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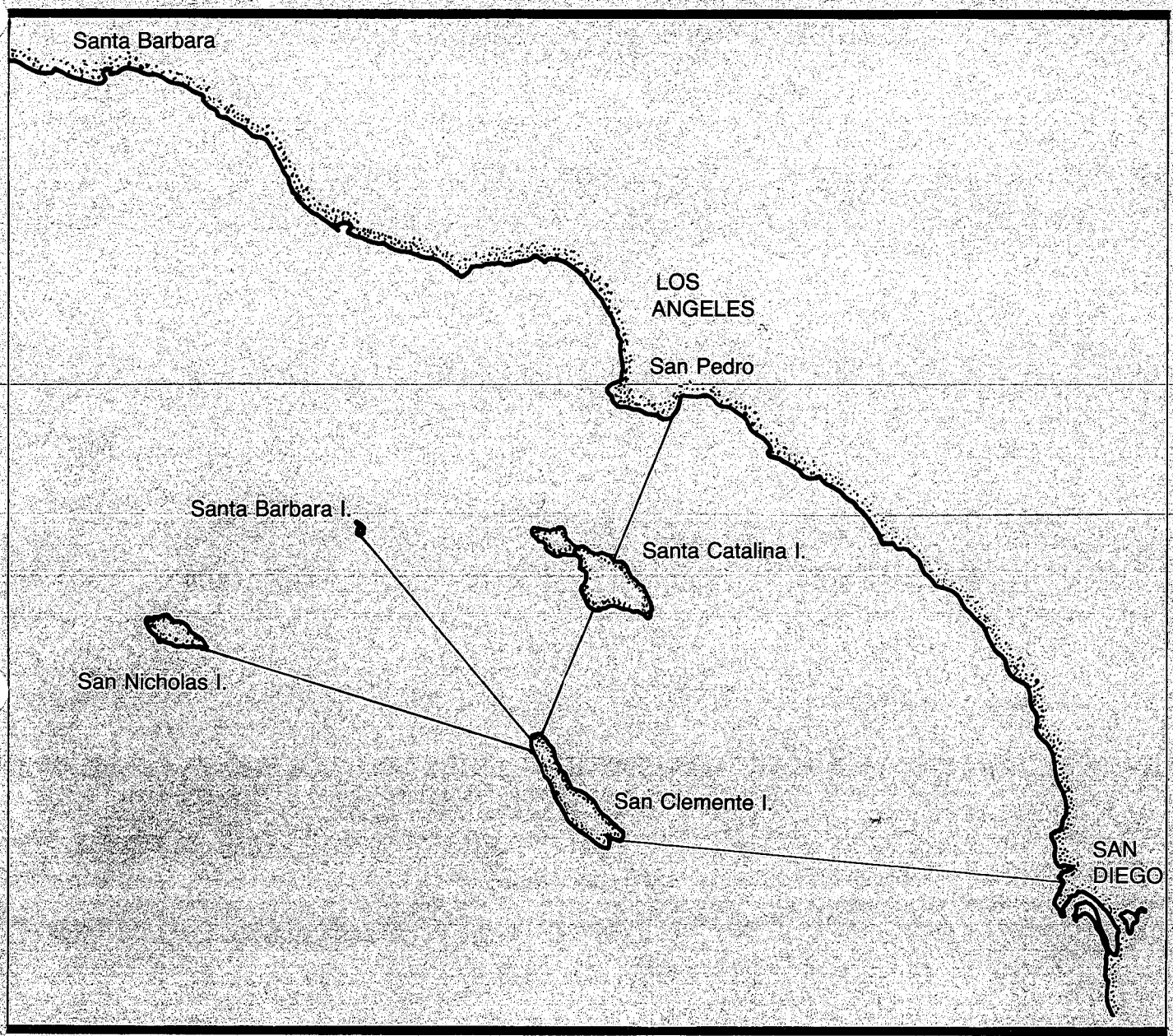

California Channel Islands Species Recovery Plan

RECOVERY PLAN FOR THE ENDANGERED AND THREATENED SPECIES OF THE CALIFORNIA CHANNEL ISLANDS[1]

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1/ This plan covers the following Federally listed species on San Clemente, Santa Barbara, and San Nicolas Islands: San Clemente Island Indian paintbrush, San Clemente Island larkspur, San Clemente Island broom, San Clemente Island bush-mallow, San Clemente loggerhead shrike, San Clemente sage sparrow, and Island night lizard.

THIS IS THE COMPLETED RECOVERY PLAN FOR THE ENDANGERED AND THREATENED SPECIES OF THE CALIFORNIA CHANNEL ISLANDS. IT HAS BEEN APPROVED BY THE U.S. FISH AND WILDLIFE SERVICE. IT DOES NOT NECESSARILY REPRESENT OFFICIAL POSITIONS OR APPROVALS OF COOPERATING AGENCIES AND IT DOES NOT NECESSARILY REPRESENT THE VIEWS OF ALL INDIVIDUALS WHO PLAYED KEY ROLES IN PREPARING THIS PLAN. THIS PLAN IS SUBJECT TO MODIFICATION AS DICTATED BY NEW FINDINGS AND CHANGES IN SPECIES STATUS AND COMPLETION OF TASKS DESCRIBED IN THE PLAN. GOALS AND OBJECTIVES WILL BE ATTAINED AND FUNDS EXPENDED CONTINGENT UPON APPROPRIATIONS, PRIORITIES AND OTHER BUDGETARY CONSTRAINTS.

LITERATURE CITATION SHOULD READ AS FOLLOWS:

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The biological staff of the Navy's Natural Resources Management Office, Staff Civil Engineering Department, NAS North Island (Jan K. Larson, Howard L. Ferguson, and Paul D. Jorgensen), provided direct input through the review of the plan, as well as through interaction with the contractors during numerous meetings and field investigations on San Clemente Island.

Susan J. Carlton prepared the plant and animal illustrations.

EXECUTIVE SUMMARY

FOR THE RECOVERY PLAN FOR THE ENDANGERED AND THREATENED SPECIES OF THE CALIFORNIA CHANNEL ISLANDS

1. Point or condition when species can be considered "recovered."

When sufficient habitat has been restored on San Clemente Island to support viable, self-sustaining populations of the seven endangered/threatened taxa and when management and use of habitat is such that survivability of the populations is assured. Quantitiative goals on San Clemente, Santa Barbara, and San Nicolas Islands will be determined when additional information, as outlined in the plan, becomes available.

2. What must be done to reach recovery?

Habitat restoration, protection of populations (extant and restored), enhancement of existing populations.

3. What specifically must be done to meet the needs of #2?

Protect existing plant populations by removal of feral animals and by fencing and signing; protect restored/rehabilitated habitat by erosion control, prevent the introduction of additional feral animals, remove existing feral animals; expand shrike and sage sparrow habitat by planting of appropriate vegetation; conduct additional research studies to determine habitat requirements, the effect of competitive influences on

reproductive success and local distribution, and the suitability of habitat restoration techniques.

4. What management/maintenance needs have been identified to keep species recovered?

   Implementation of long-range planning documents with specific reference to the species and their needs, including regular and periodic review, protective and enforced management plans; an aroused, cooperative, and sympathetic citizenry.

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1 (E = endangered, T = threatened, C = candidate)

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PART I

INTRODUCTION

Brief Overview

Unlike many recovery plans that address the recovery of a single endangered or threatened plant or animal, this plan concerns itself with describing problems or limiting factors, recommending actions, and justifying those actions for the recovery of insular ecosystems. The plan will focus on ten taxa (some of which have been afforded legal status under the Endangered Species Act of 1973, as amended) on three California Channel Islands. Nine taxa are restricted to San Clemente Island; however, one also occurs on San Nicolas and Santa Barbara Islands. Many more indigenous or endemic taxa occur on San Clemente Island and will be mentioned incidentally. This recovery plan will specifically address the following endangered, threatened (as per 42 Federal Register 40682, August 11, 1977), and candidate (as per 45 Federal Register 82480, December 15, 1980) plants and animals:

Plants: San Clemente Island Indian paintbrush (*Castilleja grisea*) - Endangered (San Clemente Island)

San Clemente Island larkspur (*Delphinium kinkiense*) - Endangered (San Clemente Island)

Thorne's royal larkspur (*Delphinium variegatum* subsp. *thornei*) - Candidate (San Clemente Island)

San Clemente Island woodland-star (*Lithophragma maxima*) - Candidate (San Clemente Island)

San Clemente Island silver hosackia (*Lotus argophyllus* subsp. *adsurgens*) - Candidate (San Clemente Island)

San Clemente Island broom (*Lotus dendroideus* ssp. *traskiae*) - Endangered (San Clemente Island)

San Clemente Island bush-mallow (*Malacothamnus clementinus*) - Endangered (San Clemente Island)

Animals: San Clemente loggerhead shrike (*Lanius ludovicianus mearnsi*) -Endangered (San Clemente Island)

San Clemente sage sparrow (*Amphispiza belli clementeae*) - Threatened (San Clemente Island)

Island night lizard [*Xantusia* (=*Klauberina*) *riversiana*] - Threatened (San Clemente, Santa Barbara, San Nicolas Islands).

Land Ownership and Management Authorities

The southernmost island of the three Channel Islands addressed in this plan, San Clemente Island, is administered by Naval Air Station (NAS) North Island, San Diego, California. San Clemente Island contains an

active military installation complete with airfield, housing for personnel, a road system, and other installations. Santa Barbara Island is part of the Channel Islands National Park and is under the management of the National Park Service. This small island is fully protected and is inhabited by the island night lizard, the only endangered or threatened species discussed in this recovery plan which occurs on all three islands. Lastly, San Nicolas Island is under the jurisdiction of Pacific Missile Test Center, Pt. Mugu, California.

For San Clemente Island, the Staff Civil Engineer is designated as the Natural Resources Management Officer. His responsibilities are for the support of various military operational requirements and for the conservation of natural resources within the scope of federal mandates on lands administered by the NAS North Island. Because of the broad conservation and management responsibilities placed on the Command by Executive Orders, Congressional legislation, and Department of Defense and Naval directives, a Natural Resources Management Office has been established within the Staff Civil Engineer Department to insure conservation of natural resources. The Natural Resources Management Branch is responsible for developing a comprehensive management plan for biological, cultural, and physical resources, for the compatible use of lands administered by the NAS North Island, for coordination of cooperative research initiated by conservation agencies and the academic community, and for implementing programs which will accomplish these objectives. The natural resources management plan and those programs specified by it were developed and initiated through cooperative agreements or memoranda of understanding between

the U.S. Fish and Wildlife Service and the California Department of Fish and Game for endangered and threatened species, the Advisory Council on Historic Preservation and the California State Historic Preservation Office for cultural resources, and the National Marine Fisheries Service for marine mammals. Other research and management projects are accomplished by contract or cooperative research agreements.

San Nicolas Island is administered by the Commander, Pacific Missile Test Center. Responsibility for natural resources management is delegated to a Special Assistant for Ecology who works within the Engineering Division of the Public Works Department of the Naval Air Station. The special assistant is involved with natural resources on San Nicolas Island, San Miguel Island, and Point Mugu. No formal natural resources management plan exists for San Nicolas Island. However, cooperative agreements have been signed between the military command and U.S. Fish and Wildlife Service, California Department of Fish and Game, Santa Monica Mountain National Recreation Area, Channel Islands National Park, and National Marine Fisheries Service.

Santa Barbara Islands is administered by the Superintendent, Channel Islands National Park, Ventura, California. Santa Barbara Island is wholly managed by the National Park Service. Management policies involving the island night lizard and other natural resources on the island are specified in the 1976 Statement of Management for Channel Islands National Monument and the 1980 General Management Plan for Channel Islands National Park, which contains a lengthy section on

natural resources. The management plan has specific recommendations for the recovery of the island night lizard, including a life history study now in progress, evaluation of non-native vegetation and lizard habitat, and removal of introduced European rabbits. An environmental assessment on the proposal to extirpate the rabbit from the island has been completed and a finding of no significant impact signed. A memorandum of understanding on rabbit removal exists between the National Park Service, Western Region, and the California Department of Fish and Game. A memorandum of agreement is in preparation between Channel Islands National Park and National Marine Fisheries Service on various natural resource issues.

Overview of Conditions: San Clemente Island

Location and Dimensions

San Clemente Island is the southernmost of the California Channel Islands, its center lying at about 32° 50'N latitude, 118° 30'W longitude (Figure 1). It is about 64 statute miles (102 km) west-northwest of San Diego and 49 miles (79 km) south-southwest of San Pedro, the nearest mainland point. The nearest point of Santa Catalina Island, the closest land, is about 21 miles (33 km) to the north; Catalina is thus interposed between San Clemente Island and the mainland.

San Clemente Island is nearly 21 miles (33 km) long, and from about 1.5 miles (2.4 km) wide near the north end, to about four miles

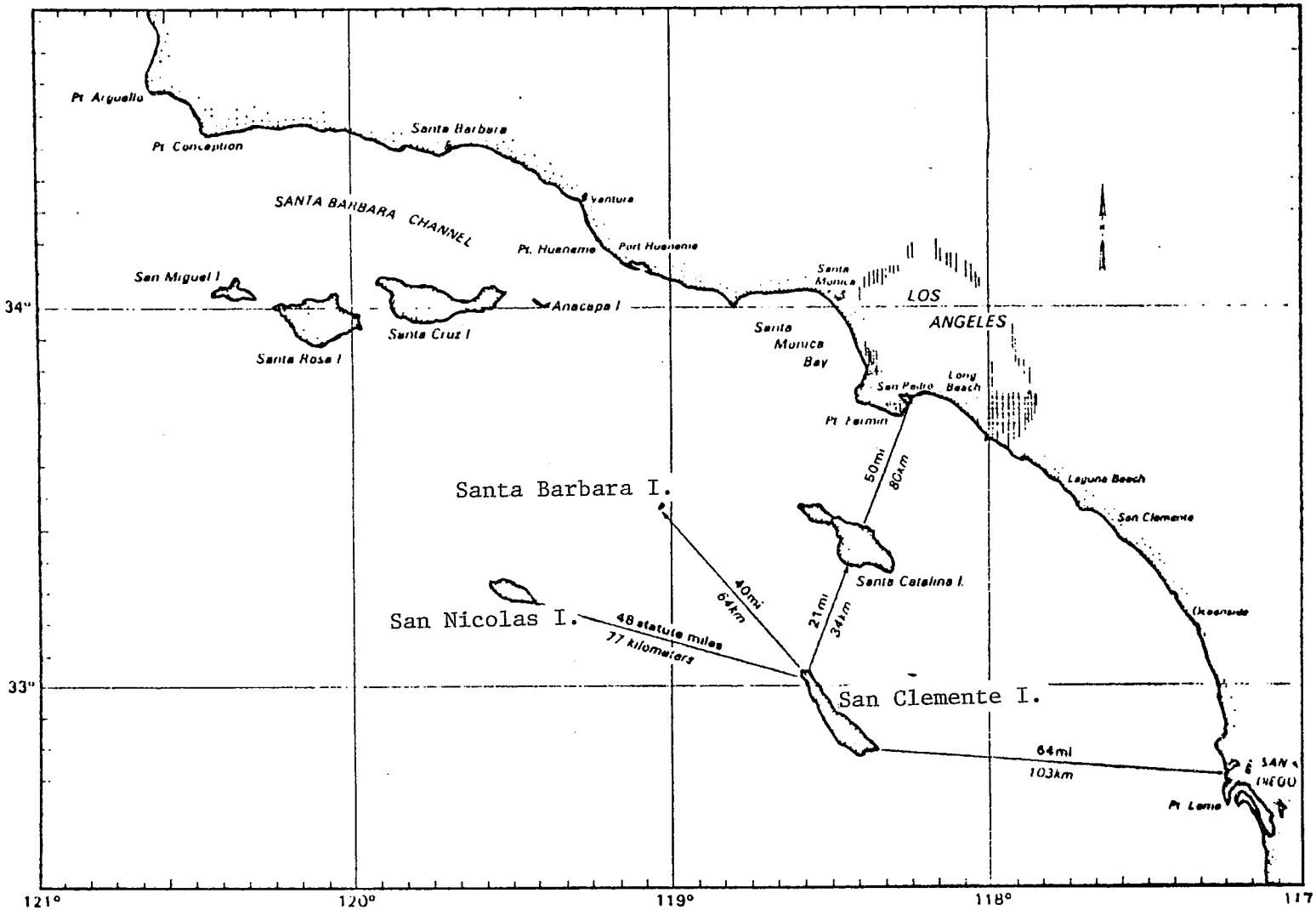


Figure 1. Location of San Clemente, San Nicolas, and Santa Barbara Islands.

(6.4 km) wide near the south end; its long axis runs approximately northwest - southeast. The total land area of the island is about 57 square miles (148.5 sq km). Its high point, called Thirst or Mount Thirst, reaches 1,965 feet (599 m) and lies near the center of the island (Raven 1963).

Geology

San Clemente Island is described as the upper part of a tilted and gently arched block, with a steep eastern escarpment and a more gently inclined west slope composed of up to 20 distinct wave-cut terrraces extending from sea level to an elevation of about 1,500 feet (450 m). This suggests that the portion of the island below that elevation was submerged and exposed intermittently, probably during the Pleistocene. The island is dissected by deep, geologically young canyons, with those on the east side dropping precipitously from 1,900 feet (500 m) to the sea (Olmsted 1958).

San Clemente Island is composed principally of volcanic rocks dating from the Miocene (Vedder and Howell 1976). Interbedded with and overlying these volcanics are sedimentary rocks and unconsolidated sediments which range in age from Middle Miocene to Holocene (Recent).

The main features of the island are two large coves (Horse and Pyramid) at the south end, the canyons on the southwestern slope, the broad central mesa and the marine terraces rising from the western coastline.

Most of the island's coastline is rugged and precipitous, especially at Mosquito Cove on the southeastern side and Seal Cove on the west. Sandy beaches are uncommon. The largest beaches are found at the southern end of the island, at China, Horse, and Pyramid Coves (Figure 2).

Climate

The island's climate is distinctly maritime, with cool summers and mild winters. The average range of seasonal and diurnal temperature is small. Based on weather records since the 1940's, the average mean summer temperature is 65°F (18°C) and the average mean winter temperature is 55°F (13°C).

High humidities are experienced throughout the year with an annual average of 80 percent. No temperatures below freezing have ever been recorded. Warm temperatures are a rarity, but occasionally when Santa Ana conditions prevail in August through October, temperatures exceed 90°F (32°C). During these periods of high temperature, relative humidity values are generally less than 25 percent.

Strong winds are infrequent at the lower elevations on San Clemente Island. Atop the higher regions of the island, gale force winds are not uncommon. The average wind speeds for all months are under 10 knots (16 km/hr) at the airfield. The predominant wind direction is from the west in all months, with short periods of northerly to easterly winds associated with Santa Ana conditions.

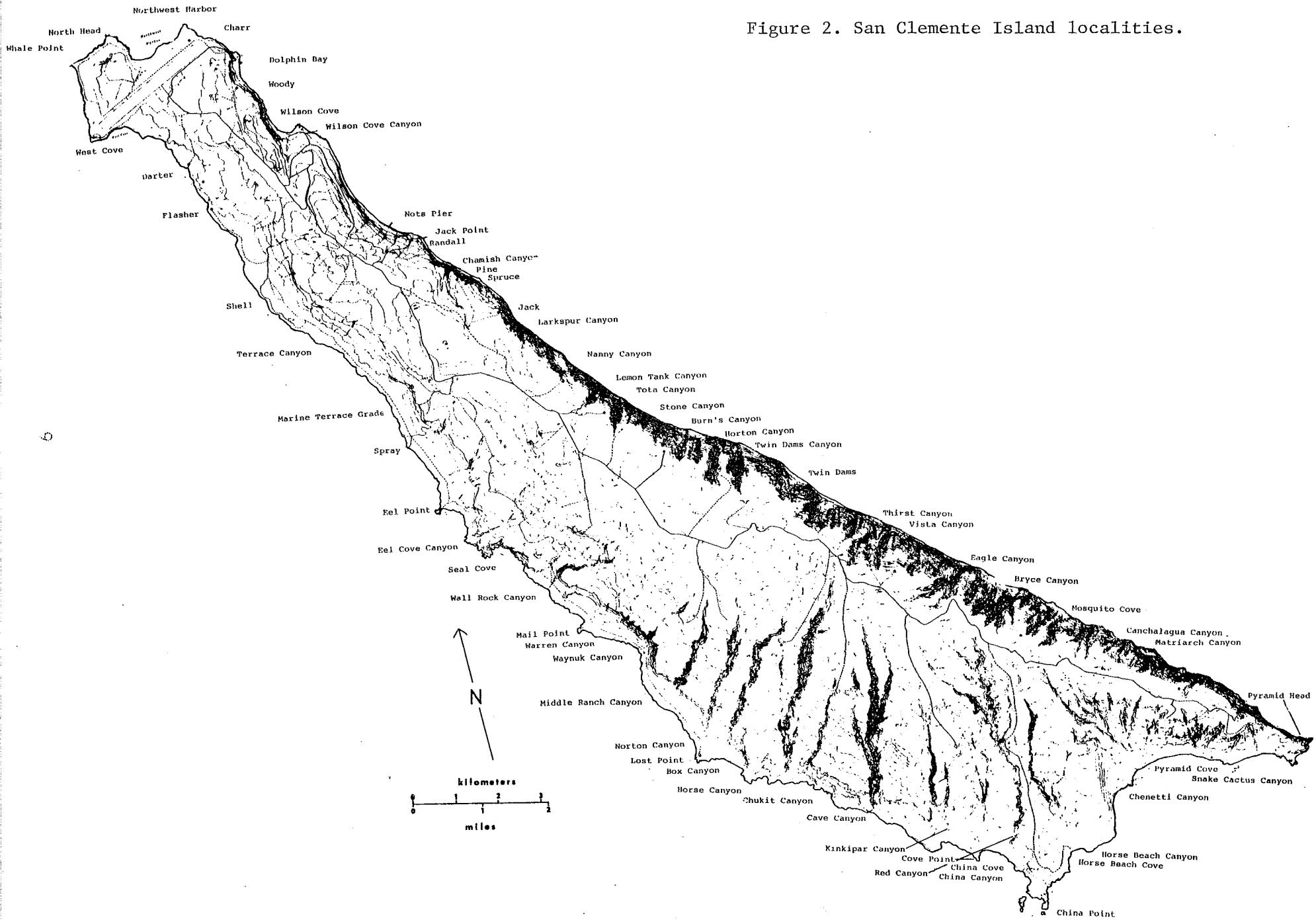


Figure 2. San Clemente Island localities.

Annual precipitation averages between five and eight inches (13 to 20 cm). The wettest months are November through March and the driest from June through September. The majority of the rain is the result of major winter storms. The major cloudy period is in the spring and summer months when the air is most stable. June and July are fairly foggy months.

Historical and Current Land Use

Goats (*Capra hircus*) were probably introduced in 1875 by an island resident (Johnson 1975), though Raven (1963) hypothesized they arrived much earlier. Around 1877, sheep were introduced and remained there until 1934 when the Navy obtained jurisdiction of the island. Apparently crops, cattle, and horses also were raised. Many areas of the island were fenced, and it can be presumed that goat and sheep populations were managed by periodic harvests. From historical reports of bird abundance during this period, some investigators infer that substantial areas of scrub habitat were present, especially in the canyons on the precipitous east slope (Stewart et al. 1974).

The major use of San Clemente Island is for research and development, testing, and evaluation of undersea weapons and various instrumentation and communication systems. Approximately three hundred military and civilian personnel commute to the island on a weekly basis.

There are four main categories of human use on San Clemente by the Navy - weapons testing, ocean technology, fleet training, and fleet support. Thirteen underwater missile testing areas are located at sea along the island's perimeter. Off the northeast side of the island, the Naval Ocean Systems Center operates underwater tracking and test ranges as well as a marine mammal facility. The U.S. Pacific Fleet conducts training activities on various parts of the island and in offshore areas. This includes simulated aircraft carrier landing practice, ship-to-shore and aerial gunnery exercises, underwater demolition training, and amphibious exercises. Troop maneuvers involving up to 4,000 people occur periodically. Fleet support activities include ship-borne equipment testing and calibration, meteorological data acquisition, explosive ordnance disposal, and communications support (Chambers Consultants and Planners 1981b).

A shore bombardment area, which is used five days per week, year round, is located in the southernmost portion of the island. This is the only such area for ship-to-shore training for the U.S. Pacific Fleet on the west coast. Bombardment is concentrated within an approximate 2-sq mile (3 km sq) target/impact zone around China and Pyramid Coves. This area is heavily contaminated with more than 20,000 rounds of unexploded ordnance. To provide for a suitable buffer zone, the shore bombardment safety area comprises about one-third of San Clemente Island. Debris from training activities includes shell casings, schrapnel, flares and smoke bombs, parachutes, and unexploded ordnance. These activities make the area highly

susceptible to fire and the area around the target/impact zone burns frequently (Chambers Consultants and Planners 1981b). The island is not visited for recreational purposes, although considerable commercial and sport fishing occurs along the coast. No hunting is allowed.

Historical Biological Investigations

Information on the biotic condition of San Clemente Island before the 1900's is very poor. J.G. Cooper collected a few bird specimens in 1863, and some correspondence and reports by lighthouse keepers between 1850 and 1885 describe the vegetative cover and animals on San Clemente Island, but only in a superficial manner.

A major problem confronting early biologists visiting San Clemente Island was the lack of good topographic maps and reference place names. Raven (1963) points out the confusion over place names used by various botanical collectors on the island and how the lack of precision regarding these names has left some living populations unlocated until recently. Recent adoption of standardized place names for island geographic features by NAS North Island, now allows precise locating of collection or observation sites (Figure 2).

The first biological inventory of San Clemente Island was in 1885 by William S. Lyon and Joseph C. Nevin, botanists, and Thomas L. Casey, entomologist. Soon visits by local resident Blanche Trask, and by biologists T.S. Brandegee, C.H. Townsend, E.A. Mearns, L. Schoenefeldt,

and A. W. Anthony (the latter three associated with the U.S. International Boundary Commission in 1894), greatly increased biological information on San Clemente Island.

Joseph Grinnell, zoologist, made the first extensive inventory of birds on two visits, and Henry C. Fall, beetle collector, visited San Clemente Island in 1897. There are records of a total of eight visits by ornithologists to the island prior to 1900. Some of the specimens from these early 19th century collections, housed at the California Academy of Science, were destroyed in the San Francisco earthquake and fire of 1906. Twentieth century collections on San Clemente Island involved many more biologists, usually working in conjunction with academic institutions such as California Academy of Sciences, Pomona College, U.S. National Museum, University of California at Berkeley, Yale University, Los Angeles County Museum of Natural History, University of Southern California, Stanford University, and the Allan Hancock Foundation.

Nevertheless, information and quantitative data on the San Clemente Island biota are still incomplete. The last decade of biological research and survey on San Clemente Island has equaled or occasionally exceeded those discoveries made between 1885 and 1970. This is principally because of the greater effort and civilian accessibility to the island and its many habitats. The implementation of the Natural Resources Management Program in 1972 has permitted an inventory of the island for the last decade through all seasons and various climatic conditions.

The availability of a research field station, field vehicles, a small boat capable of island circumnavigation, and an occasional helicopter reconnaissance has resulted in a substantial increase in the knowledge of the range of the plants and animals known on the island.

Accounts of the condition of San Clemente Island from early surveys (particularly in 1885), indicate a much more luxuriant vegetation and diverse fauna than now seen. Earlier reports from about 1873 demonstrate that malva rosa (Lavatera assurgentiflora) trees up to 12 feet (4 m) high and trunks one foot (0.3 m) in diameter "constituted an unbroken forest extending for miles upon the high plateaus" (Lyon 1886). Also prior to 1885, Dudleya virens occurred throughout the entire island, but was eaten by sheep and subsequently declined (Raven 1963). Many native shrub and tree species probably occupied large areas of maritime sage scrub, woodland, and perhaps chaparral vegetation; the latter is now virtually extirpated.

Several species now presumed extinct on the island that were collected around the turn of the century have not been rediscovered. Island lomatium (Lomatium insulare), Santa Catalina box thorn (Lycium hassei), and California dissanthelium (Dissanthelium californicum) are among the several plants last collected on the island early in this century; the latter two species are presumed extinct.

Scrub vegetation was presumably much more extensive a century ago than it is now. Grasslands dominated by native perennial species probably

formed an important part of the vegetation. Island races of bird species that were once relatively common have either been extirpated on San Clemente Island or are now rare, such as the San Clemente Island song sparrow (Melospiza melodia clementae), San Clemente Island Bewick's wren (Thryomanes bewickii leucophrys) and San Clemente Island rufous-sided towhee (Pipilo erythrophthalmus clementae). Historic accounts also show that use of the island by certain raptor species has declined. The feeding and other activities of goats are directly responsible for the loss of these resources (Raven 1963, Jones 1973, Stewart et al. 1974, Coblentz 1977). A contributing factor in the destruction of the vegetation and wildlife habitat may have been man-caused fire, but even with the absence of widespread feral goats, fire would not be expected to destroy the native vegetative cover so extensively as the goats have (Chambers Consultants and Planners 1981a).

Vegetation Communities

Accounts of the vegetation of San Clemente Island and other California Channel Islands have been reviewed and expanded in numerous research publications (Dunkle 1950, Bacigalupi 1963, Raven 1963, Axelrod 1967a and 1967b, Philbrick 1967 and 1980, Thorne 1969, Philbrick and Haller 1977, Brumbaugh 1980, Minnich 1980, Sward and Cohen 1980). Some of these concentrated on the vegetation (i.e., structure and groupings of the species composing the plant cover) while others, the floristics (i.e., taxonomy, endemism, uniqueness and geographical affinities of the species).

Among the Channel Islands, San Clemente Island harbors the highest number of endemic plants (Raven 1967). Table 1 details the endemic flora of San Clemente Island (as well as Santa Barbara and San Nicolas Islands). The present day distribution of these species on the island is discontinuous and confined to scattered populations, some varying from a few individuals to large colonies.

The vegetation of the island consists of diverse assemblages of herbs, shrubs, and trees. Annual grassland herbs are dominant in all of the present vegetation types. Many grasses and broad leaf herbs are introduced Old World species that are well adapted to intense grazing. Prominent native cacti include the low growing prickly-pears (*Opuntia* spp.), chollas (*Opuntia* ssp.), and snake cactus [(*Bergerocactus* (=*Cereus*) *emoryi*]. Native shrubs and trees are restricted essentially to precipitous hillsides along the eastern escarpment and several deep canyons on the western slope, presumably because of the protection afforded by these areas from goats and fires. Virtually no reproduction of these woody species occurs in areas inhabited by goats. The mapped vegetation types (Figure 3) are discussed below; characteristic species are listed in Table 2. Several introduced herbaceous species listed under "disturbed" or "grassland" are also common in other vegetation types.

Table 1. Endemic Flora of San Clemente, San Nicolas, and Santa Barbara Islands.

SAN CLEMENTE ISLAND SPECIES

SCIENTIFIC NAME	STATUS*	REMARKS+
Astragalus nevinii	1	Occasional in stabilized sandy areas.
Brodiaea kinkiensis	1	Common in grassland above 1,000 feet.
Camissonia guadalupensis spp. *clementina*	1	Common in sand dunes.
Castilleja grisea	E	Scattered in canyons on eastern escarpment and south end.
Delphinium kinkiense	E	Grasslands on east edge in six locations.
Delphinium variegatum spp. *thornei*	1	Only one known population.
Eriogonum giganteum var. *formosum*	1	Canyon walls and near Wilson Cove.
Galium catalinense spp. *acrispum*	1	Canyon walls and near NOTS pier.
Lithophragma maxima	1	Shaded canyons on eastern escarpment.
Lotus argophyllus ssp. *adsurgens*	1	Only a few immature individuals (total less than 25) known from 2 or 3 areas around Pyramid Cove.
Lotus dendroideus ssp. *traskiae*	E	Only 8 locations known.
Malacothamnus clementinus	E	Only 2 locations known.
Munzothamnus blairii	1	Canyon walls.
Triteleia clementina	1	Canyon walls.
Artemsia nesiotica	-	Santa Barbara, San Nicolas Islands.

Table 1 (cont.)

Cryptantha traskiae	1	San Nicolas Island
Eriophyllum veninii	2	Santa Barbara Island
Lomatium insulare	-	San Nicolas Island.
Lotus argophyllus ornithopus	-	Santa Barbara and San Nicolas Islands.
Malacothrix foliosa	-	Santa Barbara and San Nicolas Islands.
Phacelia floribunda	1	Santa Barbara Island.
Trifolium palmeri	-	San Nicolas Island.
Amsinkia spectabilis var. *nicolae*	-	San Nicolas Island.
Eschscholzia ramosa	-	Santa Barbara and San Nicolas Islands.
Hemizonia clementina	-	Santa Barbara and San Nicolas Islands.
Jepsonia malvifolia	-	San Nicolas Island.

Key for Table 1:

* - U.S. Fish and Wildlife Service status (45 *Federal Register* 82580, December 15, 1980)
1 - Taxa under review, Category 1 - enough biological data for listing.
2 - Taxa under review, Category 2 - biological data insufficient to support a listing.
E - Federally-designated Endangered species.

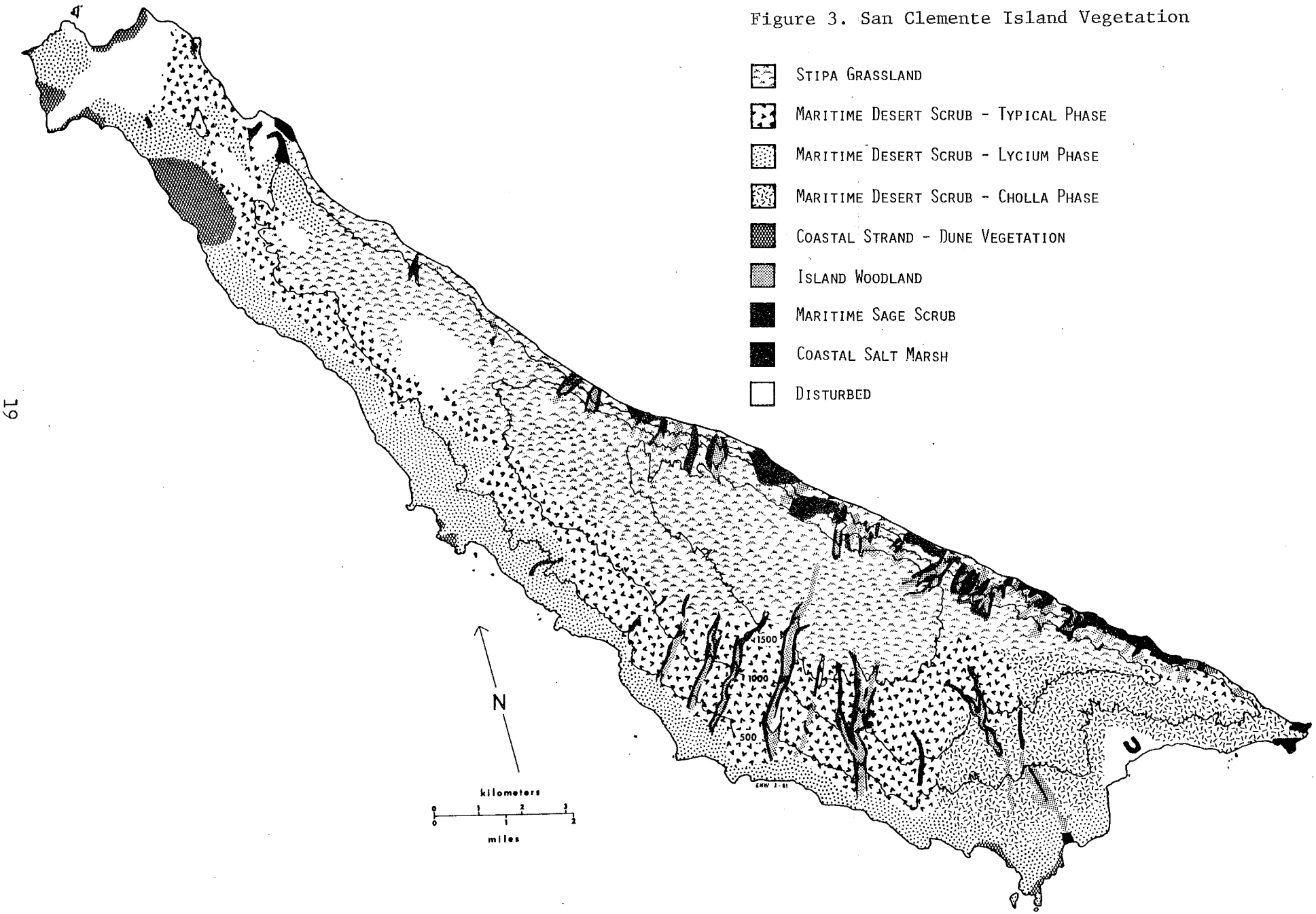


Figure 3. San Clemente Island Vegetation

Table 2. Vegetation Types and Their Characteristic Species of San Clemente Island

COASTAL STRAND AND DUNE

Abronia maritima
Abronia umbellata
Ambrosia chamissonis ssp.
Astragalus miguelensis

*Atriplex semibaccata

Atriplex leucophylla
*Cakile maritima
Camissonia cheiranthifolia
Camissonia guadalupensis ssp. clementina
Frankenia grandifolia
Heterotheca grandiflora
Suaeda california

MARITIME DESERT SCRUB - LYCIUM PHASE

Amblyopappus pusillus
Bergerocactus emoryi
Lotus argophyllus ssp. ornithopus
Lycium californicum
Mirabilis californica
Opuntia littoralis
Opuntia prolifera
Selaginella bigelovii

Senecio lyonii

MARITIME DESERT SCRUB - TYPICAL PHASE

Lotus argophyllus ssp. ornithopus
Mirabilis californica
Opuntia littoralis
Selaginella bigelovii

MARITIME DESERT SCRUB - CHOLLA PHASE

Opuntia prolifera
Selaginella bigelovii
Euphorbia misera
Perityle emoryi

MARITIME SAGE SCRUB

Artemisia californica
Artemisia nesiotica
Encelia californica
Eriogonum giganteum ssp. formosum
Eriogonum grande ssp. grande
Eriophyllum nevinii
Galvezia speciosa
Hazardia cana
Isomeris arboreus
Rhus integrifolia

GRASSLAND

*Atriplex semibaccata
*Avena barbata
*Bromus mollis
*Bromus rubens
Crassula erecta
Dichelostemma pulchellum
*Eriodium cicutarium
*Festuca spp.
*Galium aparine
*Mesembryanthemum (= Gasoul) crystallinum
*M. nodiflorum
*Hordeum spp.
*Lamarkia aurea
Lasthenia californica
Lepidium lasiocarpum
Lupinus spp.
*Malva parviflora
*Medicago polymorpha
Microseris spp.
Pectocarya linearis
*Plantago erecta
*Silene gallica
Spergularia macrotheca
Stipa pulchra
Trifolium spp.

* - denotes non-native taxa

Table 2 (cont.)

ISLAND WOODLAND

Avena spp.

Bromus spp.
Cerastium viscosum
Heteromeles arbutifolia
Lyonothamnus floribundus ssp. *asplenifolious*
Montia perfoliata
Prunus lyonii
Quercus tomentella
Stellaria media
Sambucus mexicana

COASTAL SALT MARSH

Atriplex lentiformis ssp. *breweri*
Distichlis spicata
Frankenia grandiflora
Salicornia sp.

Suaeda californica

DISTURBED AREAS

**Atriplex semibaccata*
**Avena* spp.
**Brassica* spp.
**Bromus* spp.
**Carpobrotus edulis*
**Ehrharta* sp.
**Erodium* spp.
**Gasoul crystallinum*
**Gasoul nodiflorum*
**Hordeum* spp.
**Lamarkia aurea*
**Lolium* spp.
**Malva parviflora*
**Medicago polymorpha*
**Melilotus* spp.
**Nicotiana glauca*
**Raphanus raphanistrum*
**Salsola iberica*
**Sisymbrium irio*
**Sonchus* spp.

* - denotes non-native taxa

Coastal Strand and Dunes

Coastal strand and dune vegetation is restricted to small areas along the south and northwest coasts of the island. Predominantly associated with sandy substrates, several species typical of this vegetation type also occur in scattered rocky areas behind beaches. Introduced iceplant [*Mesembryanthemum* (= *Gasoul*) *crystallinum*] and grasses are abundant.

Maritime Desert Scrub - Lycium Phase (MDS-LP)

The lowest wave-cut terraces along the southern and western shores support a mixture of low growing, dry-season deciduous shrubs [predominantly box thorn and ragwort (*Senecio lyonii*)] and cactus. Areas east of Pyramid Cove contain maritime sage scrub species, predominantly brittle-bush (*Encelia californica*) and coastal sagebrush (*Artemisia californica*). Scattered occurrences of the endangered *Castilleja grisea* and *Lotus dendroideus* var. *traskiae* are found in the area. Introduced iceplant and grasses, as well as a native stonecrop (*Crassula erecta*), are common between the shrubs.

Maritime Desert Scrub - Typical Phase (MDS-TP)

The community is dominated by dense patches of coastal prickly-pear (*Opuntia littoralis*), which serve as protected refugia for a variety

of herb and shrub species from grazing goats. Cacti are scattered throughout all upland vegetational types.

Grassland species may be seasonally abundant in areas where sufficient soil is present. Overgrazing and animal transport of loose cactus stems or seed may have expanded the range and density of maritime desert scrub over much of the island.

Maritime Desert Scrub - Cholla Phase (MDS-CP)

This vegetation phase is particularly well developed on the hotter, south-facing slopes, mostly at the southern end of the island. It is characterized by coastal cholla (*Opuntia prolifera*), but box thorn (*Lycium californicum*) and cunado (*Bergerocactus emoryi*) also occur as minor elements of this phase. Transport of cholla stems by feral animals and birds may have expanded and intensified the distribution of this vegetation type on San Clemente Island.

Maritime Sage Scrub (MSS)

This vegetation association occurs in scattered patches on steep slopes along the eastern escarpment and in a few canyons on the west side. A few dense shrubby patches of lemonadeberry (*Rhus integrifolia*) occur on relatively level ground on both sides of the island. The outer margins of the patches generally show effects of intense goat browsing.

Small enclaves of these and other less common shrub species grow in many precipitous, scattered locales. These are thought to be remnants of a formerly more prominent and contiguous vegetation that presumably covered parts of the nearby slopes and marine terraces where goat grazing currently permits only cactus scrub to persist (Stewart et al. 1974, Coblentz 1977 and 1978, Raven 1963).

During the period when maritime sage scrub covered large areas of the island, this vegetation included a significant component of chaparral shrubs such as chamise (Adenostema fasciculatum), California lilac (Ceanothus megacarpus), Catalina crossosoma (Crossosoma californicum), island tree poppy (Dendromecon rigida subsp. rhamnoides), toyon (Heteromeles arbutifolia), laurel sumac [Rhus (=Malosma) laurina], Catalina cherry (Prunus lyonii), buck thorn (Rhamnus pirifolia), blue elderberry (Sambucus mexicana), and poison oak (Toxicodendron diversilobum). This chaparral community was perhaps similar to the vegetation observed on nearby Santa Catalina Island. These chaparral taxa were probably once a significant part of the island vegetation, but currently grow only as isolated and widely scattered, mature individuals (often browse-damaged). Several of these taxa have apparently been extirpated. The analogy with other islands is unmistakable; these plants are casualties of feral goats just as has been documented on nearby Santa Catalina Island and in the Galapagos Islands (Raven 1963, Coblentz 1975, Hamann 1975, 1979, Center for Natural Areas 1976, Sward and Cohen 1980, Ferguson[1] pers. comm.).

[1] Howard Ferguson, Botanist, Naval Air Station North Island, San Diego, CA.

Grassland

Grasslands cover much of the central uplands of the island. These areas are largely dominated by exotic annual herbs, but scattered native wildflowers also exist. Although heavily grazed and with thin and eroded soils, the habitat still supports significant populations of native perennial needlegrass (*Stipa pulchra*), larkspur (*Delphinium variegatum* subsp. *thornei*, *D. kinkiense*), and brodiaea (*Brodiaea kinkiensis*).

The former extent of the native grassland may never be precisely reconstructed or determined. Nonetheless, the intense grazing by goats and sheep, resultant soil loss, and the presence of many introduced annual species adapted to heavily grazed conditions doubtlessly has reduced the historic abundance of many native species. The succulent perennial grass, *Dissanthelium californicum*, is apparently now extinct as the result of these processes (Raven 1963, Center for Natural Areas 1976, Coblentz 1975 and 1977, Hamann 1975, 1979, Sward and Cohen 1980, Ferguson pers. comm.).

In addition to goats, feral pigs also graze the herb growth. More significantly, they "root" up the soil to obtain and feed on the fleshy underground parts of plants such as wild-hyacinth (*Dichelostemma pulchellum*) and brodiaea. Within these disturbed areas, non-indigenous annuals are probably at a competitive advantage over native species (Center for Natural Areas 1976, Wood and Barrett 1979, Ferguson pers. comm.).

Island Woodland

This is the only tree vegetation type on the island and includes Catalina cherry, Catalina ironwood (*Lyonothamnus floribundus*), island oak (*Quercus tomentella*), blue elderberry, and toyon. Scattered occurrences of these trees in the western and eastern canyons constitute remnants of a formerly more extensive woodland. The groves are open assemblages of old trees. Typically the canopy closure of the groves is incomplete yet seedlings or young trees are not present (Raven 1963, Stewart et al. 1974, Sward and Cohen 1980, Chambers Consultants and Planners 1981a, and Ferguson pers. comm.).

Goats congregate in the groves and around solitary trees. Undergrowth such as shrubs, sprouts or seedlings is completely absent in these areas. The trees are browsed as high as 6 feet (2 m), the extent of a goat's reach. In some locations goats climb into the trees and browse the canopy. Humus does not accumulate in such groves. The trampling of soil by goats and pigs exposes tree roots and contributes to the death of trees. Barren mineral subsoil or bedrock predominates, and, except during the most active growing season, nearly all herbaceous growth under the trees is consumed or trampled (Coblentz 1975, Sward and Cohen 1980, and Ferguson pers. comm.).

Coastal Salt Marsh

Two small marsh areas occur behind the beaches at the mouths of Chenetti and Horse Beach Canyons on the south end of the island.

Because they are within or adjacent to the impact zone of the shore bombardment range, botanical investigation of these areas has been very limited recently. Although pre-1900 botanical investigation (which concentrated on the south end) did not report it, pickleweed (Salicornia subterminalis) occurs about the margins of the island and within these marshes. Alkali heath (Frankenia grandifolia), saltgrass (Distichlis spicata), and sea-blite (Suaeda californica) are additional associates. No insular endemic botanical species are known to be associated with this vegetation type.

Disturbed Areas

Wherever the activities of man or nature scarify, rearrange and recontour land forms, a variety of naturalized non-indigenous species usually are the first and dominant colonizers. Most disturbance-associated plants on the island are native to the Old World, where they are an integral part of the native landscape that has been intensely disturbed by human activities and grazing animals for thousands of years.

In a generalized scenerio, a recently adventive species grows first in ruderal areas near the site of its initial establishment and then disperses into nearby disturbed areas. Eventually it may significantly cover otherwise bare ground between existing native plants. Many of the exotic species initially reported in a few spots on the island over a century ago are now common throughout most habitats. Some species, however, have become established since the

last flora of the island was published in 1963. These species are limited to ruderal areas and adjacent habitats (Raven 1963, Thorne 1969, Sward and Cohen 1980, Chambers Consultants and Planners 1981a, Ferguson pers. comm.).

Figure 3 depicts only relatively large areas of ruderal habitat. The many small or narrow strips of ruderal vegetation along roads, and near sporadically used areas are not indicated. The environmental effects of human disturbance are similar to those disturbances brought about by large numbers of goats and pigs. Consequently, areas other than those designated as "disturbed" on Figure 3 seasonally may function as ruderal habitat and are susceptible to colonization by additional non-native species. Many of the non-indigenous species that characterize ruderal areas may also occur in other areas of the island and, thus, the spread of several of these species into a variety of habitats might be imminent and inevitable.

Fauna

Terrestrial Invertebrates

Little work has been formally published concerning the invertebrate fauna of San Clemente Island. Of special interest are the land snails. Several snail species of the genus *Micrarionta* (*M. intercisa*, *gabbi*, and *redimita*) inhabit only San Clemente Island. These species also are well represented in the fossil fauna of the island. The

former two species are scattered in patches within prickly-pear desert scrub community, while the latter seems to be restricted to small patches of maritime sage scrub (Roth 1975). These endemics have been proposed, evaluated, and rejected for Endangered or Threatened status because their populations appear to be well above the critical level and their habitats are not in immediate jeopardy.

Three California Channel Islands endemic snail species occur on San Clemente Island: Vertigo californica longa (found also on Anacapa, San Miguel, and Santa Barbara); Vertigo californica catalinaria (found also on Anacapa, San Miguel, and Santa Catalina); and Sterkia clementina (also found on Santa Barbara Island). Two other snail species, Quickella rehderi and Catinella oregonensis, are evidently identical to those on the mainland (Kanakoff 1950, Cohen 1980, National Park Service 1980a).

The insect fauna on San Clemente Island is relatively depauperate, but endemism is high, especially in the Diptera and Orthoptera orders. Over twenty endemic species (no endemic genera) are found on the island. Among these are unique forms of grasshoppers, crickets, beetles, flies, and wasps (Miller and Menke, 1981).

Of the Hymenoptera (bees, ants, and wasps), the species Anthophora (=urban) clementina was described by Cockerall (1939) from specimens gathered on San Clemente Island. This species now appears to be only a subspecies of A. urbana, which is native to the coastal margin of California. Phobetus (= testaceous) ciliatus, a species of

Scarabaeidae beetle described from San Clemente Island by Barrett, is now known to exist in other areas. The only truly endemic Hymenoptera present on the island is in the robber fly family Asilidae, Efferia (=Erax clementi) described by Wilcox and Martin (1945). In fact, until recently when Powell and Faulkner surveyed the island, only the original type specimens had ever been collected.

The Lepidopteran fauna of the island, especially the Rhopalocera, is extremely depauperate. In all, twelve species of butterflies have been recorded from the island: Erynnis funeralis, Papilio zelicaon, Pieris rapae, Strymon melinus, Celastrina argiolus, Brephidium exilis, Vanessa annabella, V. cardui, V. virginiensis. Of these species, only members of the genus Vanessa (thistle butterflies or painted-ladies) have been observed and collected frequently at many localities on the island.

The reason(s) for the lack of insect diversity on the island is unknown at present, but could in part be a result of the loss of vegetation cover and/or host plants that has occurred following the introduction of pigs, goats, and sheep. As reflected by the Rhopalocera example, there are currently no endemic species or subspecies of butterfly known from the island. This is not easily explained considering the diversity and degree of endemism of the flora. All species of butterflies recorded from the area are also commonly encountered both on the other Channel Islands and the adjacent mainland.

Reptiles

Only two lizard species (and no amphibians) are found on San Clemente Island. The side-blotched lizard (*Uta stansburiana*) inhabits most of the other Channel Islands as well as the mainland. The island night lizard (*Xantusia riversiana*) is endemic to two other California Channel Islands.

Birds

The avifauna of the island includes about 240 species (Jorgensen[1] pers. comm.). Approximately 30 marine-associated and terrestrial species breed or have bred on San Clemente Island. The remainder of species are mainly migrants or visitors to the island.

Horned larks (*Eremophila alpestris*) and western meadowlarks (*Sturnella neglecta*) are abundant on San Clemente Island, presumably because of the large expanse of grassland habitat. White-crowned sparrows (*Zonotrichia leucophrys*) occur in large numbers on San Clemente Island as winter migrants. American kestrels (*Falco sparverius*) also appear to be numerous, perhaps the result of the overgrazed condition which has resulted in increased foraging habitat. Gambel's quail (*Lophortyx gambelii*) and the exotic chukar (*Alectoris chukar*) have been introduced and are thriving.

[1] Paul Jorgensen, Wildlife Biologist, Naval Air Station North Island, San Diego, CA

The relatively undisturbed beaches and rocky shoreline provide excellent foraging and resting habitat for many migrating and visiting waterbirds. Western gulls (Larus occidentalis), Brandt's cormorant (Phalacrocorax penicillatus), California brown pelicans (Pelecanus occidentalis californicus), royal terns (Sterna maxima), and a variety of small shorebirds roost on off-shore rocks. Western gulls and Brandt's cormorants breed on several cliffs and off-shore rocks. Seal Cove is the only known breeding site on San Clemente Island for black oystercatchers (Haematopus bachmani). Seal Cove and China Point both offer good breeding habitat for Xantus' murrelets (Endomychura hypoleuca), although there is only one breeding record (Jorgensen pers. comm.).

Native Mammals

The mammalian fauna of San Clemente Island is depauperate. A variety of bat species that are common on the mainland have also been reported from San Clemente Island (von Bloeker 1967, Brown 1980), such as California myotis (Myotis californicus), fringed myotis (Myotis thysanodes), western big-eared bat (Plecotus townsendii), and Mexican free-tailed bat (Tadarida brasiliensis).

The endemic deer mouse (Peromyscus maniculatus clementis) is most often observed in the maritime desert scrub - typical phase grassland vegetation where it is most abundant during the spring and early summer. It is important in the diet of owls, hawks, kestrels, shrikes, and foxes, and probably feral house cats (Felis catus) and

pigs. Undoubtedly the activities of goats adversely affect their food and cover resources (von Bloeker 1967).

Island fox (Urocyon littoralis) inhabits most of the island. The fox feeds on seeds and fruits, marine and terrestrial birds (including nestlings and young), carrion, garbage, and rodents. No current estimate of the fox population on the island is available, but relative to the San Nicolas and Santa Catalina Island populations those on San Clemente Island maintain healthy numbers and are observed commonly within all habitats (Laughrin 1973 and 1977, Chambers Consultants and Planners 1981a, and Larson[1] pers. comm.).

Non-native Mammals

Some mammals and plants, generally believed to be native, may actually have been imported to San Clemente Island by American Indians. The immigration of European man eventually resulted in wholesale modification of the ecosystem through introduction and subsequent release or escape of exotic plant species and domestic animals (goats, sheep, pigs, cattle, horses, burros, dogs, and cats). In addition, earthmoving, construction, maintenance, and operation of facilities continue to reduce the native biota locally and over extensive areas.

Incidental introduction of western harvest mouse (Reithrodontomys megalotis longicaudus), California vole (Microtus californicus

[1] Jan Larsen, Natural Resources Manager, Naval Air Station North Island, San Diego, CA

sanctidiegi), Old World house mouse (Mus musculus), and rat (Rattus sp.) occurred during the last century (von Bloeker 1967). House mouse populations predominate in habitats created by man (e.g., around buildings, dumps or debris). The status of the other species is currently unknown.

Cats were introduced by man during the sheep ranching period. They are now found throughout the island, but are particularly noticeable in the Wilson Cove area where they are kept as pets. Cats also occur on several of the other California Channel Islands. The current feral cat population on San Clemente Island is estimated at 600 to 800 animals (Larson pers. comm.). Cats are most frequent around dumps, outdoor trash cans, and human habitation. They are known to take slow-moving night lizards and roosting/nesting marine birds (Lonquich 1979).

Mule deer (Odocoileus hemionus), introduced around 1962, were established on the northern portion of San Clemente Island. As has been observed on Santa Catalina Island (Center for Natural Areas 1976, and Chambers Consultants and Planners 1981a), deer have had severe impacts on island vegetation. Their numbers have been periodically reduced by hunters, and currently five or fewer may still be present on the island (Larson pers. comm.).

Feral pigs (Sus scrofa) were introduced on San Clemente Island in the 1950's, presumably from stock on Santa Catalina Island (Stewart et al. 1974). Although once numbering about 1,000 animals, their current

population is estimated at less than 100 as a result of periodic hunting and the current Feral Animal Removal Program (Larson pers. comm.).

Pigs are wary, seek refuge in dense shrub cover during the heat of the day, and are active either day or night. They are omnivorous and, thus, will eat almost anything having food value, such as vegetation (foliage as well as fruits, bulbs and seeds), invertebrates, reptiles, mice, ground-nesting birds and eggs, and carrion. They feed heavily on cholla (Opuntia littoralis) particularly in summer and fall. Acorns are a high food value resource for which pigs actively compete with goats. In the absence of introduced animals, the acorns probably would be used by native deer mice, foxes, and a variety of birds. During winter and spring pigs commonly graze areas of dense herbaceous vegetation. Although free water is important, pigs may survive seasonal dry periods using moisture-rich foods and occasional drinks from meager seeps. During the dry season pigs are seldom observed more than a half mile away from such seeps.

Scientific studies have been conducted on various aspects of the ecology and impacts of feral goats on mainland areas in many parts of the world and on coastal and oceanic islands, including the Galapagos, Hawaii, New Zealand, and nearby Santa Catalina. Studies on goats in the Galapagos and on Santa Catalina Island include original reports by Coblentz (1977), Hamann (1975 and 1979), and several review papers by Adamus (Center for Natural Areas 1976) and Coblentz (1975 and 1978).

San Clemente Island's goats have intermingled with domestic goats introduced during the sheep ranching period and with feral goats introduced from Santa Catalina Island as recently as the 1950's. They are indistinguishable from these latter goats, and are in no way unique or unusual among feral goats which occur throughout the world.

During the sheep ranching period (1877 to 1934) on San Clemente Island, goats were shot by sheepherders for target practice and recreational hunting because they were thought of as pests that competed with the sheep for available forage and damaged the range. This habitual shooting reduced their numbers significantly and temporarily lessened their impact on the island ecosystem. After sheep ranching was discontinued, goat herds were left uncontrolled except for occasional localized shooting (Meadows[1] pers. comm.).

Between 1972 (when the estimated goat population was 10,000) and 1977 (when an estimated 1,500 remained), the Navy removed more than 16,000 goats from the island. Over 12,000 were taken by a variety of herding and live trapping methods (1972 through 1975), while an additional 4,000 were taken in a year-long sport hunting program (1976 to 1977). The current population (1983) is down to about 400 animals as result of an active trapping program under contract with the Navy.

Goats occur in all habitats on the island. Herds of 100 or more individuals were once found along the precipitous eastern escarpment

[1] Donald Meadows, Los Angeles County Museum of Natural HIstory, Los Angeles, CA.

and around the steep-sided canyons and upper marine terraces, mostly on the southern half of the island. Goat herds occupy traditional home ranges that may encompass 1 to 2 square miles and out of which they seldom stray. They establish habitual bedding grounds to which they return nightly, eventually rendering these areas nearly barren and prone to erosion. Goats follow a series of established trails across slopes, clearing them of all vegetation through feeding and trampling. The compacted soil of these paths also acts to focus and channelize runoff, thereby accelerating erosion and further degrading the habitat.

Goats are capable of subsisting on a broad range of forage. They first consume the higher quality grasses and forbs. Later, they utilize the lowest quality, coarse range stubble, as well as bitter, oily shrubs shunned by other ungulates. Feral goats can persist on severely degraded ranges where no other such animals can find sufficient sustenance, thereby excluding other ungulates (e.g., deer) by suppressing high quality forage species. Eventually, even coarse bitter, woody plants may be eliminated. Their relatively low requirement for free water, particularly when plants such as cactus are available, assists them in maintaining substantial populations even in a desert environment.

In summary, feral goats on San Clemente Island severely compete with native fauna for food resources. Further, they destroy cover and essential breeding habitat (particularly dense shrub) for several bird species. A few native species, such as the endemic race of horned

lark (Eremophila alpestris insularis), rock wren (Salpinctus obsoletus), and dove weed (Eremocarpus setigerus) (the latter two species common throughout the region) may have benefited by goat grazing. Nevertheless, most native and unique biotic resources are disadvantaged or eliminated by the goats. This degradation process is well advanced with several endemics, including the San Clemente Island rufous-sided towhee, San Clemente Island Bewick's wren and California dissanthelium apparently going extinct from the island as a direct or indirect result of goat activity. Grazing activities of goats continue to threaten several other endemic plant and animal species with a similar fate.

Overview of Conditions: San Nicolas Island

San Nicolas, one of the three California Channel islands inhabited by the Island Night Lizard, is located approximately 75 mi (120 km) southwest of Los Angeles. This 22.2 square mi (36 sq km) island is under the jurisdiction of the U.S. Navy. It is oval in shape with a maximum length of 9.7 mi (16 km). The highest point on the island is 907 ft. (275 m). The island is mainly comprised of Pleistocene and Eocene marine sedimentary deposits and rock outcrops (Vedder and Howell 1976).

Climatologically, San Nicolas has relatively warm, wet winters and cool, dry summers. The average mean monthly temperature is 60.4°F (16°C). Precipitation varies from 5.4 in to 17.8 in (13.7 to 45.2 cm). Fog is present 10% of the time and most frequently occurs on the

western end of the island. During the 19th century sheep and goats were released on San Nicolas. Their activities undoubtedly modified the native flora substantially. There is some evidence that overgrazing resulted in the extinction of at least several endemic plant species. By the end of World War II, the goats and sheep had been removed (Foreman 1967).

In 1933, San Nicolas Island came under Navy jurisdiction. It has served as a weather station and bombing/gunnery range. In 1945, San Nicolas became a proving ground for Point Mugu Naval Air Station and is now under the jurisdiction of the Pacific Missile Test Center at Point Mugu (Foreman 1967).

Human uses of the island include those associated with military operations (airfield, roads, buildings, missile launch sites etc.) (See Figure 4). Fire and sand abatement activities as well as soil erosion have also contributed to modification of the native flora.

The plant communities on San Nicolas Island are characterized as salt marsh, coastal strand/sand dune, *Lycium* - *Lupinus*, *Lupinus*-mixed shrub, *Malacothrix*, *Coreopsis*, *Baccharis*, grassland, *Mesembryanthemum*, and mesophytic (Figure 5). Species composition details for each of these communities are provided in Foreman (1967).

The majority of San Nicolas Island is covered by low-lying vegetation consisting primarily of annual herbs such as slender wild oat (*Avena barbata*), various brome grasses (*Bromus* spp.), bur-clover (*Medicago*

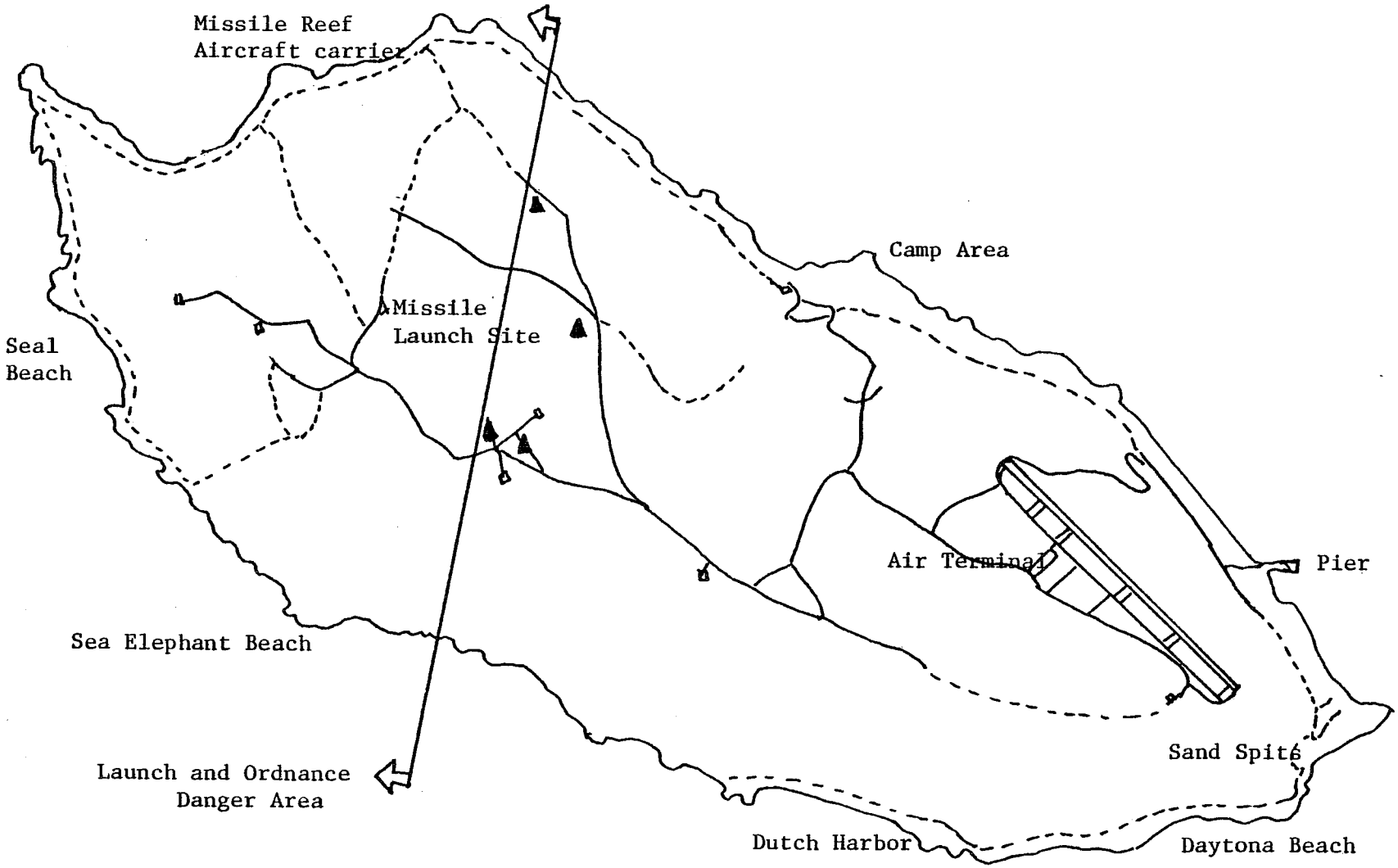
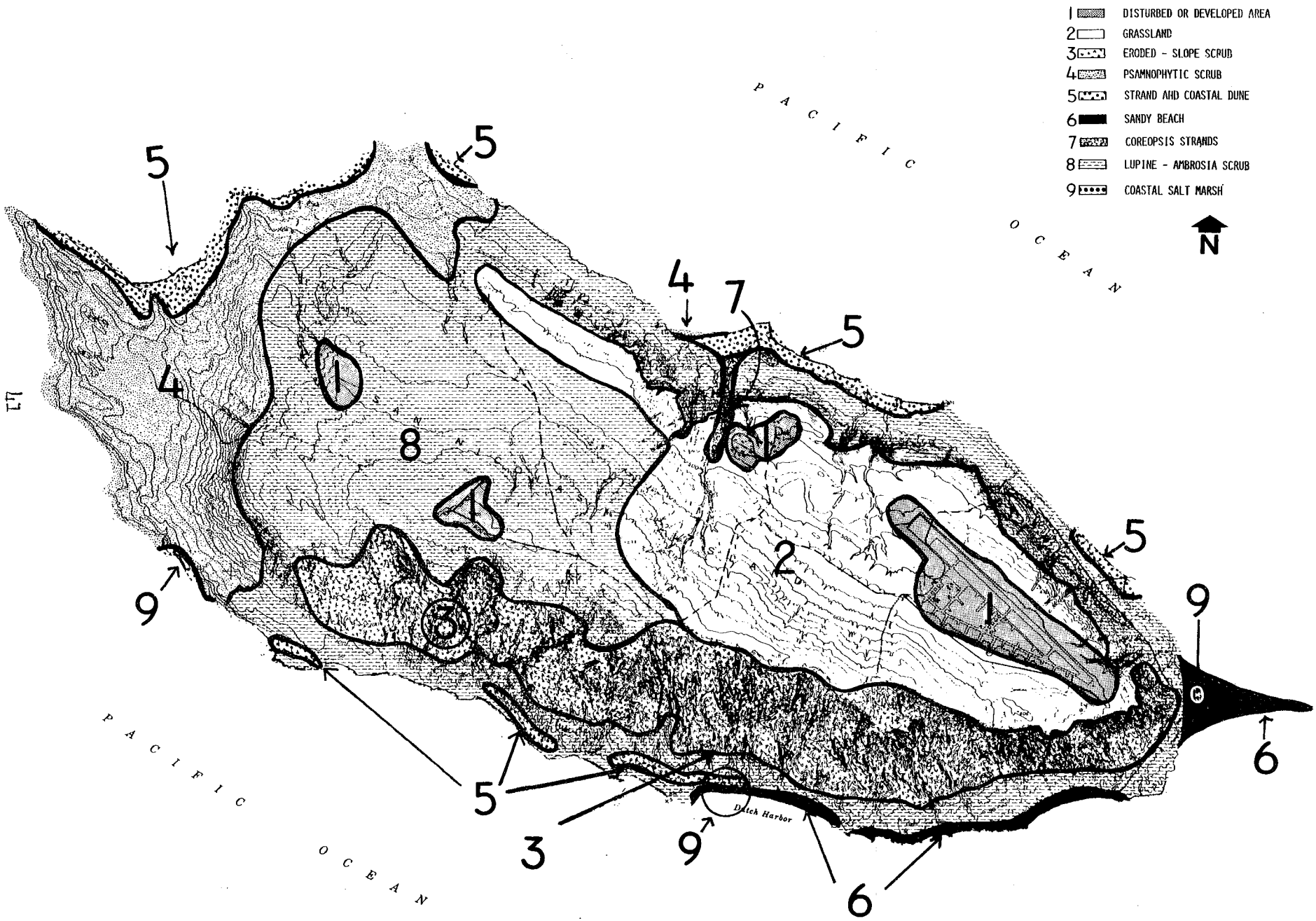


Figure 4. San Nicolas Island (Pacific Missile Test Center) localities.

------ Dirt Road
——— Paved Road

Figure 5. Plant Communities of San Nicolas Island (Westec 1978)



polymorpha), and others. Iceplant (Mesembryanthemum crystallinum and M. nodiflorum) has spread over large areas. Over most of the island, except for the northwestern end, morning-glory (Calystegia macrostegia subsp. macrostegia) is widespread. Lupine (Lupinus albifrons) is an ubiquitous and dominant perennial. Within the canyon slopes of the seaward side, Malacothrix saxatilis var. implicata is dominant (Foreman 1967).

Non-native grassland is now established in the central portion of the island. Sandy areas and some of the sparsely vegetated sites support a locoweed (Astrgalus) - lupine association. Sand dune habitats are similar to mainland coastal strand associations.

In more protected areas, especially on the northeast side of the island, coreopsis (Coreopsis gigantea) is found. Malacothrix saxatilis dominates the sparse vegetation located on the southwestern side of San Nicolas. Along the eastern end of the island, a small coastal salt marsh community flourishes.

Extant native species include the island poppy (Eschscholzia ramosa), beach morning-glory (Calystegia soldanella), and island malacothrix (Malacothrix incana). A list of endemic island flora is found in Table 1.

There are two mammalian subspecies unique to San Nicolas Island: the island deer mouse (Peromyscus maniculatus exterus), and island fox (Urocyon littoralis dickeyi). Along with the island night lizard,

these three taxa comprise the entire native terrestrial vertebrate fauna. Significant breeding populations of California sea lion (Zalophus californicus) and northern elephant seal (Mirounga angustirostiris) inhabit primarily the southern and western portions of San Nicolas Island. Steller's sea lion (Eumetopias jubata) and harbor seal (Phoca vitulina) are present. Exotic vertebrates include the side-blotched lizard (Uta stansburiana), alligator lizard (Gerrhonotus multicarinatus,) and feral cats.

Avian species include the nesting western gull and Brandt's cormorant, as well as typical seabirds of southern California. Terrestrial avian species include the American kestrel, horned lark, western meadowlark, chukar (introduced), common raven, and rock wren (Westec Services, Inc. 1978).

Overview of Conditions: Santa Barbara Island

The third island on which island night lizard occur is Santa Barbara Island, including the associated Sutil Island. Santa Barbara Island is triangular in shape, 1.5 mi (2.4 km) long and a maximum of 1 mile (1.6 km) wide. Along with associated islands, the Santa Barbara Island complex comprises roughly 263 ha. It is part of the Channel Islands National Park and is under the jurisdiction of the National Park Service (NPS).

Facilities on Santa Barbara Island are basically limited to a Quonset hut (quarters for the island's ranger), a small campground with picnic

tables and toilets, water and fuel tanks, and a primitive dock. Visitors are requested to stay on established trails.

Santa Barbara Island is bounded by rugged, precipitous cliffs. Prominent marine terraces are located along the east, northeast, and northwest sides of the island. Signal Peak, the highest point, is 634 ft (194 m) above sea level.

The average yearly precipitation is between 8-10 in (20-25 cm) (Power 1979). Climatologically, Santa Barbara Island is much like San Clemente Island and San Nicolas islands. There is no permanent water on the island.

The vegetation communities on Santa Barbara Island consist of: coastal bluff vegetation, iceplant, sea-blite, coastal sage scrub, maritime cactus scrub, and island grassland communities (National Park Service 1980b). Bare ground is present to a limited degree. The distribution of these communities is given in Figure 6.

For the past 130 years on Santa Barbara Island introduced herbivores [the European rabbit (Oryctolagus cuniculus) and feral goats], exotic plants, and agriculture practices have vastly modified the native vegetation. For example, the introduced crystalline iceplant (Memsembryanthemum crystallinum) is dominant over large areas of the island. Only reduced stands of the once widespread giant coreopsis remain. The grassland areas are dominated by exotic grass species while the shrub cover has been drastically reduced. On warmer slopes,

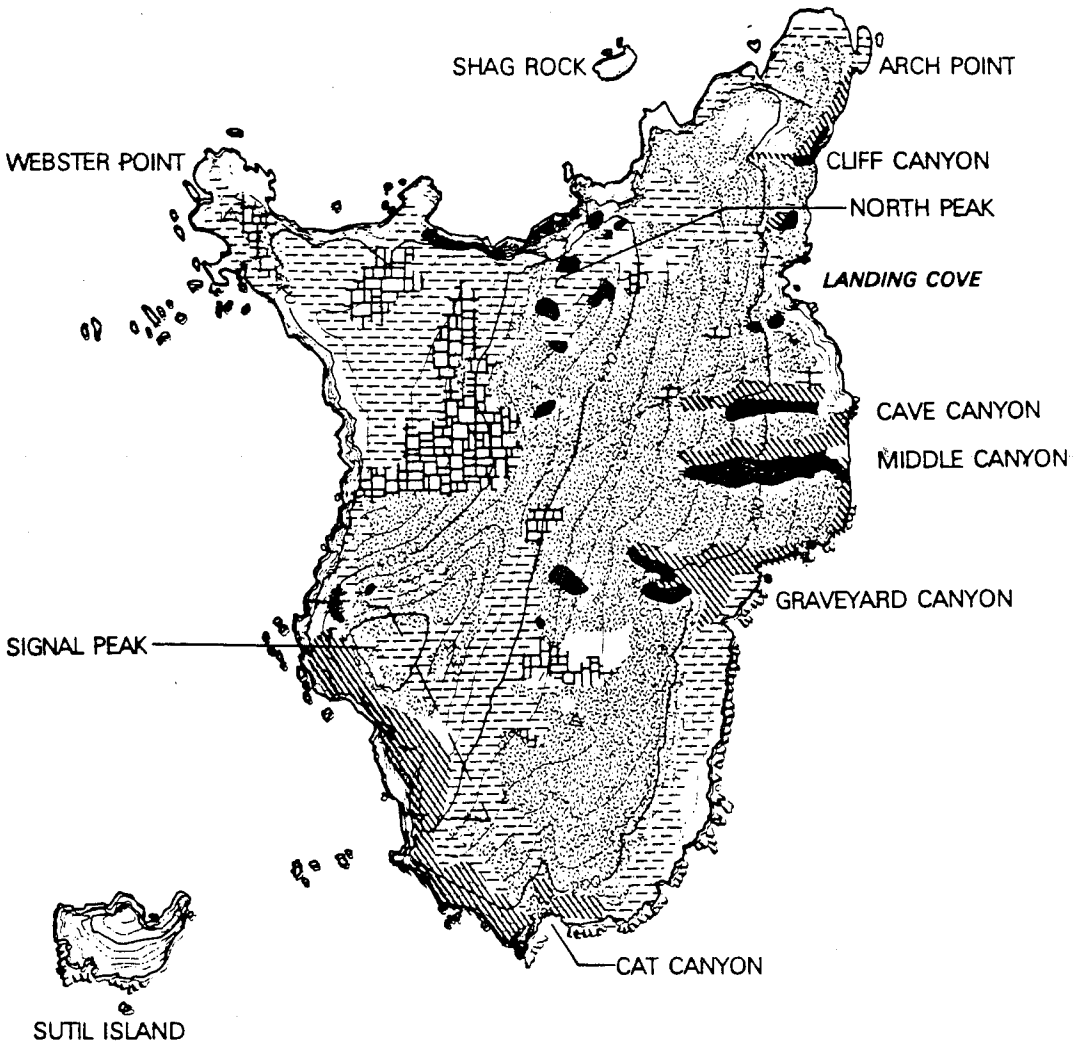
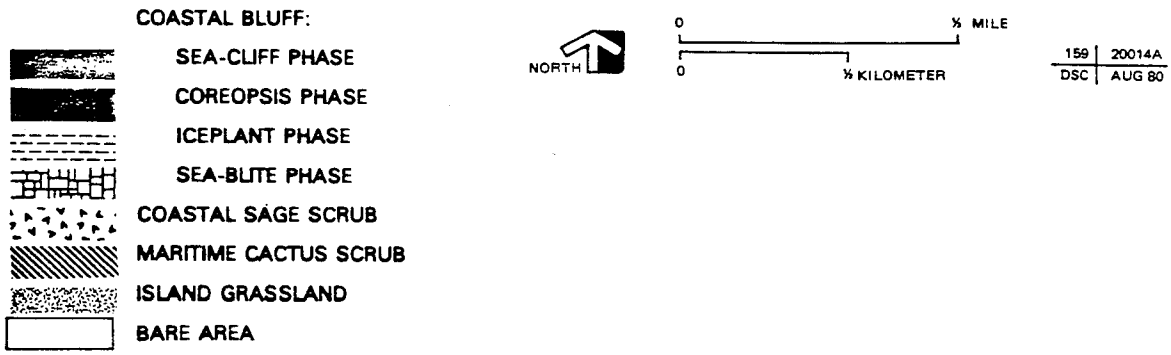


Figure 6. Vegetation Santa Barbara Island (Channel Islands National Park).



a cactus scrub community occurs along the south-facing slopes of canyons and sea cliffs. Native plant species such as the Santa Barbara Island live-forever (Dudleya traskiae), a Federally listed endangered species, are found on the nearly vertical cliffs which have escaped the full force of grazing, fire, and competition with exotic plants (National Park Service 1980a). A recovery plan specifically addressing the Santa Barbara Island live-forever is being prepared. Fires may also have led to a reduction in the island night lizard population on Santa Barbara Island.

Although agricultural practices have been discontinued, grazing by European rabbits may yet persist and, thus, may erode the habitat of the island night lizard. However, rabbits are being actively removed by NPS personnel. If any remain, their effect must be quite limited on the lizard population. The lizard, primarily restricted to the maritime cactus scrub community, is particularly associated with California box-thorn and cactus (Opuntia spp.). The three cactus species on Santa Barbara Island are Opuntia prolifera, littoralis, and oricola. Associated species include amblyopappus (Amblyopappus usillus), wild cucumber (Marah macrocarpus), box-thorn, Emory's rock-daisy (Perityle emoryi), and wishbone bush (Mirabilis californica) (Power 1979).

Box-thorn and cholla habitat covers only about 7% of the island (Wilson 1978). Regal (1968) believed that lizards may find some shelter in crevices in the soil, but stated further that this represents an extremely marginal habitat isolated from plant food

resources and subject to flooding during rains. Vegetation resources utilized as food and shelter for X. riversiana may be jeopardized by grazing of feral rabbits (if the rabbit eradication program has not totally eliminated the rabbits) and by competition with exotic iceplant (Fellers[1] pers. comm.).

Endangered, Threatened, or Rare Species

In the following discussion it should be emphasized that essential habitat designations are tentative and for some species based on limited information. Modification and refinement of essential habitat boundaries will be necessary as additional data become available. For example, the distribution of a particular plant taxon may be limited to its essential habitat. However, quite possibly, the current distribution may primarily reflect the influence of goat predation (i.e., the plant may now be limited to less accessible areas).

Flora

San Clemente Island Bush-mallow [Malacothamnus clementinus (M.&J.) Keran] (Endangered) Malvaceae - Mallow Family

Description -- This species is endemic to San Clemente Island where it is known from only two widely separated locations. The island

[1] Dr. Gary Fellers, Assistant Regional Scientist, National Park Service, Point Reyes, CA.

bush-mallow is a rounded subshrub, up to 2 m tall, with numerous shaggy branches. The flowers are many, subsessile and densely glomerate in the uppermost axils, forming interrupted spikes 1-2 dm long. The petals are pink and the calyx is loosely stellate-tomentose (Figure 7).

Distribution and Population Size -- For many decades its only known locality was at Lemon Tank, a reservoir located mid-island, where military dumping of scrap metal apparently prevented goats from destroying the plants. In 1977, a second colony was found in China Canyon and consists of two or three small plants on the edge of a rather inaccessible ledge. Artificial pollination in 1980 of Lemon Tank plants with pollen from China Canyon resulted in a successful seed set.

The species sprouts vigorously from underground runners. Currently, plants of both colonies are in cultivation at the island nursery and at a mainland nursery site under NAS North Island contract. Moreover, a healthy stand exists within the Huntington Botantic Garden (Jim Dice[1] pers. comm.). The ease of resprouting from underground parts suggests that the species may be adapted to fire, like most other species of *Malacothamnus* (David Bates[2] pers. comm.). However, too frequent fires might eliminate the plants in isolated sites.

[1] Jim Dice, Botanist, Huntington Botanical Gardens, San Marino, CA.

[2] David Bates, Director, Bailey Hortorium, Cornell University, Itaca, N.Y.

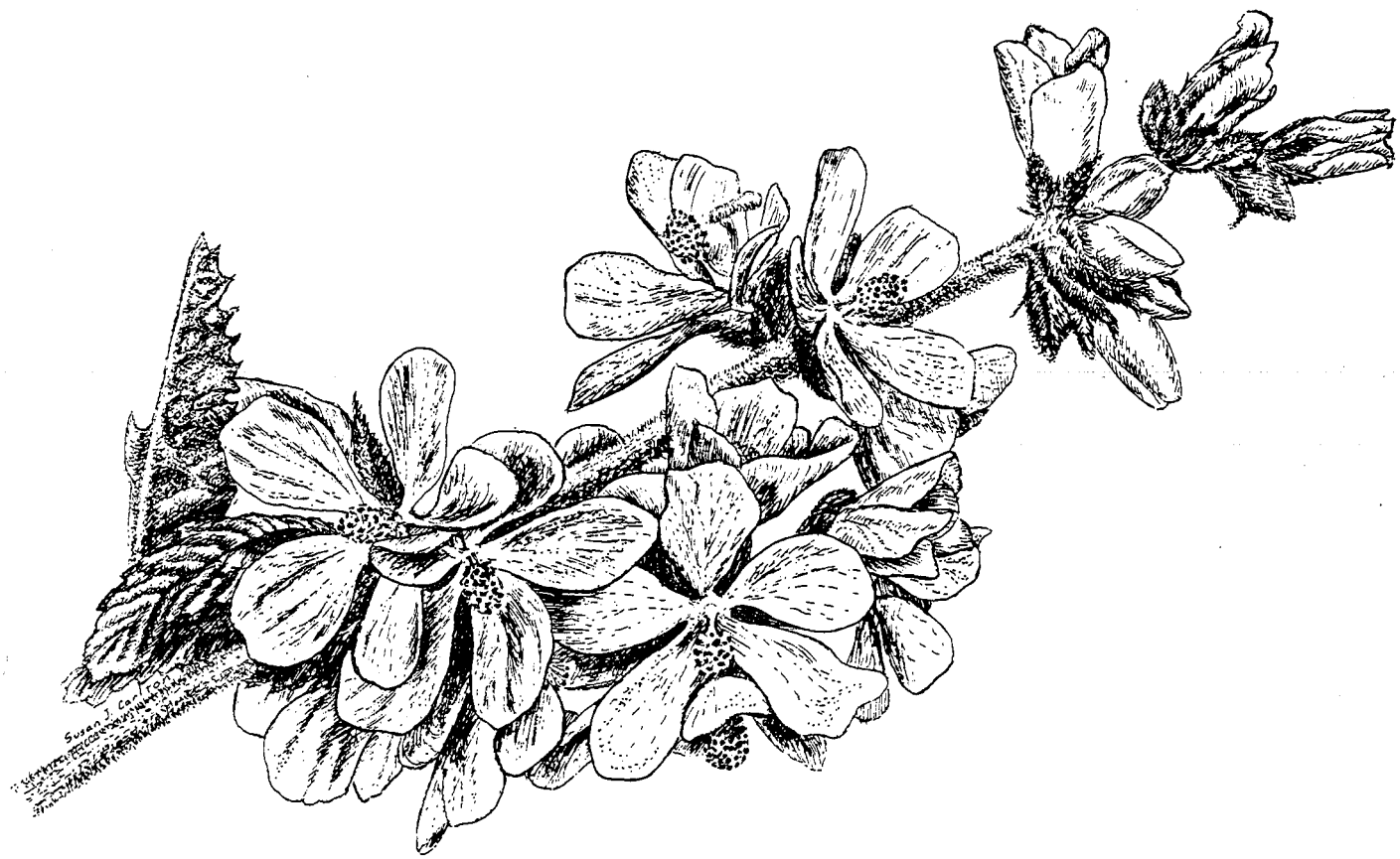


Figure 7. San Clemente Island Bush-mallow (Malacothamnus clementinus).

Observation of the shrub in cultivation in mainland gardens suggests that it may be rather short-lived, about four to six years; when the parent plant dies, all connected plantlets die also. Observations of wild plants at Lemon Tank for the past decade, however, show that plants at that site may persist much longer than those in cultivation.

Reasons for Decline -- The decline of this species seems to be primarily the result of grazing and browsing by herbivores. No historic record specifically mentions a more widespread distribution of the bush-mallow on San Clemente Island. However, the discovery of distinct and widely separated colonies might indicate that the species previously had more a widespread island distribution. Possible reasons for the decline of this species and other species are outlined in Table 3.

Essential Habitat -- Essential habitat for this species may be considered those non-grassland and non-dune portions of the island where no substantial military construction has taken place (Figure 8). This designation assumes that the species is capable of persisting in these habitats if planted. Evidence from cultivation of the plant at the San Clemente Island Nursery and on mainland sites indicates a broad amplitude in soil preference. Further study or observation of planted colonies may refine habitat requirements of this shrub.

Table 3. Matrix of Probable or Expected Biological Impacts on San Clemente Island Organisms.

The following matrix was prepared early in the development of the recovery plan. Substantiation of many of the evaluations appears in various portions of the plan. The matrix is included to serve as a reference for the expected interaction of physical and biological factors.

	Shrike	Sage Sparrow	Night Lizard	Bush Mallow	Island Larkspur	Thorne's Larkspur	Deerweed	Silver Lotus	Woodland-Star	Paint Brush	Island Fox
Exotic Plant Removal	0	0	?	+	+	+	+	+	+	+	0
Grassland Decrease	–	0	+	+	–	–	0	0	0	+	?
Controlled Burns in Grasslands	+	0	?	0	?	?	–	0	0	0	–
Wild Fires	–	–	–	–	–	–	–	–	–	–	–
Importation of Pet Carnivores	–	–	–	0	0	0	0	0	0	0	–
Importation of Pet Herbivores	–	–	–	–	–	–	–	–	–	–	0
Military Maneuvers	–	–	–	–	–	–	–	–	–	–	–
Bombing	–	–	–	–	0	0	0	–	–	–	–
New Building Construction	0	–	–	–	–	–	–	–	0	–	0
New Road Construction	–	–	–	–	–	–	–	–	0	–	–
Road Maintenance	0	–	0	–	–	–	–	–	0	–	–
Goat Removal	+	+	+	+	+	+	+	+	+	+	+
Cat Removal	+	+	+	0	0	0	0	0	0	0	+
Pig Removal	0	+	+	+	+	+	+	+	+	+	+
Deer Removal	+	+	0	+	+	+	+	+	+	+	+
Chukar Removal	0	0	0	0	0	0	0	0	0	0	–
Rat Removal	0	+	+	0	0	0	0	0	0	0	+
Cowbird Reduction	0	+	0	0	0	0	0	0	0	0	0
Kestrel Decrease	+	+	+	0	0	0	0	0	0	0	+
Shrub Cover Increase	0	+	+	+	–	–	+	–	+	+	+
Tree Cover Increase	+	0	+	–	0	0	–	–	+	0	0

+ = Positive impact for organism
– = Negative impact for organism
0 = No impact expected for organism
? = Not all factors are known or understood to evaluate impact

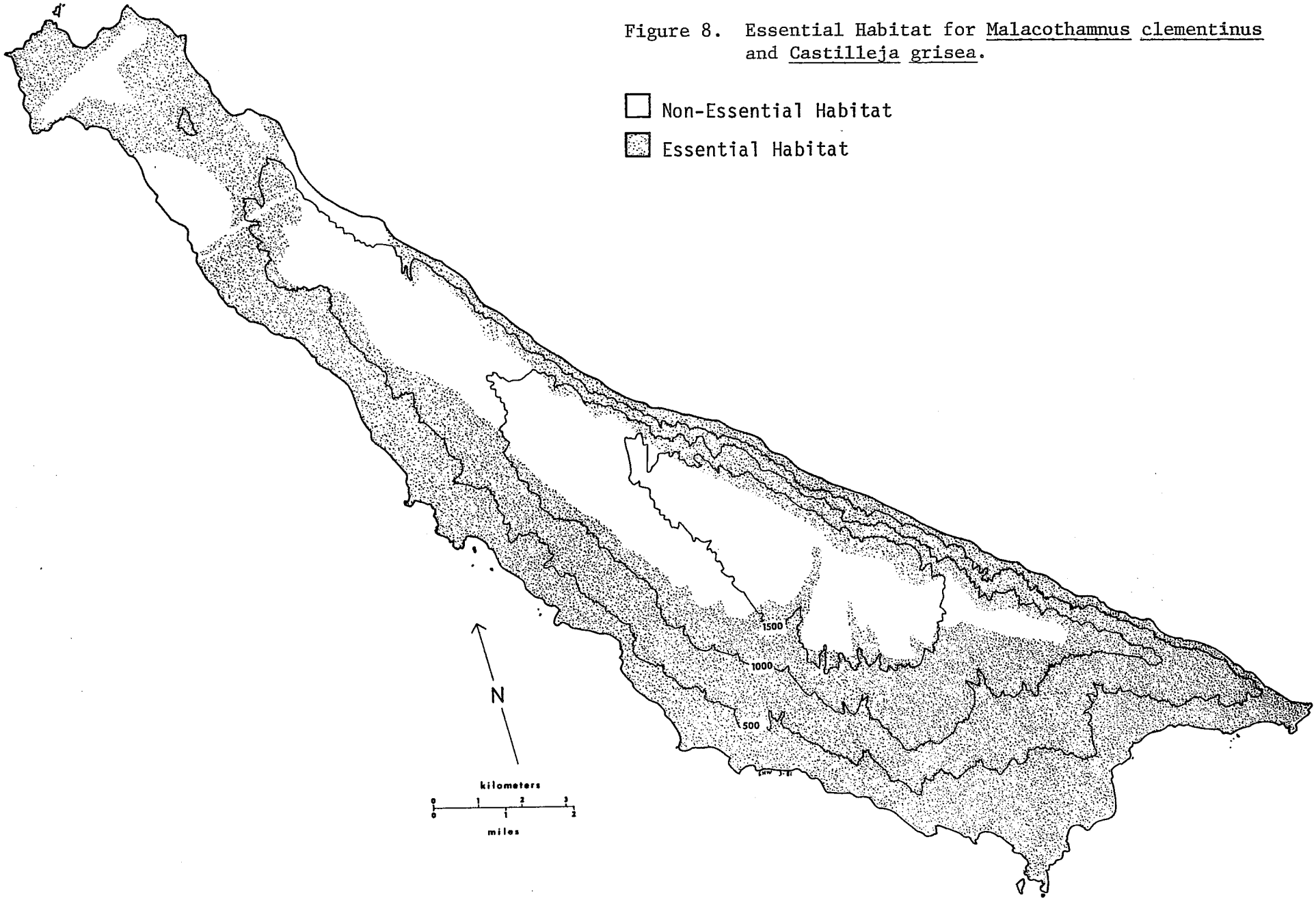


Figure 8. Essential Habitat for Malacothamnus clementinus and Castilleja grisea.

Non-Essential Habitat

Essential Habitat

San Clemente Island Larkspur (*Delphinium kinkiense* Munz) (Endangered)
Ranunculaceae - Buttercup Family

Description -- The San Clemente Island larkspur is the more common of the two endemic delphiniums on San Clemente Island. The species is a tall (1-5 dm) herbaceous perennial, with a woody branching root. The lower leaves are trifid and reduced up the stem. The inflorescence is pilose with eight to ten flowers and whitish petals and dark anthers (Figure 9).

Distribution and Population Size -- The larkspur is known from at least seven grassland sites. Plants are usually associated with moist grassland sites on the eastern slope of the island on mostly dark, grayish-brown loam, about 5-10 inches (12.7-25.4 cm) deep, although it does grow in shallower soils in several areas, apparently the result of erosion. No current information is available on its population size.

Reasons for Decline -- Field observation following fire suggests that this species is adapted to fire during its dormant period. Grazing and trampling by goats and rooting by pigs are considered to be the principal threats to this species.

The possibility of genetic exchange between the two island delphiniums could threaten the genetic integrity of the taxa, especially in disturbed transplantation sites. Historically, the two taxa appear to have been sympatric in the Eagle Canyon-Mosquito Cove area. A

Figure 9. San Clemente Island Larkspur (Delphinium kinkiense).

cautious approach to range expansion concentrating on sites adjacent to present colonies might reduce the potential of hybridization. Also, further investigation of the distinction between the two taxa appears warranted based on the range of overlapping characteristics stated in the literature and those observed in the field.

Essential Habitat -- Essential habitat for this species is noted for eastern slope grassland habitat where the colonies occur (Figure 10).

San Clemente Island Indian Paintbrush (*Castelleja grisea* Dunkle) (Endangered) Scrophulariaceae - Figwort Family

Description -- This species is an erect, leafy, shrubby perennial with a woody and much-branched stem covered with short anachnoid tomentum. Leaves are alternate, linear, obtuse, entire and from 1-3 cm long. Bracts and calyces are green, or brownish green, the former with one pair of lobes; calyx 13 mm long, medially cleft two-thirds of its length, laterally cleft 5 mm or less, and inflated in fruit. The corolla is about 1.5-2.0 cm long, pistols dull yellow and galea 7 mm long and dark green (Figure 11).

Distribution and Population Size -- *Castilleja grisea* is found occasionally on cliffs of canyons and escarpments on the east side of the island and uncommonly in the southwestern canyons of the island. Along the eastern escarpment, the species occurs on rock faces almost down to the beach. Often the plants are mixed with cacti, particularly on slopes accessible to goats.

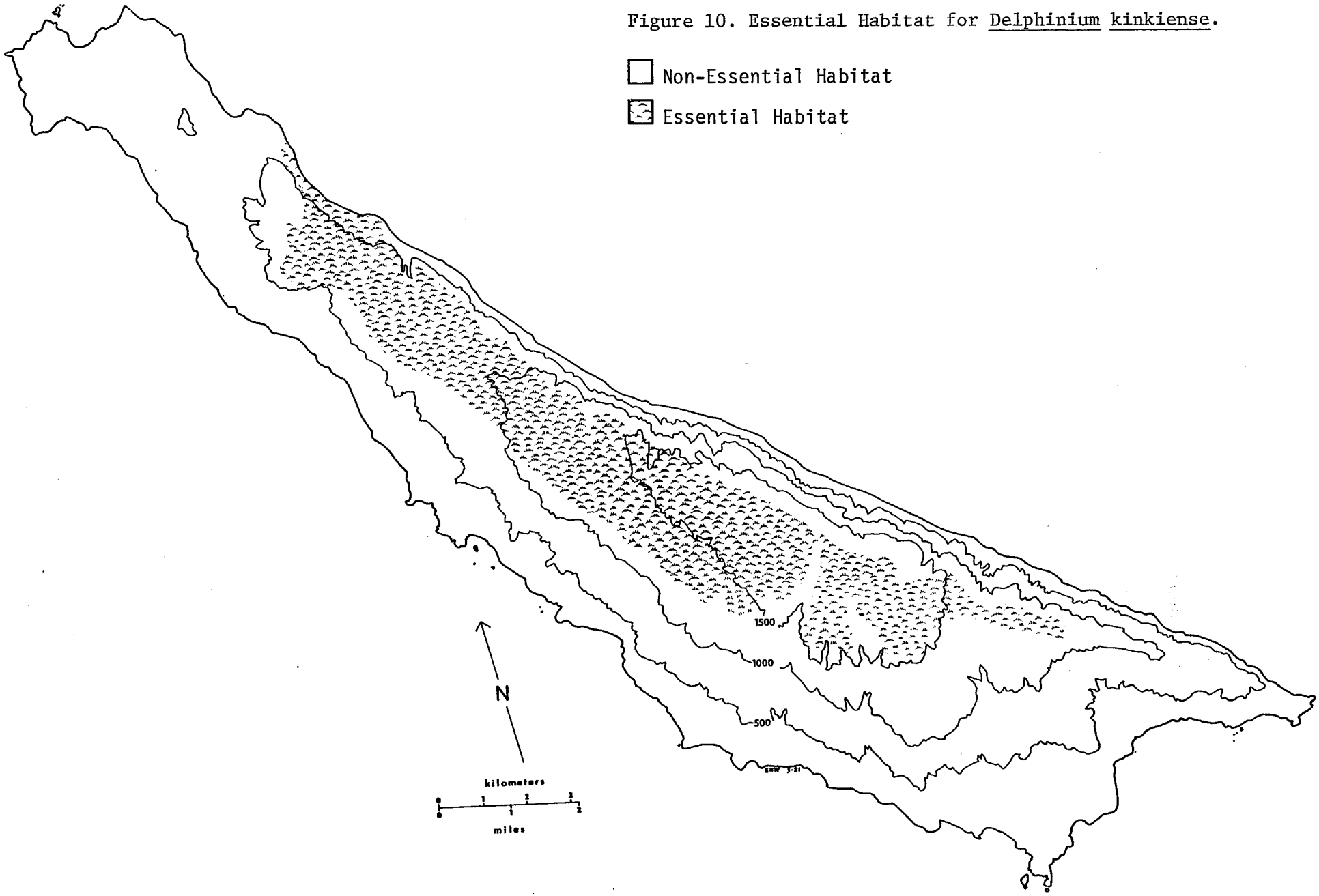


Figure 10. Essential Habitat for Delphinium kinkiense.

Non-Essential Habitat

Essential Habitat

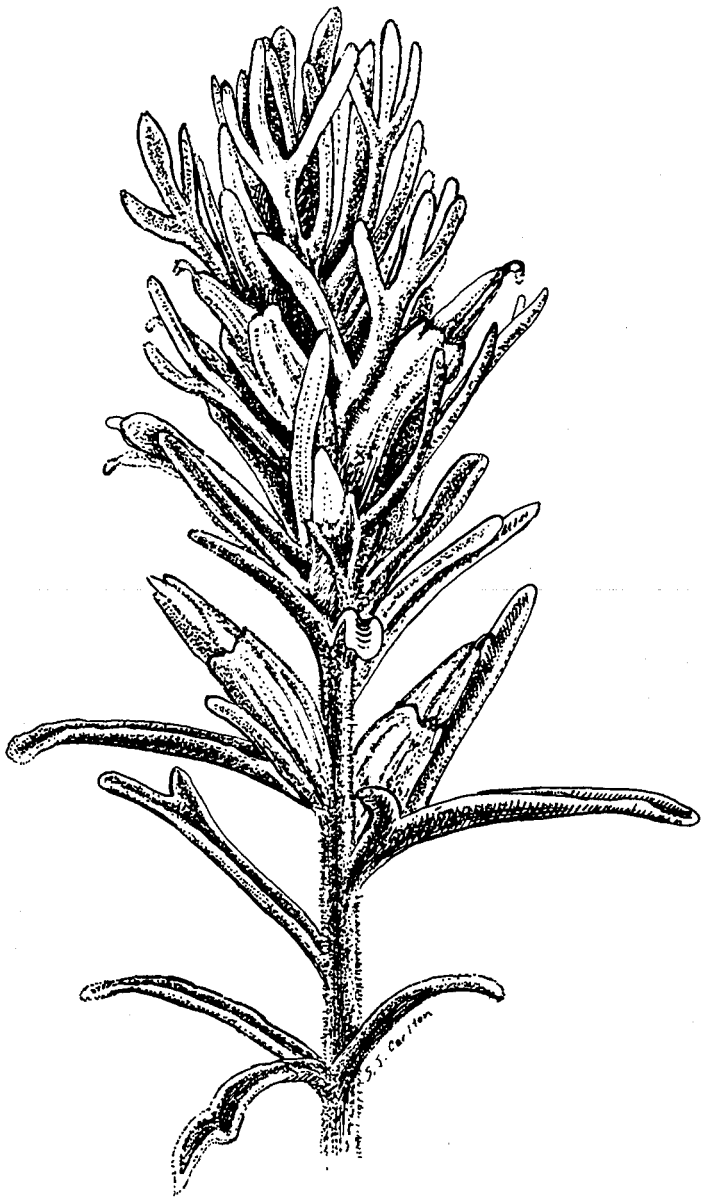


Figure 11. San Clemente Indian Paintbrush
(Castilleja grisea).

One colony at the southern end of the Island has 500 to 600 plants located in relatively flat open terrain. The presence of the plant in this open habitat suggests that it may have occurred more widely away from cliff habitat prior to heavy predation by goats. The elevation range of the species is from 9 to about 300 m. The estimate of the total population is about 1000 plants, with the largest occurrence at Pyramid Point.

Reasons for Decline -- Many species of *Castilleja* are hemiparasitic, though the association of *C. grisea* with any host plants has not yet been established on San Clemente Island. Goat trampling may impede or prevent development of haustorial connections[1] with host species, though this is conjecture. Grazing by feral herbivores and military uses such as construction and bombing adversely affected the paintbrush.

Essential Habitat -- Essential habitat for this species is all non-sand dune and non-grassland areas, particularly those at the southern end of the island lacking significant military construction (Figure 8). Because the species occurs on a wide variety of soils, the boundaries of the essential habitat are broadly circumscribed. It is possible that future studies may show a host dependency which may have an effect on the ultimate distribution of the species on San Clemente Island.

[1]specialized root structures that allow the plant to parasitize other species.

San Clemente Island Broom (Lotus dendroideus var. traskiae (Easts. ex. Noddin.) Isley) (Endangered) Fabaceae (Leguminosae: Papilionoideae) - Pea Family

Description -- This San Clemente Island endemic was once thought to be a subspecies of the common mainland Lotus scoparius (deerweed), but was recently accorded varietal status and transferred to L. dendroideus (Isley 1978).

The plant is a semi-woody, low shrub, 2 to 12 dm (decimeters) tall, with rather virgate (i.e. slender and erect) green branches. Leaves have three leaflets, each 5 to 9 mm long. Flowers are arranged in one- to five- flowered umbels with pistols yellow turning to orange then red, with age (Figure 12).

Distribution and Population Size -- Six populations of this taxon are now known, each of which is generally associated with rocky areas. The largest number of plants grow in the vicinity of Wilson Cove.

This taxon is frequently sympatric with the more common island lotus (Lotus argophyllus subsp. ornithopus). Hybrids and backcrosses between the two taxa are frequent in disturbed areas where both taxon occur.

Photographs taken 50 years apart (1925 and 1975) at the Wilson Cove Canyon site show an increase in the number of shrubs of the island broom during this interval (Figures 13 and 14). As observed during

Figure 12. San Clemente Island Broom
(Lotus dendroideus var. traskiae).

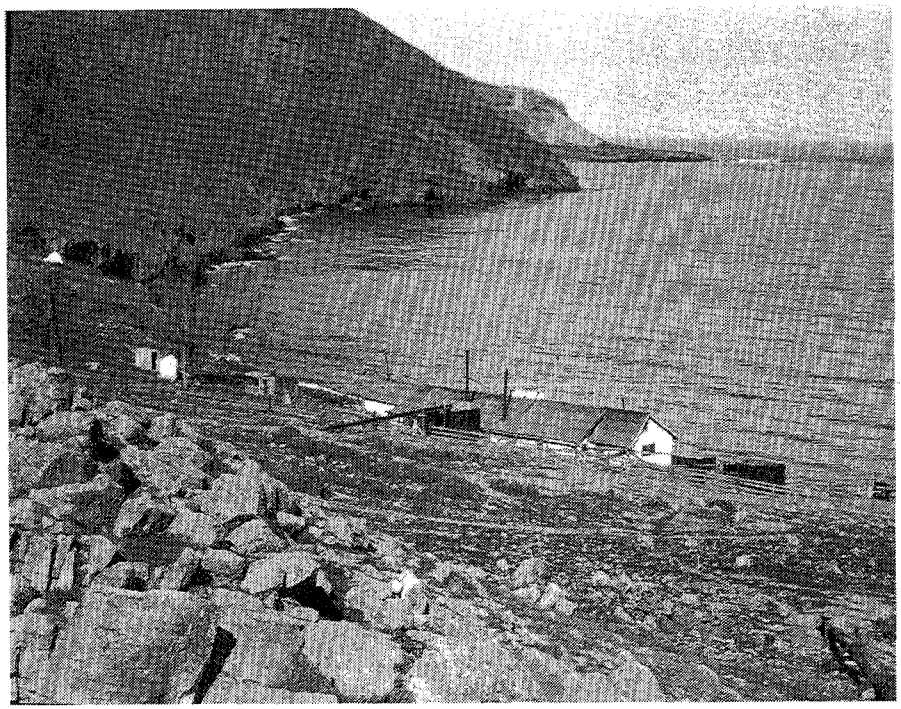


Figure 13. Wilson Cove, San Clemente Island in 1925.

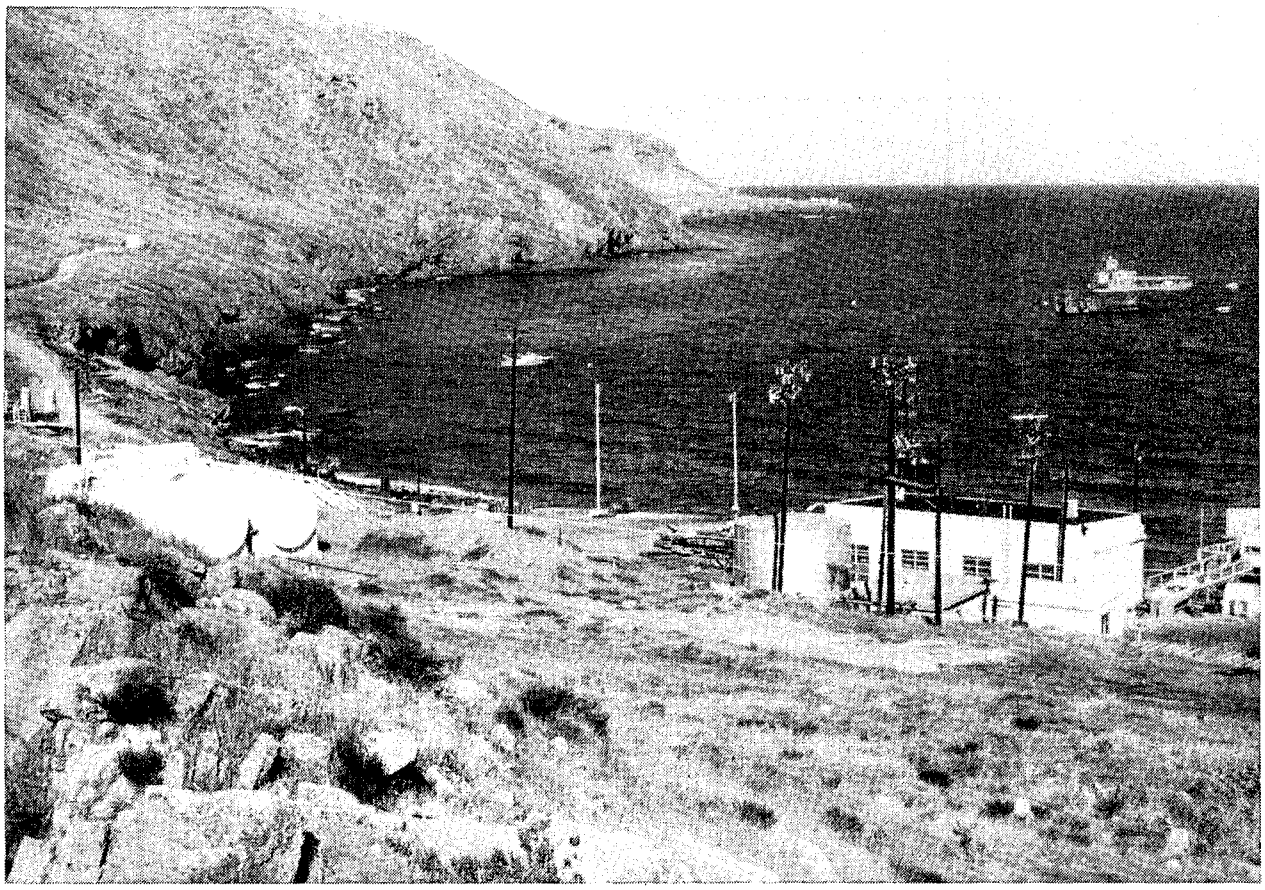


Figure 14. Wilson Cove, San Clemente Island in 1975.

the last several years of above-average precipitation, perennials can fluctuate in numbers, with greater seedling establishment during good rainfall years. Whether the increase in shrubs in 1975 compared to 1925 numbers is the result of a reduction in predation by feral herbivores or deer or favorable precipitation patterns is unknown.

Reasons for Decline -- Goats have been the primary cause for the reduction of this taxon; however, disturbances associated with military construction and maintenance activities have eliminated some individuals.

Essential Habitat -- Essential habitat for this taxon includes most of the island. Cultivation of the *Lotus* in various soils and plantings on San Clemente Island at a variety of elevations and exposures suggest that this plant is rather broad in its habitat requirements.

Thorne's Royal Larkspur (*Delphinium variegatum* Torr. & Gray subsp. *thornei* (Munz) (Candidate) *Ranunculaceae* - Buttercup

The two populations of this San Clemente Island endemic are known from grasslands at the 1600 feet (485 m) elevation near Twin Dams. A count of the population in the spring of 1980 indicated 50 shoots. In 1981 this and a newly-discovered nearby colony contained 135 shoots. Because of clumping and the closeness of the shoots, it is difficult to tell individual plants from multi-stemmed plants. No excavation of the plants was made to determine the underground condition because of the extreme rarity of the taxon. Most of the population has been

fenced with pig and goat-resistant wire. The type specimen was collected in 1966, apparently from this same population (Thorne[1] pers. comm.).

This subspecies is a herbaceous perennial which produces new above-ground stems, leaves and flowers each winter from an underground persistent root. Twenty-five seedlings were noted in the two colonies during the 1980 count (Beauchamp[2] and Oberbauer[3], unpub. data).

Reasons for the restricted island range of this taxon are not precisely known. Goat grazing and pig rooting have probably limited the distribution of this species, however, it is not known to what extent other factors are involved. Fire may play a role in the ecology of this species. Other species of Delphinium respond favorably to fire and appear to be well adapted to it. Hence, this species may also be similarily adapted. The site of the present population was burned at least once, but goat predation, combined with poor seed set prior to the known fire, may have prevented full expression of fire adaptation from seed. It appears that the dormant perennial rootstock is deep enough to escape fire damage. Fire in the population prior to seed set and onset of dormancy would probably be

[1] Dr. Robert F. Thorne, Botanist, Rancho Santa Ana Botanical Garden, Clairemont, CA.

[2] R. Mitchel Beauchamp, Botanist, Pacific Southwest Biological Services, San Diego, CA.

[3] Thomas Oberbauer, Botanist, County of San Diego, San Diego, CA.

adverse. Fire adaptation may be increased by the ephemeral nature of the plant and its rapid seed set (Ferguson pers. comm.).

San Clemente Island Woodland-Star (*Lithophragma maxima* Bacig.) (Candidate) Saxifragaceae - Saxifrage Family

Until only recently, this island endemic was believed to have been exterminated by goats, having been seen last in 1936. The species was described in 1963 from a single pressed herbarium specimen (Bacigalupi 1963). In 1978, living plants were rediscovered in Eagle and Bryce Canyons. The species is apparently a herbaceous perennial with ternate, palmately-compound basal leaves. The flowering portion of the stem contains as many as 20 flowers, which have white petals about 4 mm long, incised and pleated (Figure 15). The plants grow in shaded, moist areas of canyons, particularly in relatively deep soil on ledges with northern exposures. Attempts to propagate the species from seed have failed thus far. About 20 to 50 individuals are known to exist. The wide range in numbers is the result, in part, of observed goat predation on plants. Unlike many of the endemics now restricted to canyon walls because of the foraging by goats, *L. maxima* appears to favor the cool, moister canyons and the understory of woodland habitats.

Figure 15. San Clemente Island Woodland-Star
(Lithophragma maxima).

San Clemente Island Silver Hosackia (*Lotus argophyllus* subsp. *adsurgens* (Dunkle) (Raven) (Candidate) Fabaceae (Leguminosae: Papilionoideae) Pea Family

This distinctive endemic is a low subshrub known from exposed slopes at the southern end of the island, usually in association with the cholla phase of maritime desert scrub vegetation. The plant has short, virgate branches with leaves more or less imbricated and silvery canescent. The flowers are in umbels, 10-12 mm long, with yellow and orange petals (Figure 16).

The only known colonies on the slopes above Pyramid Cove are isolated on the second or third wave cut terraces. Here the plants are severely grazed or trampled by goats. All such known colonies have been fenced.

Several names have been proposed for variants of the *Lotus argophyllus* group on San Clemente Island (Dunkel 1941). These variants represent only portions of the spectrum of variation, however, *L. a.* subsp. *adsurgens* is a very distinctive element. The potential for hybridization between island *Lotus* taxa exists, particularly in disturbed areas.

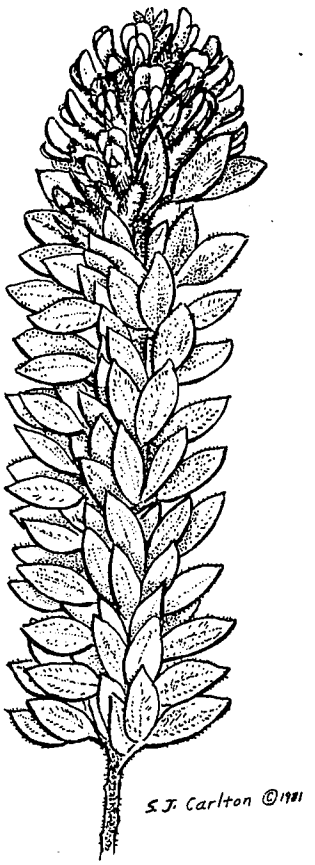


Figure 16. San Clemente Island Silver Hosackia (Lotus argophyllus ssp. adsurgens).

Fauna

San Clemente Island Loggerhead Shrike (*Lanius ludovicianus mearnsi* Ridgway) (Endangered)

Description -- The San Clemente loggerhead shrike is medium sized, with gray above, white below and on rump, black mask over eyes, black wings and tail both with patches of white. Bird measurements averaged the following: 224 mm length, 97.6 mm wing length, 100.3 mm tail length, 27.6 mm bill length, and 13.2 mm middle toe (Miller 1931).

Taxonomy -- Ridgway (1903) recognized the distinctiveness of the San Clemente population and assigned subspecific rank based upon smaller body size and larger bill. Miller (1931) and Bent (1950) later supported this taxonomic placement as did Johnson (1972), who further differentiated the *L. l. mearnsi* form as having a shorter wing and tail, and darker plumage. A recent study has incorporated measurements from museum skins and live-trapped shrikes which reinforce the subspecific ranking and indicate a smaller foot than other shrike races (Hyde 1980, 1982).

Three of the remaining seven subspecies occur in southern California or northern Baja California and could be mainland ancestral sources of the island shrikes. Johnson (1972), however, proposed a single colonizing event, most likely from the *L. l. gambeli* line, with subsequent divergences leading to the distinct *L. l. anthonyi* and *L. l. mearnsi* forms. He also suggested, that since the populations in

question are relatively sedentary, gene flow among the two insular races and/or their mainland counterparts is very unlikely. Continual morphological divergence, therefore, seems probable.

Distribution and Population Size -- Of nine recognized subspecies of loggerhead shrike, two are nonmigratory island endemics (American Ornithologists' Union 1957). The subspecies *anthonyi* is distributed among several of the California Channel Islands, particularly Santa Rosa, Santa Cruz, and Santa Catalina, whereas *L. l. mearnsi* inhabits only San Clemente Island (Figure 17).

Early accounts imply that San Clemente Island supported a considerable and widely dispersed shrike population. Grinnell (1897) claimed that "....two or three shrikes could be seen in a hour walk," and a decade later Linton (1908) also commented on the sizeable population. During a 1915 spring collecting excursion, Howell (1917) located three active shrike nests within a few kilometers of each other and also suggested the presence of auxiliary breeding shrikes, "....no matter which birds we shot, there always seemed to be others that came to take their place." A marked contrast is offered by the documentation of shrike abundance on the island since the mid-1960's. A compilation of some 600 separate post-1965 sightings chronicles a decreasing population (Cody and Diamond 1968, Jorgensen pers. comm.). A survey by Jones, completed in 1973, listed the loggerhead shrike as an uncommon resident. On a return trip in 1975, he estimated there were fewer than 50 shrikes. After an intensive year-long investigation in which a portion of the shrike population was marked, monitored, and counted,

Figure 17. San Clemente Loggerhead Shrike
(Lanius ludovicianus mearnsi).

Hyde (1980) estimated the population to be 30 birds. The present overall population size is estimated at 18-30 individuals (Hyde 1982, pers. comm.).

Habitat Requirements -- Basic habitat requirements for the loggerhead shrike include an adequate supply of invertebrate and small vertebrate prey open foraging areas, a selection of elevated perches, and sufficient roosting and nesting cover. Historical observation supports that much of San Clemente Island at one time satisfied these conditions. Shrikes presumably occupied a major segment of the island during the early 1900's since Grinnell (1897), Linton (1908), and Howell (1917) each mentioned the bird's abundance and wide distribution.

Recent observations show that shrike distribution today generally is restricted primarily to the higher and eastern sections of the island. In the fall and winter months, solitary shrikes typically occupy the island's uppermost mesas. For instance, during the period from September to January 1980-81, territories of 12 different birds were located (Hyde[1] pers. comm.). Nine of these were on the mesas, intermittently spaced from the airfield area south to below the Mount Thirst region. Two other birds occupied territories in the China Point/Horse Beach Canyon area on the lowermost southwestern terrace. The remaining shrike was observed at NOTS Pier (Northeast coast),

[1] Dr. Kenneth Hyde, Illinois College of Optometry, Chicago, Ill.

where it foraged along the nearby escarpment from approximately 220 m elevation to near sea level.

Comparative patterns of shrike nesting on the island further authenticate a diminishing population. Nests discovered during the period from 1897 to 1917 were at Pyramid Cove (extreme southern coastline), Northwest Cove, and midway along the eastern shoreline (Grinnell 1897, Linton 1908, Howell 1917). Moreover, Howell (1917) found nests in a small thorny shrub (very likely Lycium californicum) on the island's lower western terraces. All observations since 1968, however, have been indicative of a much narrower breeding habitat. Whereas shrikes commonly disperse throughout the upper mesas during the fall and winter, they apparently utilize only the island canyons for nesting activities. Current shrike breeding seems confined to a zone from the China Point region (southwest corner) around to the southeastern Pyramid Point area, northward no further than Burns' or Stone Canyons, approximately midway on the eastern side of the island. This area encompasses roughly one-half of the pre-1920 breeding habitat.

Life History -- The biology of mainland shrikes has been described by Miller (1931) and Bent (1950). Although their discussion is, at times, somewhat anecdotal, it nevertheless serves as the basis for the following summary.

Loggerhead shrikes occupy both breeding and winter territories. In much of California, particularly southern and central coastal regions,

shrikes are nonmigratory (Craig 1978); the only discernible pattern of movement is associated with the establishment of these separate seasonal territories.

The size of individually defended areas varies considerably in relation to quality of the environment. Bent (1950) gives a range for breeding territories of 11 to 39.5 acres (4.5 to 16 ha).

Basic reproductive data on mainland shrikes reveal that breeding chronology are fairly uniform, although some temporal deviations have been noted. For example, pair formation is usually accomplished during January or February but has been reported as early as November. Likewise, shrikes have nested in February, yet March and April constitute the prime nesting period. Despite the placement of some nests close to the ground, they are normally located in a small tree or shrub at a height of 6 m. The nests are sturdily constructed, have high insulative properties (Skowren and Kern 1980), and are well concealed by dense foliage.

Sexual dimorphism does not occur among loggerhead shrikes and, as is common with nondimorphic birds, both sexes participate in nest site selection, nest construction, and care and feeding of young. Incubation may also be shared (*L. l.* ludovicianus, Bent 1950) or performed solely by the female (*L. l. gambeli*, Miller 1931). A clutch consists of four to seven eggs ($\bar{x}$=5), the incubation period is generally 14 days (range of 12-16), and fledging occurs in

approximately 20 days. Renesting is considered a common reproductive strategy of mainland shrikes.

While little is known regarding the biology and behavior of the *L. l. mearnsi*, however much of the preceding discussion of mainland shrikes is probably applicable to the insular form as well. Available information gathered from an array of field notes, recent observations, and a current study (Hyde 1982), indicate the reproductive regime of the San Clemente Island race parallels that of mainland races. A comparison between the *L. l. mearnsi* and *gambeli* populations reveals that both are nonmigratory and tenaciously occupy breeding and winter territories. Moreover, the timing of pair formation, nesting, and postjuvenal molt also corresponds. There are differences, however. For instance, of the six nests and seven fledgling groups reported on San Clemente Island since 1897, none contained more than five eggs or young, three or four being the normal clutch size. Furthermore, whereas incubation among mainland shrikes is apparently performed by females only, both sexes of San Clemente Island loggerhead shrike incubate (Hyde 1980).

Data on incubation and nestling periods, fledgling and juvenile survival, habitat viability, and the proclivity of insular shrikes to renest are notably lacking.

Shrikes are highly efficient, search-type predators (Craig 1978, Craig et al. 1979, Morrison 1980). They forage from a variety of elevated perches (1-14 m above the ground) and prey on a diversity of food

items. Their diet seems related more to prey abundance, detectability, and size rather than to specific prey type. Food consists primarily of insects and spiders, with an optimal size range of 15-25 mm (Craig 1978); although lizards, snakes, birds, and small mammals are also eaten (Miller 1931, Bent 1950, Slack 1975, Craig 1978, Craig et al. 1979). Large prey are often impaled to facilitate feeding or for storage purposes (Watson 1910, Wemmer 1969, Smith 1972). Mainland shrikes feed successfully on the average of five times per hour during the nonbreeding period and approximately twice that rate throughout the breeding season (Morrison 1980).

Knowledge of *L. l. mearnsi* feeding behavior to date is limited to a few field observations. These data indicate that the diet of island birds is quite similar to mainland forms. It consists principally of insects (Coleoptera, Orthoptera, and Lepidoptera) and arachnids. Several cases of shrikes feeding on mice have been reported, and in numerous instances, observers have witnessed shrikes consuming lizards. There are only two species of reptiles on the island, the side-blotched lizard and the island night lizard. Since snakes are absent, the diet of island shrikes differs, at least in this respect, from that of mainland birds. The only case of predation on a bird was a record of a young house finch being taken.

Reasons for Decline -- Specific causes of the declining shrike population on San Clemente Island are not presently known. One possibility appears to have been the presence of the large, long-standing feral goat population. Severe grazing and browsing

pressure by goats radically changed vegetation characteristics on the island which may have decreased or adversely modified habitat suitability for shrikes. Nesting and roosting sites required by the shrike may have been eliminated. One case of avian extinction and two cases of extirpation from San Clemente Island have already been attributed to habitat destruction by goats (Jones and Diamond 1976). Habitat encroachment or disturbance such as that effected by goats and/or human beings could significantly reduce the viable habitat of the shrike, leading to reduced productivity. The problem may alternatively be one of a diminishing or inaccessible food supply or an inability of shrikes to otherwise exploit available, but different, resources. This could also be related to the pressure of goats. Unfortunately, there are no quantitive data available on the island's invertebrate fauna to clarify this question.

Another causative factor might be associated with the bird's wariness, an attribute that differs from mainland conspecifics. Grinnell (1897) characterized the shrike as "the shyest of any bird on the island." This behavior was also acknowledged by Miller (1931) and Hyde (1980). A related factor that may account for the reduced shrike population is interspecific competition. Antagonistic interaction between shrikes and several sympatric species [vis, northern mockingbird (*Mimus polyglottos*), common raven (*Corvus corax*), Say's phoebe (*Sayornis saya*), American kestrel (*Falco sparverius*)] was described by Hyde (1980, 1982). There is a large kestrel population on the island [e.g., 70 birds were counted on January 2, 1981, within a two-hour

period (Hyde unpub. data), 25 on 9 July 1975 (Jones[1] pers. comm.)] and direct interaction between shrikes and kestrels is a common occurrence. Competition between the two seems especially pronounced with regard to perch and food preferences, to the extent that shrike behavior is notably impaired. Competition for limited resources, in terms of ecological niche theory, is commonly viewed as a factor in species displacement, because one of the forms is invariably at at competitive advantage over the other. The degree of niche overlap and the relative competitiveness of the kestrel and shrike have yet to be determined in relation to the decline of the bird. Jones and Diamond (1976) found that as shrike numbers declined over the last 75 years, kestrel numbers have concomitantly increased. The kestrel was not mentioned by Mearns (1907) or Grinnell (1897), and Linton (1908) considered it only an occasional resident. Yet by 1973, Jones viewed the kestrel as a common island inhabitant. Finally, the problem could be the result of an inter-relationship of two or more of the above, or of an as yet unidentified factor.

Essential Habitat -- In view of the shrike's current distribution, the possibility of rehabilitation of parts of the island, and potential for reoccupation of historical range, the entire island is considered essential habitat.

[1] Dr. H. Lee Jones, Biologist, Athene Wildlife Associates, Topanga, CA.

San Clemente Island Sage Sparrow (*Amphispiza belli clementeae* Ridgway) (Threatened)

Description -- The San Clemente sage sparrow is a small gray bird with black streaks on sides and a single black spot on the chest, dark cheeks, and moustache streaks on sides of throat, white line over eye, and white corners of tail.

Taxonomy -- Ridgway (1898) separated the San Clemente race from mainland conspecifics on the basis of its larger size and larger bill. Van Rossem (1932) argued in favor of this subspecies designation, as did Grinnell and Miller (1944), Miller (1968), and Johnson (1972). However, in each instance, the *A. b. clementeae* race is considered only moderately distinct from the four other subspecies. Indeed, Johnson (1972) emphasized the recent divergence of the San Clemente population, resulting, presumably, from a single invasion of "overwater waif dispersal."

Distribution and Population Size -- The San Clemente sage sparrow (*Amphispiza belli clementeae*) is a San Clemente Island endemic subspecies (Figure 18). This form is nonmigratory. Its nearest mainland cognate, and supposed source, is Bell's age sparrow (*A. b. belli*), a resident of coastal southern California (American Ornithologists' Union 1957).

Early 20th century ornithologists viewed the San Clemente island sage sparrow as a conspicuous element of the island's avifauna (Grinnell

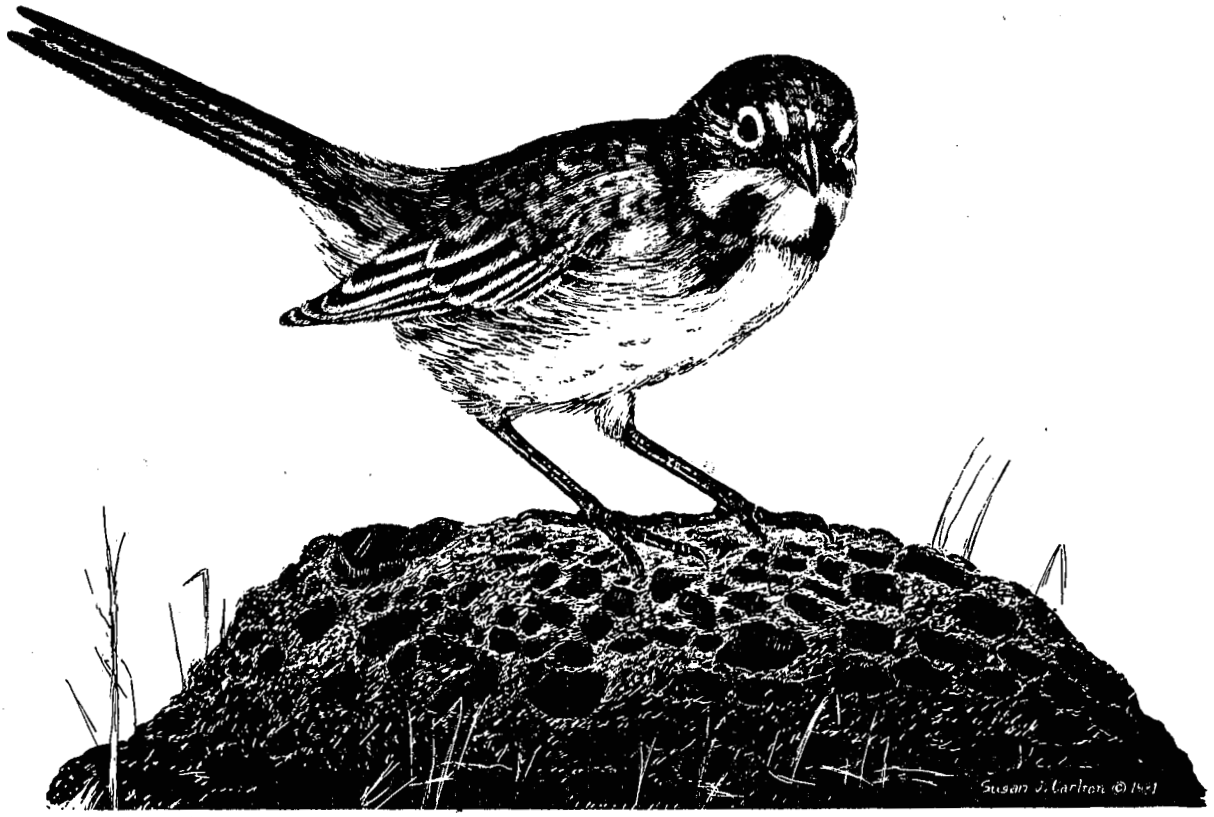


Figure 18. San Clemente Sage Sparrow
(Amphispiza belli clementeae).

1897, Linton 1908, Howell 1917). These reports, however, were essentially the result of infrequent, faunistic surveys rather than intensive quantitative assessments. Nevertheless, it appears that the bird was formerly abundant on the island and has since experienced a population decline.

Two recent investigations attempted to more thoroughly evaluate the status and population trends of A. b. clementeae. Byers (1976) traversed line transects during a one-year period. He then projected these results to known available habitat to derive a population maximum of 112 birds. He also determined the adult-juvenile ratio for 1976, which suggested a stable or slightly expanding population.

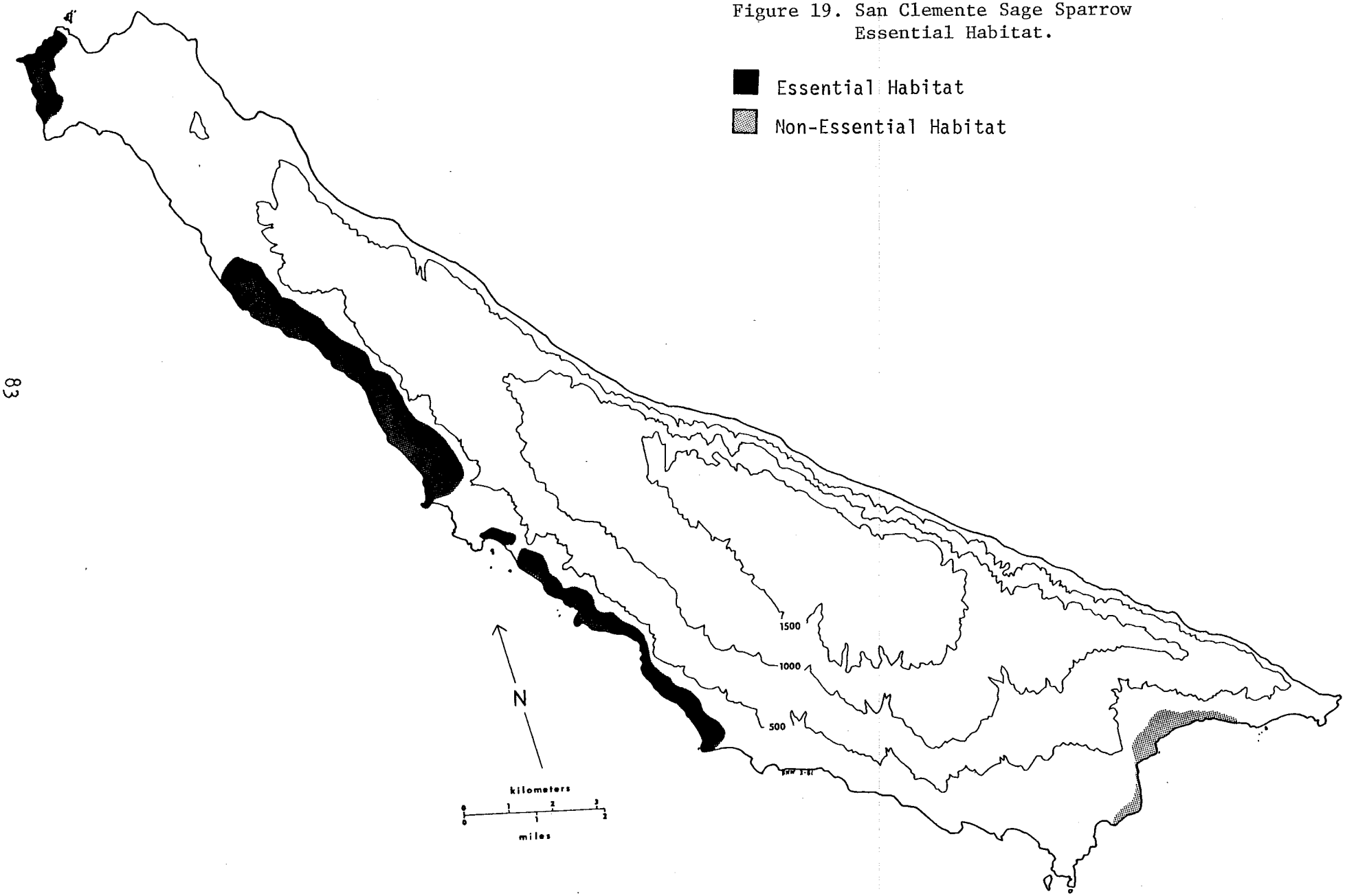
Preliminary results of a current long-range study indicate a somewhat larger but seemingly non-expanding San Clemente Island sage sparrow population (Hyde 1980, 1982). During the period from December 12, 1979, to June 15, 1980, a total of 157 sage sparrows were banded and color coded. Three interrelated methods were then used to estimate sparrow densities and ultimate population size. Each technique depended upon the ratio of banded sparrows observed during each census process: (1) a direct count was conducted by traversing a large proportion of sparrow habitat on several occasions; (2) line transect counts were employed monthly; and (3) a statistical analysis, the Schnabel Index, was applied in order to incorporate the year's productivity. The resulting estimate was 176-213 prebreeding and 264-296 post-breeding birds. Data on reproductive success for the 1980 breeding season, although limited (i.e., eight nests yielding 15

fledglings), indicated a stable or slightly declining situation (Hyde 1980, 1982). More current information indicates a population size of 250-400 individuals (or possibly as high as 500) and a stable or slightly increasing populations size (Hyde 1982, pers. comm.).

Habitat Requirements -- Mainland sage sparrows typically inhabit a moderately dense, xerophytic scrub community. The habitat of the Great Basin populations consists typically of homogenous stands of sagebrush (*Artemisia* spp.) and salt bush (*Atriplex* spp.), whereas in coastal Southern California, sage sparrows occupy chamise (*Adenostoma fasciculatum*) chaparral associations (Miller 1968).

The only vegetation association on San Clemente Island that resembles mainland sage sparrow habitat is the *Lycium* phase of the maritime desert scrub community. As a distinct vegetative unit, it occurs, insofar as the sage sparrow is concerned, in only four discontinuous locations. The largest area is a narrow coastal belt along the western lowermost marine terrace (West Shore Zone). This zone occupies approximately 5 km^2 of coastal terrace extending north from Eel Point (Figure 19). Secondly, an intermediate zone is located approximately 4 km south of the West Shore Zone in the vicinity south of Seal Cove. Apart from being about one-half the size of the previous zone, and possessing a lower average *Lycium* density, this area is markedly similar to the first. Thirdly, a region which is fundamentally different from the first two is located at the extreme north end of the island (North Head). This area possesses only diffuse patches of *Lycium* and far fewer cactus patches. Finally, a

Figure 19. San Clemente Sage Sparrow Essential Habitat.



largely unexplored site is situated at the island's extreme south end, in proximity to Pyramid Cove.

The San Clemente Island sage sparrow, like its conspecifics, is essentially a ground dweller. Individuals feed predominantly on the ground and use the shrub canopy for feeding, protection, roosting, song perches, and nesting. Nests are usually constructed about 4 dm above the ground surface in dense foliage.

A recent demographic analysis of the San Clemente Island sage sparrow reveals a direct relationship between sparrow density and the four ecological zones just described. Population densities decrease essentially in the order presented above, with the highest density found at the West Shore Site and the lowest densities in the North Head and Pyramid Cove areas. Preliminary data suggest that movement from one zone to another, or more than limited distances within a given zone, is rare (Hyde 1980, 1982).

The San Clemente sage sparrow is restricted to lower elevations than some mainland conspecifics. Mainland sage sparrows occur from sea level to about 8,250 feet (2500 m) in elevation (Miller 1968). In contrast, the insular population, apparently responding to a restricted vegetative distribution, rarely occurs more than 100 to 130 feet (30 to 40 m) above sea level, even though the highest point on San Clemente Island is 1,978 feet (599 m).

Life History -- Most sage sparrow races do not exhibit strong migratory tendencies, and coastal forms, especially *A. b. belli* in southern California, are non-migratory (Miller 1968). Like *A. b. belli*, its probable mainland ancestor, *A. b. clementeae* does not migrate (American Ornithologists' Union 1957, Hyde 1980, 1982). Results of Hyde's (1980, 1982) study further disclosed that adults, and to a large extent juveniles as well, moved very little within their local habitat. These data suggest the existence of distinct subpopulations. Preliminary analysis of sage sparrow vocalizations supports this contention (Hyde pers. comm.).

Breeding phenology of mainland and island sage sparrows seems to be quite similar. The San Clemente Island sage sparrow, like some mainland forms, begins the reproductive cycle (e.g., singing, courtship, territorial confrontation) in late January or early February. Breeding behavior intensifies until actual nesting, which extends from mid-March through at least mid-June. Both forms also establish and maintain only breeding territories of moderate size. Miller (1968) estimated the average territorial size of *A. b. belli* at 1.6 acres (0.65 hectare); this is within the size range for island pairs observed during the 1980 reproductive season (Hyde pers. comm.). Nests of island and mainland birds are normally located in low dense shrubs at a height of 76 to 127 centimeters (30-50 in).

An apparent, and potentially significant, difference between the San Clemente Island sage sparrow and its mainland complement relates to reproductive efficacy: clutch size averages four eggs (range 3-5) in

the mainland form while limited data from the 1980 breeding season points to a smaller clutch size in A. b. clementeae (Hyde 1980, 1982). The eight nests located all possessed three or fewer eggs or nestlings. Of perhaps greater importance is that of 12 eggs observed, 7 hatched but only 4 fledged. On the other hand, of a total of 19 nestlings, 15 survived at least long enough to leave the nest. Overall, however, the survival of 15 young from eight nests does not indicate an expanding population.

The incubation period for mainland sage sparrows is 13-14 days (Miller 1968). This interval for the insular race is unknown, as is the nestling period. Mainland sparrows are recognized re-nesters (Miller 1968) but this has not yet been confirmed for the clementeae form. However, Hyde (1980, 1982) found prolonged territorial defense, extended pairing, and feeding of young, which are indicators of renesting.

Postbreeding adults and juveniles combine to form foraging flocks. On San Clemente Island, these flocks range from small (3-4 birds) to relatively large assemblages (20-25 individuals). Although some nomadic tendencies were noted, the flocks remain primarily within their local habitat.

As with nearby mainland sage sparrows, A. b. clementeae juveniles undergo a post-juvenal molt by late summer (August-September). At this time, plumage of adults and juveniles becomes indistinguishable.

Sage sparrows are primarily ground and stem gleaners. Miller (1968) found the diet of mainland birds to consist of a variety of seeds and apparently other plant material as well as invertebrates. Hyde (1980, 1982) observed San Clemente Island birds feeding on fruits of cactus (*Opuntia* and *Bergerocactus*), *Atriplex semibaccata* seeds, grass inflorescenses, insects, and what appeared to him to be spiders.

Reasons for Decline -- Possible reasons for the decline of *A. b. clementeae* are similar to those suggested for the San Clemente Island loggerhead shrike: (1) a reduced or unavailable food supply; (2) habitat destruction because of feral pigs and goats and/or human activity; and (3) competition with an ecological analogue, such as the white-crowned sparrow (winter only), house finch, or horned lark, which all partially overlap with the San Clemente Island sage sparrow. Other problematic causes of decline, however, bear little relationship to the shrike decline. Specifically, the sage sparrow appears unable to effectively invade and use marginal habitat. There are, scattered throughout the island, tracts of *Lycium*, which appear superficially to be suitable for sage sparrows. However, low concentrations or complete absence of sparrows is noted in these suboptimal zones. Predation may be a significant factor limiting the population growth of sage sparrows. While no direct evidence of predation has been reported, there is reason to at least suspect that predation may be significant. San Clemente Island harbors several possible predators that occur in sage sparrow habitat; these are listed in order of presumed importance: feral cats, island fox, kestrels, and other raptors [red-tailed hawks (*Buteo jamaicensis*), northern harriers

(Circus cyaneus) and barn owls (Tyto alba)]. Also, brown-headed cowbirds (Molothrus ater), which have not been recorded breeding on any Channel Island, were present throughout 1980 and must be considered a potential nest parasite.

Essential Habitat -- Based on the above accounts of distribution and habitat requirements, essential habitat is delineated as the Lycium phase of the maritime desert scrub community along the west coast of the Island and a small amount of maritime sage scrub on the east coast (Figure 19).

Island Night Lizard [Xantusia (=Klauberina) riversiana Cope] (Threatened)

Description -- Xantusia riversiana is a moderate-sized lizard, though it is one of the largest members of the family Xantusiidae. Adults range from 65 to 109 mm in snout-vent length ($\bar{x}$ = 84 mm on San Clemente Island, $\bar{x}$ = 83 mm on Santa Barbara Island, and $\bar{x}$ = 89 mm on San Nicolas Island) while its nearest mainland relatives, X. henshawi and X. vigilis, range from 47 to 70 mm and 36 to 60 mm respectively (Bezy et al. 1980, Goldberg and Bezy 1974, Zweifel and Lowe 1966, Lee 1975). The species is one of the classic examples of divergent body size among insular species (Carlquist 1965). In this case, large size is believed to be characteristic of prehistoric xantusiid species and thus is one of the relict features of X. riversiana (Bezy et al. 1980, Regal 1968).

Taxonomy -- By comparison with its mainland relatives (i.e., X. henshawi and X. vigilis), the island night lizard is quite distinct (Figure 20). Bezy et al. (1980) assert that the species is more divergent morphologically and genetically than the other modern vertebrate inhabitants of the California Channel Islands, and for this reason it has been formally accorded separate generic status [i.e., Klauberina, by Savage (1957, 1963)]. Analysis of genetic relationships among Xantusia species (Bezy et al. 1980) estimates the divergence of X. riversiana from mainland xantusiids in Miocene time. The species had become extinct on the mainland as long as one million years ago leaving relictual populations on San Clemente, San Nicolas, and Santa Barbara Islands. The separate island lizard populations are similar to one another. Genetic variability between islands is extremely small and there are slight differences in scalation, color pattern, body size, and clutch size between island populations (Bezy et al. 1980).

Distribution and Population Size -- San Clemente Island Population: Attempts to assess the abundance of X. riversiana are confounded by the unique habits of the lizards. Secretive behavior makes it impossible to census all animals in a sample area because retreats are frequently inaccessible. X. riversiana are sedentary as well as secretive which places a bias on recapture statistics. In a mark-recapture census of lizards inhabiting a rock outcrop, marked animals recovered after a month's time were frequently located at the original site (rock) of capture or less than three meters away (Mautz[1]

[1] Dr. William J. Mautz, Univ. Calif., Irvine, CA.

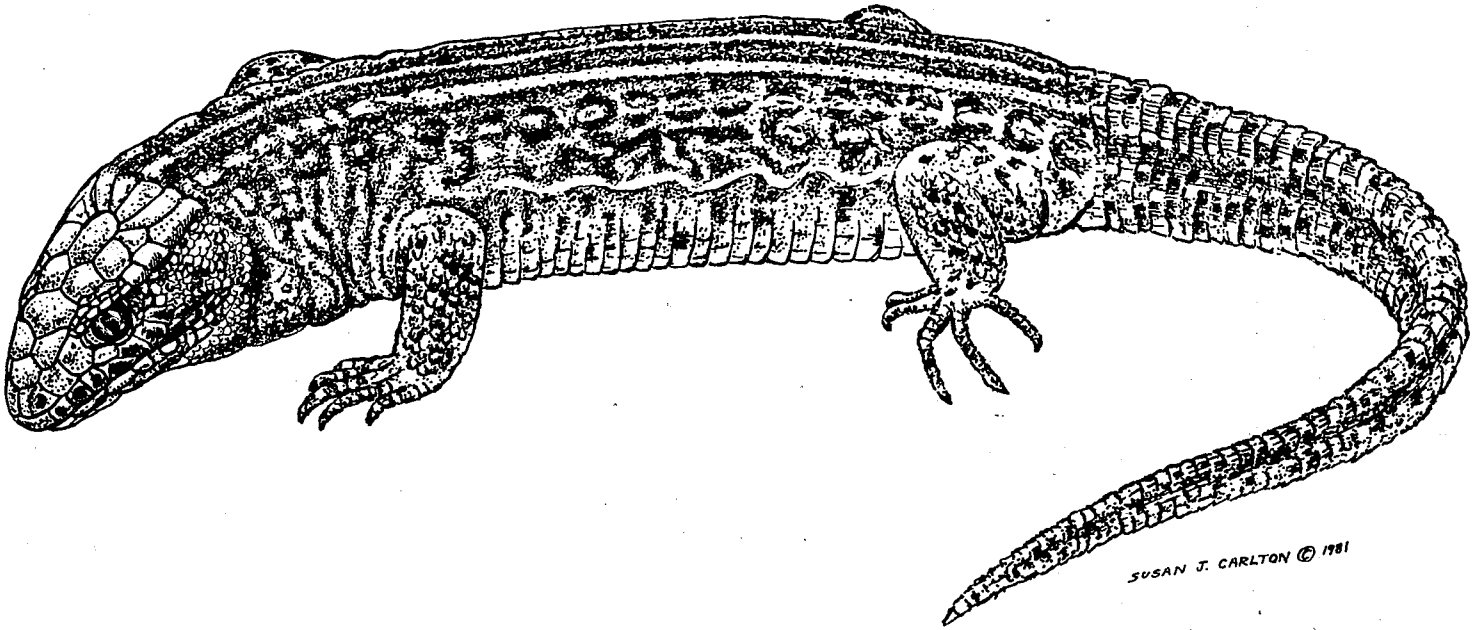


Figure 20. Island Night Lizard (Xantusia riversiana).

ms). Thus, the common method of censusing lizards by trapping them in pitfalls will sample animals over an extremely localized area and is biased toward catching lizards living adjacent to the trap. However, pitfall trap data can provide a relative indication of lizard abundance simply by the total number of animals the traps intercept. Wilson (1977) placed grids of 16 pitfall traps in eight habitats on San Clemente Island (Figure 21). Although microhabitat structure is more indicative of lizard density, dominant plant species like coastal prickly-pear and box-thorn provide important shelter for X. riversiana and lizard abundance can be roughly gauged by habitat type. The dead pad-like stems of prickly-pear accumulate about the living plants resulting in particularly suitable cover. The Lycium phase of maritime desert scrub supports the largest density of lizards followed by sites with extensive cactus patches growing on rocky soil (Table 4). Not all cactus-dominated habitats are suitable for X. riversiana. Patches of coastal cholla do not support large lizard populations. Coastal cholla grows upward in a tall, erect branched plant with a distinct trunk in contrast to the lateral spreading growth of coastal prickly-pear.

No X. riversiana were trapped in the oak woodland or stabilized dune habitats, but it is possible to locate lizards in small numbers in these habitats by turning rocks and boards. This fact emphasizes that lizard abundance varies with the presence or absence of rock outcrops and ground surface cover. These physical features are as fully important as the vegetation structure in determining population density of X. riversiana. In prickly-pear, the lizards are most

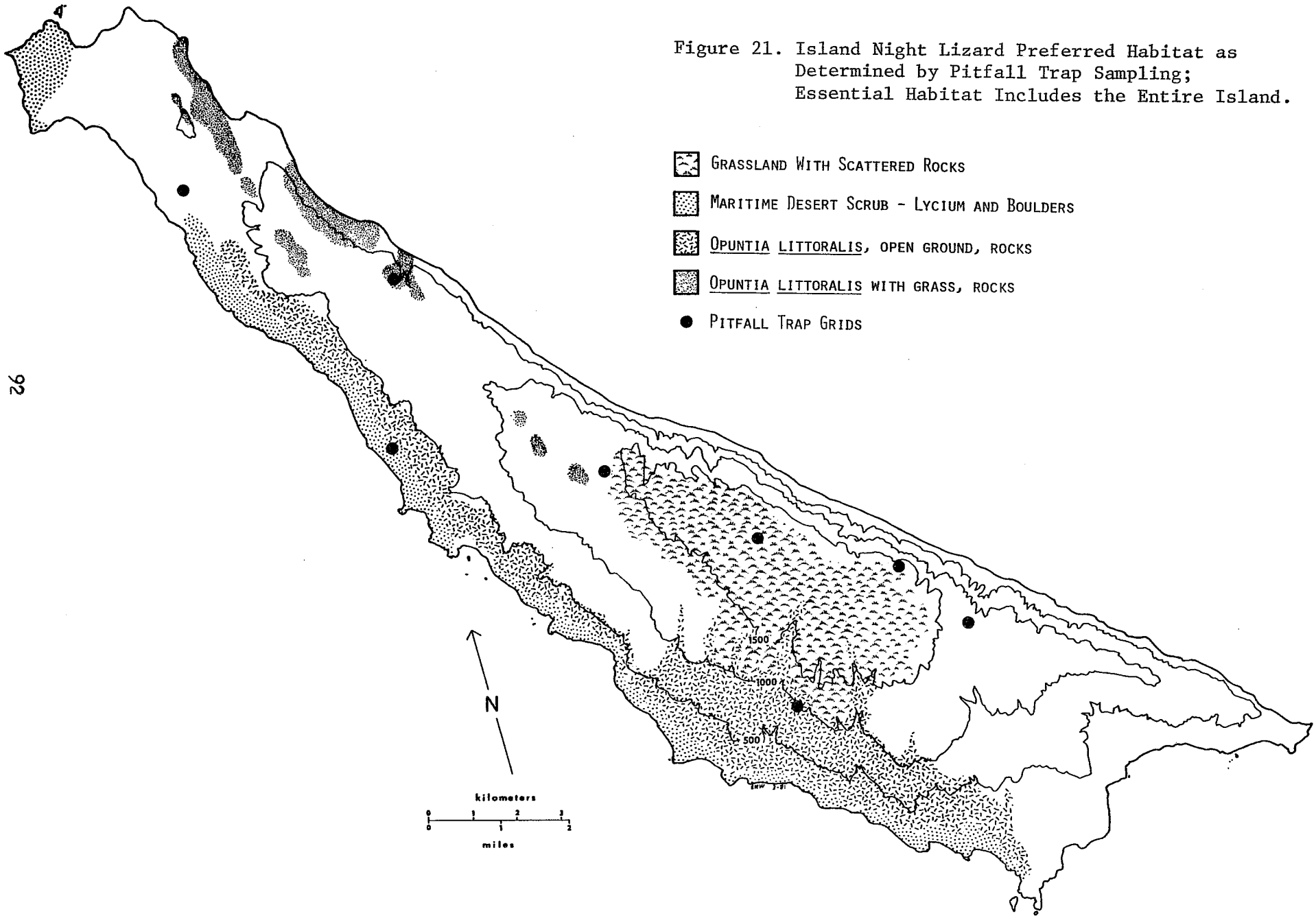


Figure 21. Island Night Lizard Preferred Habitat as Determined by Pitfall Trap Sampling; Essential Habitat Includes the Entire Island.

Table 4. Relative Abundance of *Xantusia riversiana* in San Clemente Habitats (Based on data from Wilson, unpublished)

SAMPLED HABITAT	TOTAL TRAP DAYS	TOTAL LIZARDS CAPTURED	LIZARDS PER TRAP DAY
Maritime Desert Scrub (Lycium Phase)	608	144	0.237
Maritime Desert Scrub (*Opuntia littoralis* and grasses on rocks)	928	94	0.101
Maritime Desert Scrub (*Opuntia littoralis* modified by goats on rocks)	384	41	0.099
Grassland with scattered rocks	384	30	0.078
Grassland with no rocks	544	2	0.004
Cholla (*Opuntia prolifera*)	384	4	0.010
Oak Woodland	128	0	0.0
Stabilized Dunes	864	0	0.0

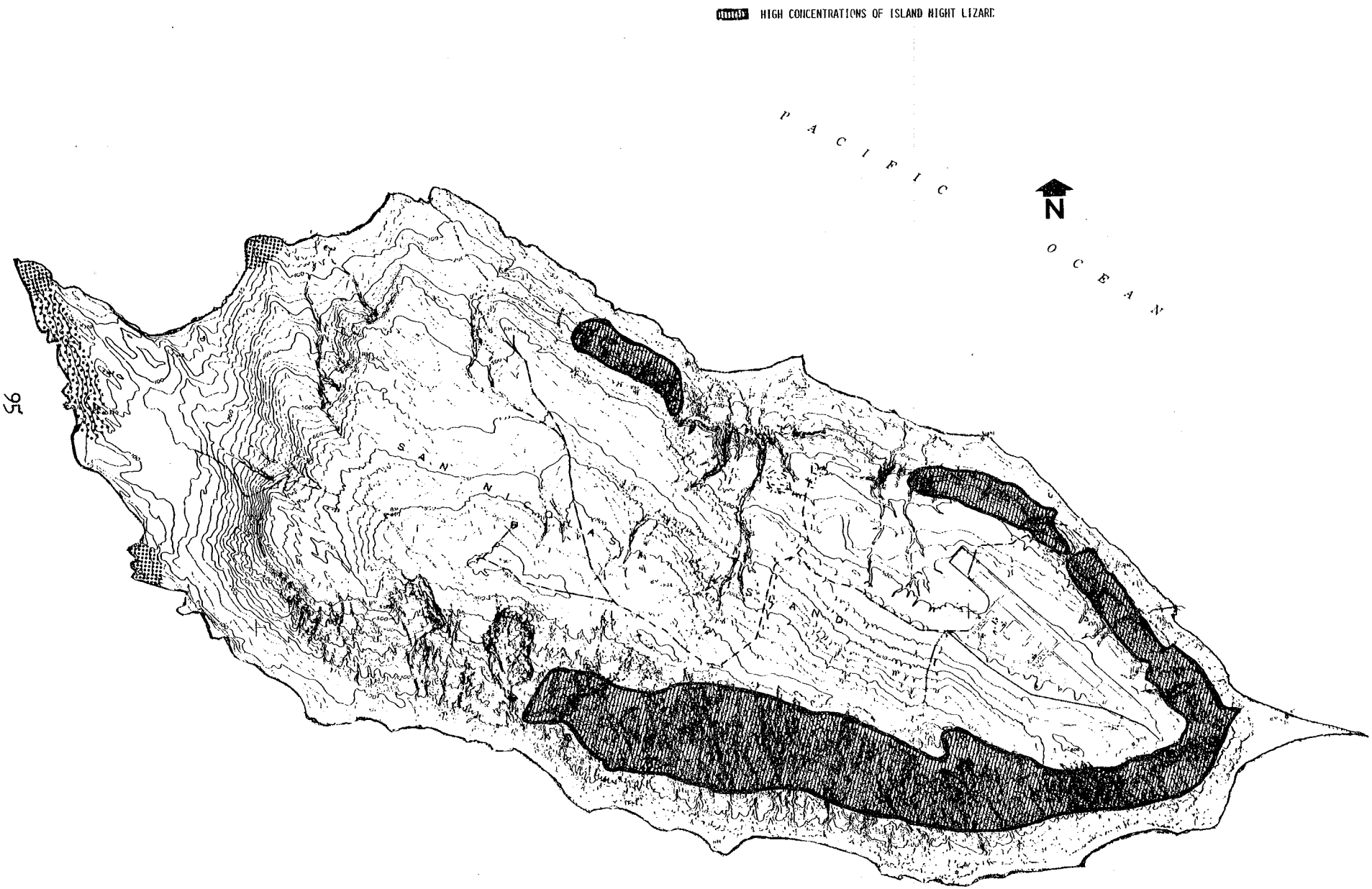
abundant in older patches in which prickly-pear growth is especially thick and deep layers of dead pads have accumulated on the ground. The most uniformly favorable habitat is maritime desert scrub - Lycium phase on the northwestern tip and southwest-facing coast of the island. North of Seal Cove, this habitat provides a continuous mixture of low, dense vegetation and rock outcrops which the lizards favor. South of Seal Cove, maritime desert scrub - Lycium phase is believed likely to support large populations of X. riversiana. Mautz (1982) found island night lizard densities of 800-1,300 individuals/ha on prime habitat (e.g., maritime desert scrub-Lycium and Opuntia phases).

San Nicolas Island Population: Observers have noted that the island night lizard is very difficult to find on San Nicolas Island, a marked contrast to the situation on San Clemente Island (Regal[1] and Bezy[2] pers. comm.; Mautz pers observ., Regal 1974). In 1977, preliminary results estimated an island night lizard population size of 14,800 (Wilson cited in Westec Services, Inc. 1978) on San Nicolas Island. Prickly-pear cactus supported the highest densities (35 lizards/ha), followed by the Lycium - Lupinus community (8/ha), and Coreopsis sites (4/ha). Other plant communities support island night lizards in low densities (less than 2/ha) (Figure 22).

[1] Dr. Philip Regal, Univ. of Minnesota, Minneapolis, MN.

[2] Dr. Robert Bezy, Los Angeles County Museum of Natural History, Los Angeles, CA.

Figure 22. Island Night Lizard High Density Areas on San Nicolas Island (Westec 1978).



Santa Barbara Island Population: Wilson (1979) estimated the number of island night lizards on Santa Barbara Island at 550 to 700 individuals. A small, isolated population of *X. riversiana* has been discovered on Sutil Islet, a 7.5 hectare piece of land 0.6 kilometers southwest of Santa Barbara Island (Wilson 1978). Only a few lizards have been captured on Sutil and the total population is undoubtedly quite small.

Habitat Requirements -- Like other members of the family Xantusiidae, *X. riversiana* is intensely secretive and requires shelter. This may include a wide variety of cover ranging from rock crevices and stones on the ground to dense patches of vegetation. The latter includes such plant growth as thick patches of cactus (*Opuntia littoralis* and *Bergerocactus emoryi*) and mat-like thickets of box thorn (*Lycium californicum*) and the non-native Australian saltbush (*Atriplex semibaccata*). Areas beneath wooden boards and other large pieces of debris also provide good retreats.

Cover is important in protecting lizards from predation and allowing them to regulate body temperature. Like other lizards, *X. riversiana* controls its body temperature through behavioral thermoregulation (i.e. by moving through the microhabitat and seeking places with compatible environmental temperatures). The species thermoregulates over a lower temperature range than most lizards and will not tolerate temperatures above 40°C (Regal 1968, Mautz 1979). Thus, the lizards must be able to retreat from extreme ground surface temperatures on hot days. The best cover for effective temperature regulation is

thick vegetation which intercepts solar radiation and buffers the ground surface from temperature extremes. Additionally, effective shelter is provided by rocks whose recesses will not overheat on hot days. The best microclimatic conditions for X. riversiana appear to occur in a thick, low-lying vegetation growing on rocky soil. Under these conditions, shafts of solar radiation penetrating to the ground surface produce a mosaic of thermal microenvironments (Regal 1968). The lizards can then move about to select a proper thermal environment and find food with minimal risk of exposing themselves to predators.

The island night lizard can be found in all San Clemente Island habitats, however, lizard abundance varies drastically both between habitats and over the geographic range of a given habitat type. It appears that microhabitat structure largely governs the abundance of lizards in a particular area and is a much more important factor than the overall habitat type.

Life History -- Demographic parameters for reproduction in X. riversiana are well-documented (Amrein and Amrein 1951, Brattstrom 1951, Goldberg and Bezy 1974). X. riversiana is a viviparous lizard. Mating begins in March, and gestation proceeds through the summer months to the appearance of young in September. The sex ratio of the current population is 50:50, but only about half of the adult female population is reproductively active in a given year. Mean brood size of gravid females is 3.76 resulting in a reproductive potential of 1.88 young produced per female per year in the entire population. By comparison with other lizards, this is a very low figure. Futhermore,

X. riversiana does not attain sexual maturity until the third or fourth year of life, an extraordinary delay for a lizard of its size. With such a low capacity for reproductive output, X. riversiana cannot support high rates of predation. The species represents an extreme pattern of lizard life history characteristics including slow growth, low reproductive effort, late maturation, long lifespan, and low predation (Tinkle 1969).

This suite of life history features magnifies the importance of the potential of predation on lizard populations. Secretive habits afford a measure of protection, however, the potential for exotic predators to overwhelm the reproductive capacity of X. riversiana poses an important threat to the species.

A variety of mammals and birds actually or potentially prey on X. riversiana. Native predators include common raven, American kestrel, burrowing owl (Athene cunicularia), San Clemente loggerhead shrike, island fox, and perhaps other raptorial birds (Hyde, Wilson[1] and Jorgensen pers. comm.). Exotic predators are feral cat and possibly rat. Predation pressure on X. riversiana is quantitatively unknown. Kestrels are probably the most important avian predator because they are abundant and skilled hunters of small mammals, lizards, and insects.

[1] Roger Wilson, Husky Oil, Calgary, Alberta, Canada.

The island fox feeds primarily on vegetation and insects but also takes mice and lizards (Fawcett[1] pers. comm,). Feral cats are an important predator because they only recently came into contact with lizards and frequently prey on them. Cats have been on San Clemente Island at least 30 years. They frequent the residential area around Wilson Cove and the trash dump, but also occur in habitats throughout the island. Of a sample of 18 cats taken in February and March 1974, ten contained food in their stomachs. Of these, eight contained one or more X. riversiana for a total of 17 lizards. Other stomach contents included mice and side-blotched lizards, but on an individual prey item basis X. riversiana accounted for 40 percent of the sampled stomach contents (Wilson unpublished data). There is no information regarding predation on X. riversiana by rats on San Clemente Island. Rats are usually associated with dump sites and buildings, however, they are not restricted to developed areas. Though probably absent over most of the island habitats, they have been observed in the dense maritime desert scrub - Lycium phase vegetation far from human habitation (Mautz pers. obser.). This is one of the preferred habitats for X. riversiana (Figure 21). In view of the broadly omnivorous diets of these rodents, they may constitute another recent source of X. riversiana mortality.

X. riversiana is an omnivore, and feeds on a wide variety of arthropods and plant material (Schwenkmeyer 1949, Brattstrom 1952). Captive animals will consume other small lizards, including other

[1] Larry Fawcett, Univ. of California, Santa Barbara, CA.

xantusiid species (Mautz pers. obser.) and it is possible that X. riversiana in the wild will cannibalize juveniles. The lizards do not appear to be limited by any particular food requirements and their generalized dietary habits may account, in part, for their ability to occupy the variety of San Clemente Island habitats.

Reasons for Decline -- The Channel Island habitats provide a special set of ecological circumstances for X. riversiana. It is one of three lizard species on San Nicolas Island and the only one on Santa Barbara Island. Predators are few, and maritime climatic conditions relatively stable. These aspects have all been emphasized as contributing to the survival of X. riversiana on the Channel Islands and to the extinction of mainland stock (Savage 1967, Regal 1968, Bezy et al. 1980). Under these circumstances, X. riversiana has evolved a life history strategy emphasizing low reproductive potential, and long lifespan - a pattern which, however, is extremely sensitive to disturbance by habitat destruction and introduction of exotic species. There is no information on the status of X. riversiana prior to ranching activities and the introduction of feral animals on San Clemente Island. However, with habitat structure as the predominant influence on present distribution, it is possible to deduce the change from past habitat modification on the island. The optimum habitat, maritime desert scrub - Lycium phase, is largely the result of climate and soil conditions along the west coast of the island and probably has not been altered to the detriment of the lizards by grazing mammals. The important changes most likely occurred in upland areas on the southern half of San Clemente Island where grazing and soil

erosion have replaced shrub and herbaceous vegetation with grassland, cholla cactus and bare gound. Rocky areas are now well exposed by the loss of original vegetation and are a deteriorated habitat for X. riversiana. Unlike maritime desert scrub - Lycium phase or old Opuntia littoralis patches, chaparral shrub vegetation is not sufficiently dense to provide full shelter by the plants alone. Upland regions lacking rock outcrops or scattered boulders, such as the flat grassland northwest of the mid-island, probably did not support large X. riversiana populations even when covered by shrubs. However, rocky areas shaded by shrubs would be a superior structural habitat for the lizards, and a diversity of shrub and herbaceous species may also serve as a source of food. A reasonable hypothesis is that the most extensive deterioration of X. riversiana habitat has occurred with the vegetation changes on rocky upland areas of the southern half of the island.

The effect of the feral cat predation on X. riversiana is uncertain. Although cats frequently feed on the lizards, apparently the low predation rate is not important to overall X. riversiana populations. In optimal habitats, lizard populations appear to be dense and reproducing, and cats may not be sufficiently numerous to have a severe impact on the lizards.

Military operations, as a whole, may have a small effect on the lizards because of the small area involved relative to the lizard's total island distribution. Grading, construction and shore

bombardment obviously disrupt lizard habitat, but the impact is local and restricted to the immediate surroundings of the activity.

Restoration of plant communities following removal of feral goats, pigs, and deer should have no adverse effect on X. riversiana in maritime desert scrub - Lycium phase and should augment the population status in areas now covered by grass, cholla cactus, and barren ground. A possible conflict with the status of X. riversiana remains in coastal prickly-pear habitat, since cactus has flourished as a result of overgrazing, and, if ecological succession following goat removal involves contraction of the prickly-pear habitat, then portions of the lizard population will also be affected. One other possible conflict might result from shrubland development. If developing chaparral scrub communities become a more favorable habitat for feral cats and these animals persist on the island, then their increasing populations may have a greater detrimental impact on X. riversiana. The goats and sheep released on San Nicolas during the 19th century undoubtedly substantially modified the native flora although these animals were removed by the end of World War II.

Essential Habitat -- In summary, the most abundant populations of X. riversiana are located in maritime desert scrub - Lycium phase along the southwest-facing coast and in the older Opuntia patches of the northwest half of San Clemente island. Because these regions are so widespread and because the lizard occurs in lesser numbers in most other habitats, the entire island is delineated as essential habitat.

Areas with high concentrations of Island Night Lizard on San Nicolas Island are indicated in Figure 22 (Westec Services, Inc. 1978). Lizard habitat appears to be confined to relatively limited areas: strands of Opuntia littoralis about the airfield, refuge dumps, rocks, as well as driftwood piles along the coast (Regal 1974, Wilson 1978). Essential habitat on San Nicolas includes the prickly-pear vegetative community.

Essential habitat on Santa Barbara Island tentatively is described as patches of Opuntia. Current field studies will provide additional information to more precisely delimit the essential habitat on Santa Barbara Island.

Other Endangered, Threatened, or Rare Species

Historically, three other species designated by the Service as endangered occurred on one or more of the California Channel Islands. These are the southern bald eagle (Haliaeetus leucocephalus), American peregrine falcon (Falco peregrinus anatum), and the California brown pelican (Pelecanus occidentalis californicus). All three bird species are protected endangered species under California law (California Adminstrative Code, Title 14, Section 670.5) and the Federal Endangered Species Act. The primary threat to their existence generally has been judged to be contamination of their food chain by cholorinated hydrocarbon pesticides. Each of these has its own recovery plan.

Under California law, the island fox is listed and afforded protection as a rare species (CAC 14:670.5). Although the island fox maintains a healthy population on San Clemente Island and also on Santa Catalina, San Miguel, Santa Rosa, Santa Cruz and San Nicolas Islands, it is still considered to be in jeopardy (Laughrin 1973, 1977).

PART II

RECOVERY

Objectives

The prime objective of this recovery plan is to restore endangered/threatened species to non-listed status by restoring and protecting habitat that can support viable self-sustaining populations; the size and extent of the populations necessary for recovery need to be determined. Once the threats to these taxa have been removed or minimized and the habitats are restored, adequately protected, and properly managed, reclassification for some taxa may be considered. Other taxa, however, because of their current extremely precarious condition will probably not warrant consideration of reclassification to non-endangered status in the forseeable future.

The major assumption regarding the current biotic condition of San Clemente Island is that many indigenous taxa now occur in numbers significantly lower than was historically the case. This is based upon general, qualitative statements made by early biologists. The main reason for the depressed condition of many island taxa, including the seven listed species addressed in this recovery plan, is attributable to habitat destruction and competition from exotic plants and animals and human disturbance. Island biota are particularly vulnerable to perturbation by alien, pre-adapted organisms (Carlquist 1965). Restoration of the San Clemente, Santa Barbara, and San Nicolas island ecosystems should involve removal of exotic animals and

plants, control of unnatural erosion, and revegetation with indigenous plants.

The relatively small size of these islands and associated military operations increase the potential for further disturbances. The impacts of military operations on E/T species both on San Clemente Island and San Nicolas Island need to be scrutinized to insure that such activities are not detrimental to recovery efforts. Recreational use of Santa Barbara Island should be carefully controlled.

Additional research should be undertaken to enhance our understanding of the interrelationship of E/T species with the environment. Only limited data on natural history, ecology, habitat requirements, and population dynamics are available for most of these species. To better manage these E/T species, particularly the plants, additional information is essential so that their needs can be properly addressed.

The basic objectives of the recovery plan include:

1. Identify present adverse impacts to biological resources and strive to eliminate or minimize them. This is especially important for the San Clemente loggerhead shrike and may involve control of native species such as the American kestrel.

2. Protect known resources from further degradation by: a) removal of feral herbivores, carnivores, and selected exotic plant species; b) control of unnatural erosion in sensitive locations; c) direct military operations and adverse recreational uses away from biologically sensitive areas.

3. Restore habitats by revegetation of disturbed areas using native species.

4. Identify areas of San Clemente Island where habitat restoration and population increase of certain addressed taxa may be achieved through a careful survey of the island and research on habitat requirements of each taxon.

5. Delist or upgrade the listing status of those taxa that achieve vigorous, self-sustaining population levels as the result of habitat stabilization, restoration, and preventing or minimizing adverse human related impacts.

6. Monitor effectiveness of recovery effort by undertaking baseline quantitative studies and subsequent follow-up work.

Step-down Outline

Prime Objective: To restore endangered and threatened (E/T) species to non-listed status (if possible) and prevent further decline by restoring and protecting habitat that can support viable, self - sustaining populations; determine the population size and extent of properly managed habitat for each species in order to consider reclassification or delisting. Once the threats to these taxa have been removed or minimized and the habitats are restored, adequately protected, and properly managed, reclassification for some taxa may be considered. Other taxa, however, because of their current extremely precarious condition will probably not warrant consideration of reclassification to non-endangered status in the forseeable future.

1. Habitat restoration.
    11. Eliminate selected non-native species.
        111. Remove feral animals from San Clemente Island (SCI)
        112. Establish a rat removal program around developed areas on SCI.
        113. Remove feral cats from San Nicolas Island (SNI).
        114. Remove European rabbits from Santa Barbara Island (SBI).
        115. Remove or control selected exotic plants on SCI.

116. Remove or control selected vegetation within island night lizard essential habitat on SBI.

12. Conduct soil survey of SCI.

13. Construct check-dams to control erosion on SCI.

14. Revegetate eroded and disturbed areas on SCI.

141. Collect seeds, propagate plants, and maintain stock of plants suitable for erosion control and revegetation of other disturbed areas.

142. Select and prepare sites for restoration including fencing and posting if necessary.

2. Implement management recommendations for E/T species.

21. Re-establish E/T plant species on SCI by revegetation.

211. Cultivate E/T plants at Native Plant Nursery and, if necessary, at "satellite" locations.

212. Study plant growth characteristics of E/T species in nursery on SCI.

213. Select areas suitable for revegetation or re-establishment of E/T species.

2131. Identify non-cliff sites for *Castilleja grisea*.

2132. Identify sites for re-introduction of *Lotus dendroideus* ssp. *traskiae*, *Delphinium kinkiense* and *Malacothamnus clementinus*.

214. Rehabilitate areas if necessary by minimizing erosion, or providing mulch or irrigation.

22. Conduct specific programs for island night lizard once management recommendations are formulated to enhance populations.

23. Provide good quality habitat for E/T birds.

    231. Conduct other specific programs for E/T birds once management recommendations are formulated to enhance populations.

    232. Establish and/or expand woodland habitat.

    233. Expand Lycium habitat.

24. Modify existing management plans to minimize habitat disturbance.

    241. Modify existing General Management Plan for SBI to reflect recovery actions for island night lizard.

    242. Incorporate recovery actions for island night lizard into management plan for SNI.

    243. Incorporate other recovery actions into Natural Resources Management Plan (SCI, SNI, SBI).

3. Habitat protection.

    31. Implement policies to minimize habitat disturbance or loss.

    311. Promulgate and enforce Naval instructions that require environmental review of military operations on SCI and SNI.

    312. Establish regulations prohibiting habitat disturbance on SBI.

    313. Insure that Naval activities do not jeopardize E/T species on SCI and SNI.

    3131. Conduct Section 7 consultations.

    3132. Study impacts of military use on SCI and SNI species.

32. Prevent introduction of additional exotic organisms.

    321. Ban transportation of exotic plants and animals (except for approved revegetation projects).

    322. Inspect equipment being transported to SCI and SNI and steam clean if necessary.

    323. Monitor new construction and military training sites annually for the presence of exotic plants on SNI and SCI.

33. Fence and/or post vulnerable colonies of E/T plants including areas of reintroductions.

34. Maintain restriction of recreational use of SBI to existing designated trails.

35. Establish ecological reserve for regions of high density of island night lizard on SCI and SNI.

4. Develop delisting criteria (i.e., the size of populations and amount of suitable habitat necessary before reclassification can be considered).

    41. Determine habitat and other requirements for E/T plants.

        411. Ascertain micro-climatic regime within the distribution of each species.

        412. Determine soil characteristics at typical locations for each species.

        413. Describe community affinities for each species.

        414. Develop accurate maps of plant communities on SCI.

        415. Complete phenological study for each E/T plant species in the wild.

416. Examine reproduction biology (pollinators, germination requirements, seedlings, and recruitment) for each species.

42. Determine taxonomic relationship of Delphinium.

43. Determine cultivation techniques for Castilleja grisea.

44. Determine habitat requirements, preferences, population size and dynamics, distribution, and current threats to survival of shrike and sage sparrow for the development of additional management recommendations for habitat restoration.

45. Examine potential and actual competitive relationship between kestrels and shrikes, and modify management recommendations accordingly.

46. Assess impact of possible predation, nest site competition, nest parasitism, and insufficent food supply on shrike and sage sparrow.

47. Determine island night lizard essential habitat, habitat requirements and preferences, population size, distribution, and effects of exotic plants on the lizards and utilize data for development of habitat recommendations and habitat restoration.

48. Study effects of fire and/or controlled burning on E/T taxa and/or their habitat and revegetation on SCI.

5. Evaluate success of management actions.

51. Monitor condition and status of the plant populations.

511. Establish recording weather stations on SCI.

512. Prepare and update accurate vegetative maps indicating distribution of plant communities.

513. Determine success of revegetation with non E/T native species.

5131. Record photographic recovery sites during April and September biennially.

5132. Monitor vegetative community recovery plots annually.

5133. Monitor abundance and distribution of certain recovery indicator species.

514. Monitor known sites (natural and revegetated) of E/T plant species annually.

52. Monitor abundance, distribution, and assess population trends of the island night lizard biennially.

53. Monitor abundance, distribution, and assess population trends of E/T birds annually.

6. Increase public support.

61. Inform island users of biological sensitivity of the islands.

611. Post SCI and SNI air terminals and other areas with information on E/T species.

612. Educate island personnel to prevent pet introduction.

62. Inform public of recovery efforts and conservation needs of these E/T species.

7. Use existing laws and regulations protecting E/T species.

71. Evaluate success of law enforcement.

72. Propose appropriate new regulations or revisions.

Narrative

Recovery of these endangered and threatened (E/T) taxa will be dependent upon the restoration, enhancement, and management of respective island ecosystems on San Clemente, Santa Barbara, and San Nicolas Islands.

1. Habitat restoration

To restore habitat to provide a more suitable environment for these E/T species, revegetation, control of erosion, and removal of exotic species will be necessary.

11. Eliminate selected non-native species.

The removal of various animal pest species on all these islands will clearly be beneficial to native species. These pest species have adversely modified the island ecosystems and have directly and/or indirectly competed with the native flora and fauna.

111. Remove feral animals from San Clemente Island (SCI)

Feral animals have had a disruptive and otherwise adverse effect on native species through degradation of the habitat (i.e., increased soil erosion, alteration of natural vegetative community). Exotic species have also directly affected E/T species by predation (e.g., cats versus island night lizard) or grazing.

Implementation of the NAS North Island Feral Animal Removal Program for the San Clemente Island will rid the island of goats, pigs, cats, and the last few deer. This program is well underway and has been highly successful. As of July 1983, approximately 400 goats, 30 pigs, 600 cats, and 5 deer remain on San Clemente Island.

Removal of feral cats from San Clemente and San Nicolas Islands must involve an ongoing program of trapping. Because of the secretive nature of these animals, their removal is significantly more difficult than for the feral herbivores. As stated previously, the island night lizard population on San Clemente Island may be in equilibrium with predation pressure created by these introduced animals. There may even be some benefit to the lizard as the result of cat predation on introduced mice and rats. This, however, has no quantitative basis and the net result could be detrimental to the native animals. A trapping program for cats that does not harm island foxes is an important aspect of the recovery plan. Current feral cat removal efforts on San Nicolas Island should be continued until total removal is accomplished.

112. <u>Establish a rat removal program around developed areas on SCI</u>. An active rat removal program should be initiated around developed areas on San Clemente Island. The spread of rats

into the native habitats may be detrimental to low-nesting sage sparrows and the island night lizard.

113. Remove feral cats from San Nicolas Island (SNI).

For rationale please see item 111.

114. Remove European rabbits from Santa Barbara Island (SBI).

European rabbits have had a disastrous effect on the native flora of Santa Barbara Island and must be completely removed. Recently the National Park Service has undertaken an ambitious rabbit removal program that is progressing well. Although all rabbits may not have been eliminated, the results so far have been very promising.

115. Remove or control selected exotic plants on SCI.

Along with the non-native animal removal program, a program to eliminate or control noxious weeds is part of the Natural Resources Management Plan of San Clemente Island. Removal of these plants by hand or topical application of individual plants with herbicide are the safest methods in light of the vulnerability of island plants to non-selective weed control methods. Any large-scale spraying program would be inappropriate.

116. Remove or control selected vegetation within essential island night lizard habitat on SBI.

If studies of the island night lizard on Santa Barbara Island show that control of exotic vegetation would result in overall ecological benefit to the island, then removal of selected vegetation should be undertaken. Iceplant may have a negative impact on the vegetation structure of lizard habitat on Santa Barbara Island. It may be advisable to remove this exotic plant pending the outcome of Gary Feller's study of the status of *X. riversiana* there. Vegetation removal for the benefit of the lizard is not recommended at this time for San Clemente Island. This is because San Clemente Island presently supports extensive areas of suitable habitat for *X. riversiana* and natural succession following feral herbivore removal may be sufficient to preserve and enhance habitats for the lizards. The possiblity that *Optuntia littoralis* habitat may diminish with the release from grazing pressure is outweighed by the benefits of feral animal removal to other habitats.

12. Conduct soil survey of SCI.

To determine suitable habitat location for revegetation projects on San Clemente Island and to aid in the re-establishment of endangered and candidate plant species, it is necessary to conduct a complete soil survey. The soil survey will also provide guidance in an erosion control program. This work is nearing completion.

13. Construct check-dams to control erosion on SCI.

Unnatural erosion should be minimized by construction or repair of earthen dams on San Clemente Island. Check-dams will also enhance the revegetation effort and the subsequent growth of plant material should further reduce erosion.

14. Revegetate eroded and disturbed areas on SCI.

Revegetation is essential to begin restoration of the habitat. No grassland habitat will be artifically expanded although existing grasslands of exotic species will be manipulated and revegetated with native grass species. Only those taxa endemic to grassland (e.g., *Delphinium* spp.) will be planted.

Plantings of maritime sage scrub associates should occur on hills or knolls where wind dispersal of seeds is likely. Also, enhancement of soil moisture through the use of mechanical devices, such as screen fog interceptors, in conjunction with planting of shrubs, would increse the probability of successful growth and establishment. Mulching by mechanical means may also be necessary.

141. Collect seeds, propagate plants, and maintain stock of plants suitable for erosion control and revegetation of other disturbed areas.

Revegetation of San Clemente Island would probably occur by natural means once feral herbivores are removed. However,

to delist species as rapidly as possible and to insure their continued existence, it is important that artificial planting of plant species which would not be expected to become re-established within five years be done at sites where natural range expansion will be expedited, such as at windy knolls where seed would readily disperse. To provide plant material for revegetation, island seed should be collected from non-sensitive plant taxa on the island.

To supply necessary propogation material for revegetation and to allow island personnel to view and appreciate many of these endemic plants, a plant nursery has been established on San Clemente Island and should be maintained. At the nursery, several taxa have been in cultivation since 1978. In addition to nursery propagation, a seed collection program has been undertaken to provide seed stock for future revegetation. Since maintenance of the genetic make-up of the island biota is an important aspect of biotic preservation, the stock used for revegetation will be selected only from island plants. The use of nursery stock and seed collected from the island should provide all the necessary stock for revegetation.

142. <u>Select and prepare sites for restoration including fencing and posting if necessary</u>.

Once sites for rehabilitation have been chosen, some site preparation will probably be necessary. This may include

removal of exotic vegetation to create space for planting and to lessen competitive influences. Signing and posting of the sites should prevent inadvertent adverse human impacts.

2. Implement management recommendations for E/T species.
Numerous actions have been proposed to maintain and restore populations of these E/T species.

21. Re-establish E/T plant species on SCI by revegetation.
The status of the E/T plant species will be enhanced by an active program to restore them in areas of the island from which they were extirpated. Subsequent to feral herbivore removal, revegetation of the island would probably occur by natural means. To insure the continued existence of E/T species, it is important that artificial planting be done at sites where natural range expansion will be expedited, such as at windy knolls where seed would readily disperse.

211. Cultivate E/T plants at Native Plant Nursery and, if necessary, at "satellite" locations.
It may be necessary to cultivate plants such as the *Lotus* and *Delphinium* at the San Clemente Island nursery to have a stock for revegetation purposes.

212. Study plant growth characteristics of E/T species in nursery on SCI.

The nursery will also provide an opportunity to study the plant growth characteristics of E/T species on San Clemente Island. Information gleaned from such studies should be useful in developing additional management recommendations from these E/T plants.

213. Select areas suitable for revegetation or re-establishment of E/T species.

To accomplish revegetation, areas must be identified that are suitable for revegetation or other forms of restoration. Such decisions will be based on results of the soil survey on San Clemente Island, historical information on vegetation structure, and an evaluation of individual species' habitat requirements and preferences.

2131. Identify non-cliff sites for *Castilleja grisea*.

Selection of reintroduction sites depends on the habitat requirements of this species. The paintbrush should be transplanted to non-cliff sites.

2132. Identify sites for re-introduction of *Lotus dendroideus* ssp. *traskiae*, *Delphinium kinkiense*, and *Malacothamnus clementinus*.

Precautions must be taken to ensure that re-introduction sites are selected for the *Lotus* and *Delphinium* such that hybridization with other subspecies does not occur.

214. Rehabilitate areas if necessary by minimizing erosion, or providing mulch or irrigation.

Some rehabilitation of selected transplant sites may be necessary prior to transplantation. This would include, for example, measures to prevent or minimize erosion, mechanical mulching, or irrigation if needed. Transplant sites should be properly prepared to enhance the probability of successful re-establishment of plants.

22. Conduct specific programs for island night lizard once management recommendations are formulated to enhance populations.

No comprehensive management recommendations have yet been made for the island night lizard. Once recommendations are formulated based on research and monitoring projects for the lizard, specific programs will be implemented to help safeguard the population.

23. Provide good quality habitat for E/T birds.

Management recommendations for the shrike and sage sparrow on San Clemente Island have not been solidified because of a need for more information. However, preliminary studies indicated that expansion of good quality habitat for both bird species is essential. The historical composition of the plant communities on San Clemente Island is rather speculative. The relative abundance/density of the species

within the communities is even more speculative. The re-establishment of shrublands and woodlands, therefore, will involve the planting of known and assumed plant associates in locations where such planting will not conflict with existing native, semi-natural Stipa grassland, Lycium phase of maritime desert scrub, dune strand, or existing woodland vegetation. The bulk of the planting will be species of the maritime sage scrub association since this community contains the majority of the endemic shrubs and woodland habitat.

231. Conduct other specific programs for E/T birds once management recommendations are formulated to enhance populations.

Other specific programs for both bird species will be implemented once recommendations are formulated based on result of future studies.

232. Establish and/or expand woodland habitat.

Woodland habitat on SCI should be expanded to provide additional shrike nesting habitat, especially at the upper ends of large canyons where open foraging habitat is close by. This may occur "naturally" as a result of herbivore removal. Establishment of woodland habitat by planting trees to provide nest sites for shrikes should be attempted first in those areas where dead stumps indicate former woodland. Generally, these areas are on the eastern escarpment or in

association with canyons on the east and west side. The moisture funneling through these canyons and subsequent condensation on the canopy creates a relatively high moisture condition for trees. The substrate of existing woodlands is very rocky. It is assumed that soil loss has taken place since roots are exposed at these sites. Attempts to grow Quercus and Prunus at the island nursery site suggest that a deep soil per se is not an important environmental factor in the growth of these trees. Moisture may be available to trees in the rocky sites once they root into the fractured substrate. Historic accounts do not seem to indicate an extensive woodland, so attempts to reforest the entire island would be inappropriate.

233. Expand Lycium habitat.

If research indicates that it would be practical to expand or improve existing Lycium habitat favored by the sage sparrow, then this project should be undertaken.

24. Modify existing management plans to minimize habitat disturbance.

Several existing land management plans on the three islands (SCI, SBI, SNI) need to be modified to minimize disturbance to E/T species and their habitats.

241. Modify existing General Management Plan for SBI to reflect recovery actions for island night lizard.

The "General Management Plan" for SBI should incorporate the recovery actions outlined for the island night lizard. This will help ensure adequate consideration for the management of this species in the analysis and decision for future land-use plans.

242. Incorporate recovery actions for island night lizard into management plan for SNI.

The "Management Plan" for San Nicolas Island should be updated to reflect recovery needs of the island night lizard. This will aid in preventing an action or activity that may inadvertently be harmful to the lizard or its habitat.

243. Incorporate other recovery actions into Natural Resources Management Plan (SCI, SNI, SBI).

The Natural Resources Management Plans for each island should also address the necessary recovery actions for their respective E/T and candidate species.

3. Habitat protection.

Survival and eventual recovery of these species is dependent on adequate protection of their habitat. Regardless of other management actions to conserve these E/T species, if

habitat is not properly managed, recovery will not be possible.

31. Implement policies to minimize habitat disturbance or loss. Disturbance or adverse habitat alteration must be kept to a minimum to provide the best opportunity for these species to expand their populations and recover.

311. Promulgate and enforce Naval instructions that require environmental review of military operations on SCI and SNI. The standard environmental review processes as well as those specifically outlined in Naval "instructions" on San Clemente and San Nicolas Island should be actively adhered to and enforced. In addition, the official Naval "Instruction", written to protect San Clemente Island cultural and natural resources, should be amended as needed to most efficiently protect listed species. This would include setting aside "standard operating areas" for routing Naval operations on the island.

312. Establish regulations prohibiting habitat disturbance at SBI. Specific regulations prohibiting habitat disturbance of E/T species should also be established by the National Park Service on Santa Barbara Island.

313. Insure that Naval activities do not jeopardize E/T species on SCI and SNI.

To protect and restore habitat of E/T species the impact of military activities on San Clemente Island and San Nicolas Island must be determined.

3131. Conduct Section 7 consultations.

Section 7 of the Endangered Species Act requires that any Federal agency (including military installations) consult with the U.S. Fish and Wildlife Service when a proposed activity may affect E/T species. This provision helps insure that Federal agencies do not approve or undertake actions that could jeopardize the continued existence of E/T species.

3132. Study impacts of military use on SCI and SNI species.

Various studies on endangered/threatened taxa and their relationships to the islands' ecosystems should be undertaken to assess the effect of military activities on the conservation and recovery of these taxa.

32. Prevent introduction of additional exotic organisms.

A vital step in protecting the habitat of these island E/T species will be to prevent the introduction of additional exotic organisms.

321. Ban transportation of exotic plants and animals (except for approved revegetation projects).

Strictly enforced policies preventing the transportation of plants and animals, whether transported intentionally or unintentionally in crates, equipment, hay, etc., should be formulated for all three islands.

322. Inspect equipment being transported to SCI and SNI and steam clean if necessary.

Only vegetative material for approved revegetation projects should be permitted to be brought to the islands. This would require systematic inspection of equipment and materials being transported to the islands.

323. Monitor new construction and military training sites annually for the presence of exotic plants on SNI and SCI.

Military construction and training sites should be monitored annually for the presence of exotic plants on San Clemente and San Nicolas Islands..

33. Fence and/or post vulnerable colonies of E/T plants including areas of reintroductions.

Fencing or posting of the boundaries of sensitive plant colonies on San Clemente Island should be done. Areas that are being prepared for revegetation may also need to be fenced. Some sensitive plant locations already have been fenced to exclude goat and pig predation. This has been

very effective, particularly for Delphinium populations. Several sample areas of various plant communities have been fenced to permit observation and comparison of grazed versus ungrazed situations. Baseline data presently being acquired from these plots will allow quantitative representation of the natural recovery of the vegetation once feral herbivores are extirpated. Removal of deer, goats, and pigs from the Wilson Cove area has resulted in the growth of many Lotus plants there. Military operations in the form of personnel training, road grading for power pole placement, oil line placement and soil or rock quarrying, have destroyed vegetation. In order to remove the threat of habitat destruction by human use in the Wilson Cove area, areas of known occurrence with adequate buffers for population expansion should be posted.

34. Maintain restriction of recreational use of SBI to existing designated trails.

Santa Barbara Island is already protected by the NPS in its entirety, and the restriction of recreational use to established trails should be continued to minimize human disturbance.

35. Establish ecological reserve for regions of high density of island night lizard on SCI and SNI.

Regions of high population density of island night lizard should be protected from disturbance by the establishment of

ecological reserves on San Clemente and San Nicholas Islands. On San Clemente Island these include the *Lycium* phase of maritime desert scrub along the immediate west coast and upland rocky areas dominated by *Opuntia littoralis*.

4. Develop delisting criteria (i.e., the size of populations and amount of suitable habitat necessary before reclassification can be considered).

Before consideration can be given for reclassifying a species (either upgrading to threatened status or delisting) it is necessary to determine the number of organisms, the size of the secure habitat, or the number of such populations/habitats required to support viable, self-sustaining populations. To obtain this information and to properly manage these taxa, additional research studies are necessary.

41. Determine habitat and other requirements for E/T plants.

Before extensive restoration of habitats is undertaken for the re-establishment of E/T plants, it is necessary to better define their basic habitat requirements.

411. Ascertain micro-climatic regime within the distribution of each species.

Micro-climatic data are needed to round out our knowledge of habitat requirements. This will aid in defining the best locations for restoration attempts.

412. Determine soil characteristics at typical locations for each species.

Recently completed soil studies should be used to reveal soil characteristics at typical locations for each species. This will aid in the defining the best locations for restoration attempts.

413. Describe community affinities for each species.

Additional data are needed that indicate the community relationships of these taxa so these relationships may reveal additional conservation needs and habitat requirements which can then be incorporated into the plan.

414. Develop accurate maps of plant communities on SCI.

Maps showing plant distributions on the island and floral affinities are needed to further our understanding of the ecological requirements of E/T plant species.

415. Complete phenological study for each E/T plant species in the wild.

Phenological studies have been initiated for most listed plants on San Clemente Island, but more complete information is needed for all species especially in the wild.

416. Examine reproduction biology (pollinators, germination requirements, seedlings, and recruitment) for each species. Along with the study of the phenology, pollinators, and germination requirements, more information is required on the reproductive requirements of the various taxa. This information is needed to aid in the management of the plant species. Moreover, the cultivation requirements of each species should be determined.

42. Determine taxonomic relationship of Delphinium. Before planting or seeding of *Delphinium kinkiense* is undertaken, a study of the taxonomic validity and genetic relationship of this taxon to the other island larkspur, *D. variegatum* ssp. *thornei*, should be completed. This will determine if there will be a possibility of hybridization between the two subspecies at the re-establishment sites.

43. Determine cultivation techniques for Castilleja grisea. The best cultivation and transplantation techniques for *Castelleja grisea* should be determined. The present populations of this shrub are located on coastal canyon walls and cliffs and will expand naturally. However, integration of this shrub into other associations on level ground is essential. Location of the introduction sites should take into consideration information gained from the soil survey. If establishment is difficult or if the propagation of plants from seeds or cuttings is not

successful, an investigation into the parasitic relationships of this species may become necessary. Efforts to propagate the species should focus on seed stock in order to maintain as high a level of heterozygosity as possible in the new populations.

44. Determine habitat requirements, preferences, population size and dynamics, distribution, and current threats to survival of shrike and sage sparrow for the development of additional management recommendations for habitat restoration.

To develop management recommendations for the San Clemente loggerhead shrike and sage sparrow, additional information is needed on their habitat preferences and requirements, population sizes, distributions, and population dynamics. It is essential to provide the loggerhead shrike with suitable and sufficient nesting habitat.

45. Examine potential and actual competitive relationship between kestrels and shrikes, and modify management recommmendations accordingly.

Competition between shrikes and kestrels on San Clemente Island seems to be a factor which may be suppressing or retarding shrike reproduction success. A continual high degree of niche overlap between these two species would be detrimental to shrikes, given their extremely low numbers. A study analyzing the competitive relationship between

shrikes and kestrels should be instituted immediately. Depending on the findings of the study, reduction or removal of kestrels may be warranted.

46. Assess impact of possible predation, nest site competition, nest parasitism, and insufficent food supply on shrike and sage sparrow.

The above factors may be having a negative influence on shrikes and sage sparrow, thus possibly preventing population expansion and slowing recovery. Definitive studies on these items should be used to determine what additional problems affect these subspecies.

47. Determine island night lizard essential habitat, habitat requirements and preferences, population size, distribution, and effects of exotic plants on the lizards and utilize data for development of habitat recommendations and habitat restoration.

Island night lizard habitat preferences should be determined for all islands. Population size, habitat requirements essential habitat, density, population dynamics, the effect of other factors such as human use, should be studied to develop additional management recommendations. Because the lizard is confined to the dry lands of these islands, and has a life history sensitive to physical and biological disturbance, it will always be vulnerable to introductions

of exotic biota and human disturbance. Detailed information on this species is lacking and is particularly needed for the populations on Santa Barbara Island and San Nicolas Island. San Nicolas Island has yet to be adequately surveyed for essential lizard habitats. The lizard surveys should be coordinated to include permanent sets of pitfall grids so data from separate islands will be comparable and populations can be monitored in the future.

48. Study effects of fire and/or controlled burning on E/T taxa and/or their habitat and revegetation on SCI.

Fire in maritime sage scrub does not seem to be a beneficial factor. The *Lycium* phase of maritime desert scrub does not appear to regenerate quickly after a fire, despite the fact that *Lycium* shrubs commonly spread by underground stems. The role of fire on the island's shrub vegetation must be studied experimentally as revegetation occurs. The planting of shrublands and chaparral should be done in a manner which creates breaks in the fuel loads. Deliberate creation of fuel breaks by vegetation removal would, however, be contrary to the revegetation efforts of the recovery plan. With grasslands, additional study is needed to see if non-native grasses can be suppressed by controlled burning in favor of native *Stipa*, as well as other indigenous plants. Establishment of sage scrub and chaparral vegetation on San Clemente Island will very likely involve an increase in fire frequency. The role of fire in

chaparral vegetation is quite clear and those island species which are assumed to be associated with this community in the past all seem to have resprouting or germination capabilities in response to a burn. Once established, these chaparral stands would need to be protected only from too frequent fires.

The increased amount of vegetation resulting from the removal of goats, pigs and deer and the need for grassland management, may require some type of controlled burning program on San Clemente Island. If burning is judged necessary, the effects on all E/T species should be studied. The potential long-term effects on all habitats, particularly grassland community structure, should be evaluated prior to beginning a burning program. Analyzing fire ecology to determine the impact of fire on revegetation of maritime desert scrub (*Lycium* phase) and maritime sage scrub should also provide useful information for island night lizard and sage sparrow habitat restoration.

5. Evaluate success of management actions.

All E/T taxa must be monitored throughout the course of the recovery program to assess its success and determine if additional actions or modifications of activities are necessary.

51. Monitor condition and status of the plant populations.

The status and condition of all known sites of E/T plant species (including restored or transplantation sites) should be carefully monitored annually. This will aid in assessing whether different or more extensive restorative measures are necessary.

511. Establish recording weather stations on SCI.

To monitor the broad changes resulting from revegetation programs and herbivore removal on San Clemente Island plant populations, weather recording stations should be established in major vegetation communities.

512. Prepare and update accurate vegetative maps indicating distribution of plant communities.

The distribution of plant communities on all three islands should be accurately mapped and regularly updated to help evaluate the overall success of management actions.

513. Determine success of revegetation with non E/T native species.

Efforts to restore and revegetate disturbed habitats, woodlands and maritime desert scrub (*Lycium* phase) on San Clemente Island should be monitored quantitatively to evaluate success. Such a monitoring program was begun in 1981.

5131. Record photographic recovery sites during April and September biennially.

Photographs taken at permanent stakes or other such markers will provide a general overview and permanent record of the time-sequence of recovery of the various plant communities.

5132. Monitor vegetative community recovery plots annually.

Annual quantitative analysis of permanent study plots will indicate the condition of the vegetation. Poor condition may necessitate implementation of additional recovery actions.

5133. Monitor abundance and distribution of certain recovery indicator species.

Several species are considered indicators of good or acceptable habitat quality. Monitoring them provides a relatively rapid and inexpensive method of appraising the general quality of the overall habitat.

514. Monitor known sites (natural or revegetated) of E/T plant species annually.

The progress of recovery of E/T species on restored sites or in natural situations will be evaluated by quantitatively analyzing those areas.

52. Monitor abundance, distribution, and assess population trends of the island night lizard biennially.

The status of the island night lizard should be monitored biennially via analysis of its density, distribution, and population size on Santa Barbara, San Clemente, and San Nicolas Islands. The potential exists for major changes in vegetation community structure from revegetation projects, fire management and herbivore removal. The amount and quality of island night lizard habitat, most importantly maritime desert scrub, should be carefully monitored in case this habitat is replaced with other types less suitable to the lizard such as sage scrub. Such trends may be an overall benefit to an island, but must be monitored for their effect on the lizard.

53. Monitor abundance, distribution, and assess population trends of the E/T birds annually.

The San Clemente Island loggerhead shrike and sage sparrow populations should continue to be surveyed after the completion of comprehensive baseline studies. Abundance, distribution, population trends and habitat condition should be monitored annually to evaluate management programs.

6. Increase public support.

Public support for the conservation of these E/T species can be enhanced by increasing the public's awareness of the sensitivity and uniqueness of the island's ecosystems.

61. Inform island users of biological sensitivity of the islands.

Users of the islands can have a substantial impact on habitat quality and the recovery of these E/T species. The speed and extent of recovery and of management success will depend upon the assistance and cooperation of all individuals frequenting the islands.

611. Post SCI and SNI air terminals and other areas with information on E/T species.

Many individuals will have an opportunity to read posters/pamphlets on conservation of the E/T species if such information is posted at convenient locations that people routinely frequent.

612. Educate island personnel to prevent pet introduction.

This can be done through articles in local papers (especially military base newsletters), distribution of pamphlets, posting of signs or by other measures. The information materials should stress the importance of keeping all pets off the islands to prevent the inadvertent introduction of exotic animals.

62. Inform public of recovery efforts and conservation needs of these E/T species.

This can be accomplished by presentations, distribution of educational pamphlets, and news releases.

7. Use existing laws and regulations protecting E/T species. All Federal and State laws pertaining to the protection and conservation of E/T species should be used to further the recovery effort.

71. Evaluate success of law enforcement. Additional or more extensive efforts to enforce existing laws protecting these E/T species may be needed. Periodic evaluations will provide an assessment of needed modifications in this area.

72. Propose appropriate new regulations or revisions. Revisions in existing regulations may be necessary to enhance conservation efforts of these E/T species. If revisions are not adequate to further conservation and recovery goals, new legislation may be proposed.

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PART III

IMPLEMENTATION SCHEDULE

Table I that follows is a summary of scheduled actions and costs for the recovery program of the endangered/threatened species of the Channel Islands. It is a guide to meet the objectives of the Recovery Plan as elaborated upon in Part II, Narrative section. This table indicates the priority in scheduling tasks to meet the objective, identifies which agencies are responsible to perform these tasks, specifies a time-table for accomplishing such tasks, and lastly, outlines the estimated costs to perform them. Implementing Part III is the action of the recovery plan, which when accomplished, will bring about the recovery of these endangered/threatened/subspecies. Priority 3 items (as defined on the following page) are not included in Part III.

GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULES

Information Gathering - I or R (research)

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

Acquisition - A

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

Management - M

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

Other - O

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

RECOVERY ACTION PRIORITIES

1 = An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.

2 = An action that must be taken to prevent a significant decline in species population/habitat quality, or some other significant negative impact short of extinction.

3 = All other actions necessary to provide for full recovery of the species.

PART III
IMPLEMENTATION SCHEDULE
RECOVERY PLAN FOR CHANNEL ISLANDS SPECIES

General Category	Plan Task	Task No.	Task Priority	Duration[1] of Task (yrs.)	Responsible Agency[2] FWS Region	FWS Program	Other	Fiscal Year Costs (Est.) ($1,000's) 1	2	3	Comments/Notes
M5	Remove feral animals from SCI	111	1	Duration unknown	1	SE	NI	150	50	10	
M4	Establish rat trapping program around developed areas on SCI	112	2	Ongoing			NI	3	3	3	
M4	Remove feral cats from SNI	113	2	In progress			PM	20	10	10	
M5	Remove European rabbits from SBI	114	2	In progress			NPS	20			
M4	Remove or control selected exotic plants on SCI	115	2	Continuous			NI	5	5	6	
M4	Remove selected exotic vegetation within essential INL habitat on SBI	116	2	TBD			NPS	TBD			
I2	Conduct soil survey on SCI in progress	12	2	1			NI	45			

General Category	Plan Task	Task No.	Task Priority	Duration[1] of Task (yrs.)	Responsible Agency[2] FWS Region	FWS Program	Other	Fiscal Year Costs (Est.) ($1,000's) 1	2	3	Comments/Notes
M3	Construct or repair earthern dams on SCI	13	2	3			NI	2	2	2	
M3	Collect, propagate, and maintain native plants	141	2	Ongoing (SCI, SNI) TBD (SBI)		NPS	PM NI	1 10 7	1 10 7	1 10 7	
M3	Select and prepare sites	142	2	3			NI NPS PM	3	3	3	
M1	Cultivate E/T plant species at nursery	211	1	Ongoing			NI	2	2	2	
M1	Study plant growth of E/T species at nursery on SCI	212	2	2			NI	5	5		
M2	Identify sites for *Castilleja grisea*	2131	1	1			NI	1.5			
M2	Identify sites for *Lotus*, *Delphinium*, and *Malacothamnus*	2132	1				NI	1.5			

General Category	Plan Task	Task No.	Task Priority	Duration[1] of Task (yrs.)	Responsible Agency[2] FWS Region	FWS Program	Other	Fiscal Year Costs (Est.) ($1,000's) 1	2	3	Comments/Notes
M3	Rehabilitate areas by minimizing erosion etc.	214	1	Ongoing			NI	5	5	5	
M3	Actions for night lizards once recommendations are made	22	2	TBD			NI, NPS PM, CDFG	TBD			
M3	Enhance E/T bird pops.	231	1	TBD			NI, CDFG	TBD			
M3	Establish/expand woodland	232	1	Ongoing			NI	1	1	1	
M3	Expand Lycium	233	1	TBD			NI	TBD			
M3	Modify existing General Mgt. Plan for SBI to reflect recovery actions for INL	241	2	1			NPS	1			
M3	Incorporate recovery actions for INL into mgt. plan for SNI	242	2	1			PM	1			
M3	Incorporate other recovery actions in Natural Resources Mgt. Plan (SCI, SNI, SBI)	243	2	1			NI PM NPS	1 1 1			
O3	Promulgate/enforce Naval instructions re: environmental review	311	2	Ongoing			NI PM	TBD			

General Category	Plan Task	Task No.	Task Priority	Duration[1] of Task (yrs.)	Responsible Agency[2] FWS Region	FWS Program	Other	Fiscal Year Costs (Est.) ($1,000's) 1	2	3	Comments/Notes
I14	Conduct Section 7 consultations	3131	1	TBD	1	SE		.5	.5	.5	
							NI	.5	.5	.5	
R1	Studies to determine impact of military activities on E/T spp.	3132	1	TBD	1	SE		1.0	1.0	1.0	
							NI	TBD			
							PM	5.0	5.0	5.0	
M4	Ban transport of exotic organisms	321	2	Ongoing			PM	TBD			
							NI	TBD			
							NPS	TBD			
M4	Inspect equipment going to SCI and SNI	322	2	Continuous			NI	TBD			
							PM	TBD			
M4	Monitor new construction for exotic plants	323	2	Continuous			NI	TBD			
							PM	TBD			
M3	Fence and post vulnerable colonies of E/T plants	33	1	Ongoing			NI	3	3	3	
R3	Ascertain microclimatic regime for each E/T plant species	411	1	3			NI	3	3	3	
R3	Determine soil characteristics for each plant species	412	1	1			NI				Completed
R3	Describe community affinities for each E/T species	413	1	2			NI		2	2	

General Category	Plan Task	Task No.	Task Priority	Duration[1] of Task (yrs.)	Responsible Agency[2] FWS Region	FWS Program	Other	Fiscal Year Costs (Est.) ($1,000's) 1	2	3	Comments/Notes
R3	Develop accurate maps of plant communities	414	1	1			NI				Completed
R7	Phenological study for each E/T plant species	415	1	2			NI		5	5	
R7	Examine reproductive biology and cultivation requirements	416	1	2			NI		5	5	
R5	Determine taxonomic relationship of *Delphinium*	42	2	1			NI	TBD			
R7	Determine cultivation techniques for *Castilleja*	43	2	2			NI		3	3	
R3	Determine habitat requirements, population size, distribution, current threats etc. for shrike and sage sparrow	44	1	3			NI CDFG	10	10	10	
R10	Examine competitive relationship of shrike and kestrel	45	1	2	1	SE	 NI CDFG	5 5	5		Underway FY-83 Underway FY-83
R10	Assess impact of predation, nest site parasitism etc. on shrike and sparrow	46	1	2			NI CDFG	5	5		

General Category	Plan Task	Task No.	Task Priority	Duration[1] of Task (yrs.)	Responsible Agency[2] FWS Region	FWS Program	Other	Fiscal Year Costs (Est.) ($1,000's) 1	2	3	Comments/Notes
R3	Determine essential habitat, habitat requirements, distribution, etc.	47	2	3			NI NPS PM CDFG	5 3 4	5 3 4	5 3 4	
R4	Study effects of fire and/or controlled burning on SCI	48	2	2			NI	TBD			
I2	Establish weather stations at SCI to monitor plant pops.	511	2	3			NI	12	12		
I1	Prepare and update accurate vegetative maps indicating plant distribution	512	2	1			NI			5	
I2	Record photographic recovery sites	5131	2	Continuous			NI	1	1	1	
I2	Monitor veg. community recovery plots annually	5132	2	Ongoing			NI	5	5	5	
I2	Monitor abundance and distribution of certain recovery indicator species on SCI	5133	2	Continuous			NI	3	3	4	
I1	Monitor known sites of E/T plant spp. annually	514	1	Ongoing			NI	5	5	5	

General Category	Plan Task	Task No.	Task Priority	Duration[1] of Task (yrs.)	Responsible Agency[2] FWS Region	FWS Program	Other	Fiscal Year Costs (Est.) ($1,000's) 1	2	3	Comments/Notes
I1	Monitor INL biennially	52	2	Biennial			NI	3		4	
							NPS	2		2.5	
							PM	2		2.5	
							CDFG				
I1	Monitor E/T birds annually and assess pop. trends	53	1	Ongoing	1	SE					
							NI	6	6	6	
							CDFG				
M5	Educate island personnel re: introduction of exotics	612	2	Ongoing			NI	.5	.5	.5	
							PM	.5	.5	.5	
02	Evaluate success of law enforcement	71	2	Biennial	1	LE			1.0		
							DFG		1.0		
02	Propose new regulations revisions	72	2	As needed	1	LE			1.0		
							DFG		1.0		

[1] "ongoing" - currently underway
"continuous" - once a task is begun it will continue indefinitely.
TBD = To be determined

[2] Agency abbreviations:
NI = Naval Air Station, North Island
PM = Pacific Missile Test Center, Point Mugu
NPS = National Park Service, Channel Islands National Park
CFG = California Department of Fish and Game
SCI = San Clemente Island
SBI = Santa Barbara Island
SNI = San Nicolas Island
SE = Endangered Species program, Fish and Wildlife Service
LE = Law enforcement, Fish and Wildlife Service
Fiscal year 1 = FY 84, 2 = FY 85, 3 = FY 86

Table 5. Agencies From Whom Comments were Requested:

California Department of Fish and Game - Sacramento, CA

California Coastal Commission - Long Beach, WA

U.S. Navy - Point Mugu, CA; San Diego, CA; San Bruno, CA

National Park Service - San Francisco, CA

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