | x | |
| Long-eared bat | Myotis evotis | | x | |
| Long-legged bat | Myotis volans | | x | |
| Little brown bat | Myotis lucifugus | | x | |
| Small-footed bat | Myotis subulatus | | x | |
| Yuma bat | Myotis yumanensis | | x | |
| Pallid bat | Antrozous pallidus | | x | x |
| Red bat | Lasiurus borealis | | x | |
| Hoary bat | Lasiurus cinereus | | x | |
| Silver-haired bat | Lasionycteris noctivagans | | x | |
| Mexican freetail bat | Tadarida brasiliensis | | x | |
| Western big-eared bat | Plecotus townsendi | | x | |
| California mule deer* | Odocoileus hemionus californicus | x | x | x |
| Black-tail deer* | Odocoileus hemionus columbianus | x | x | x |
| Wild boar* (x) | Sus scrofa | | x | x |
| Mountain lion* | Felis concolor | x | x | x |
| Bobcat* | Lynx rufus | x | x | x |
| Black bear | Ursus americanus | | x | |
| Gray fox* | Urocyon cinereoargenteus | x | x | x |
| San Joaquin kit fox* | Vulpes macrotis mutica | | x | x |
| Coyote* | Canis latrans | x | x | x |
| Raccoon* | Procyon lotor | x | x | x |
| Ringtailed cat* | Bassariscus astutus | x | x | |
| Opossum* | Didelphis marsupialis | x | x | x |

| Common Name | Scientific Name | Fort Ord[1] | Fort Hunter Liggett[2] | Camp Roberts[3] |
|---|---|---|---|---|
| Badger* | Taxidea taxus | x | x | x |
| Beaver | Castor canadensis | | x | x |
| Blacktailed jackrabbit* | Lepus californicus | x | x | x |
| Audubon cottontail* | Sylvilagus audubonii | x | x | x |
| Brush rabbit | Sylvilagus bachmani | x | x | |
| Western grey squirrel* | Sciurus griseus | | x | x |
| California ground squirrel | Spermophilus beecheyi | x | x | x |
| Merriam chipmunk | Eutamias merriami | | x | |
| Spotted skunk* | Spilogale putorius | x | x | x |
| Striped skunk* | Mephitis mephitis | x | x | x |
| Long-tailed weasel* | Mustela frenata | x | x | x |
| Desert woodrat | Neatoma lepida | | x | |
| Dusky-footed woodrat* | Neatoma fuscipes | x | x | x |
| Pacific kangaroo rat | Dipodomys agilis | | x | |
| Heermann kangaroo rat* | Dipodomys heermanni jolonensis | | | x |
| Santa Cruz kangaroo rat* | Dipodomys venustus | x | | |
| Norway rat*(x) | Rattus norvegicus | | x | |
| Roof rat*(x) | Rattus rattus | | x | |
| Muskrat | Ondatra zibethicus | | | x |
| Valley pocket gopher* | Thomomys bottae | x | x | x |
| California mole* | Scapanus latimanus | x | x | x |
| California vole* | Microtus californicus | x | x | x |
| California pocket mouse* | Perognathus californicus | x | x | x |
| California mouse* | Peromyscus californicus | x | x | |
| Brush mouse | Peromyscus boylei | | x | x |
| Deer mouse* | Peromyscus maniculatus | | x | x |
| Pinyon mouse | Peromyscus truei | | x | |
| House mouse*(x) | Mus musculus | x | x | x |
| Western harvest mouse* | Reithrodontomys megalotis | x | x | x |
| Trowbridge shrew | Sorex trowbridgei | | x | |
| Ornate shrew* | Sorex ornatus | | x | |
| Shrew* | Sorex sp. | x | | |
| Sea otter | Enhydra lutrus | x | | |
| Stellar sea lion | Eumetopias jubata | x | | |
| California sea lion | Zalophus californianus | x | | |
| Elephant seal | Mirounga angustirostris | x | | |
| Harbor seal | Phoca vitulina | x | | |
| Baird dolphin | Delphinus bairdi | x | | |
| White-sided dolphin | Lagenorhynchus obliquidens | x | | |
| Killer whale | Orcinus orca | x | | |
| Gray whale | Eschrichtius glaucus | x | | |

(x) Introduced.

* Habitat and/or food association with the Beechey ground squirrel.

[1] Considered a partial species list. Source: Department of the Army, 1975.

[2] Considered a partial species list. Source for reptiles, amphibians, birds and mammals: California Department of Fish and Game, 1976. Source for fishes: Department of the Army, 1973 and Snider, pers. comm.

[3] Considered a partial species list. Source for birds and mammals: Department of the Army, 1976. Source for fishes: California Department of Fish and Game, 1955 and Snider, pers. comm. Reptiles and amphibians of Camp Roberts are based on distribution maps in Stebbins, 1965.

APPENDIX C

# MONTEREY COUNTY

DEPARTMENT OF AGRICULTURE

(408) 758-3876 · 120 WILGART WAY · P.O. BOX 1370 · SALINAS, CALIFORNIA 93901

RICHARD W. NUTTER
AGRICULTURAL COMMISSIONER

August 17, 1976

## AGRICULTURAL DAMAGE BY GROUND SQUIRRELS TO LANDS ADJACENT TO MILITARY PROPERTIES

The following is the result of a mail survey conducted by this department to determine agricultural damage by ground squirrels to those lands adjacent to Camp Roberts and Fort Hunter Liggett.

The survey is based on the reporting of 40 ranches representing 77,921 acres. Crop values were taken from the Monterey County Annual Crop Reports 1972-75.

| CROP | ACREAGE LOSS | CASH VALUE | ACREAGE LOSS BY YEAR |
|---|---|---|---|
| Dry Pasture | 3,614 | $ 12,649.00 | 1972 - 929 |
| Irrigated Pasture | 324 | 25,920.00 | 1973 - 1,289 |
| Cereal Grain | 1,300 | 312,000.00 | 1974 - 1,561 |
| Row Crop | 550 | 346,500.00 | 1975 - 2,009 |
| Total Loss | 5,788 | $ 697,069.00 | |

REPORTED LOSS FROM COYOTES: $7,150.00

| | | |
|---|---|---|
| Sheep | 1 | $ 100.00 |
| Lambs | 133 | 6,650.00 |
| Pigs | 1 | 100.00 |
| Calves | 3 | 300.00 |

Extensive damage reported to irrigation systems and roadways.

RWN:ms

APPENDIX D

# DEPARTMENT OF AGRICULTURE

COUNTY OF SAN LUIS OBISPO · P. O. BOX 637, SAN LUIS OBISPO, CALIFORNIA 93406
County Airport - Edna Road Telephone AC/805 543-1550, Ext. 254

August 9, 1976

SURVEY DATA OF GROUND SQUIRREL DAMAGE TO CROPS ADJACENT TO CAMP ROBERTS

Seven adjacent property owners that farm over 12,000 acres have reported the following dollar losses due to ground squirrels from Camp Roberts destroying their crops. Also shown is their estimate of their extra cost of controlling squirrels due to reinfestation.

| | 1973 | 1974 | 1975 | 1976 | TOTAL |
|---|---|---|---|---|---|
| CROPS | | | | | |
| Wheat | $ | | | 2,000.00 | 2,000.00 |
| Barley | 3,317.22 | 4,889.13 | 5,089.53 | 5,704.47 | 19,000.35 |
| Safflower | | | 1,200.00 | | 1,200.00 |
| Pasture | 3,095.00 | 3,225.00 | 3,384.00 | 3,665.00 | 13,369.00 |
| Other | 110.00 | 100.00 | 215.00 | 375.00 | 800.00 |
| Sub-Total | 6,522.22 | 8,214.13 | 9,888.53 | 11,744.47 | 36,369.35 |
| REINFESTATION | | | | | |
| Cost of retreatment | 870.50 | 1,040.92 | 1,341.66 | 1,724.80 | 4,977.88 |
| Total | $7,392.72 | 9,255.05 | 11,230.19 | 13,469.27 | 41,347.23 |

APPENDIX E

LAND USE REGULATIONS FOR AREA "B"
CAMP ROBERTS, CA

1. These Land Use Regulations are intended to provide for multiple purpose use of these lands for military purposes, grazing by domestic livestock and, at the same time, protect the ecology and environment of the area to assure continued habitat for indigenous wildlife forms. Adherence to the Land Use Regulations will conserve and enhance the natural environment while permitting beneficial use.

2. Use of the leased premises by the lessee shall be limited to SHEEP GRAZING ONLY.

3. The following definitions shall apply for the purpose of this lease, notwithstanding any other commonly known definitions:

Animal Unit (AU) - Five (5) Ewes with lamb, or Rams or weaned lambs or older sheep.

Animal Unit Month (AUM) - One (1) Animal Unit grazing for an entire month.

4. The availability of adequate forage and the general condition of the range, as DETERMINED BY THE DISTRICT ENGINEER, shall govern the intensity of grazing by the lessee. The protection of the range cover from damage or destruction by overgrazing, fire, erosion or other causes is expressly considered a part of good range management. Accordingly, the lessee shall comply with the following management practices:

a. Grazing capacity - 3500 Animal Unit Months, as defined above, for the period 1 October to 30 September annually. ANY INCREASE IN THE GRAZING CAPACITY MUST HAVE THE PRIOR WRITTEN APPROVAL OF THE DISTRICT ENGINEER. IT IS ALSO EXPRESSLY UNDERSTOOD THAT THE DISTRICT ENGINEER RESERVES THE RIGHT TO (1) LIMIT THE NUMBER OF SHEEP AT THE BEGINNING OF THE GRAZING SEASON, AND (2) REDUCE THE ALLOWABLE AUM's IN A POOR FORAGE YEAR, OR WHENEVER NECESSARY TO PROTECT OR CONSERVE THE RESOURCES. If the lessee grazes more than 3500 AUM'S during the annual period of 1 October to 30 September lessee shall pay for each additional AUM at a rate as determined by dividing the annual rent by 3500 AUM. Conversely, if the lessee is prevented from grazing 3500 during the said annual period as a result of compliance with written instructions from the District Engineer requiring a reduction in allowable AUM'S, the lessee shall be credited for each AUM not grazed at a rate determined by the aforesaid formula.

b. Grazing season - The primary grazing season shall be from 1 January to 1 June. Grazing earlier in the winter period will be permitted only when the District Engineer determines there is adequate new growth of forage.

Permission to graze prior to 1 January must be obtained in writing from the District Engineer. Under normal conditions, no grazing will be allowed between 1 June and 1 September of each year. Any exceptions must be obtained in writing from the District Engineer.

c. Salting stations - Will not be placed adjacent to artificial lakes or potable water points and will be moved as needed to prevent serious trampling of vegetation.

5. The primary use of Camp Roberts' Military Reservation is for military training and related activities; the grazing of sheep on the installation is secondary and subject to these activities. Consequently, the lessee is expected to conduct his grazing operation in a manner which will not interfere with such military use or objectives at any time. Grazing will be closely coordinated with the Post Commander, Camp Roberts, or his authorized representative, so that no interference with military training will occur. Also see Land Use Regulation No. 6. When military circumstances so warrant, the lessee agrees to move his livestock to another area (within the leased premises) within three (3) days after being notified in writing by said Post Commander or his authorized representative. There may be occasional circumstances that will require the livestock be moved to another area within the leased premises on shorter notice. No reduction in rental will be allowed for the movement of livestock required pursuant to this condition and the lessee shall hold the Government harmless for any loss of weight to livestock resulting therefrom.

6. When livestock are grazing on the premises, the lessee, or his representative, will contact the Director of Operations and Training Office, Camp Roberts, on a daily basis, unless otherwise requested by the Post Commander, in order to maintain adequate coordination between military uses and the lessee regarding the grazing operation.

7. Lessee shall bury or otherwise dispose of dead livestock in a manner satisfactory to the Post Commander, or his authorized representative, within twenty-four (24) hours after detection by the lessee or notification by the Government.

8. Lessee shall insure proper cleanup of areas used by his personnel, i.e., disposal of all types of refuse and debris generated at temporary living and work sites.

9. Lessee will insure that all his personnel operating under the terms of this lease are acquainted with and comply with the following:

a. Posted speed limits and pertinent traffic control signs.

b. Posted (restricted) areas.

c. Hunting and fishing regulations.

10. The leased premises will be subject to fishing and hunting by authorized persons during the regular seasons.

11. On or before the 10th day of each month during the grazing period, the lessee shall submit a certificate under the penalty of perjury that lists the number of Animal Unit Months grazed on the area during the previous month. The forms will be provided by the District Engineer. The certificate will be prepared in duplicate and submitted to the following:

District Engineer
US Army Engineer District, Sacramento
ATTN: SPKRO-M
650 Capitol Mall
Sacramento, California 95814

Reserve Components Training Command
California National Guard
ATTN: Facilities Engineer
Camp Roberts, CA 93451

12. The sheep will be in bands of not more than 1,600 head and shall be accompanied by a herder. The sheep will not be bedded down more than three (3) nights in any one area.

13. The Lessee will have joint use of the Nacimiento River for sheep watering purposes. Any matters pertaining to this joint use not settled between Lessees will be arbitrated by the Post Commander whose deicision will be final.

14. Areas fenced for wildlife purposes and reforestation enclosures shall not be grazed.

15. The lessee shall comply with applicable Federal, State, and local animal health laws and regulations of sheep placed on the leased premises, and upon request furnish written evidence to this effect to the District Engineer.

16. Lessee shall sheep graze the cantonment area of the East Garrison as requested and prescribed by the Post Commander for the Purposes of reducing the fire hazard in this area.

17. Lessee at this own cost and expense shall perform the following services of maintenance, repair or protection:

a. Lessee will maintain in a sheep tight condition, all Reservation Boundary Fence, excepting chain link fence, and all other fencing separating his leased premises from adjoining Government or non-Government property. All materials used in maintaining Government-owned fences become the property of the U.S. Government and shall not be removed by the Lessee. A certificate that all fences are sheep tight will be made a part of the monthly report on range usage.

18. Work to be performed by the Lessee for which a credit or refund will be allowed by the Government is shown on the attached Work Schedule. The amount of credit or refund to be allowed by the Government will be the lessee's actual cost of performing the work but not to exceed the amount of the Government estimate shown in the Work Schedule. The District Engineer shall have the right to perform an audit of the lessee's records for the purpose of determining the accuracy and allowability of costs claimed for said work. The lessee shall notify the Facilities Engineer, Camp Roberts, at lease three (3) days prior to commencing the work and immediately upon completion thereof. Work as used herein included all labor, equipment, and materials. The District Engineer reserves the right to modify any of the items of said work as may be in the best interest of the Government. The District Engineer also reserves the right to negotiate with the lessee for accomplishment of additional work items during the term of the lease. In addition to the work shown on the attached Work Schedule, it is specifically understood that the Lessee agrees to perform, in accordance with the provisions of this paragraph, such rodent, Loco Weed, and Russian Thistle control work as may be determined by the District Engineer to be in the best interest of the Government.

19. Effective on or about 1 May of each year certain areas within the leased premises may be Control-burned by the Government. The location and size of actual burn areas may vary according to military requirements. The Government assumes no responsibility for the loss of grazing due to controlled burning on these areas.

LAND USE REGULATIONS
AGRICULTURE AND GRAZING LEASE
HUNTER LIGGETT MILITARY RESERVATION (HLMR)
AREA "B" 86,000 ACRES

1. These Land Use Regulations are intended to: (1) provide for the multiple purpose use of these lands for military purposes, grazing by domestic livestock, public recreation, water conservation and wildlife habitat; (2) protect the ecological balance to insure the continued productivity of the land while permitting economic returns to the lessee.

2. The primary use of the HLMR is for military activities. The grazing operation is one of many secondary uses subject to the military requirements for the area. The lessee shall conduct his operation in a manner which will not interfere with military use.

3. The lessee or his representative, hereinafter referred to as "lessee" shall closely coordinate the agricultural and grazing operations with the Deputy Post Commander, HLMR, or his authorized representative hereinafter referred to as "said commander." In addition, said lessee shall be available to correct emergency situations with regard to the lease. Accordingly, the lessee shall provide said commander with current emergency telephone numbers where the lessee may be contacted during working and non-working hours. When livestock are grazing on the premises, the lessee, or his representative, will contact the Facilities Engineering Office, HLMR, at least once each week in order to maintain adequate coordination between military uses and the lessee's operation.

4. In the event military requirements so demand and upon 48 hours notice from the said commander, the lessee shall gather, move and hold his livestock outside specified areas within the leased premises. If adequate forage does not exist on the remaining areas, livestock shall be removed from the installation. No reduction in rental will be allowed for such movement of livestock. The lessee shall hold the government harmless for any weight loss in livestock or inconvenience incurred pursuant to this condition.

5. It is the expressed intent of the government that the land be utilized in accordance with sound range management practices consistent with concurrent multiple purpose use. The protection of the soil and its vegetative cover from deterioration by erosion, overgrazing, wildfire, noxious weed infestation or other causes is considered part of sound range management. Accordingly, the following practices are established:

a. Types of Use: (1) The grazing use of the leased premises shall be limited to large livestock, i.e. cattle or horses. The grazing of other types of livestock (sheep, goats, pigs, etc.) must have the prior written consent of the District Engineer, Sacramento District, or his authorized representative, hereinafter referred to as "District Engineer." (2) Any other agricultural use of the leased premises such as the cutting of native hay, growing crops, etc. must have the prior written consent of the District Engineer.

b. Grazing Capacity: The maximum grazing capacity of the leased premises shall not exceed 45,000 Animal Unit Months (AUM's) (as defined in paragraph No. 6 below) during each lease year (1 November-31 October). Of said 45,000 AUM's, no more than 5,000 AUM's shall be utilized during the period 1 November-31 December and no more than 6,000 AUM's shall be utilized during the period 1 August-31 October of each lease year.

c. Intensity of Grazing: The availability of forage and the general condition of the range shall govern the intensity of grazing by livestock. It is the expressed concern of the government that the range not be overgrazed and that a layer of living or dry vegetation (mulch) be maintained to protect the soil from erosion and to enhance growing conditions for forage crop seedlings. All grazing shall cease on any part or all of the leased area, when, in the opinion of the District Engineer, the accessible forage has been utilized to a degree where further grazing is not in the best interest of the government. Accordingly, said grazing capacity may be modified by the District Engineer as follows: (1) The District Engineer reserves the right to reduce the number of allowable AUM's in any lease year. Therefore, if the lessee is prevented from utilizing 45,000 AUM's during a lease year as a result of compliance with written instructions from the District Engineer (said instructions requiring a reduction in allable AUM's), the lessee shall be entitled to a rebate in rental. Said rebate shall be determined by dividing the annual rental rate by 45,000 AUM's and then multiplying by the number of AUM's not attained. (2) The District Engineer may allow an increase in the grazing capacity providing adequate forage exists, as determined by the District Engineer, to support additional AUM's (generally this determination will be made by 31 May of each lease year). Permission in writing must be granted by the District Engineer prior to the lessee's exceeding the AUM grazing capacity. The lessee hereby agrees to pay for each additional AUM at the rate defined in paragraph 5c (1) above.

d. Distribution of Livestock: The lessee shall make every effort to obtain optimum distribution of livestock over the leased area to obtain uniform range utilization, to minimize "sacrifice" (overgrazed) areas and to reduce the overall fire hazard. Accordingly, salt blocks and feed supplements shall not be located adjacent to watering areas or improved roads but shall be distributed uniformly throughout the remaining leased area. The lessee shall periodically move salt block and feed supplement sites at the direction of said commander. Any salting stations which may be designated on the ground and marked accordingly by said commander shall be utilized.

6. The lessee shall submit by the 10th day of each month a certificate that lists the number of animal unit months (AUM's) grazed during the previous month. The certificate, to be provided by the District Engineer, specifies the method for computing AUM's. The form shall be made out in triplicate and sent to the following addresses:

| | | |
|---|---|---|
| District Engineer | Deputy Post Commander | Commander |
| ATTN: SPKRE-M | ATTN: ATZO-HLMR-FE | US Army Training Center |
| 650 Capitol Mall | Hunter Liggett Mil. Res. | ATTN: AFZW-FE-BG |
| Sacramento, CA 95814 | Jolon, CA 93928 | Fort Ord, CA 93941 |

The following definitions shall apply for the purpose of this report, not withstanding any other commonly known definitions:

Animal Unit = One (1) horse; one (1) cow, heifer, steer or bull; one (1) weaned calf

Animal Unit Month (AUM) = One animal unit grazing for an entire month.

7. The lessee shall comply with all federal, state and local animal health laws and regulations with respect to livestock grazing on the leased premises; and upon request, shall furnish written evidence to that effect to the said commander. In accordance with appropriate Army regulations (AR 40-565) said commander reserves the right to impose quarantine, immunization or other health requirements deemed necessary to prevent or control zoonotic diseases.

8. The government reserves the right to verify the number of animals brought onto the leased premises. Therefore, the lessee shall notify the Facilities Engineering Office, HLMR (Phone No. 408 385-5911 Ext. 2515 or 2514) at least 48 hours in advance of placing new livestock on the leased premises. Copies of all shipping documents and, if required, health certificates shall be furnished by the lessee to said commander. (NOTE: This may include "way bills", owner's written statements, brand inspection reports or shipping permits depending on the type, certification and origin of the livestock.)

9. It is the lessee's responsibility to confine his livestock within the leased premises. It is recognized, however, that the lessee's livestock may occasionally stray onto other leased areas within HLMR and, likewise, that livestock from other HLMR leases may stray onto the leased premises. Therefore, it is encumbant upon the lessee and to other parties leasing or subleasing government land at HLMR to facilitate retrieval of livestock which have strayed from a particular leasehold. Accordingly, the following conditions are set forth:

a. The lessee shall notify the government by contacting the HLMR Facilities Engineering Office, Phone No. 408 385-5911 Ext. 2514 or 2515, at least three days in advance of working (branding, shipping, etc.) livestock on the leased premises. In the absence of an authorized representative at the Facilities Engineering Office, said commander may be contacted at Ext. 2505 (evenings use Ext. 2606). Upon receipt of such notice, the government will make a concerted effort to contact the other lessees at HLMR and notify them to be present, if they desire, to retrieve any of their livestock which may have strayed onto the leased premises.

b. The lessee hereby authorizes said commander to invite other lessees at HLMR, their representatives and employees to be present during the time said work is being performed for the purposes of collecting and removing their stray livestock from the leased premises. In the event a dispute arises concerning ownership or other matters pertaining to the retrieval of livestock, said dispute shall be immediately submitted to said commander for resolution.

c. The lessee shall provide the Facilities Engineering Office with the names and phone numbers of his representatives who are authorized to receive notices concerning the working of livestock by other lessees at HLMR. It is the lessee's responsibility to insure that authorized persons are readily available to receive messages concerning the working of livestock and thus avail themselves of the opportunity to retrieve their stray livestock.

10. The lessee shall immediately dispose of dead livestock in a manner satisfactory to the said commander. The lessee may be required to remove dead animals entirely from the installation as determined by said commander.

11. The entire leased area is subject to hunting (during regular seasons), fishing and other recreational uses by persons authorized by the government.

12. The lessee and all people in his employ shall adhere to installation regulations regarding vehicle travel, security, safety, hunting, fishing and woodcutting.

13. The lessee shall insure proper clean-up of areas used by his personnel and shall dispose of all refuse and debris generated at his temporary work sites to the satisfaction of said commander.

14. The lessee shall honor all wildlife, forestry, weather station, study, bivouac area and other exclosures and shall immediately remove livestock straying therein. The government reserves the right to erect additional exclosures for which no rental adjustment will be made.

15. The lessee at his own cost and expense, shall participate in a noxious weed control program which shall be in accordance with the standards set by the local county agricultural agent. The lessee shall obtain written approval from said commander prior to using any pesticide on the leased premises. All pesticide applications must be supervised by a certified government pest controller. As used herein, the term pesticide includes herbicides, insecticides, fungicides, and rodenticides, but does not include products commonly known as medicines.

16. The lessee, at his own cost and expense, shall repair and maintain in a livestock-tight condition, the fences, cattleguards, gates and other facilities as indicated on said Exhibit "A". All materials used in maintaining government-owned facilities shall be at least the same type and quality as those used in

original construction. All materials used for such repairs shall become the property of the government. The lessee shall repair all said facilities damaged by private vehicles and natural hazards (unless the District Engineer determines the damage from said natural hazards to be excessive, above and beyond normal wear and tear). The government shall repair said facilities damaged by military and firefighting activities. Emergency repairs, as determined by said commander, shall be made within 48 hours after notification by said commander.

17. Work to be performed by the lessee for which a credit or refund will be allowed by the government is shown on the attached Work Schedule (WS). The amount of credit or refund to be allowed by the government shall be negotiated prior to beginning each project. Appropriate Technical Specifications, locations, schedules and the negotiated credit amounts will be made a part of this lease by Supplemental Agreement. The term "work" implies all labor, equipment and materials. The District Engineer reserves the right to modify, add, or delete items of work on the WS as may be in the best interest of the government. The District Engineer will negotiate with the lessee for the accomplishment of additional work or modification of scheduled work. The lessee shall notify and coordinate with said commander prior to beginning work projects.

18. The lessee shall not accept any federal cost sharing payments for soil conservation practices required by the lease that will result in duplicate payment for such practices.

19. The right is reserved for others, as directed by said commander to conduct conservation programs, fire control and prevention (including maintenance of firebreaks), pest and weed control on the leased premises.

20. Water for livestock watering purposes is available from all existing reservoirs, check dams, improved and unimproved springs, and rivers within the leased area. In addition, the lessee may obtain water from the government-owned and operated wells shown on said Exhibit "A".

21. During the period 1 May through 31 October of each lease year, certain areas within the leased premises may be control burned by the government. The location and size of the burn areas may vary according to military requirements. The government shall notify the lessee prior to such control burning to insure the safety of the lessee, his employees, equipment and livestock.

22. The western boundary of the leased premises is established as a "natural line of drift" for cattle. This boundary is not fenced; however, the area westward is steep and brush covered. The lessee will be required to contain his animals within the leased premises. Animals found west of this boundary will be returned to the leased premises by the lessee within 48 hours after notification by said commander.

APPENDIX F

EXAMPLE SPECIMEN LABELS FOR SEVERAL GROUND SQUIRREL RODENTICIDES. THESE LABELS ARE PRESENTLY LEGAL UNDER CALIFORNIA LAW, BUT ARE CURRENTLY BEING UPDATED TO MEET STRICTER STATE AND EPA STANDARDS UNDER CALIFORNIA SECTION 24-C REGISTRATIONS (LEVINGSTON, PERS. COMM.).

SPECIMEN LABEL

SKULL and CROSSBONES POISON

AA

1080 POISON BAIT - OAT GROATS

SKULL and CROSSBONES POISON

DANGER: KEEP OUT OF REACH OF CHILDREN

INGREDIENT STATEMENT:

| | | |
|---|---|---|
| Active Ingredient: | Sodium Fluoroacetate..... | 0.120% |
| Inert Ingredients: | ..... | 99.880% |
| | TOTAL..... | 100.000% |

DANGER: Harmful if swallowed. May cause secondary poisoning in other animals. Keep pets and domestic animals away from baited areas. Keep out of reach of irresponsible persons. Do not contaminate feed and foodstuffs. Spilled bait should be cleaned up immediately. Wash hands after using.

FIRST AID TREATMENT: If swallowed, immediately induce vomiting by giving a tablespoonful of salt in a glass of warm water and repeat until vomit fluid is clear. Then give two tablespoonfuls of Epsom salt in water. Have victim lie down and keep warm and quiet. Call a physician immediately.

DIRECTIONS FOR USE: Spread bait evenly by hand, machine spreader, or aircraft (consult "Guidelines for Applying Rodent Baits by Aircraft for Control of Ground Squirrels" for further procedures) at the rate of five or six pounds per swath acre through infested area, depending on degree of infestation. Bait should be applied in swaths 30 feet wide with 30 feet between swaths. This poison bait is to be applied only under the supervision of the County Agricultural Commissioner.

SPECIMEN LABEL

SKULL and CROSSBONES POISON

GROUND SQUIRREL - 1080 POISON BAIT

AA

SKULL and CROSSBONES POISON

DANGER: KEEP OUT OF REACH OF CHILDREN

INGREDIENT STATEMENT:

| | | |
|---|---|---|
| Active Ingredient: | Sodium Fluoroacetate..... | 0.078% |
| Inert Ingredients: | ..... | 99.922% |
| | TOTAL..... | 100.000% |

DANGER: Harmful if swallowed. May cause secondary poisoning in other animals. Keep pets and domestic animals away from baited areas. Keep out of reach of irresponsible persons. Do not contaminate feed and foodstuffs. Spilled bait should be cleaned up immediately. Wash hands after using.

FIRST AID TREATMENT: If swallowed, immediately induce vomiting by giving a tablespoonful of salt in a glass of warm water and repeat until vomit fluid is clear. Then give two tablespoonfuls of Epsom salt in water. Have victim lie down and keep warm and quiet. Call a physician immediately.

DIRECTIONS FOR USE: Evenly scatter a teaspoon quantity of bait (about 30 baits per pound) on bare ground to cover 2 to 3 square feet at side or behind each burrow. Do not over bait, and do not place bait in piles. This poison bait is to be applied only under the supervision of the County Agricultural Commissioner.

SPECIMEN LABEL

AA

ZINC PHOSPHIDE BROADCAST POISON GRAIN BAIT
(For Ground Squirrel, Rat and Meadow Mouse Control)

INGREDIENT STATEMENT:

| | |
|---|---|
| Active Ingredient: Zinc Phosphide..... | 1.69% |
| Inert Ingredients:..... | 98.31% |
| TOTAL..... | 100.00% |

FIRST AID TREATMENT: Call a physician immediately. If conscious, induce vomiting by giving a tablespoonful of salt in a glass of warm water and repeat until vomit fluid is clear. Give milk or white of egg beaten with water. Keep patient warm and quiet.

INSTRUCTIONS FOR USE: A permit from the County Agricultural Commissioner is required to possess this bait material.

For Ground Squirrel: Spread bait evenly by hand, mechanical spreader or aircraft at the rate of six pounds per swath acre through infested area.

For Meadow Mice: Spread bait evenly by hand, mechanical spreader or aircraft at the rate of 5-10 pounds per acre, depending on the density of the infestation.

For Rats: Spread bait evenly by hand, mechanical spreader or aircraft over infested area at the rate of three to eight pounds per acre, depending on rat density.

Consult agricultural commissioner for specific instructions.

WARNING
~~CAUTION:~~ Harmful if swallowed. Avoid breathing dust or fumes. Avoid contact with skin. Wash hands after using. Avoid contamination of feed and foodstuffs. Keep away from children and domestic animals with due regard to wildlife. If applied by hand wear rubber gloves. Clean up spilled bait and dispose by suitable means.

Specimen Label

ZINC PHOSPHIDE SPOT POISON GRAIN BAIT
(For Ground Squirrel, Rat and Meadow Mouse Control)

AA

INGREDIENT STATEMENT:

| | |
|---|---|
| Active Ingredient: Zinc Phosphide..... | 0.8% |
| Inert Ingredients: ..... | 99.2% |
| TOTAL..... | 100.0% |

FIRST AID TREATMENT: Call Physician immediately. If victim is conscious, induce vomiting by giving a tablespoonful of salt in a glass of warm water and repeat until vomit fluid is clear. Give victim milk or white of egg beaten with water. Keep patient quiet and warm.

INSTRUCTIONS FOR USE: A permit from the County Agricultural Commissioner is required to possess this bait material.
For Ground Squirrels: Evenly scatter a tablespoon quantity of bait on bare ground at side or behind each active burrow.
For Meadow Mice: Lightly scatter teaspoon quantities of bait in runways near active burrows.
For Rats: Place a teaspoon quantity of bait in each active burrow or scatter small amounts of bait in protected places frequented by rats, but inaccessible to livestock, poultry and other wildlife.

WARNING: Harmful if swallowed. Avoid breathing dust or fumes. Avoid contact with skin. If applied by hand, wear rubber gloves. Do not contaminate feed or foodstuff. Keep out of reach of children, domestic animals and wildlife. Spilled bait should be cleaned up immediately. Wash hands after using.

*SPECIMEN LABEL*

Skull and Cross Bones POISON

STRYCHNINE SQUIRREL POISON GRAIN BAIT

Skull and Cross Bones POISON

Active Ingredient: Strychnine Alkaloid ..... 0.29%

Inert Ingredients: ..... 99.71%

First Aid Treatment: If less than ten minutes has passed since the poison was taken give a tablespoonful of salt in a glass of water. Have victim lie down in a quiet, darkened room and keep him warm, call a physician immediately.

Instructions for Use: Scatter one level tablespoonful of bait on bare ground to cover two or three square feet at the side or behind the burrow. Do not over-bait or place in piles.

Warning: Convulsive Poison! Keep out of reach of children and domestic animals with due regard to wildlife. Harmful if swallowed. Avoid contamination of feed and foodstuffs. Bait spillage should be immediately cleaned up and disposed of by suitable means. Wash hands after using.

Prepared by _____ Agricultural Commissioner
name of county

_____
address

Net Weight _____ lbs.

Formula:

| | |
|---|---|
| Grain (recleaned) | 100 pounds |
| Bicarbonate of soda | 5 ounces |
| Saccharin | 1/2 ounce |
| Heavy corn syrup | 20 ounces |
| Thin Starch paste | 60 ounces |
| Glycerin | 2 1/2 ounces |
| Dye (National Alkali Fast Green 2G) | 2 ounces |
| Strychnine (powdered alkaloid 99.5%) | 5 ounces |

SPECIMEN LABEL

AA

ANTI-COAGULANT RAT AND SQUIRREL BAIT

INGREDIENT STATEMENT

| | |
|---|---|
| Active Ingredient: (2-Diphenylacetyl)-1,3-indandione..... | .01% |
| Inert Ingredients:..... | 99.99% |
| TOTAL.... | 100.00% |

CAUTION: KEEP OUT OF REACH OF CHILDREN.

FIRST AID TREATMENT: Call a physician. If consious, induce vomiting by giving a tablespoonful of salt in a glass of warm water and repeat until vomit fluid is clear. Keep patient quiet.

INSTRUCTIONS FOR USE: Place a cupful of bait in bait box or in shallow container preferably in protected feed stations, bait stations should be located in dry locations frequented by rats. Broadcast bait for squirrels at a handful per hole, wearing protective gloves. Inspect stations daily and add bait as needed, increase the amount when containers are emptied overnight. Continue as long as any bait is taken, which may be from two to four weeks. For roof rats put bait at ground floor and top floor or attic levels. For Norway rats put bait at or near ground level and at burrows and harborages.
Note: A single feeding on this bait will not control rats and squirrels. Bait must be eaten at several feedings on five or more successive days, with no periods longer than 48 hours between feedings.

Caution!
~~WARNING~~: Keep away from humans, domestic animals and pets. If swallowed, this material may reduce the clotting ability of the blood and cause bleeding. In such cases, intravenous and oral administration of Vitamin K combined with blood transfusions are indicated as in the case of hemorrhage caused by overdoses of bis-hydroxycoumarin. Spilled bait should be cleaned up immediately. Wash hands after using.

CAUTION

CAUTION

# CARBON BISULPHIDE FUMIGANT

Active Ingredients: Carbon Bisulphide - - - - - - - - - - - - - - - - - - - - - - 100%

First Aid Treatment: Move patient to fresh air if atmosphere is contaminated. Apply artificial respiration if not breathing.
If Swallowed: if conscious induce vomiting by giving a tablespoonful of salt in a glass of warm water and repeat until vomit fluid is clear. Call a physician immediately.

Instructions for Use: Consult Agricultural Commissioner for suggestions as to proper use.

WARNING: Flammable. Vapor is explosive. Keep away from fire, sparks, lighted cigarettes, etc. Do not leave in direct sunlight. Store in cool, dry place. Avoid prolonged breathing of vapor. Use with adequate ventilation. Keep out of reach of children or irresponsible persons.

Net Contents _____ Gals.

Skull and
Cross Bones
POISON

# METHYL BROMIDE FUMIGANT

Skull and
Cross Bones
POISON

## For Ground Squirrels

Active Ingredients: 100% P-O-T-A-S-H

Methyl Bromide: 100% DO NOT INHALE VAPORS

WARNING: POISONOUS LIQUID AND VAPOR! Contact with liquid may produce burns. Do not breathe vapor. Do not get in eyes, on skin, or on clothing. In case of contact, immediately remove all contaminated clothing, including shoes. Wash skin thoroughly with soap and water and flush eyes with water for at least 15 minutes. Get medical attention.

DIRECTIONS: Use one 20cc ampoule per squirrel burrow. Break each ampoule, while enclosed in cloth bag, at least one foot below the soil surface using a special applicator available from the Agricultural Commissioners Office. Immediately fill or cover each burrow with soil and pack.

DANGER: Keep out of the reach of children.

CAUTION: Do not drop or throw. Store in a cool, well ventilated place. Use only in well ventilated building or in open. Do not remove ampoule (enclosed in white cloth bag) from the cloth bag.

ANTIDOTE: Remove victim to fresh air immediately. Keep victim lying down and warm. Give artificial respiration if breathing has stopped. Call a physician immediately.

Net Contents: Each ampoule 20cc

State Registration No.: _____

APPENDIX G

SELECTED GUIDELINES AND CONSTRAINTS APPLICABLE TO THE USE OF TOXICANTS FOR GROUND SQUIRREL CONTROL IN CALIFORNIA

Extract A. California Administrative Code - Regulations Concerning Economic Poisons (Pesticides). Title 3 - Agriculture; Chapter 4 - Plant Industry; Subchapter 1 - Chemistry; Group 2 - Economic Poisons;

Article 15 - Toxicity Definition and Caution Statements

2425. Warning or Caution Statement. Warning or caution statements, which are necessary, and if complied with, adequate to prevent injury to living man and useful vertebrate animals, useful vegetation, and useful invertebrate animals, must appear on the label in a place sufficiently prominent to warn the user, and must state clearly and in nontechnical language the particular hazard involved in the use of the economic poison, e.g. ingestion, skin absorption, inhalation, flammability or explosion, and the precautions to be taken to avoid accident, injury, or damage.

(a) The label of every economic poison shall bear warnings or cautions which are necessary for the protection of the public, including the statement, "Keep out of reach of children", and a signal word such as "Danger", "Warning", or "Caution" as the Director may prescribe, on the front panel or that part of the label displayed under customary conditions of purchase: Provided however, the Director may permit reasonable variations in the placement of that part of the required warnings and cautions other than the statement "Keep out of reach of children", and the required signal word, if in his opinion such variations would not be injurious to the public. If an economic poison is marketed in channels of trade where the likelihood of contact with children is extremely remote, or if the nature of the product is such that it is likely to be used on infants or small children without causing injury under any reasonably foreseeable conditions, the Director may waive the requirement of the statement "Keep out of reach of children" if in his opinion such a statement is not necessary to prevent injury to the public. The Director may permit a statement such as "Keep away from infants and small children" in lieu of the statement "Keep out of reach of children" if he determined that such a variation would not be injurious to the public.

(b) The label of every economic poison which is highly toxic to man as described in Section 2424 shall bear the word "Danger" along with the word "Poison" in red on contrasting background in immediate proximity to the skull and crossbones, and an antidote statement including directions to call a physician immediately on the front panel or that part of the label displayed under customary conditions of purchase: Provided, however, the Director may permit reasonable variations in the placement of the antidote statement if some reference such as "See antidote statement on pack panel" appears on the front panel near the word "Poison" and the skull and crossbones.

## Article 21 - Restricted Materials

2460. Restricted Materials. The director designates and establishes as necessary to carry out the provisions of Division 7 of the Food and Agricultural Code the pesticides stated in this section as restricted materials.

(a) Certain pesticides containing arsenic.

(1) Sodium arsenite, including any preparation of arsenic trioxide or arsenous acid with sodium hydroxide or sodium carbonate which contains as an active ingredient arsenic all in soluble form.

(2) Other pesticides containing inorganic arsenic.

(b) Pesticides containing cadmium.

(c) Pesticides containing mercury.

(d) Certain carbamate compounds.

(1) Aldicarb (Temik)
(2) Carbaryl (Sevin)
(3) Carbofuran (Furadan) (Except granular formulations containing not more than 5% carbofuran)
(4) Methomyl (Lannate) (Nudrin)

(e) Certain fumigants.

(1) Chloropicrin
(2) Methyl bromide
(3) Aluminum phosphide (Phostoxin)
(4) Carbon bisulfide
(5) Calcium cyanide

(f) Seeds treated with mercury compounds.

(g) Conifer seeds treated with endrin.

(h) Certain avicides

(1) 4-aminopyridine (Avitrol)
(2) 3-chloro-p-toluidine hydrochloride (Starlicide)
(3) Strychnine

(i) Certain rodenticides

(1) Sodium flouroacetate (Compound 1080)
(2) Strychnine
(3) Zinc phosphide

(j) Certain organic phosphorus pesticides.

(1) Azinphosmethyl (Guthion)
(2) Carbophenothion (Trithion)
(3) Dimethyl phosphate of 3-Hydroxy N,N-dimethyl-ciscrotonamide (Bidrin)
(4) Dimethyl phosphate of 3-Hydroxy-N-methyl-ciscrotonamide (Azodrin)
(5) O,S-dimethyl phosphoramidothioate (Monitor)
(6) O,O Dimethyl phosphorodithioate, S-ester with 4-(mercapto-methyl)-2-methoxy-$\Delta^2$ -1,3,4-thiadiazolin-5-one (Supracide)
(7) Demeton (Systox)
(8) Disulfoton (Di-Syston)
(9) EPN
(10) Ethion
(11) Ethyl 3-Methyl-4-(Methylthio) Phenyl (1-Methyl Ethyl) Phosphoramidate (Nemacur)
(12) Methyl parathion
(13) Mevinphos (Phosdrin)
(14) Parathion
(15) Phorate (Thimet)
(16) Phosphamidon
(17) Schradan (OMPA)
(18) Sulfotepp
(19) TEPP
(20) Dialifor (Torak)
(21) O,O-Diethyl O-±4-(Methylsulfinyl) Phenyll Phosphorothioate (Dasanit)
(22) O-Ethyl S,S-Dipropyl Phosphorodithioate (Mocap)

(k) Certain chlorinated organic pesticides.

(1) Aldrin
(2) Benzene Hexachloride (BHC)
(3) Chlordane
(4) DDD (TDE)
(5) DDT
(6) Dieldrin
(7) Endosulfan (Thiodan)
(8) Endrin
(9) Heptachlor
(10) Lindane
(11) Toxaphene

(1) All other pesticides registered for use in the form of a dust except those products containing only exempt materials specified in Section 2466.

(m) Certain other pesticides.

(1) Paraquat
(2) Sodium cyanide

Amends Section 2463 to read:

2463. Permits.

(a) Restricted materials specified in Section 2460 shall be possessed or used only under permit of the agricultural commissioner or under his direct supervision in any county in which there is a commissioner, or under permit of the director in any county in which there is no commissioner, except as follows:

(1) No permit shall be required for possession or use of the restricted materials specified below, including dust formulations thereof, when possessed and used only for the following nonagricultural purposes in accordance with the registered label: home use, structural pest control, industrial use, institutional use, and uses by public agencies which have entered into and operate under a cooperative agreement with the Department of Health pursuant to Section 2426 of the Health and Safety Code.

(A) Pesticides containing arsenic other than sodium arsenite as specified in Section 2460 (a) (1).
(B) Pesticides containing cadmium
(C) Pesticides containing mercury
(D) Carbaryl (Sevin)
(E) Chloropicrin
(F) Methyl bromide
(G) Disulfoton (Di-Syston)
(H) Aldrin
(I) Benzene hexachloride (BHC)
(J) Chlordane
(K) Dieldrin
(L) Endosulfan (Thiodan)
(M) Heptachlor
(N) Lindane
(O) Strychnine (rodenticide uses only)
(P) Toxaphene
(Q) Zinc Phosphide
(R) Pesticides included in Section 2460 (1)

(2) No permit shall be required to possess or use pesticides containing sodium arsenite as specified in Section 2460 (a)(1) when sold as diluted ready-to-use syrups or dry baits registered and labeled for use as poison baits for the control of insects and other arthropods.

(3) No permit shall be required to possess or use pesticides, included in Section 2460 (1) which are registered for use in the form of a dust and packaged in containers holding 25 pounds or less, or for the use of such pesticides packaged in containers holding more than 25 pounds registered for and used in enclosed areas such as greenhouses.

(4) No permit shall be required to possess or use any restricted material specified in Section 2460 when possessed and used only on livestock or poultry in accordance with the registered labeling.

(5) No permit shall be required to possess or use chloropicrin or methyl bromide when packaged in containers holding one and one half pound or less.

(6) Permits to possess restricted materials shall not be required of economic poison registrants or pesticide dealers when operating under their licenses, or by commercial carriers to transport such materials.

(7) No permit shall be required to possess or use paraquat when possessed and used only for home use in accordance with the registered labeling.

(8) A permit to possess or use O-Ethyl S,S-Dipropyl Phosphorodithioate (Mocap) shall be required only for turf use.

(b) The person in charge of the property to be treated or the pest control operator or both may apply for a permit, but the permit shall not be valid for possession or use by any operator or person not named in the permit.

(c) A permit to use restricted materials shall have an expiration date no later than the calendar year for which issued and shall be valid for the period specified unless sooner revoked or suspended. A copy of each permit shall be retained by the issuing officer.

(d) The person named in a restricted materials permit is authorized to possess materials for which the permit was valid after such permit expires, provided it is stored in accordance with Section 3136.

2463.1 Chloropicrin and Methyl Bromide. (in part)

(a) Field Fumigation.

(1) Except as provided in paragraph (3), chloropicrin or methyl bromide, singly or in combination, for field fumigation of soil by injection, shall be applied at a minimum depth of six inches, unless otherwise specified by the registered label for the intended use, and covered with a gas confining tarp of a thickness approved by the commissioner or director.

## Article 22 - Sale, Use and Possession of Sodium Monofluoroacetate

2470. Definitions. As used in this article, unless a different meaning is apparent from the context:

(a) Terms defined in the Food and Agricultural Code have the meanings therein set forth.

(b) "Poison bait" means any mixture or preparation of sodium fluoroacetate, also known as Compound 1080, used with any diluent, substance, or device intended to attract or lure rodents, predatory animals, or other pests.

(c) "Public agency" means federal, state, county or municipal officers or employees, in their official capacities, or persons under the immediate supervision of such officers or employees.

(d) "Structure" means any building, dock, ship or conveyance.

2471. Sale, Possession, and Use in General.

(a) Sales. Each sale of sodium fluoroacetate or any preparation thereof shall be reported to the Director within thirty days from the date of sale.

(b) Records. A written record of all sodium fluoroacetate received and of its use shall be made and kept at least two years after use of the last quantity of each lot received.

(c) Possession. Sodium fluoroacetate or poison bait exposed for pest control or other purposes is deemed to be in the possession of the person by whom it was exposed, unless removed by an unauthorized person.

(d) Storage. All stocks of sodium fluoroacetate and poison bait and all equipment, containers, and utensils which have been used in their preparation or handling, shall be stored in an adequately locked space at all times when not in use. Such space shall be entirely separate from any space, including refrigerated space, where food or drink for humans or animals is kept or stored. All keys to such space shall be kept in the custody of responsible persons.

(e) Containers. No sodium fluoroacetate or poison bait shall be kept or placed in drinking cups, pop bottles or other containers of a type commonly used for food or drink. Sodium fluoroacetate poisoned water shall be stored and transported only in durable, shatter-resistant receptacles.

(f) Labels. All containers, bait boxes or receptacles in which poison bait is kept, transported or exposed shall bear on the outside a conspicuous poison label which shall conform to the label required by Section 20757 of the Health and Safety Code on packages of sodium fluoroacetate sold within the State.

(g) Handling.

(1) All persons who may be required to handle sodium fluoroacetate in any form, whether or not subject to safety orders issued by the Division of Industrial Safety, shall be informed of the hazards, standards of custom and usage, and precautions recommended by the manufacturer, and shall be provided with adequate protective clothing and devices (including respiratory equipment and gloves) as specified in such recommendations.

(2) All weighing, measuring and packaging of sodium fluoroacetate in dry powdered form shall be done in a location or room that has a minimum of cross currents so as to curtail the dissemination of the dry powder into the workroom atmosphere.

(3) Sodium fluoroacetate poisoned water shall be dispensed by syringe, gravity-feed tubing or suitable pouring device, to prevent spillage.

(h) Waste Disposal.

(1) Unused sodium fluoroacetate poisoned water and rinse water contaminated with sodium fluoroacetate shall be flushed to the sewers or excessively diluted (at least 10 to 1) and allowed to soak into barren, porous soil where there is no danger of contaminating water supplies.

(2) No sodium fluoroacetate or substance contaminated therewith shall be poured on vegetation or disposed of in any manner which might endanger domestic animals or beneficial wildlife.

(3) Unused poison baits, and used poison containers other than impervious containers which can be washed free from contamination, and recovered carcasses of poisoned animals shall be destroyed by complete burning or by burying under not less than two feet of soil.

2472. Use for Pest Control Purposes.

(a) Baits. Except as herein specified, sodium fluoroacetate shall not be mixed with or added to any substance or preparation which is or may be taken as food or drink by humans or animals.

(1) For control of house rats and mice, sodium fluoroacetate discolored with nigrosine black dye may be mixed with or added to water, at the rate of not more than one-half ounce of sodium fluoroacetate to one gallon of water; or to cereal grains in dry, uncooked form, at the rate of not more than one ounce of sodium fluoroacetate to 28 pounds of grain. Such cereal grains shall be adequately discolored and may be of one or more varieties, whole, rolled or ground to the consistency of fine meal, but not flour.

(2) For control of pests other than house rats and mice, sodium fluoroacetate with suitable warning discoloration may be added to or mixed with water, grain or other baits.

(b) Bait Boxes and Containers.

(1) Bait boxes may be made of wood, metal or equivalent material, but shall be of rigid construction with unobstructed means of ingress and egress and adequate baffles to maintain the bait within the box.

(2) Openings to bait boxes used for baiting house rats and mice shall not exceed two and one-half inches in any dimension, and shall be not less than one-half inch above the floor of the box.

(3) Bait boxes for outdoor placement shall be constructed and placed in such manner as to protect the bait from rain or flooding.

(4) Each bait box when in use shall be securely fastened.

(5) Containers for exposed sodium fluoroacetate poisoned water shall be constructed of noncorrodible, shatter-resistant material which is moisture-proof for a period to exceed by one week the placement period. Such containers shall not be reused unless cleaned.

(6) Containers for exposed poison bait shall be stable enough to resist tipping or movement by rodents. Containers, other than bait boxes, shall have a flat base or bottom, the diameter of which is not less than three times the height of the container.

(c) Prohibited Use. Nothing in these regulations shall be construed to permit the use of tracking powder containing sodium fluoroacetate in any form, with or without bait.

(d) Indoor Placement. Poison bait shall not be placed in dwellings or dwelling quarters, except by public agencies or licensed structural pest control operators working under direction and supervision of public agencies. Poison bait may be placed in other structures under the following conditions only:

(1) No open container shall be filled to more than one-half its capacity.

(2) No poison bait or container thereof shall be placed on or near food or feed, or containers of food or feed, or spilled food or feed, or in any place where food or feed contamination is likely to occur.

(3) No poison bait or container thereof shall be exposed above the level of the floor of the room or enclosure in which it is placed.

(4) Except for exposure during a period when the structure or room remains closed and locked, all poison bait shall be protected by bait boxes.

(5) Immediately following the period of exposure of any poison bait in or under any structure, all unused poison bait, used poison containers, and recoverable carcasses of poisoned animals shall be picked up. Baits and containers shall be picked up, if possible, by the same person who placed the baits.

(6) A detailed record, diagram or chart shall be made showing the location of all poison bait placements in or under structures, the time of day and date the placements are made, the amount and concentration of the bait, the type of room or area treated and the number of individual placements therein, the name of each person engaged in placing the baits, the number of baits or containers recovered, and an accounting of those not recovered. Such records shall be open at all reasonable times for inspection on request of the Director or agricultural commissioner.

(e) Outdoor Placement. Poison bait placed outside of structures for control of house rats and mice shall be protected by bait boxes, except in garbage or refuse dumps or in locations which are adequately patrolled or otherwise closed to access by unauthorized persons.

Extract B - California Food and Agriculture Code;
Division 6 - Pest Control Operators

## Chapter 2. General Provisions

11501. The purposes of this division and Chapter 1 (commencing with Section 12501), Chapter 2 (commencing with Section 12751), Chapter 3 (commencing with Section 14001), and Chapter 3.5 (commencing with Section 14101) of Division 7 are as follows:

(a) To provide for the proper, safe, and efficient use of pesticides essential for production of food and fiber and for protection of the public health and safety.

(b) To protect the environment from environmentally harmful pesticides by prohibiting, regulating, or controlling uses of such pesticides.

(c) To assure the agricultural and pest control workers of safe working conditions where pesticides are present.

(d) To permit agricultural pest control by competent and responsible licensees and permittees under strict control of the director and commissioners.

(e) To assure the users that economic poisons are properly labeled and are appropriate for the use designated by the label.

(f) To encourage the development and implementation of pest management systems, stressing application of biological and cultural pest control techniques with selective pesticides when necessary to achieve acceptable levels of control with the least possible harm to nontarget organisms and the environment.

## Chapter 5. Aircraft Operation Regulation

### Article 1. Generally

11901. It is unlawful for any person to operate any aircraft in the business of pest control unless the pilot operating the aircraft holds one of the following:

(a) A valid certificate of qualification issued by the director.

(b) A valid apprentice certificate issued by the director.

### Article 10. Recommendations and Usage

12971. Except as provided in Sections 12974 and 12975, before any pesticide application is made, the applicator shall be in possession of a written recommendation showing the following:

(a) The name and dosage rate of the pesticide or pesticides and other materials to be used.

(b) The pest or pests to be controlled.

(c) The owner or operator, location of and approximate acreage to be treated.

(d) The crops or property to be treated.

(e) The signature and address of the person making the recommendation and name of the business or company which he represents.

(f) The suggested schedule or time, if any, for the pesticide application.

Article 10.5. Pesticides and Worker Safety

12980. The Legislature hereby finds and declares that it is necessary and desirable to provide for the safe use of pesticides and for safe working conditions for farmworkers, pest control applicators, and other persons handling, storing, or applying pesticides, or working in and about pesticide-treated areas.

The Legislature further finds and declares that the development of regulations relating to pesticides and worker safety should be the joint and mutual responsibility of the Department of Food and Agriculture and the Department of Public Health, until the operative date of Governor's Reorganization Plan Number 1 of 1970, and on and after such date, should be the joint and mutual responsibility of the Department of Food and Agriculture and the Department of Health.

The Legislature further finds and declares that in carrying out the provisions of this article, the University of California, the Department of Industrial Relations, and any other similar institution or agency should be consulted.

12981. The director shall adopt regulations to carry out the provisions of this article effective as soon as practicable, however, no later than the first calendar day of the 1974 Regular Session of the Legislature. Such regulations shall include, but are not limited to, all of the following subjects.

(a) Time limits for worker entry into areas treated with pesticides as determined by the director to be hazardous to worker safety.

(b) Handling of pesticides.

(c) Handwashing facilities.

(d) Farm storage and commercial warehousing of pesticides.

(e) Protective devices, including, but not limited to, respirators and eyeglasses.

(f) Posting, in English and Spanish, of fields, areas, adjacent areas or fields, or storage areas.

The State Department of Public Health, until the operative date of Governor's Reorganization Plan Number 1 of 1970, and on and after such date, the Department of Health, shall participate in the development of any regulations adopted pursuant to this article. Such regulations that relate to health effects shall be based upon the recommendations of the Department of Public Health, until the operative date of Governor's Reorganization Plan Number 1 of 1970, and on and after such date, the Department of Health. The original written recommendations of the State Department of Public Health, any subsequent revisions of those recommendations, and the supporting evidence and data upon which the recommendations were based shall be made available upon request to any person.

12982. The director and the commissioner of each county under the direction and supervision of the director, shall enforce the provisions of this article and the regulations adopted pursuant to it. The local health officer may assist the director and the commissioner in the enforcement of the provisions of this article and any regulations adopted pursuant to it. The local health officer shall investigate any condition where a health hazard from pesticide use exists, and shall take necessary action, in cooperation with the commissioner, to abate any such condition. The local health officer may call upon the State Department of Public Health, until the operative date of Governor's Reorganization Plan Number 1 of 1970, and on and after such date the Department of Health, for assistance pursuant to the provisions of Section 2951 of the Health and Safety Code.

## CHAPTER 3. RESTRICTED MATERIALS

### Article 1. Generally

14001. The director shall control and otherwise regulate the use of restricted materials found to meet the criteria of Section 14004.5.

14002. This chapter applies to all agencies of the United States and the State of California and its subdivisions or to their officers, agents, or employees, except when acting within the scope of their authority and while engaged in conducting or supervising research on any restricted material. Nothing in this Section affects the liability of a public entity under Section 862 of the Government Code.

14003. This article does not relieve any person from liability for any damage to the person or property of another person which is caused by the use of any restricted material.

14004. The director, and the commissioner of each county under the direction and supervision of the director, shall enforce this chapter and the regulations issued pursuant to it.

14004.5. The director, after investigation and hearing, shall designate and establish as necessary to carry out the purposes of this division, a list of restricted materials based upon, but not limited to, any of the following criteria:

(a) Danger of impairment of public health.
(b) Hazards to applicators and farmworkers.
(c) Hazards to domestic animals, including honeybees, or to crops from direct application or drift.
(d) Hazard to the environment from drift onto streams, lakes, and wildlife sanctuaries.
(e) Hazards related to persistent residues in the soil resulting ultimately in contamination of the air, waterways, estuaries or lakes, with consequent damage to fish, wild birds, and other wildlife.
(f) Hazards to subsequent crops through persistent soil residues.

14005. The director, after investigation and hearing, shall adopt regulations which govern the application in pest control or other agricultural operations of any restricted material which he finds and determines is injurious to the environment, or to any person, animal or crop.

14006. The regulations shall prescribe the time when, and the conditions under which, a restricted material may be used or possessed in different areas of the State, and may prohibit its use or possession in such areas. Such usage shall be limited to those situations in which it is reasonably certain that no injury will result, or no nonrestricted material or procedure is equally effective and practical. They may provide that a restricted material shall be used only under permit of the commissioner or under the direct supervision of the commissioner, subject to any of the following limitations:

(a) In certain areas.
(b) Under certain conditions relating to safety.
(c) When used in excess of certain quantities or concentrations.
(d) When used in certain mixtures.
(e) In compliance with the industrial safety orders of the Department of Industrial Relations and any order of the director or commissioner.
(f) On agreement by the owner or person in possession of the property to be treated to comply with certain conditions.
(g) Any other limitation the director determines to be necessary to effectuate the purposes of this chapter.

14006.5. Except as provided in Section 14006.6, no person shall use any pesticide for any agricultural use except under a written permit of the commissioner. No permit shall be issued for any restricted material for use in any manner other than pursuant to its registration without the approval of the director. In addition, no permit shall be granted if the commissioner determines that the provisions of subdivision (a), (b), or (c) of Section 12825 would be applicable to the proposed use.

Before issuing a permit for any pesticide, the commissioner shall consider local conditions including, but not limited to, the following:

(a) Use in vicinity of schools, dwellings, hospitals, recreational areas, and livestock enclosures.
(b) Problems related to heterogeneous planting of crops.
(c) Applications of materials known to create severe resurgence or secondary pest problems without compensating control of pest species.
(d) Meteorological conditions for use.
(e) Timing of applications in relation to bee activity.
(f) Provision for proper storage of pesticides and disposal of containers.

Each permit issued for any pesticide shall include conditions for use in writing.

14006.6. A permit shall not be required for the agricultural use of "exempt materials" determined in accordance with Section 14006.7, or for the agricultural use of any other pesticide not designated as a restricted material which the commissioner determines may be used under local conditions without undue hazard.

Permits for the use of pesticides shall not be required of persons found to be qualified by the director who are engaged in experimentation or research on the use of pesticides, where no charge is made to the grower.

14006.7. The director, after investigation and hearing, shall designate by regulation a list of "exempt materials" for which the director finds additional restrictions, other than registration and labeling requirements are not necessary to carry out the purposes of this chapter. Such exempt materials may be used without a permit provided that such use shall conform with the registered label or printed instructions.

## Article 3. Compound 1080

14061. As used in this article, "Compound 1080" means sodium fluoroacetate or any preparation of sodium fluoroacetate.

14062. Except as otherwise provided in this article, it is unlawful for any person to sell, use, or possess any Compound 1080.

14063. Subject to regulations of the director, any of the following persons may sell, use, or possess Compound 1080 for the purposes or uses which are specified:

(a) Any federal, State, county, or municipal officer or employee, in his official capacity, or any person under the immediate supervision of such officer or employee, may possess Compound 1080 for use for pest control purposes.
(b) Any research or chemical laboratory may possess Compound 1080 for use for the purposes of such laboratory.

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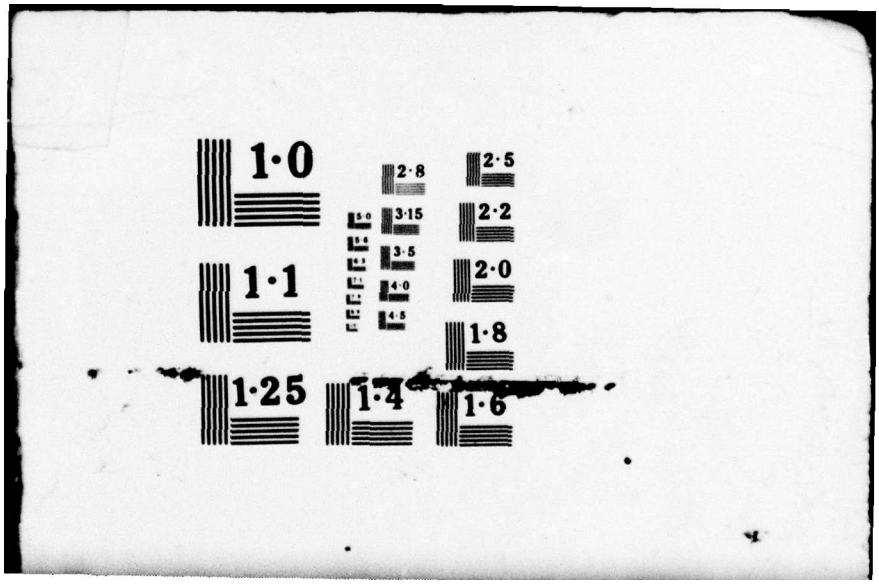
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(c) Any person duly licensed as a structural pest control operator under Chapter 14 (commencing with Section 8500) Divison 3 of the Business and Professions Code, may possess Compound 1080 for use in his business.

(d) Any wholesaler or jobber of any economic poison may sell Compound 1080 to any person included within the above classifications, or for export.

## Extract C - California Department of Food and Agriculture Vertebrate Pest Control Handbook (1975)

### GUIDELINES FOR BAITING FIELD RODENTS

**Pre-Treatment**

1. Annual rodent control plans shall be reviewed by the California Department of Fish and Game regarding hazards to rare and endangered species as specified in the "Joint Policy Statement of the California Department of Food and Agriculture, California Department of Fish and Game and the California Agricultural Commissioners Association Regarding Rare and Endangered Species."
2. Actual damage or threat of damage must be sufficient to warrant application of rodent baits. As a safeguard to humans and domestic animals, alternative methods such as fumigants or anticoagulant baits in bait boxes should be considered in preference to broadcasting acute toxic baits around inhabited buildings or suburban areas and domestic animals.
3. Baiting shall not be done unless tests indicate satisfactory bait acceptance occurs in areas to be treated.
4. Bait should be chosen on the basis of selectivity as well as acceptance value.
5. When county agricultural commissioners anticipate control programs involving other than established practices the California Department of Food and Agriculture, Control and Eradication, should be advised.

**Treatment**

1. The county agricultural commissioner or his staff should be aware of the conditions at the site of application and in a position to direct and control the manner in which the application is made.
2. Toxic baits used in control operations shall be artificially colored or dyed. The departmental suggestions contained in the Vertebrate Pest Handbook should be used.
3. Quantities of toxic bait exposed shall be regulated so that residual bait will not present a hazard to nontarget species.
4. Property owners or tenants shall be advised to dispose of rodent carcasses on the ground surface immediately adjacent to inhabited areas. A shovel or pitch fork should be used to minimize possible contact with ectoparasites.
5. There are no specific statutory provisions requiring the posting of warning signs for rodent control. However, when premises are posted in accordance with county policy, they are to be posted as prescribed by the Penal Code, Section 596 - ("... signs located at intervals of distance not greater than one-third of a mile apart and in any case not less than three such signs having words with letters at least one inch high reading 'WARNING - POISON BAIT PLACED OUT ON THESE PREMISES,'...")
6. All accidentally spilled grain bait *shall* be cleaned up immediately.
7. Discarded or used containers shall be disposed of in accordance with California laws and regulations pertaining to disposal of pesticide containers.

**Post-Treatment**

An annual written evaluation should be made of representative areas describing the degree of control and any observed effects on nontarget wildlife.

## SAFETY PRECAUTIONS

The safe handling and use of rodenticides is a responsibility of the agricultural commissioners.

1. Commissioners shall inform employees involved in field rodent control as to the provisions of Regulations Concerning Sale, Use and Possession of Sodium Fluoroacetate (Compound 1080).
2. All bags, sacks, or other containers should have the word "POISON" stenciled or printed directly on package. This is in addition to the normal labeling requirements.
3. Toxic baits and concentrates shall be stored in an adequately locked space at all times when not in use. Such space shall be entirely separate from where food or drink for humans or domestic animals is kept or stored.
4. All persons handling toxic baits or concentrates should be advised as to:
   a. The characteristics of these materials.
   b. The necessity of using adequate protective clothing and devices such as gloves and/or bait spoons for dispensing baits.
   c. The necessity for keeping all skin abrasions and cuts adequately protected.
   d. The possibility of inadvertent poisoning of wildlife and domestic animals by improper bait exposure.
   e. The symptoms of poisoning in man and recommended first aid if such symptoms occur.
5. To prevent the accidental spillage of toxic grain, containers (including sacks, shoulder bags and saddle bags) should be so designed and in such repair that leakage or spillage does not occur. Shoulder bags should be equipped with a zipper or other device for closing. Equip saddle bags with either a zipper or drawstring to facilitate quick closing.
6. Toxic bait accidentally spilled should be immediately and thoroughly cleaned up.
7. Do not leave containers or prepared bait unattended, or where it can be obtained by children, irresponsible persons or animals.
8. Unused bait should be returned to the local agricultural commissioner or disposed of in a Class I dump.
9. Burn empty bait containers (check local regulations).
10. Wash hands with soap and water after handling poison baits and before eating or smoking.

## GUIDELINES FOR APPLYING RODENT BAITS BY AIRCRAFT FOR CONTROL OF GROUND SQUIRRELS

**Pre-Treatment**

1. Actual damage or threat of damage must be sufficient to warrant aerial application of rodent baits. Alternative methods shall always be considered.
2. No baiting shall be implemented unless tests indicate satisfactory bait acceptance occurs in representative areas.
3. The area to be treated shall be clearly defined on topographic maps or aerial photographs for use by the pilots.
4. The pilot shall be thoroughly familiar with the property(ies) to be treated.
5. Property lines and boundaries shall be clearly visible from the air.
6. The aircraft shall be calibrated with nontoxic baits under the supervision of the agricultural commissioner or his staff.
7. A written, general evaluation should be made of several representative areas describing damage or threat of damage, bait acceptance and the presence of nontarget wildlife.

**Treatment**

1. The county agricultural commissioner or his staff should be aware of the conditions at the site of application and in a position to direct and control the manner in which the application is made.
2. Aerial baiting should not occur on the same parcel of land more often than once every two years with the same toxicant.
3. No treatment shall be made when wind velocity impairs effective bait placement.
4. No treatment should be made when fields are muddy, have standing water, or when rain is expected within 24 hours.
5. Treated bait shall not be applied near farm buildings or over water supplies.
6. Ground-to-air communication shall be in use during treatment.
7. The aircraft baithopper shall be:
   a. Thoroughly cleaned before the first baiting of the program, after final baiting of the program, and if baiting hopper has been used for other pesticides during the program.
   b. Emptied of bait at the end of each day's operation and bait stored in locked container.
8. The rate of application shall be monitored daily by measuring bait dispersal in the treated areas.
9. All accidentally spilled grain bait *shall* be cleaned up immediately.

**Post-Treatment**

A written evaluation should be made of representative areas describing the degree of control and any observed effects on nontarget wildlife.