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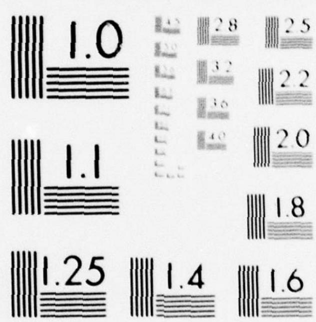


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Technical Document 145

# NAVAL OCEAN SYSTEMS CENTER ENVIRONMENTAL RESOURCES CONSERVATION 1974 - 1978

Ronald La Rosa

15 March 1978

Final Report: February 1974 - February 1978



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NAVAL OCEAN SYSTEMS CENTER
SAN DIEGO, CALIFORNIA 92152

NAVAL OCEAN SYSTEMS CENTER, SAN DIEGO, CA 92152

AN ACTIVITY OF THE NAVAL MATERIAL COMMAND

**RR GAVAZZI, CAPT, USN**
Commander

**HL BLOOD**
Technical Director

The Environmental Resources Conservation Program was funded and managed by the Naval Ocean Systems Center. Research, formulation of master plan, and Program monitoring were performed by Ronald La Rosa, environmental consultant, in concert with NOSC Public Works Department. This is the final report for Program Phases I, II, and III ending June 30, 1978.

Released by

R. Hightower
Head, Production Control Division

Under Authority of

R. F. Kimball
Deputy Public Works Officer

## ACKNOWLEDGMENTS

The following Navy organizations assisted in the NOSC Environmental Resources Conservation Program: NOSC Public Works Department, Public Affairs Office, and Technical Information Division; Eleventh Naval District Public Works Center San Diego; and Resident Officer in Charge of Construction, San Diego Area. Civilian agencies contributing to the Program include the U.S. Forest Service, County Environmental Development Agency, Soil Conservation Service, Harbor Kiwanis Club, and California Native Plant Society.

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| REPORT DOCUMENTATION PAGE | | READ INSTRUCTIONS BEFORE COMPLETING FORM |
|---|---|---|
| 1. REPORT NUMBER<br>18 NOSC TD-145 | 2. GOVT ACCESSION NO. | 3. RECIPIENT'S CATALOG NUMBER<br>9 |
| 4. ~~TITLE (and Subtitle)~~<br>6 Naval Ocean Systems Center Environmental Resources Conservation 1974-1978 | | 5. TYPE OF REPORT & PERIOD COVERED<br>~~Technical Document~~ Final rept.<br>Feb[redacted]74 – Feb[redacted]78 |
| | | 6. ~~PERFORMING ORG. REPORT NUMBER~~ |
| 7. AUTHOR(s)<br>10 Ronald La Rosa | | 8. CONTRACT OR GRANT NUMBER(s)<br>15 N66001-77-N-8422 new |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS<br>La Rosa Enterprises<br>3695 Cedarbrae Lane<br>San Diego, CA 92106<br>New 410 817 | | 10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS<br>12 47p. |
| 11. CONTROLLING OFFICE NAME AND ADDRESS<br>Naval Ocean Systems Center<br>San Diego, California 92152 | | 12. ~~REPORT DATE~~<br>11 15 Mar[redacted]78 |
| | | 13. ~~NUMBER OF PAGES~~<br>50 |
| 14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) | | 15. SECURITY CLASS. (of this report)<br>UNCLASSIFIED |
| | | 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE |
| 16. DISTRIBUTION STATEMENT (of this Report)<br>Approved for public release; distribution unlimited | | |
| 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) | | |
| 18. SUPPLEMENTARY NOTES | | |
| 19. KEY WORDS (Continue on reverse side if necessary and identify by block number)<br>Environments<br>Conservation<br>Management<br>Environmental Protection | | |
| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number) | | |

The Naval Ocean Systems Center, San Diego, has undertaken a program to preserve and enhance environmental resources at its Point Loma facility through planting of trees and shrubs, erection of bird of prey roosting snags, placement of watering devices, creation of food plots, and establishment of an endangered plant repository.

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## FOREWORD

For more than 125 years, San Diego's Point Loma has been a military reservation, designated so by President Millard Fillmore in 1852. Since 1906, when the Navy Radio Station was established, the Navy and Point Loma have been linked in the pursuit of peace through research and development.

The Naval Ocean Systems Center recognizes its responsibility to this historically significant land; that is, to preserve, protect and improve the 507 acres that are entrusted to us. In recent years, our commitment to this responsibility has been a well planned and executed program to assure that the natural state of the land is protected.

This three-year program has resulted in the installation of hundreds of trees and shrubs, some of them endangered species, to enhance the environment and increase biological productivity.

We are taking steps, also, to repair or correct erosion problems by revegetating disturbed soil, restoring natural contours, and reconfiguring drainage patterns to check run-off and soil loss.

Today, more than 100 years after the military was charged with the protection of Point Loma, we are more aware than ever before of our responsibility to assure that valuable resources are protected and improved. Our program is one of creative conservation. Our aim is to improve our Point Loma land environment in recognition of the public trust granted a century and a quarter ago.

R. R. GAVAZZI
Captain, U.S. Navy
Commander

## OBJECTIVES

The principal objectives of this resource conservation project include:

- Preparation of a continuing environmental data base, including quantitative inventory of plantlife, vegetation distribution, wildlife, census, and analysis of diversity and high-quality habitats.
- Environmental monitoring of wildlife response to watering devices and roosting/nesting structures; changes in wildlife populations and diversity; plantlife vigor and health; soil stabilization measures.
- Formulation of portions of NOSC master plan, including definition of major problems, and future plan objectives based on previous environmental monitoring and program evaluation.

## RESULTS

Resource reconnaissance and environmental monitoring were conducted between 1974 and 1978. Pertinent environmental resource data are given in tables and figures and documented in photographs. Wildlife censuses and vegetation surveys revealed that animal habitats have been improved and some endangered plant species can be successfully transplanted. Monitoring reveals that both landscape and wildland plantings have become established to provide wildlife food plots, vegetative screens, and stabilization of soil. This project has shown that Naval Ocean Systems Center at Point Loma has complied with federal conservation mandates and has preserved, and continues to enhance, the natural environment.

## RECOMMENDATIONS

- Make erosion control a top priority task
- Accomplish habitat enhancement on specifically identified sites
- Modify existing resource inventory and environmental planning data to incorporate rapid retrieval information cards.

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INTRODUCTION AND BACKGROUND

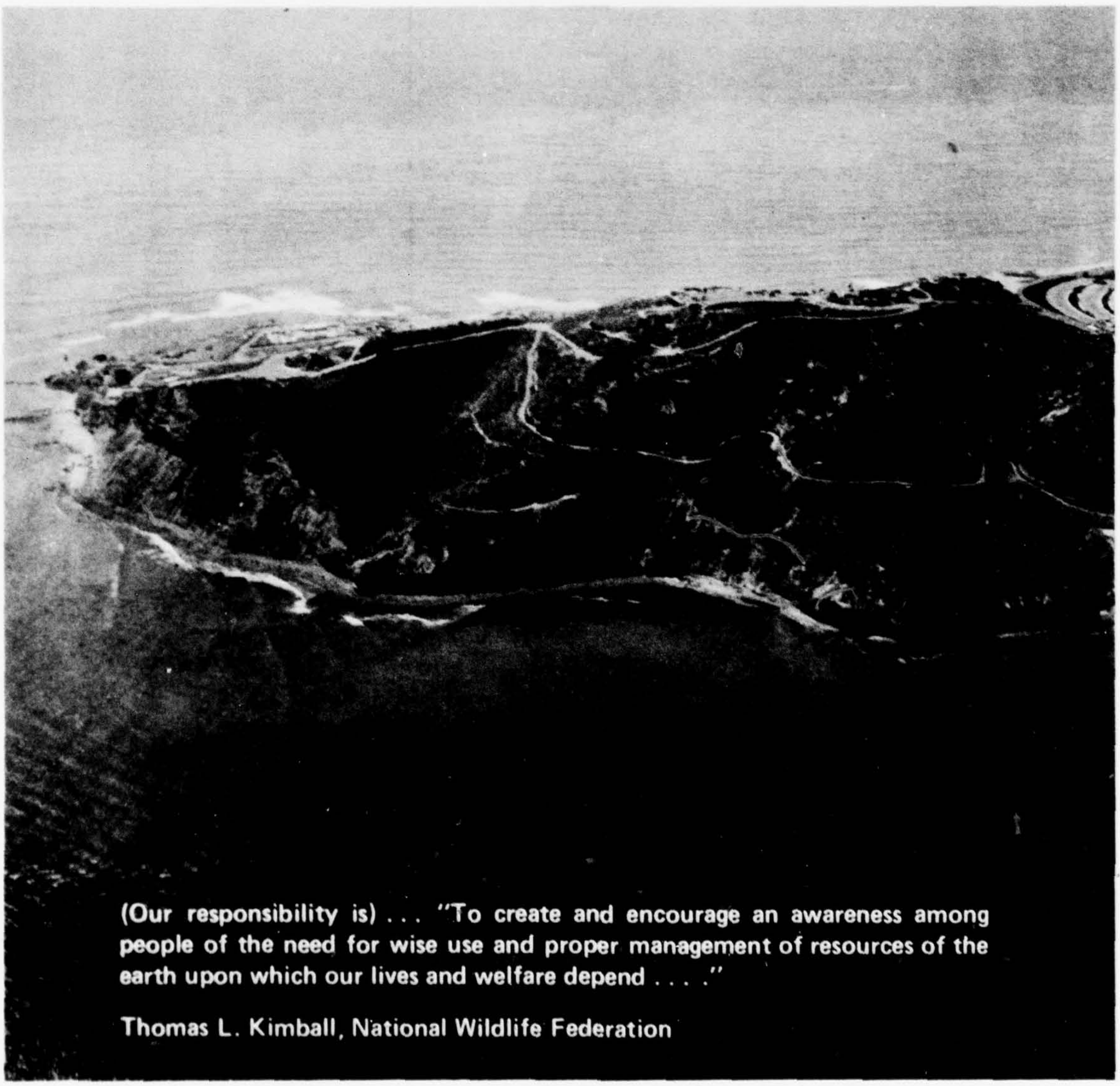


Figure 1. Tip of Point Loma.

## POINT LOMA

In 1542, Juan Cabrillo sailed into San Diego Bay and anchored on a spit of land on the lee side of a 5-mile* peninsula. Today, 436 years later, Cabrillo would be astounded by the transformation of the hillside and sand spit into what is now known as Roseville, La Playa, and Shelter Island. The Portuguese seafarer would find, however, that much of the coastal bluffs he named Point Loma has remained unchanged over the last four centuries. Although much of the tree-like shrub cover was used as fuel for ship cookstoves and oil rendering furnaces in whaling ship days, the southern three and one-half miles of Point Loma has remained relatively undeveloped due to its history of military ownership since 1852.

Figure 2. Simulated Cabrillo landing party. (Photo by Action Studios, Point Loma)

*Metric Conversion Table

| To Convert From | To | Multiply By |
|---|---|---|
| Inches | Metres | $2.54 \times 10^{-2}$ |
| Feet | Metres | $3.048 \times 10^{-1}$ |
| Miles | Metres | $1.609 \times 10^{3}$ |
| Acres | Metres$^2$ | $4.046 \times 10^{3}$ |
| Tons | Kilograms | $9.071 \times 10^{2}$ |
| Degrees Fahrenheit | Degrees Celsius | $t°_C = (t°_F - 32)/1.8$ |

The "Point" is located on Catalina Boulevard (Highway 209) about ten miles from downtown San Diego (one of thirteen incorporated cities within San Diego County). (See figure 3, vicinity map.) The Cabrillo National Monument, Fort Rosecrans National Cemetery, and scenic vistas, including seasonal whale watching, attract one and one-half million visitors annually. (Anon. 1975.)*

Although it is known that the Dieguено Indians inhabited lands around the Peninsula, reports of hearths and other ancient sites suggest Point Loma may contain significant archaeological resources. Due to the classified nature of the Naval Ocean Systems Center and the fact that little earth moving has taken place over the years, archaelogical surveys have been unnecessary under the provisions of the National Environmental Policy Act.

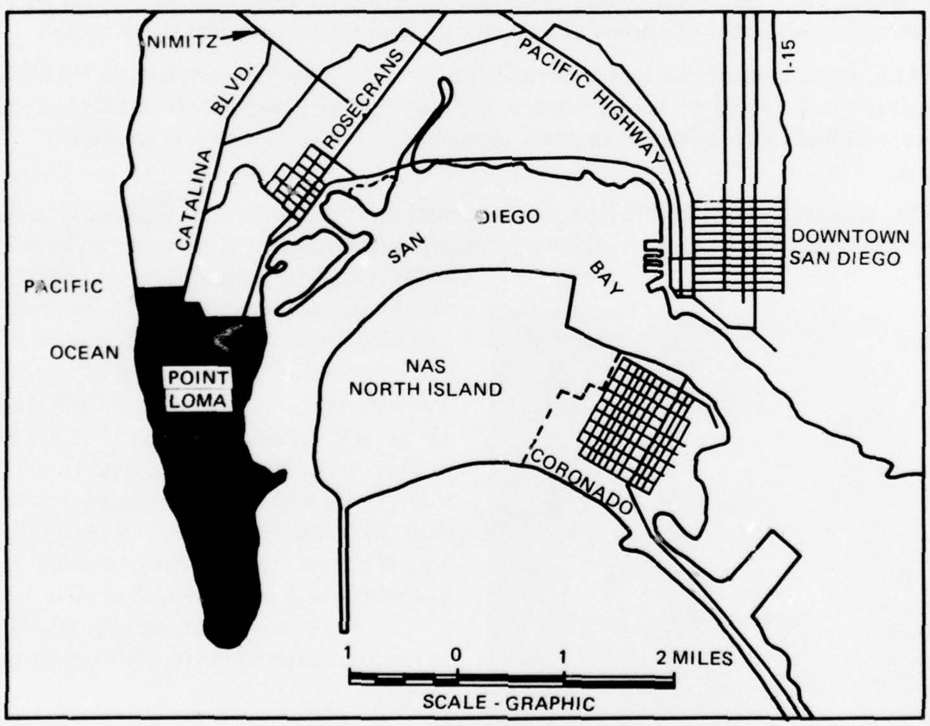


Figure 3. Vicinity Map.

*See bibliography at end of report.

## NAVAL OCEAN SYSTEMS CENTER

*The first small radio station atop* Point Loma was built in 1906 after a survey party had named it an ideal site for radio transmission studies. During World War I the station was a vital link in military communications and, particularly since the beginning of World War II, Point Loma has served as the birthplace of scientific and technical discoveries essential to meet the needs of the U. S. Navy. In recent years research efforts have been expanded to include technology in the physical and human sciences. At Point Loma, programs improved what was already developed and pushed scientific research to unexplored areas.

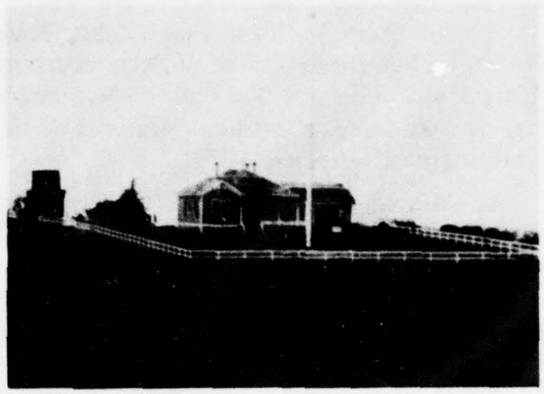

Figure 4. Point Loma's first radio building.

In March 1977 the Naval Ocean Systems Center was created from the merger of the Naval Electronics Laboratory Center (NELC) and the Naval Undersea Center (NUC).

NELC demonstrated the first experimental Navy Tactical Data System to enable Fleet Commanders to make rapid decisions, became the Navy's lead laboratory in microelectronics technology, and had recently begun to make contributions in the area of biomedical engineering.

NUC was established in 1967 to provide undersea surveillance and weapon systems, as well as deep ocean technology. Launch equipment and torpedo testing were performed at Morris Dam, Long Beach, and San Clemente. Ocean technological achievements included a variety of manned submersibles and associated deep water equipment. NUC also was responsible for the Navy's Marine Mammal Program (Outlook, 1977). (Note: Before consolidation, the Naval Undersea Center initiated a resource conservation program to bring San Clemente Island into ecological balance by removing feral livestock and instituting erosion control measures. A report of these activities and the island's unique resources is currently in preparation.)

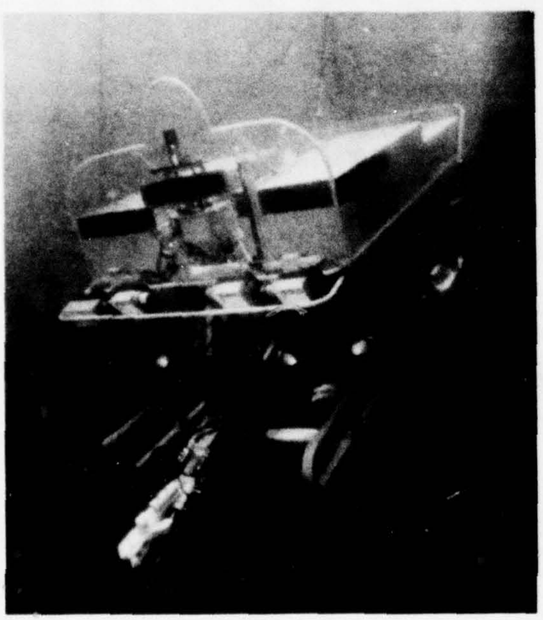

Figure 5. Cable-controlled underwater recovery vehicle developed by NUC.

## NOSC AND THE COMMUNITY

Although the Naval Ocean Systems Center was established in 1977, personnel associated with the previous facilities (NUC and NELC) have received national recognition in the fields of electronics, computer science, and oceanic research. Aside from

NOSC's substantial role in the field of National Defense, the Center has continued to provide a service to the civilian public.

NOSC has traditionally participated in the San Diego Annual Science and Engineering Fair, County Schools Meet the Scientist Program, and local Boy Scouts of America projects. The Center continues to cooperate with the National Marine Fisheries Service in its annual gray whale census, the Harbor Kiwanis Club Beautification Program, and the efforts of local plant societies and wildlife rescue centers to relocate rare and endangered flora and fauna.

Figure 6. Whale census requires patience and a sharp eye.

Since the early 1970's the Center has been actively engaged in a mutually cooperative program with the superintendent of Cabrillo National Monument to preserve, restore, and enhance native chaparral, wildlife, and tide pool life at Point Loma (see page 29 for revegetation measures). In 1974, 38 acres were deeded to the Park Service for public nature trails to enable expansion of interpretive programs. The Center has welcomed the interjurisdictional cooperation of the California Department of Fish and Game, Soil Conservation Service, and Cleveland National Forest Service in the preparation of erosion control plans, replanting programs, and wildlife habitat improvement efforts.

## CONSERVATION AND THE ENVIRONMENT

The military has begun to be recognized for its stewardship of the land and concern for resource conservation. This fact is most evident in Southern California where military facilities provide one of the last bastions from urban development. Since the inception of Secretary of Defense awards in the early 1970's, military bases have received national recognition for efforts to protect threatened species, enhance wildlife habitats, prevent soil erosion, and protect the environment. According to an editor who took a cross-country tour of military installations practicing resources management, the environmental mission is second only to the primary military mission; even the latter reflects maximum feasible consideration of environmental concerns. (Pardo, 1973).

## RESOURCE CONSERVATION – A BEGINNING

Initial volunteer efforts of Naval Electronics Laboratory Center (NELC) personnel to plant native pine trees and provide water basins and feeding stations for wildlife were augmented by a limited survey in 1973 to identify critical deficiencies. After a presentation to the five military tenants on Point Loma, NELC's Commander, Capt. Norton Harding, committed the Center to an ongoing program to protect and enhance the environment on 357 acres of undeveloped land. (See table 1.)

Table 1. NOSC land use.

| Land Use Category | Acreage |
|---|---|
| Developed Facilities | 145 |
| Unaltered Wildlands | 320 |
| Land Deeded to National Park Service | 38 |
| Enhanced Areas (landscape, habitat improvement, etc.) | 42 |

In 1974, the County of San Diego's Environmental Development Agency was asked to assist in environmental research and monitoring for NELC's Environmental Resources Conservation Program. The County provided a senior Environmental Management Specialist who had experience in wildlife biology and wildlands enhancement, and knowledge of environmental legislation.

Figure 7. ERC multidisciplinary task team.

## ENVIRONMENTAL PLANNING

The NOSC Environmental Resources Conservation (ERC) Program has been implemented through a multidisciplinary team approach. An ERC Task Team of engineers, planners, and an environmental specialist was augmented by a soil scientist architect and contracts administration officer and staff. Master Planning (see page 26) provided the framework for the division of conservation activities into annual phases. Each phase has been implemented through the teamwork of an environmental consultant, Navy Public Works Center, Resident Officer in Charge (contracts and inspection), and the selected civilian contractor. After a phase-end evaluation, the Master Plan has been revised accordingly. The program's underlying philosophy is one of minimizing research costs and maximizing on-the-ground conservation efforts.

### ERC – A PROGRAM FOR ACTION

The substantial success of the NOSC Environmental Resources Conservation Program, now concluding Phase III, can be attributed to the fact that authority to undertake conservation measures rests with the Commander and environmental planners who can approach their work without requirement for approval from a multiple and/or remote authority. Conservation activities are, of course, tempered with sound judgment and input from other jurisdictions. ERC tasks generally include resource reconnaissance and monitoring, coordination of environmental designs, and preparation of reports. Naval Ocean Systems Center has undertaken its resource stewardship and formulated a program directed to action – protection of the environment and provision of a legacy for the future.

# ENVIRONMENTAL RECONNAISSANCE, CONSERVATION AND MONITORING

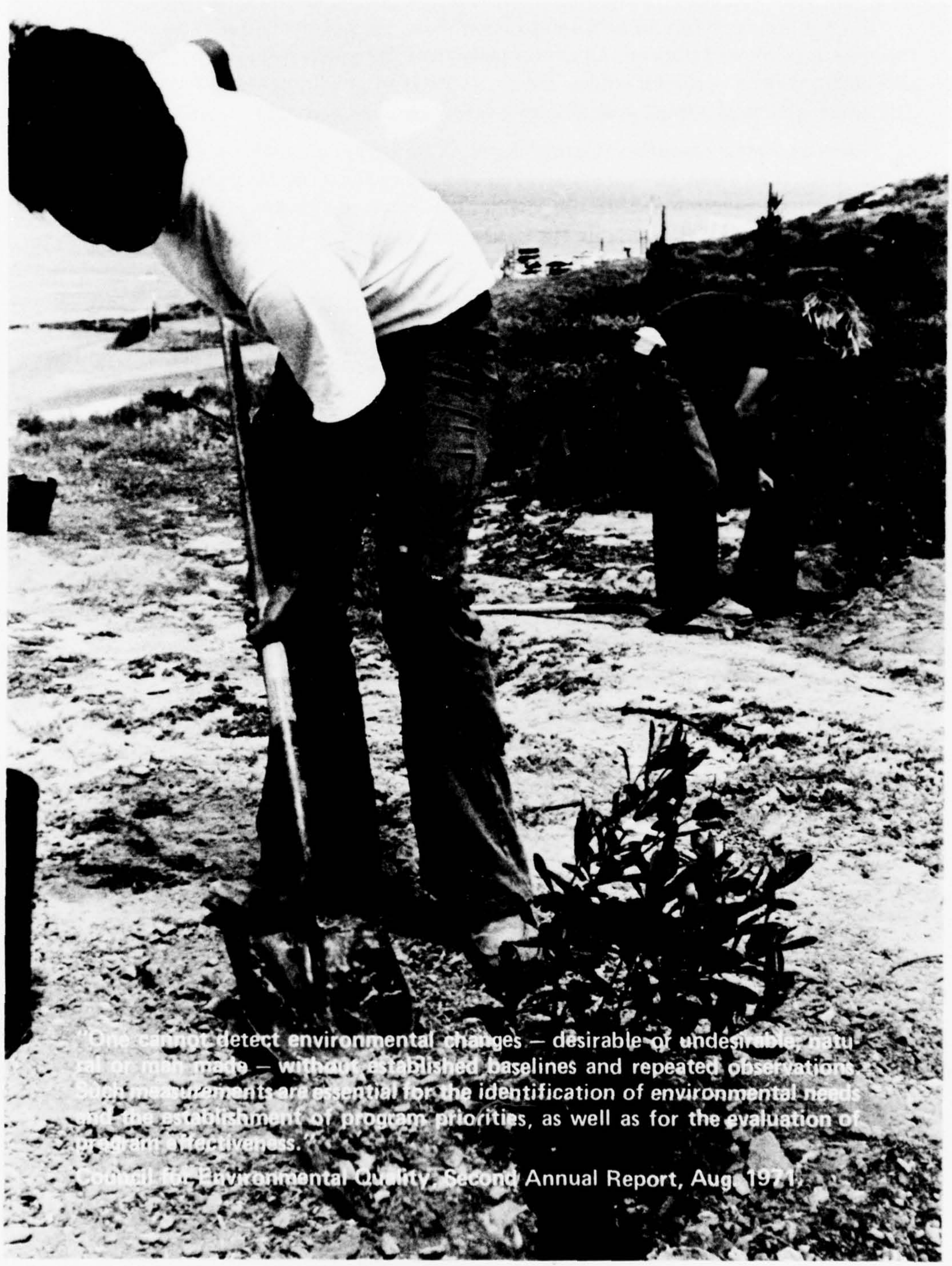


Figure 8. Conservation crew installing plants.

## ENVIRONMENTAL SETTING

The Naval Ocean Systems Center is responsible for about three of the 76 miles of San Diego County's Coastline. Shaped by wind and water into dramatic bluffs, wind and sea caves and tidal pools, the hills and canyon fingers comprising Point Loma contain unique plants, provide habitats for a great variety of animals, and hold unsurpassed vistas.

Population growth and urban expansion make the relatively undeveloped open space and wildlands of Point Loma an important legacy for the preservation as well as wise use of a diminishing resource — coastal lands. Today all levels of government are recognizing the coastal environment as a limited and unique resource to be managed carefully.

Environmental resources (meteorologic, oceanographic, geologic, biologic, and aesthetic) have been to some degree surveyed and mapped by the Division of Mines and Geology, Soil Conservation Service, Department of Interior, County of San Diego, and by professional organizations, including the California Native Plant Society and San Diego Archaeological Society.

The information contained in this report and associated maps is a continuing effort to compile data for use as a "master" environmental impact statement. Data on noise, air quality, seismic conditions, and land use are contained in documents associated with the NOSC Master Land Use Plan.

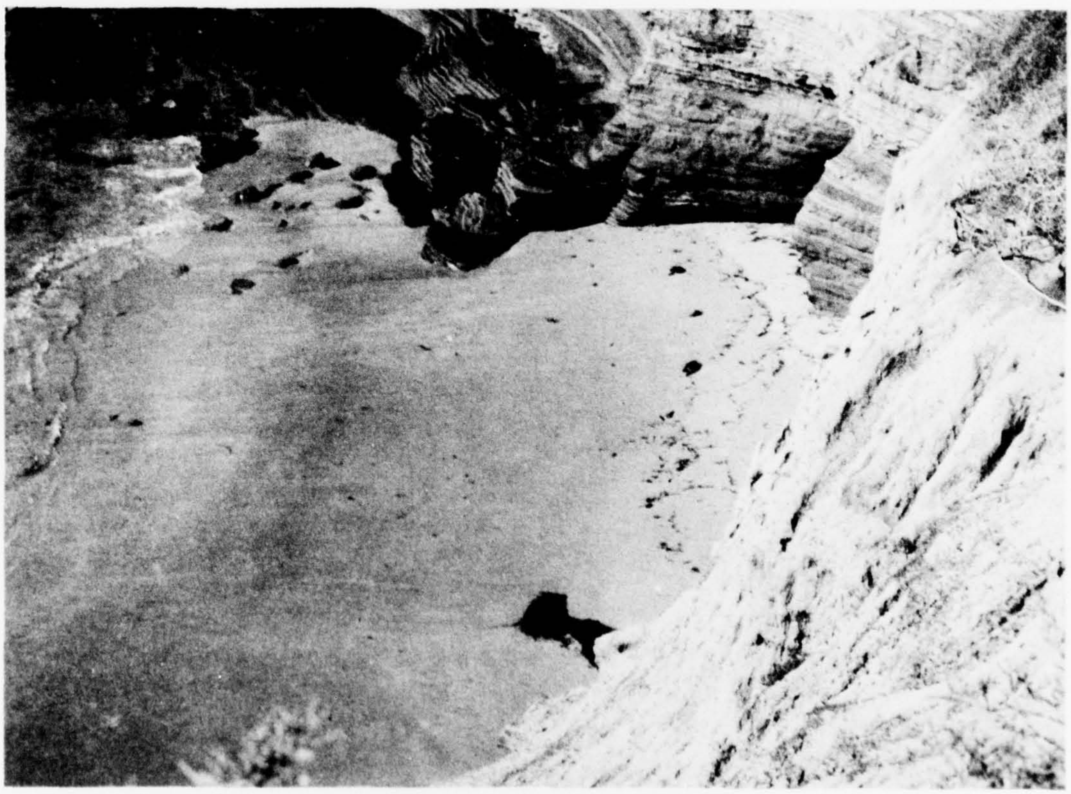

Figure 9. Coastal bluff.

## METEOROLOGICAL CHARACTERISTICS

The coast of southern California at San Diego is characterized by a mild Mediterranean climate. Winter temperatures range from a high of 63°F to lows reaching 55°F; summertime temperatures range from 66°F to 78°F. In the 102-year history of the San Diego Weather Station, freezing temperatures have been recorded eleven times, with snow occurring only twice. The highest recorded temperature was 111°F, with only ten days exceeding 100°F. The prevailing winds are from the west in the summer, and from the northwest in the winter; continuous afternoon daily winds prevail from 8 to 15 miles per hour with a maximum recorded velocity of 45 miles per hour. The area is subject to high humidity and salt spray.

To a large extent, such climatic influences govern plant growth or vegetative cover. Rainfall at Point Loma is widely variable, both in amount and distribution. Normal rainfall for the area is 10 inches a year, with 75 percent occurring from November through March. The extremes of annual precipitation are reflected in the facts that up to one half the seasonal norm has occurred in one month and great variations exist among particular storms. Such erratic patterns depict periods with rainfall in excess of plant needs, and long dry spells. Plant and animal species adapted to the climate of Point Loma are able to survive these periods through use of fog, dew, and mist. (Went, 1955)

## OCEANIC RESOURCES

The waters of the Pacific have obvious influences on Point Loma's vegetation and physiography which comprise wildlife habitats. However, description of oceanic resources is discussed separately in order that the reader focus on the main emphasis of the Program – the preservation and enhancement of terrestrial resources.*

There are no definite boundaries describing the relationship of man to the coastal environment and the living creatures of the sea. The ocean is a cradle of life and weather, a reservoir of water and energy, and a complex pollution problem. Although the sea as a resource serves man in aesthetic, recreational, and economic functions, it plays a more important role than providing these obvious human benefits. Marine and coastal plant communities determine associated animals, while offshore waters and the tidelands attract and guide 90 percent of the West Coast's migratory birds.

Ocean waters are categorized as the neritic zone, or waters over the continental shelf to thirty metres, and the epipelagic zone, or waters off the continental shelf down to two hundred metres. Beyond the continental shelf lies the pelagic or oceanic zone.

Coastal bottom habitats off San Diego County are divided into general substrate environments – rock and sand. Nearshore marine environments can be further divided into environments under the direct influence of the tides. The subtidal zone is that area on or near the bottom from the lower limits of the low tide zone to the 200-foot contour where large dark-brown algae or other seaweeds dominate. Animals typical of this zone are the purple sea urchin, the green sea anemone and California spiny lobster. (For a list of plants and animals associated with marine habitats, consult table 2.)

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*Resources – Although limitations of budget and staff precluded involvement in near-shore resources, the relationship of on-shore land use to tidal organisms is of concern and could become a part of ERC Program in the near future.

Figure 10. *Atriplex*, a salt-resistant species.

Table 2. Nearshore habitats and associated wildlife.

| HABITAT | WILDLIFE |
|---|---|
| SANDY BEACH/ROCKY SHORE | |
| Brown algae<br>Little ice plant<br>Salt grass<br>Surf grass | Caspian tern; Heerman's California gull; Brown pelican; Western sandpiper; Scoter duck; Cormorant; Smelt; Croaker and Flat fish; Sea star; California cockle, Green abalone and limpet. |
| COASTAL BLUFF | |
| California encelia<br>Coastal buckwheat<br>Lemonadeberry<br>Quail brush | Beechy ground squirrel; Brush rabbit; Cliff swallow; House finch; Brown towhee; California thrasher; Side-blotched and California legless lizards. |

The upper portion of the subtidal zone is a transitional area between the tidal zone with its dominant tidal surge and the kelp zone where the effect of tidal surge is lessened by water depth. This lower zone begins near the thirty-foot depth. Because the surge is strong in the upper subtidal zone, the brown algae population is relatively small. A gradual transition into this seaweed community is noted with first smaller, then larger species of seaweed, and finally giant kelp, a golden-brown seaweed easily seen from the elevated shore.

The subtidal environment is a stable zone where changes in salinity or effects of pollution are not easily detected. Destruction of the subtidal rocky substrates by sand encroachment may be the greatest threat to this habitat. If the rocks are covered with sand, free-moving organisms will leave, and sessile (permanently attached) organisms will die from being covered by the sand and/or from the increased sand load in the water.

Typical stationary organisms found among the kelp fronds or on the ocean bottom include sponges, corals and worms. Mobile or free-moving organisms such as small fish, sea urchins, and abalones feed upon the kelp. The sea urchin has a greater impact upon the kelp for, unlike the abalone which feeds upon the fronds, the sea urchin eats the holdfasts, thereby causing the plant to drift away.

Tidal zones are broken down into four units defined as follows: low-tide zone, area below 0.0-foot tide level; mid-tide zone, area between 0.0 and 2.5-foot tide level; high-tide zone, area between 2.5 and 5.0-foot tide level. Tide pools are found in rocky substrates in all four intertidal zones. The mid-tide zone is characterized by mussel beds at its upper limits and patches of surf grass at its lower limits. Wave action is still a dominant force in the midtide zone, but dehydration or increased salinity due to evaporation is not as severe as in the splash zone.

Figure 11. Tide pools.

The coast of San Diego County is visited by several species of marine mammals including whales, dolphins, sea lions and seals. The gray whale migrates southward past our shore in the winter months en route to mating and calving areas in the lagoons of Baja California. These huge mammals range from 40 to 50 feet in length and weigh up to 35 tons. The Pacific black fish, a large porpoise, is frequently seen offshore in schools of up to 50 individuals as are Bottle-nose, Common and Pacific white-sided dolphins (Ingles, 1965).

## GEOLOGY

The coastal plain was created by volcanic and granitic rocks 70 million years ago, and generally consists of a series of wavecut terraces or escarpments now elevated above sea level.

Most of the sea floor off our coast is covered with mud for miles out to sea. However, a strip of sand 1-1/2 to 3 miles wide extends along most of the shoreline. Off Point Loma, the sand is interrupted by rock bottom. Small patches of rock are scattered along most of the coastline, especially within the half mile of sea floor closest to the beach (Inman, 1954). Where resistant rock occurs along the coast, the typical result of wave erosion is a sea cliff fronted by a narrow, sandy beach. In Point Loma, where highlands occur adjacent to the coast, beaches are nearly absent.

### STRATIGRAPHY

The youngest rocks present on Point Loma are the Pleistocene marine terrace deposits, consisting of reddish, fine-to-coarse sands. These terrace deposits extend to a depth of 40 feet and comprise the ridge and downslope of the Peninsula. Underlying the terrace deposits are the much older sandstones, mudstones, and shales of Cretaceous age. Interbedded here are thin strata of grayish colored sandstones, mudstones and shales, with individual beds varying in thickness from a few inches to three feet. Recent alluvial and colluvial deposits have been formed in gullies/ravines and at the base of the hillslopes (La Rosa, et al, 1973).

### SOILS

Griner and Nagorski (1970) characterized soils on Point Loma according to: (1) topographic positions – ridge tops, steep side slopes and concave toe slopes; (2) shallow (10 to 20 inches), moderately deep (20 to 36 inches), deep (36 to 60 inches), and very deep (over 60 inches); and (3) ph – neutral to slightly acid.

Ridge top slopes varying from 2 to 16 percent are underlain by iron cemented hardpan which restricts the passage of water. This soil group is very erodible, especially under poor vegetative cover. The moderately deep soils are underlain by hardpan or marine sandstone, have low water-holding capacity, and are nearly as erosive as the shallow soils. Deep soils overlie loose to weakly cemented sands but erode rather slowly except where influenced by barren escarpments.

Figure 12. Eroded sandstone.

Soils on the steep side slopes of 16-75 percent extend from ridge top to concave toe slopes, and in some places, directly to the ocean. Rock outcrops and barren escarpments commonly occur. The textural range varies from fine sandy loam to clay loam, with small amounts of surface gravel in some areas. Steep slopes, shallow depth, and low water-holding capacity together with position below the ridge top combine to make this group of soils highly erodible. Soils of the concave toe slopes (1-15 percent) are mostly deep and have a loamy surface texture with clay subsoils. Underlying materials are soft marine sandstone and shale with a high water-holding capacity.

## ENGINEERING GEOLOGY

The steep slopes on all sides of the Point are strongly dissected, partly because wave action erodes the base formations, creating excessively steep escarpments along the shoreline. The most strongly resistant rocks are occasional thin interbeds of gray sandstones occurring at low elevations; least resistant formations are the alluvial deposits near the base of slopes and marine terrace deposits at the top of the slopes. In the areas where the surface "cap" has not been removed from the reddish-brown terrace deposits by erosion, it tends to serve as a shield protecting the underlying, less indurated material from erosion.

The NOSC program for erosion control, which includes an improved system for surface water disposal, structural measures for gully control, and some grading operations, also considers geological factors such as bearing strength, erosion resistance, stability of slopes, and ease or difficulty of excavation.

## HYDROLOGY

Aspects of the rainfall-runoff relationship include the hydrologic cycle, from rainfall impact to streamflow coming to rest at sea level. Falling raindrops impact soil particles by dislodging, scattering, aggregating and compacting them. The net effect is a lower infiltration rate for almost any given soil. However, dense vegetative cover can reduce up to 95 percent of raindrop energies (Griner and Nagorski, 1970).

The entry of rain into the soil medium involves a slower movement of water, which is a function of particle size, chemical composition, and air voids. Most of the rainfall on Point Loma, prevented from downward movement (groundwater) by relatively impervious layers of bedrock, is retained as soil water and used by plantlife.

Figure 13. Surface erosion.

The Soil Conservation Service classifies soils into four major hydrologic categories based on an indication of relative infiltration and transmissive properties of soil profiles.

Soils that generally occur on coastal bluffs and moderate slopes have the characteristic of high filtration rates and consist of deep, well-drained sand or gravel. Soils comprising ridge tops have high runoff potential (produced by a very slow infiltration rate) and consist of clay. Table 3 shows comparative runoff by soil type for given cover types (Griner and Nagorski, 1970).

Table 3. Cover and soil type: comparative runoff.

| | Cover Condition | | | Hydrologic Soil Grouping/Runoff Potential* | | | |
|---|---|---|---|---|---|---|---|
| Vegetative Cover | Good | Fair | Poor | Type A | Type B | Type C | Type D |
| Coastal sage scrub | X | | | Low | Low | Moderate | High |
| | | X | | Moderate | High | High | High |
| | | | X | High | High | High | High |
| Chamise chaparral | X | | | High | High | High | High |
| | | X | | Moderate | High | High | High |
| | | | X | High | High | High | High |
| Mixed chaparral | X | | | Low | Moderate | Moderate | Moderate |
| | | X | | Low | Moderate | High | High |
| | | | X | Moderate | High | High | High |

*A. Low; B. Moderately Low; C. Moderate; D. High

## BIOLOGICAL RESOURCES: VEGETATIVE COVER; FLORA; WILDLIFE

The Environmental Resources Conservation Program included a reconnaissance of vegetation and wildlife which is discussed in some detail in reports prepared for NOSC from 1973 through 1977.

California's coastal *vegetative cover* consists of three phases: coastal sage scrub, the vegetative cover comprising the bluffs and west and south-facing slopes of the peninsula; northern coastal scrub extending from Oregon to Northern California; and a southern coastal scrub which occurs south of San Diego well into Baja California. Chaparral vegetative cover occurs, generally, inland of the coastal hills or along the coast at higher, more mesic (moist) elevations (Barbour and Major, 1977).

In addition, nonnative plant communities exist and are classified (for the purposes of this report) as urban landscape, naturalized, and exotic shrub cover; conservation plantings comprise a separate topic. For the purposes of the report, *flora* is used to describe plant species which have the status of some degree of endangerment ascribed by professional societies and the Department of the Interior.

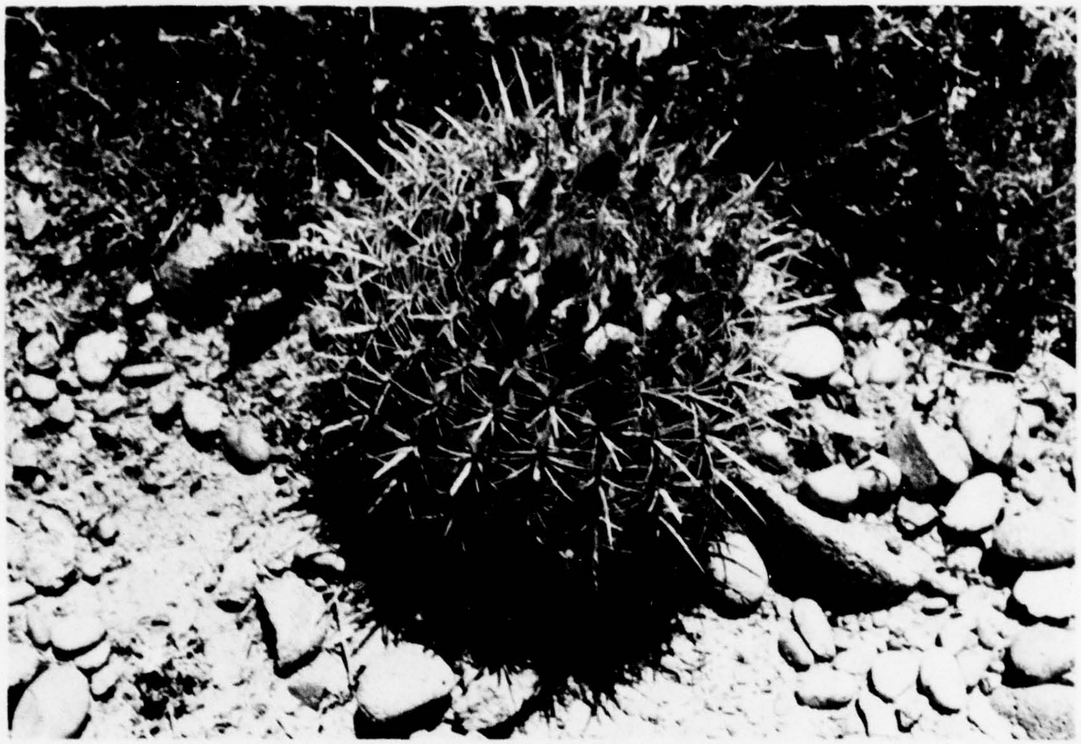


Figure 14. Endangered coast barrel cactus.

*Wildlife* of the coastal zone generally includes a diverse number of mammals, birds, reptiles and amphibians; however, Point Loma, as a peninsula setting which has been "cut-off" from natural interior areas, is an exception.

## VEGETATIVE COVER

Point Loma could be described as something of a biological "island" as far as plant cover is concerned, since the biotic interface between coastal sage, southern scrub and chaparral has been precluded by increasing urban development since the middle 1800's.

Coastal sage scrub – composed mostly of low growing, aromatic, narrow-leaved plants, the most common of which are California sage (*Artemesia californica*), Black sage (*Salvia mellifera*), flat-top buckwheat (*Eriogonum fasciculatum*), Lemonadeberry (*Rhus integrifolia* and Encilia (*Encilia californica*). (Barbour and Major, 1977.) California sage is the dominant drought-deciduous species, while Lemonadeberry comprises the majority of evergreen plant cover. (Maps showing plant distribution as well as quantitative vegetation checklists are contained in a Master Plan Report Phase I on file with the NOSC Public Works Department.) In areas of land use along lower slopes, Quail brush (*Atriplex lentiformis*) has become established. Plant cover of the southern slope, the most arid portion of the peninsula, is characterized by drought-resistant succulents including Coast barrel cactus (*Ferocactus veridescens*), Fish-hook cactus (*Mammillaria dioica*) and Prickly pear (*Opuntia littoralis*). (See figures 14 and 15.)

The local patterning (concentrated populations) of plant species within coastal sage scrub can be explained by the complex relationship of soil, moisture and disturbance history; however, little is known on the dynamics of this distinctive plant community and it will be the subject of further study in the future.

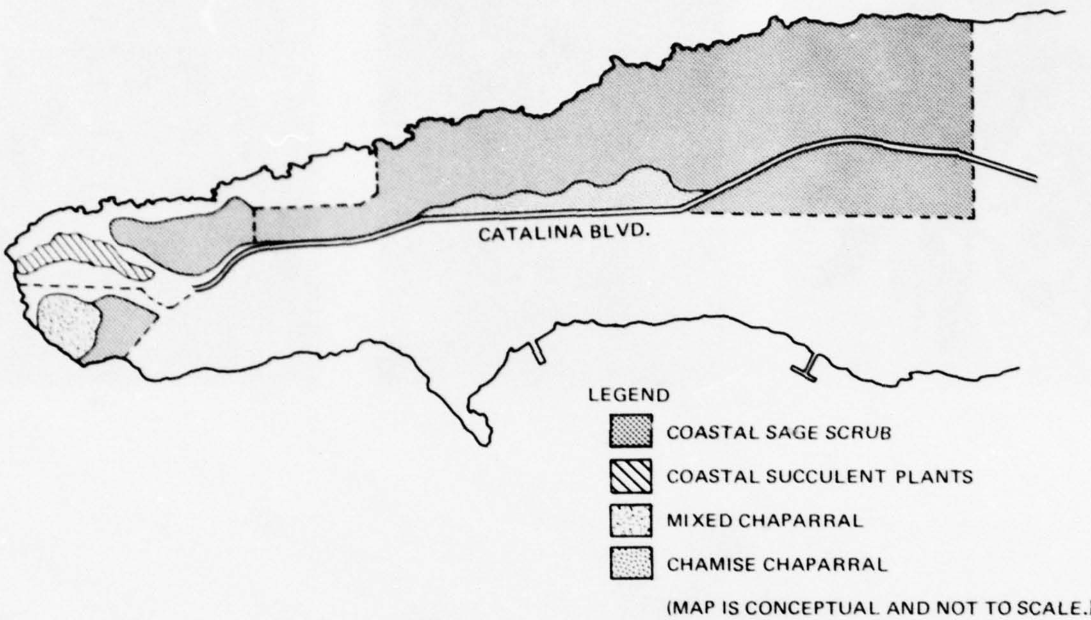



Figure 15. Vegetative cover distribution.

Chaparral – shrub communities existing on NOSC lands include: (1) chamise chaparral characterized by nearly pure stands of chamise (*Adenostoma fasculatum*); and (2) southern mixed chaparral including broad-leaved shrubs such as Toyon (*Heteromeles arbutifolia*) and Laurel sumac (*Rhus laurina*). Chamise occurs on infertile slopes and ridges, while mixed chaparral assumes small tree-like proportions in mesic, east-sloping canyons near Battery Humphrey.

Urban Landscape – includes decorative plantings along Catalina Boulevard and among developed portions of NOSC. Dominant species consist of Monterey pine (*Pinus radiata*, Monterey cypress (*Cupressus macrocarpa*), California Pepper (*Shinus molle*), Ironbark (*Eucalyptus sideroxylon*), and Ice plant (*Mesembryonthemum edule*).

Naturalized Exotic Species – Three species of plants have become naturalized over portions of Point Loma and include Australian saltbush (*Atriplex semibaccata*), Australian acacia (*Acacia spp.*) and Tree tobacco (*Nicotiana glauca*). Acacia is a very prolific species whose seeds are dispersed by various animals, while saltbush and tobacco seeds are scattered by winds.

Conservation Plantings – Vegetation installed for the purposes of aesthetic enhancement and wildlife habitat improvement include species endemic to the San Diego coastal habitats: Toyon (*Heteromeles arbutifolia*), Wild cherry (*Prunus illicifolia*), Coast white lilac (*Ceanothus verrucosus*), Lemonadeberry (*Rhus integrifolia*), California sycamore (*Platanus racemosa*), and Torrey pine (*Pinus torreyana*).

FOUR FACETS OF . . .

WILDLAND CONSERVATION.

Figure 16.

## FLORA: RARE AND ENDANGERED PLANTS

The San Diego Region has a relatively large number of plant species and a large number of rare and endangered plants due to complex interactions between soil, climate, topography and paleobotanic history. Field survey to determine the existence of rare or endangered plants has some inherent problems, including the fact that some species are very inconspicuous, while others may not sprout due to lack of moisture during critical periods (Harrison, et al, 1971).

Terms associated with the concept of threatened plants are defined to clarify discussion of rare and endangered plants. The Endangered Species Act of 1973 set forth by the Federal Department of Interior defines only two classes of vulnerability. An *endangered species* is one "threatened with extinction throughout all or a significant portion of its range" and a *threatened species* is one "likely to become endangered within the foreseeable future throughout all or a significant portion of its range" (Schreiner 1975).

Another definition is given by the California Native Plant Society (a professional organization): "An *endangered plant* is one threatened with extinction and is not likely to survive if causal factors now at work continue operating." "A *rare plant* is one that exists in only one or a very few restricted localities, occurs in such small numbers that it is seldom seen or collected regardless of its total range, or exists only on a type of habitat that could *disappear or change for any reason*" (Powell 1974). The term *vigor* refers to the population dynamics of a plant and is related to the reproductive capabilities and actual numbers of individuals of species.

While the Society is the major authority for this list, it presently has no legislative power behind it. In contrast, inclusion under the Endangered Species Act would provide federal restrictions for endangered and threatened plants. Figure 17, which shows rare and endangered plants occurring on NOSC lands, is compiled from the California Native Plant Society (Powell 1974), the Department of Interior (Greenwalt 1976, Schreiner 1975) lists, and personal observation.

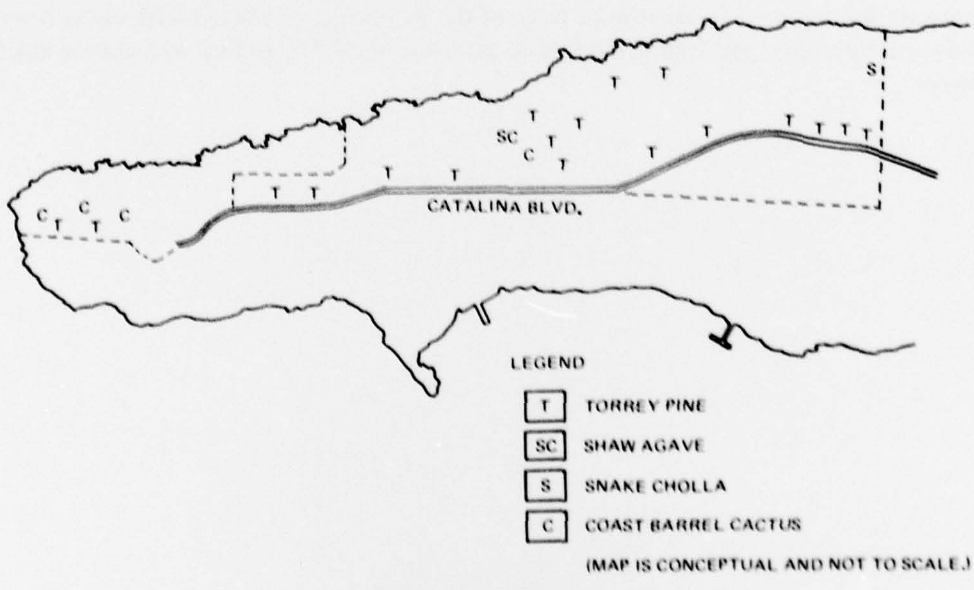



Figure 17. Rare and endangered plant life.

## WILDLIFE

The majority of wildlife ranging over NOSC is comprised of avifauna. Several probable explanations for the lack of mammalian, reptilian, and amphibian species are: small terrestrial animals have been virtually isolated from the San Diego Region; high quality habitats including salt marsh, tidal creeks, grasslands, and riparian woodlands have been urbanized into residential Point Loma; and the presence of feral house cats for many years may have caused the extirpation of some small animal species. Reptiles which occur in coastal habitats and which may be suffering population declines include San Diego horned and California legless lizards. The International Union for Conservation of Nature has designated these reptiles as depleted (Honegger, 1968).

A great diversity of avifauna inhabits and/or migrates over NOSC lands. Coastal bluffs provide roosting and loafing sites for Brandt's cormorant, the endangered California Brown pelican and a variety of gulls. Brown towhees, Valley quail and California thrashers inhabit saltbrush thickets, and a diverse number of songbirds including hummingbirds, sparrows, finches, jays, wrens, flycatchers, thrushes, waxwings, bushtits and shrikes utilize the habitats afforded by weedy areas, woodlands and shrub thickets. Due to limited prey hunting area, populations of raptors are low. However, falcons, hawks and owls are seen regularly. Swallows and swifts annually nest in the cliffs of the Point.

## ARCHAEOLOGY

Cultural resources have been described in the Introduction; due to the paucity of data, this resource merits further study.

## AESTHETICS

Point Loma provides a green belt, natural buffer, and open space between the rugged coastal bluffs of the western slope and the residential community of the eastern hillside. The absence of development on the top or ridge of the peninsula, combined with vistas from Woodward, Sylvester, and Gatchell roads on portions of NOSC, add up to a unique visual resource.


Figure 18. Endangered snake cholla (test plot).

## NOSC RESOURCES CONSERVATION PROGRAM

The Naval Ocean Systems Center (NOSC) Environmental Resources Conservation Program began as an idea: that Naval commands at Point Loma would actively protect, even enhance, natural resources within reservation boundaries. The then Naval Electronics Laboratory Center (NELC) responded very favorably to the thesis of the proposed program, and when a more detailed program outline was solicited, County of San Diego and NELC staff jointly prepared a land use map and formulated environmental planning designs and methodologies for resource conservation (La Rosa, 1975). An initial allocation of $50,000 was budgeted for contractor and consultant costs for the first three years. The program received support of the civilian community and resulted in the donation of trees by the U.S. Forest Service and the Harbor Kiwanis Club.

### PROGRAM DEVELOPMENT

The Environmental Resources Conservation (ERC) Program sought to protect and enhance NELC's natural and physical resources by bringing the area into ecological balance; increasing animal and plant diversity; enhancing aesthetic values; restoring native plant cover; and minimizing soil erosion. Through the ERC Program, the Navy could meet its Department of Defense obligation in conservation management by increasing the military community's environmental awareness and by establishing a base line of environmental data to measure future change.

Figure 19. Harbor Kiwanis and Cleveland National Forest lend a hand.

Objectives. Program tasks consist of the gathering of data and preparation of maps including:

- Preparation of a continuing environmental data base, including quantitative inventory of plantlife, vegetation distribution, wildlife, and analysis of diversity and high-quality habitats.
- Environmental monitoring of wildlife response to watering devices and roosting/nesting structures; changes in wildlife populations and diversity; plantlife vigor and health; soil stabilization measures.
- Formulation of portions of NOSC master plan, including definition of major problems, and future plan objectives based on previous environmental monitoring and program evaluation.

PROGRAM SPINOFF

As a result of an ongoing conservation effort, other projects having an impact on the environment have been analyzed including:

- Deposit of sewage digester sludge (two sites comprising 20 acres) — environmental designs for earth contours for aesthetics/runoff control, and revegetation for soil stability and wildlife habitats.

- Command Control & Communications Systems Integration Test Site — existing landscape plans were modified to include endemic and/or rare trees to maintain character of the natural setting and to provide aesthetic and wildlife values.
- NOSC lands — wildlife rescue and plant societies now consider the Center a refuge for release of displaced wildlife and a repository for endangered plants.

ENVIRONMENTAL CONSERVATION: MONITORING A TORREY PINE . . .

AND FREEDOM FOR A REHABILITATED BARN OWL.

Figure 20.

## MASTER PLANNING

In order to be wholly effective, resource management must envision the ultimate goals to be achieved for the sum total of the resources. Environmental planning requires an inventory of resources. It is then possible to forecast the total management requirements for an extended period and, further, to lay out the incremental steps, with corresponding budgeting to attain both short- and long-range goals.

The NOSC Environmental Resources Conservation Master Plan has been subject to revision as more information is gained through continuing resource reconnaissance, environmental monitoring, and evaluation of Program Phasing. The ERC Program provides an action-oriented approach with emphasis on accomplishment of long-term environmental goals through a coordinated series of high-impact, short-term projects. Phase I involved an initial study of resources and environmental needs assessment. Phase II concentrated on installation of plant material. Phase III activities were a continuation of the previous phases as well as the beginnings of three experimental projects. Phase IV, discussed under Recommendations, will focus on erosion control and runoff management.

## DATA BASE

The ERC Program continues to use standard techniques of resource reconnaissance, wildlife management, and environmental monitoring practiced by local, state and federal government agencies. Phases I and II incorporated various research methodologies, including diurnal observations, nocturnal listening, field surveys and censuses, review of existing literature, and interviews. Research methods, including test plots, statistical transects, and animal trapping, will be employed in subsequent phases.

## VEGETATION SURVEY

A reconnaissance of Naval Ocean System Center lands revealed that vegetative cover was absent from some areas due to City of San Diego sewerage treatment operations – disturbance from collection lines and deposit operations. Although these sites had regrown with pioneer weeds, they lacked the diversity of plant life essential to wildlife productivity. Due to the low profile of coastal shrubs, and the absence of trees in wildland areas, perching sites for birds of prey (raptors) were lacking.

High quality vegetative cover was found in canyon fingers near Woodward and Sylvester roads due to the influence of slope and drainage. In addition, Cliff euphorbia (*Euphorbia misera*) and Coast spice bush (*Caeoridium dumosum*) – species which are disappearing due to development of nonmilitary coastal lands – were found in wide-spread populations.

A vegetation inventory was compiled to indicate the locality, vegetative cover type, and abundance of each species. From field surveys, a plant distribution map was prepared showing discrete changes in plant life due to disturbance, introduction of nonnative plants, moisture gradient, and/or slope exposure. A study of vegetational characteristics comprising wildlife habitats is underway to analyze plant life for the components of diversity (vegetative types), composition (actual makeup of the types) and interspersion (the mix of types). Methodology includes aerial photography and field checks of census plots along a transect line.

## WILDLIFE CENSUS

An initial determination was made of the area's wildlife through censusing — bird and mammal survey route, reptile traps, night listening, and observation of tracks and scats (fecal matter). The greatest diversity of animal life is found in the avifauna; Point Loma has a representative population of birds associated with coastal habitats. In addition, recent observations indicate an increasing number of songbirds found in eastern states are migrating along our coast and visiting Point Loma.

Neighboring residential areas with mature trees, dense landscaping, and several remnant natural canyons provide corridors and habitats for a number of songbirds and raptors. Because bird species interact with urban landscape and native plant cover, an approach is being formulated to determine estimates of bird densities and vegetative cover and quality, in order to identify habitat components. This information is essential to develop a plan for resource management.

*Figure 21. California valley quail, one of the ten "indicator species."*

In order to assess overall biological productivity and to establish baseline data to measure environmental change and resource management, ten animals continue to be studied under the concept of indicator species (Table 4). Wildlife is a good indicator of biological health; changes in species distributional patterns, abundance, and diversity could be reflected by these indicator species (La Rosa, et al, 1973).

Table 4. Indicator species.

| Species | Habitat Characteristics |
|---|---|
| Valley quail; Mourning dove | Range includes mix of dense thickets, weedy areas and open brush. |
| California thrasher | Habitat consists of dense shrub and cactus thickets. |
| American kestrel | Nests in cavities and ledges and hunts in open, weedy areas. |
| Scrub jay | Requires insects and fruit; found in variety of thickets and woodlands. |
| Starling | Range includes turfed areas and urban landscape. |
| Logger-head shrike | Roosts in woodlands and hunts in open brushlands and fields. |
| Brown towhee | Inhabits wide range of vegetative cover in proximity to dense shrubs. |
| Anna's hummingbird | Habitat includes native and exotic flowering plants in wildlands and urban landscape. |

## EROSION STUDIES

Conservation of soil resources is of major concern to NOSC management; to this end, soil losses have been calculated and problems have been identified in areas of steep slopes, natural drainages and disturbed sites; soil engineering plans are being formulated. (See discussion under Program Evaluation and Recommendations.)

Catalina Boulevard – before and after.

Figure 22.

## ENVIRONMENTAL ENHANCEMENT

The Environmental Resources Conservation Program not only considers natural, physical, and cultural resources, but visual or aesthetic resources as well. This comprehensive approach is integrated with the mission of the Naval Ocean Systems Center and related future land use. Enhancement of NOSC lands goes beyond simple "beautification." Components of wildlife management, engineering geology and landscape architecture are combined to provide an action-oriented, ecological approach to land use planning and environmental protection. Facets of the ERC Program include: enhancement of developed areas; improvement of biological productivity; revegetation of disturbed sites; control of runoff and soil loss; and rare/endangered plant legacy (consult Table 5 for a discussion of conservation sites and objectives).

Table 5. Conservation sites and objectives.

| Site | Activity | Objectives |
|---|---|---|
| Structures and facilities | Install shrubs and trees | Aesthetics |
| Paved surfaces, roadsides and cut slopes | Install forbs, shrubs and trees | Aesthetics; erosion control; dust control |
| Wildlands | Install water and perch devices | Enhance habitat; increase animal productivity/diversity |
| Altered areas | Install plants and irrigation | Aesthetics; increase biological productivity |
| Fill sites | Install plants and irrigation | Control erosion; aesthetics |
| Canyon/arroyo | Install trees | Control erosion; increase overstory for wildlife |
| Threatened plant populations | Install additional species/numbers | Enhance/expand existing populations; create repository |

## DEVELOPED AREAS

Plant material was installed on/around ridge brows, cut slopes, parking areas, fences, and along State Highway 209. Criteria for plant list selection included native/endemic species, drought resistance, growth characteristics, and the environmental setting. Character of the existing landscape was maintained where possible; in all instances, however, wildlife use of the plantings was considered. Designs created included aesthetic, vegetative screens with habitat values including food (berries, nuts, insects and nectar), cover (dense over/under story), and nesting sites (Martin, et al, 1961).

## WILDLANDS

The inherent low vegetational profile and aridity of the coastal sage scrub community were relieved through the addition of avian perching structures and watering devices. Canyon areas will continue to be planted with rare Torrey pine seedlings and other endemic trees in order to provide overstory among low-growing shrubs, thereby increasing plant diversity, an essential of good wildlife habitat. Another essential, water – often the limiting factor in wildlife productivity in arid coastal lands – was provided through shallow drinking troughs regulated by float valves.

A factor inhibiting wildlife productivity and ecological balance was the abundance of abandoned house cats. A program of public information, cooperation from NOSC personnel, and live-trapping has helped alleviate this problem.

## DISTURBED SITES

Environmental designs were prepared for sites altered by filling, grading, or cutting operations. Plans included the installation of endemic plants to provide wildlife values and aesthetic considerations. Minor sites, including cut banks and small fill areas, have been revegetated to provide ground cover and screens. A fifteen-acre fill site has been designed to create natural hill-and-valley contours which will also guide and slow runoff. Vegetation will be installed to create natural-looking plant communities of herbaceous plants, shrubs, and small woodlands, providing vegetation diversity and corresponding wildlife habitats.

Figure 23. Wildlife habitat enhancement – perching snag.

## RARE AND ENDANGERED PLANT REPOSITORY

Although only small scattered populations of the rare Torrey pine tree and endangered Coast barrel cactus occur on NOSC lands, efforts continue to enhance these resources. Further, the endangered Snake cholla associated with coastal sage scrub but not occurring on NOSC property, has been transplanted as an experimental project to create a repository for displaced flora. To date, over 500 Torrey pines have been planted to create woodland habitats and a legacy for generations to come.

## ENVIRONMENTAL MONITORING

In order to measure environmental change and to determine the success of each phase of the Program, a continuing effort was made to monitor plant growth, soil loss/stabilization, wildlife populations, and the effectiveness of watering and perching devices. This information is the basis for revision of the ERC Program Master Plan and environmental protection recommendations.

## VEGETATION

All of the plant material installed has been influenced by the salt-laden breeze and has taken on the wind-swept characteristic typical of Point Loma vegetation. Pine species planted at ridge lines have shown poor growth, while Acacias have adapted well to these locations. The Toyon has exhibited the fastest growth rate of the native shrubs installed; although drought resistant, this species responds well to available moisture in well-drained soils. In addition, the San Diego sunflower, considered to be in jeopardy, has been planted as a ground cover at two locations and is thriving.

Monitoring of Torrey pines in the Woodward area has confirmed a pocket of fine claying soil in the sandy alluvium of the canyon mouth. Here, poor water percolation and the build-up of dissolved salts has caused the loss of a small percentage of trees. Pines planted on sandy slopes, however, have begun to establish themselves and will be taken off regular irrigation in the near future, as planned. No cypress canker, and only minor pine mite infestation, has been observed in the existing landscape. Irrigation of plant material installed in wildland areas has necessitated the use of drip-type watering systems which work on the principle of bringing water from a main valve, through tubes, directly to each plant. Although these systems can provide a savings in water use over conventional spray irrigation, an inherent problem exists in the fact that watering cannot be accomplished on an individual basis. Therefore, variables such as soil profiles, competitive plants, and slope exposure pose problems. Analysis has provided data – and solutions to be incorporated in future environmental plans.

Experimental efforts to establish seedlings without irrigation show great promise, although closer supervision of contractor personnel will be necessary to insure proper planting methods. Test plots to determine the effectiveness of transplanting endangered cactus have been successful. NOSC will become a repository for threatened plant species displaced from similar coastal habitat. This will expand the range of these species, and enhance existing populations, insuring their survival.

The results of revegetation of fill sites have not been as dramatic as the successes of other conservation areas. The reclamation of these sites was approached on a mix of tactics including hand seeding during the rainy season, hydro-seeding (a mixture of seeds, fibre and water dispensed under pressure), and phased installation of shrubs and trees with irrigation. Monitoring revealed none of these efforts was completely successful. Soil composition, slope angle and exposure, and irrigation failures due to clogging and rodent damage were inhibiting factors. However, future revegetation efforts will be more effective as these and other reclamation procedures are incorporated along with slope reduction, surface manipulation, and grounds maintenance.

## WILDLIFE

Regular observations at wildlife drinkers revealed these devices have been used initially by a variety of small mammals and birds including rabbits, warblers and quail. Birds of prey, such as falcons, owls, and hawks, have used perching snags within days after installation. Nesting platforms for large raptors have been used only for roosting; however, the planned installation of trees to screen the structures could encourage their use as nesting sites.

Wildlife censuses over three seasons are inconclusive but some trends are apparent: populations of California Valley quail (*Lophotryx californicus*), Mourning dove (*Enaidura macroura*) and Brown towhee (*Piplio fuscus*) have greatly increased; Scrub jays (*Aphelocoma coerulercens*) and Anna's hummingbirds (*Calypte anna*) appear to be more common; and populations of raptors are stable. Increasing frequency of sightings of migratory birds of prey and songbirds indicates the suitability of Point Loma to these uncommon visitant species. (Consult Table 6 for a discussion of wildlife census data.) Introduced, nonnative species such as Rock doves (pigeons) and House sparrows have not expanded their range over NOSC. Starlings are of concern and will continue to be monitored closely. Although

Table 6. Wildlife census.

| Vegetative Cover & Associated Habitats | Wildlife Species | Mean (To Nearest Tenth) |
|---|---|---|
| Coastal Scrub | California Thrasher | 2.5 |
| Brushlands | Brown Towhee | 6.0 |
| (10 segments) | Valley Quail | 9.5 |
| | Scrub jay | 2.5 |
| Coastal Scrub | Brown Towhee | 7.5 |
| Open Areas | Valley Quail | 10.0 |
| (5 segments) | Starling | 3.5 |
| | Mourning Dove | 7.0 |
| | American kestrel | .5 |
| Domestic Landscape | Starling | 8.5 |
| and Structures | Mockingbird | 1.0 |
| (4 segments) | Anna's hummingbird | 2.0 |
| Disturbed Sites | Mourning Dove | 13.0 |
| (3 segments) | Valley Quail | 5.0 |
| | Loggerhead shrike | .5 |

| Wildlife Species | 1974 | Population Means* for all Habitats 1975 | 1976 | 1977 |
|---|---|---|---|---|
| Valley quail | 16 | 17 | 21 | 23 |
| Mourning dove | 6 | 10 | 7 | 12 |
| Brown towhee | 9 | 8 | 10 | 9 |
| Starling | 6 | 12 | 7 | 4 |
| Scrub jay | 2 | 1 | 3 | 1 |
| Mockingbird | 1 | 1 | 3 | 2 |
| Anna's hummingbird | 1 | 1 | 2 | 2 |
| American kestrel | 1 | 1 | 1 | 1 |
| California thrasher | 3 | 2 | 1 | 1 |
| Shrike | 1 | 1 | 1 | 1 |

*Survey method consisted of establishing transects along roadways. These were divided into 100-yard-long segments, and the wildlife seen within 50 yards of the center of the transect were recorded. Thus, an index of wildlife use was obtained on a linear series of 100-yard by 100-yard blocks (approximately 2 acres). Each block was covered in 5 minutes, by foot or automobile. A population index (mean) for each species was developed by dividing the number of birds counted by the number of transect blocks.

actual sightings of Gray fox have not increased, evidence of their activity over much of NOSC and northerly areas of Point Loma is more apparent.

The following discussion substantiates the results of habitat enhancement. Increased food and cover through plant material installation, and greater availability of water and perching sites through increased irrigation and man-made devices have provided essential habitat components. For example, a 4-acre area near Woodward and Gatchell Roads, previously used for military training, resulted in soil and plant cover disturbance. With the addition of over one hundred small trees, irrigation, and associated grasses and forbs (herbaceous plants), the diversity and number of species increased dramatically. Although these changes reflect a local movement of wildlife in response to an almost "instant habitat," it is apparent that the actual number of animal species should continue to increase over the long term until habitat components and wildlife numbers reach a balance.

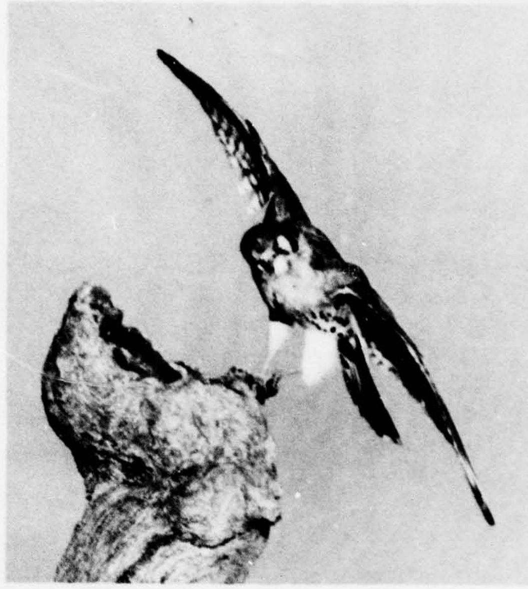


Figure 24. American kestrel makes use of a perching snag.

Figure 25. Some of the several hundred rare Torrey pines planted for wildlife and as a legacy for San Diegans.

# PROGRAM EVALUATION AND RECOMMENDATIONS

"People in the end shape the environment. If a better environment is passed down to future generations, it will be because of the values and actions of people – all of us – today."

Council for Environmental Quality First Annual Report, 1970.


Figure 26. Bldg 33, Naval Ocean Systems Center.

## CONCLUDING REMARKS

The Naval Ocean Systems Center can claim a significant achievement because it has accepted the call to duty as a stalwart guardian of some priceless relics of the past — organisms whose biological secrets may yet be called upon and wildlands set between rugged sea cliffs and a metropolis.

Figure 27. Wildlands and urban area interface.

The Center has indeed become a contributing member of the community vitally interested in using resources wisely and concerned about environmental quality. It is worthy of note that outsiders contributed the primary effort in some instances, with NOSC participating through suggestion and encouragement. At other times the Center was the prime mover, providing capital and technology when needed. But throughout the Environmental Resources Conservation Program, teamwork and cooperation were self-evident — with all working toward a common goal. And this is as it should be, for what greater mandate does any public servant have than to make this land of ours a better place to live in?

## RECOMMENDATIONS

A detailed discussion of environmental needs assessment and Phase IV conservation planning, including associated maps and methodologies, is not included in this report. Instead, findings and recommendations of a general nature are presented under the categories of Erosion Control, Habitat Enhancement, and Data Base.

## EROSION CONTROL

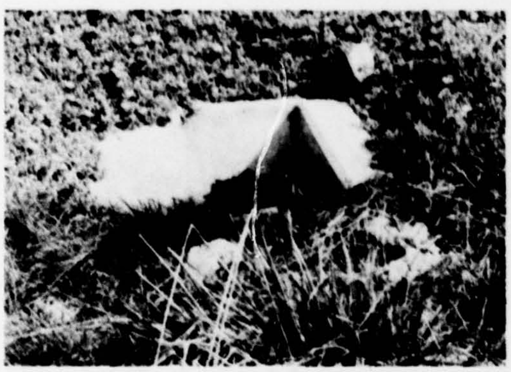
Future environmental planning efforts should focus on erosion problems identified by the Soil Conservation Service and ERC Program Staff. Erosion control should be given top priority including:

- Filling and revegetating of channel at northern NOSC perimeter.
- Contouring and replanting disturbed sites at northern boundary, north of pistol range and west of painting facility.
- Constructing check dams in canyon fingers to slow runoff and trap sediment.
- Instituting reclamation techniques at sludge fill sites, and bluff stabilization west of the Command Control and Communications Systems Integration Test Site and paint shop facilities.

## HABITAT ENHANCEMENT

Habitat improvements needed on specific sites in the near future include:

- Replacing of failing Torrey pines with water-tolerant California sycamores east of Gatchell Road.
- Planting ravines west of Gatchell Road to California sycamore, Torrey pine, and Toyon to provide for over-story vegetative cover.
- Adding Torrey pine and California sycamore seedlings to Woodward Canyon to create eventual woodland and to stabilize soil.



(a) SOIL STABILIZED BY VEGETATION.

(b) EROSION DUE TO PLANT COVER DISTURBANCE.

Figure 28. Storm drains.

- Installing perching snags in all canyon fingers east of Gatchell Road to increase hunting territories and provide resting sites for resident and visitant raptors.
- Planting additional Torrey pines in alluvium southeast of the Command Control and Communications Systems Integration Test Site.
- Increasing the width of the vegetative screen along State Highway 209 with Toyons to provide dense understory and food for wildlife.

## DATA BASE

Existing resource inventory and environmental planning data should be modified to include:

- Utilization of needle-sort data cards to provide data on environmental resources, needs assessment, and methodologies. These cards should be indexed to a 1-acre grid system. They would provide a dynamic record of current enhancement/maintenance commitments and future management plans and would document resources, environmental deficiencies, and program costs in a single catalogue.
- Continuation of environmental monitoring to include refinement of baseline data and graphic documentation as a basis for Master Planning and Program evaluation.
- More research to sample herpifauna in order to determine the existence level of a declining species.

Figure 29. Torrey pines planted by a conservationist 20 years ago.

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