

State of California  
The Resources Agency  
Department of Fish and Game

ANAHEIM BAY STUDY  
JULY 1970 TO JUNE 1971<sup>1/</sup>

by

Paul D. Romero  
California State College  
Long Beach

ABSTRACT

An ecological study made of Anaheim Bay, Orange County, California, 1970-71, documented its utilization and importance to resident and migratory birds. Some 102 species of birds are found in the area together with a wide variety and abundance of other vertebrates and invertebrates.

Anaheim Bay is an important wintering area for shorebirds, waterfowl, and other water-associated birds. Peak bird population occurs in late December. Bird activity and use of the area is highly dependent on tidal conditions and less so on time of day and weather. Three of California's endangered birds--California brown pelican, California least tern, and light-footed clapper rail--inhabit Anaheim Bay.

Routing of the Pacific Coast Freeway through Anaheim Bay, as proposed, would have serious effects on one of the most extensive tidal marshes remaining in southern California.

---

<sup>1/</sup>Supported by Federal Aid in Wildlife Restoration Project W-54-R-3,  
"Special Wildlife Investigations."

## RECOMMENDATIONS

Based on the results of the Anaheim Bay Study herein reported the following recommendations are made:

1. An alternative to the routing of the Pacific Coast Freeway through Anaheim Bay be adopted.
2. Anaheim Bay Wetlands be retained in public ownership and maintained as a natural area.
3. Studies be immediately undertaken to determine the status of the California least tern, light-footed clapper rail, and California brown pelican, and factors affecting their welfare at Anaheim Bay.

## INTRODUCTION

Two-thirds of California's coastal wetlands have been destroyed and 40% of these--in southern California--are in danger of destruction from dredging, filling or other developments reducing their value to fish and wildlife. One of the few extensive salt marsh areas between San Francisco and the Mexican border is Anaheim Bay. This bay retains much of its natural habitat and sustains large numbers of wintering shorebirds, migrating waterfowl and a substantial number of resident birds which presently include one endangered species. Along with the bird life, the bay serves as a spawning area, nursery ground and shelter for marine fish and other organisms.

In October 1969, the author learned that Anaheim Bay was in danger of facing possible destruction due directly to the proposed construction of the 605/1 freeway. It was also learned that little is known about the wildlife that inhabit Anaheim Bay.

The study was originally initiated to fulfill, in part, the requirements for the Masters of Arts Degree at California State College, Long Beach. On July 1, 1970, the study acquired a double purpose. On this date the author was employed by the Department of Fish and Game, Special Wildlife Investigations, to document bird use of Anaheim Bay.

## OBJECTIVE AND SCOPE OF STUDY

Main objective of this study was to describe the ecology of Anaheim Bay and to obtain data, over a one-year period, on bird use and how such bird use relates to habitats and different weather, time, and tidal conditions.

Study effort, for the most part, was directed to the censusing of birds in designated areas during different weather conditions, tidal conditions, and time periods, and identifying the nature of the habitats characterizing Anaheim Bay.

## ANAHEIM BAY

### Physical Description

#### Location

Anaheim Bay is located 33° 44' N, 118° 04' W, in Township 5 South, Range 11 and 12 West in the western portion of Orange County, California. The bay is east of the City of Seal Beach and west of Sunset Beach and extends approximately one mile north of Pacific Coast Highway (Figure 1).

Anaheim Bay is 927.5 acres, consisting of 243 acres of harbor, 8.5 acres of beach, 133 acres of channels, 38 acres of mudflats, 27 acres of fill and roads, and 478 acres of marsh vegetation.



## Geology

Part of the extensive Los Angeles sedimentary basin formed during the Pleistocene period, the bay is approximately 10 feet in elevation. It overlies a synclinal depression which, acting like a collecting basin, has partially filled with alluvial deposits of fine sands, silts and clays interspersed with peats and coarse sands. The bay is relatively flat, although the San Gabriel and Santa Ana rivers once emptied into the bay. One elevated irregularity, Hog Island, is part of the dissected scarp of the Inglewood-Newport fault which crosses northwesterly through Anaheim Bay. This fault, which is approximately 3,055 feet inland, along with the Bolsa-Fairview fault has created many subsurface salt water aquifers (Willems, 1968) and these faults may put a geophysical stress in the Anaheim Bay area.

Anaheim Bay is divided into two major sections--the harbor area and the marsh. The harbor area is formed by artificial rock jetties to protect the loading and unloading of naval vessels. North of the harbor are four major channels formed by the flushing action of the tides. Three of the four major channels have been undisturbed. Soil composition within these channels varies greatly between the uppermost reaches of the channels as compared to the lowermost. Standard Geological Substrate analysis shows that the uppermost parts of the channels are composed of 86% sand, 10.1% silt, and 3.8% clay, whereas the lower portions are composed of 4.6% sand, 68.7% silt, and 26.7% clay. (C. MacDonald, personal communication.) Channel banks and mudflat firmness depends on tidal exposure time. In the uppermost reaches of the channels, studies show that the aerobic surface of the channel substrate is approximately 1 cm. deep. Below 1 cm. the mud is very black, indicating anaerobic conditions (Fritz, 1970).

## Hydrology

Winter rains, two freshwater drains, and an agricultural irrigation ditch are the only sources of fresh water flowing into Anaheim Bay. However, none of these contribute a significant amount of fresh water to the bay.

Water salinity measurements range from 19.6 to 35.4 parts per thousand. Samples below 30‰ were measured after rains (Tasto, 1971). Water temperature ranges from a summer high of 27°C to a winter low of 10.5°C. Dissolved oxygen ranges from 2.1 to 6.7 mg/l (Kauling, personal communication).

## Climate

The climate of Anaheim Bay may be termed within a dry-summer subtropical area with warm summers and mild winters. Average annual rainfall is approximately 12 inches, with the major amount usually occurring between the months of November and April. The average maximum temperature is 72°F and the humidity is generally high during most of the year. The prevailing winds are from the southwest, with an average velocity of 10 knots. In addition, fog and low clouds may be expected between the months of November and February.

## History

The history of Anaheim Bay is extensive as well as interesting. The land was originally part of an 1,834 land grant to Juan Nieto from Governor Figueroa. At this time Anaheim Bay was part of an extensive marsh system ranging from Los Alamitos Bay on the west to Bolsa Chica Bay on the east. These marshes were relatively undisturbed although mule teams commonly traversed the marsh delivering goods from Wilmington Harbor to the City of Anaheim (Grimshaw, 1937).

In 1868, the California Legislature granted the Anaheim Lighter Company a 20-year franchise to operate a new port called Anaheim Landing (Friis, 1963). This port remained active and played a role in the development of Anaheim and the surrounding area until 1875 when the Southern Pacific railroad came to Anaheim.

With the coming of the railroad, the entire coastal area experienced a large recreational boom. Water recreation and hunting became very popular in the Anaheim Bay area. Between 1899 and 1900, 23 hunting clubs were established in the Los Alamitos-Bolsa Chica marsh complex (Talbert, 1952). Hunters from these clubs shot large numbers of shorebirds and waterfowl. The Bolsa Chica Gun Club, located in Bolsa Chica Bay, was active until 1945.

In the 1920's a large number of people were attracted to Anaheim Bay. Many beach cities developed almost overnight. The cities of Seal Beach, Sunset Beach, and Huntington Beach were incorporated by the early 1920's; and, in 1926 State Highway 1 was constructed to facilitate transportation between these cities (Talbert, 1952). As the cities grew, Anaheim Bay decreased in size. In January 1944, the Federal Government purchased 5,000 acres, including Anaheim Bay, to develop the United States Naval Weapons Station, Seal Beach. This Naval base remains active today as an ammunition depot for the Pacific Fleet.

After the Navy purchase, Anaheim Bay was left relatively undisturbed until early 1960 when Huntington Harbor, a marine residential area, was built in the area known as Sunset Bay. Sunset Bay was actually the easternmost arm of Anaheim Bay. This portion of the marsh was essentially destroyed by the construction of Huntington Harbor.

In 1969 Sunset Beach Aquatic Park was constructed adjacent to the southern portion of Anaheim Bay. This park was designed to provide water-associated recreation. When completed it will include a marina, parking, picnic area and other associated facilities.

Anaheim Bay is now threatened by a freeway alignment which would destroy much of the natural amenities existing here today. The route of the Pacific Coast Freeway (605/1) has been planned to traverse the middle of Anaheim Bay (Figure 2). This freeway would consume a minimum of 28.6 acres of irreplaceable marsh land. The area remaining between Pacific Coast Highway and the freeway is planned to be added to the Sunset Beach Aquatic Park to expand their recreational facilities. If these projects proceed, 118 acres of invaluable marsh habitat would be destroyed, with undetermined effects on the remainder of the marsh.



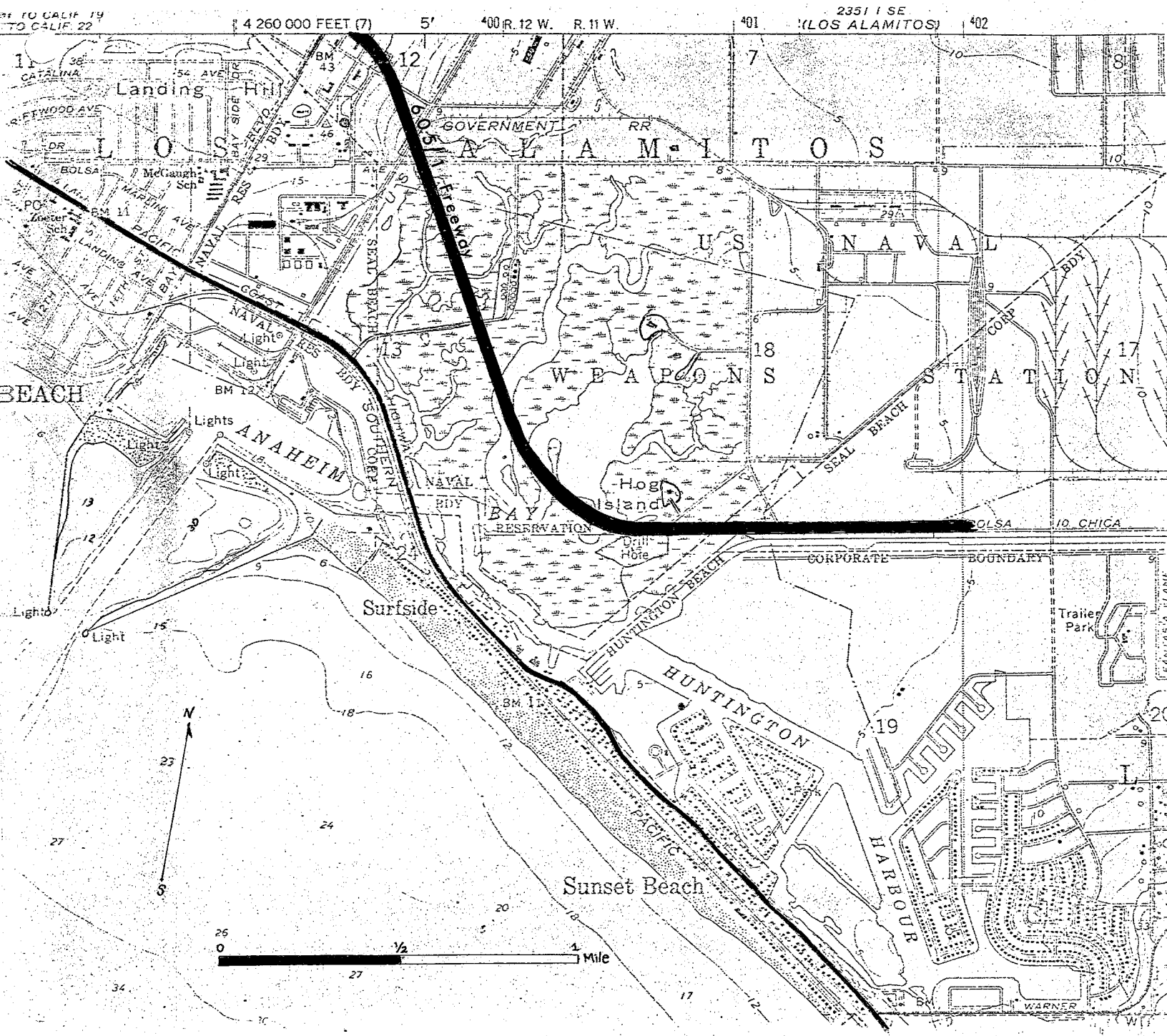


Figure 2. Proposed Route of the Pacific Coast Freeway (605/1)

## STUDY METHODS

### Bird Census

Full-time field work began in July 1970, and continued until October 1970. After October, part-time work was continued through May 1971. Bird censuses were taken by route method using fixed stops in a predetermined sequence conducted as follows:

After a preliminary survey of Anaheim Bay, 12 census sites were selected and identified by either fixed landmarks or wooden stakes. Each census began by recording tide height, wind speed and direction, and sky conditions. (Values determined from the Beaufort scale.) On arrival at each stop, the census site was briefly scanned and a count was made of individuals of each species within the census site. Bird activity was also described: i.e. roosting, loafing or feeding. Numbers were recorded directly in a field notebook. Occasionally, because of large bird numbers, estimates were made instead of exact counts. Upon the conclusion of each count, field notes were transferred to a bird survey form (Exhibit E-1, appended).

All observations were taken using 7 x 50 binoculars or a 20 X spotting scope. Counts were taken while standing behind an automobile which served as a blind. Each sequence began at a different census site to ensure randomness of tidal conditions. Counts were begun an hour before peak high or maximum low tide during daylight hours. No less than two and no more than five counts were taken in any month. Counts averaged three a month with 37 censuses being conducted over a 12-month period.

From these counts and other sources of data incorporated into the United States Naval Weapons Station, Seal Beach (1969) "Fish and Wildlife Management Plan" a checklist of vertebrates and invertebrates occurring on the study area was computed (Exhibit E-2, appended).

### Location of Census Sites

Twelve census sites were chosen to represent the various ecosystems existing in Anaheim Bay. Each site was selected because of its physical features and its accessibility. Because of the types of habitat involved, a slight bias had to be incorporated into the selection of the census sites.

All of the areas discussed in the section on Ecosystems are represented by census sites. The sites are shown on Figure 3 and described as follows.

Site #1 - Open Harbor: The open harbor is bounded on the south by the ocean, on the north by beach, and on the west and east by jetties. This area is influenced by tidal conditions and can become rough under adverse weather conditions. The open harbor consists of 156 acres--78 acres comprised the census area.

Site #2 - Beach: This beach is used by Navy personnel and their families during the summer months. The beach consists of 8.5 acres and is bounded on the north by a parking lot, on the west by the Seal Beach Strand, and on the south and east by the open harbor.



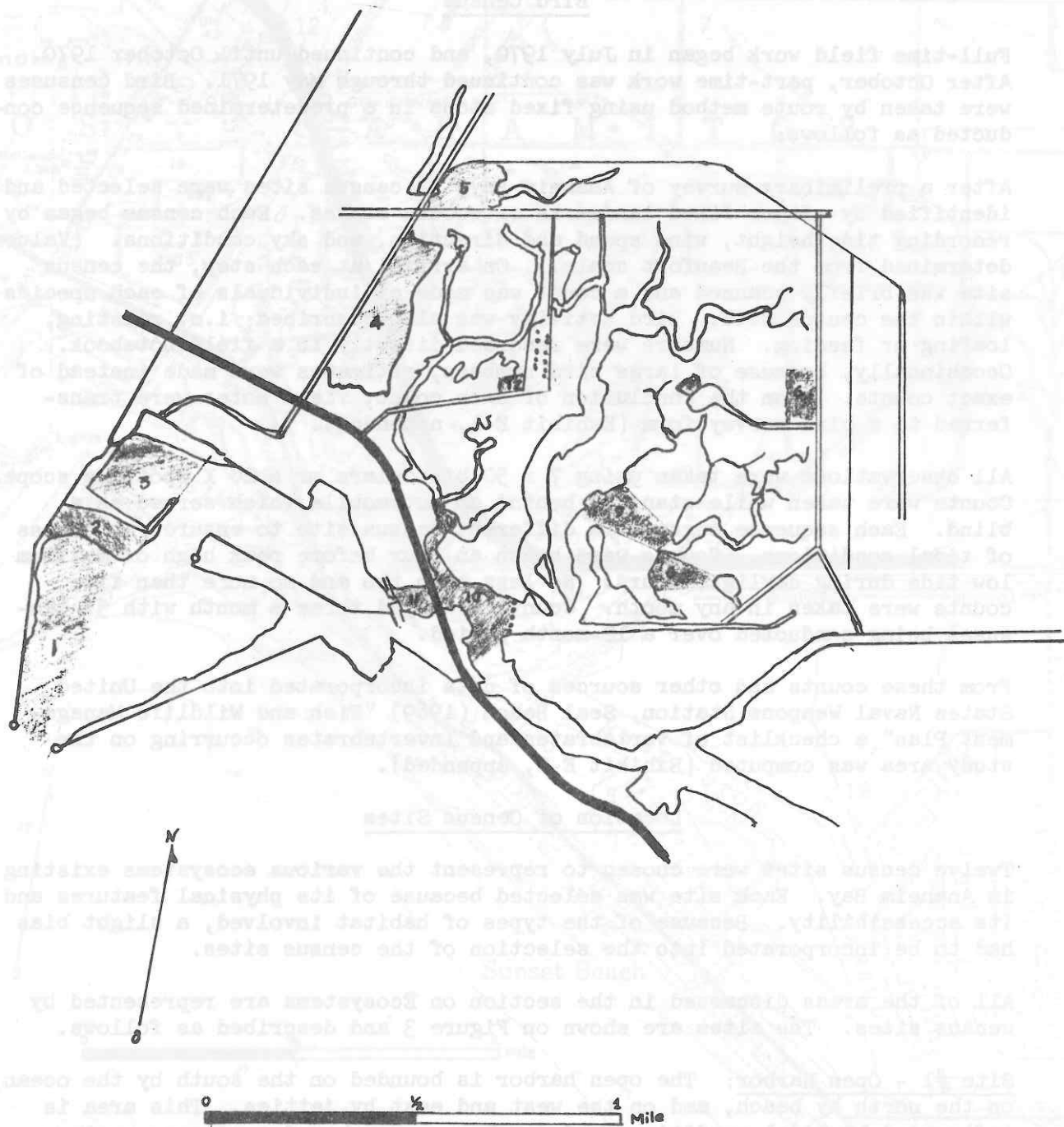


Figure 3. Census Sites #1 through #12

Site #2 was selected as a census site because of its ready accessibility.

Site #3 - Inner Harbor: The inner harbor, designed by the Navy as a loading dock, is bounded on all sides by rock jetties. Entrance to Huntington Harbor is located to the southeast. This harbor differs from the outer harbor because it is protected from adverse weather conditions and provides shelter for birds. Twenty-four of its 79 acres were used for this census site.

Site #4 - Land Fill: One of the largest mudflats (25.5 acres), was chosen as a census site. This area is relatively nontidal and is bounded on the north by Bolsa Avenue, on the south by Pacific Coast Highway, on the west by Kitts Highway and on the east by the marsh. During extreme high tides, shorebirds group along the edges of this area to escape high waters.

Site #5 - Tidal Pool: The tidal pool census site represents a midtide mudflat. This census site consists of 9.2 acres and is bounded on the north by the Government railroad tracks, on the south by Bolsa Avenue, on the west by Kitts Highway, and on the east by marsh vegetation. This area, when exposed, provides a mudflat utilized heavily by feeding birds.

Site #6 - Marsh #1: This area of 6.5 acres typifies a mixed vegetation marsh. Five or more plant species are found in this area. The marsh is inundated only on the extreme high tides and there are no channels traversing it. Site #6 is surrounded by marsh on two sides and by Navy access roads on the south and east.

Site #7 - Channel Mudflats: There are a few high tide channels that serve as mudflats. These channels are approximately six inches deep and when exposed, shorebirds are usually seen feeding in these areas. Two mudflats were selected and together they consist of 1.3 acres. These mudflats are viewed from the Navy degrading area and are located by fixed landmarks.

Site #8 - Marsh #2: This marsh area, located by fixed landmarks, consists of 4.5 acres. The area is triangular in shape and like Site #6 is typical of marsh habitat. This area has no channels traversing it, but unlike Site #6, is frequently under tidal water.

Site #9 - Tidal Basin: The tidal basin was chosen as a census site because at tides of one foot or less there is an extensive mudflat exposed. This 36.7-acre area is bounded on all sides by marsh vegetation. The census area comprised 10.4 acres and is located by fixed landmarks.

Site #10 - Tidal Channels: Major tidal channels, in and around the entrance to Huntington Harbor, were selected as a census site. Observation of these channels is accomplished from the birdge crossing the entrance to Huntington Harbor. These channels support large numbers of long-legged waders and migrating waterfowl and are bounded on all sides by marsh vegetation.

Site #11 - Entrance to Harbor: Census site #11 consists of 4.1 acres at the entrance of Huntington Harbor. This area is bounded on the east and west by rock jetties and open to water on the north and south. This area was selected because of its rocky shoreline.

Site #12 - Signal Oil Mudflat: The Signal Oil Mudflat was chosen as a census site because of its physical composition. This area resembles a "hard pan" area and is inundated by five foot or greater tides. Many species of shore-birds and long-legged waders are seen in this area. The mudflat is bounded on the north and east by the Signal Oil lease road and exposed to the marsh on the south and west. The census site consists of 1.3 acres.

#### Bird Use Values

To obtain relative bird use values the 12 census sites were grouped by major ecosystems. For example, sites #1 and #3 were grouped as open water ecosystem. Monthly census counts were combined for each major ecosystem, then averaged to obtain mean monthly counts. The mean monthly counts were equated as birds per 100 acres of major ecosystem within the total salt marsh environment (International Bird Census Committee, 1970).

Total numbers were computed by multiplying mean monthly counts for each major ecosystem by the acreage of the respective ecosystem. This value was then divided by the amount of major ecosystem actually censused.

#### Plant Identification

Plant sampling and identification occurred between July and November 1970. Marsh plants were collected and identified using Munz (1959) and Mason (1957). All identified plants were mounted and placed in the herbarium at California State College, Long Beach. A checklist of marsh plants, including their major localities was compiled. (Exhibit E-3, appended.)

### ECOSYSTEMS

Four major ecosystems are recognized within Anaheim Bay. Typical of the salt marsh environment these include (1) tidal marsh, (2) tidal channels and mudflats, (3) sandy beach; and (4) open water. Description of these ecosystems and their bird use follows. Appended Figures F1-F7 depict bird use values for these ecosystems.

#### Tidal Marsh

Tidal marsh, which comprises the largest ecological system within Anaheim Bay, consists of 478 acres. All portions of the marsh are bounded by a major channel or by a Navy access road which act as a dike against the bay. This ecosystem, shown in Figure 4, is a mixture of salt marsh vegetation with plant dominance depending on elevation and the plants' tolerance to tidal submergence. Cordgrass (*Spartina foliosa*) is the dominant plant along the small channels and shallow depressions, whereas pickleweed (*Salicornia virginica*) and saltwort (*Batis maritima*) are dominant in areas away from the channels. In areas of higher elevation, such as the banks of the large channels and along the access roads, glasswort (*Salicornia subterminalis*) is dominant.



Figure 4. Tidal Marsh

Tidal marsh is inundated by tides of 4.5 feet or greater. At this height water leaves the channels and slowly covers the marsh. During tides of six feet or greater the entire marsh vegetation is submerged. Only the tallest of the cordgrass extend above the water line at this height.

Census sites #6 and #8 (Figure 3) are located in this ecosystem. Nine marsh plant species have been identified in these census sites whereas 29 species occur in the tidal marsh.

Bird Use: Tidal marsh is principally a roosting and loafing area for birds. Willets, long-billed curlews, and marbled godwits frequently utilize this area as a loafing zone. Willets occasionally feed in the marsh vegetation. From late October until April, western meadowlarks and Belding's savannah sparrows roost in large numbers in census site #6. These birds move to the tidal marsh at sunset and western meadowlarks leave at sunrise. Belding's savannah sparrows rarely leave the marsh vegetation.

Great blue herons and snowy egrets occur in the tidal marsh during the winter months. Most often these birds would roost in the marsh and feed in the small channels and mudflats.

The tidal marsh is pocked with small mud basins. These depressions were so numerous and, in some cases, so small that their acreage values were included. Bird use of these potholes is not typical of the tidal marsh but more exemplified by the bird use of the tidal channels and mudflats.

Three species of birds nest in the marsh vegetation. These included light-footed clapper rail, Belding's savannah sparrow, and black-necked stilt.

#### Tidal Channels - Mudflats

Many tidal channels and mudflats are found within Anaheim Bay (Figure 5). This ecosystem comprises 171 acres of the bay and is probably the most valuable wildlife area. Census sites #4, #5, #7, #9, #10, and #12 are all located here.



Figure 5. Tidal Channels



F

Tidal channels consist of three major water courses through the tidal marsh. Channel depths range from 35 feet (near Huntington Harbor entrance) to one foot, with an average depth of 4 to 6 feet. Channel widths range from 1,200 feet, where tidal basin is formed, to approximately 2 feet. Tidal action through these and other channels are caused by the formation of heads of water at tidal gates or elevated siltation areas (Fritz, 1970). All of the major channels are bounded by marsh vegetation.

The ends of the tidal channels often form expanded tidal mudflat areas. These mudflats are usually bounded by tidal vegetation but in some cases may be bordered by a road or a dike. Where this is the case, the mudflats often trap tidal water which helps sustain large populations of the California horn snail (*Cerithidea californica*) and the striped shorecrab (*Pachygrapsus crassipes*) (Tasto, 1971).

Two mudflats in Anaheim Bay are fairly substantial in size. One area, the "tidal pool" was formed from the blockage of a tidal channel by a dike. This pool is in the northwest edge of the marsh (Figure 3) and often contains tidal water during low tides. Tidal water enters and leaves this area via two tide gates beneath an asphalt roadway.

The other mudflat area is a fill area. This area is relatively nontidal except when tides of 5.5 feet or higher inundate the area. The fill area (Figure 6) is 800 by 200 feet and is undergoing successional changes. Saltgrass (*Distichlis spicata*) and *Salicornia bigelovii* are growing in this area. On the western boundary of this area many dune indicators and lowland plants are found.



Figure 6. Fill Area Mudflat



B

Bird Use: The tidal channel - mudflat ecosystem is the most extensively utilized area by birds throughout the year. Most often birds are feeding, although dabbling ducks and gulls often roost and loaf on the mudflats during low tides.

The tidal channels often serve as feeding areas during low tides. The tidal basin, when exposed, is the largest mudflat area in Anaheim Bay and almost every species of shorebird and waterfowl frequent this mudflat.

During extreme high tides birds leave the marsh area and congregate in the fill mudflat area. Most birds loaf or roost in this area during high tide condition and quite often loaf in this area when the tide height is medial.

#### Sandy Beach

Sandy beach (Figure 7) along with the harbor jetties act as a protective barrier for Anaheim Bay. The beach is composed of fine to coarse sand and is approximately 10 feet in elevation. It comprises 8.5 acres and is 1,000 feet long and 500 feet wide and is continuous with the Seal Beach strand. Entrance to the beach is restricted to Navy personnel and their families.

The beach is heavily used by people during the summer months. During this period the beach is cleaned twice a month which greatly affects bird activity. The beach is little influenced by tidal action and is census site #2.



Figure 7. Beach Ecological Zone

F

Bird Use: The beach serves as a feeding area for sanderlings, western sandpipers, willets, marbled godwits and the black-bellied plovers. These birds feed in this area in small numbers.

The beach also serves as a gull and tern roosting and loafing area. These birds are the most common inhabitants of this ecological zone, although their populations are low during the summer.

#### Open Water

Open water predominates in the harbor areas and in the tidal channels during high tides.

The harbor areas which directly connect with the ocean, comprise 243 acres. They have been dredged to a minus 35 feet to allow large vessel entrance. The harbors are bounded on the east and west by rock jetties open on the south to the ocean, and are bordered by marsh on the north. Census sites #1 and #3 are included in this area.

Open water (Figure 8) also occurs at the entrance to Huntington Harbor marina. This area is between the inner harbor and the tidal marsh. It consists of 4.5 acres and includes census site #11. Like the harbor region, this area has been dredged to a minus 35 feet and is bounded on the east and west by rock reinforcement.



Figure 8. Open Water Ecological Zone

Bird Use: The open harbor ecological zone is used only by diving birds and waterfowl. Large populations of surf scoters and western grebes inhabit this area. Although surf scoters rarely feed in this area, they do utilize the open water for roosting and loafing. Occasionally western grebes, red-breasted mergansers, and eared grebes feed in open water but they most commonly roost and loaf here.

## BIRD OBSERVATIONS

### Seasonal Occurrence

One hundred and two bird species were observed in the study area. These included 25 species of shorebirds, 14 species of waterfowl, 12 species of gulls and terns, and 6 species of long-legged waders. Remaining species were land and other water-associated birds.

Migration patterns play a large part in determining the abundance of birds during the year. Census counts indicate that mid-August is the period when the first waves of migrating birds arrive. Peak migration was reached in late December when 10,490 birds were present in Anaheim Bay (Figure F-1, appended).

Shorebirds (Figures F-2 and F-3, appended) increased rapidly through August until a first peak was reached in September when 520 dowitchers, 450 western sandpipers, 330 willets, and 385 black-bellied plovers were seen on September 18. Maximum numbers occurred in December. On December 31, 591 black-bellied plovers, 800 western sandpipers and 405 marbled godwits roosted in the fill area. Shorebird numbers decreased rapidly after February indicating peak passage of the northward migration. After the month of May the only shorebirds observed were small populations of willets and marbled godwits.

Arrival of migrant waterfowl (Figures F-4 and F-7, appended) was first observed on August 20, when 3 pintail were seen feeding in one of the major channels. On August 26, 150 pintail, in eclipse plumage, roosted on a sand bar north of the "degraining area." Shortly after, American widgeon, green-winged teal, cinnamon teal, mallard and shoveler appeared in the bay. Waterfowl reached their peak numbers in October. On October 26, 1,200 pintail were seen loafing in the tidal pool. Pintail appeared to be the dominant species of waterfowl until late December when American widgeon arrived in large numbers. On January 25, 473 American widgeon were feeding in the tidal pool, whereas only 70 pintail were seen in the same area. This proportion appeared to be the same throughout the bay. Waterfowl numbers decreased drastically in March and by the month of April no migrant waterfowl were seen.

The first herons appeared in mid-August (Figure F-5, appended). Nine great blue herons and 1 common egret were seen on August 14. Heron numbers remained low during September but increased in October. On October 5, 42 black-crowned night herons and 35 snowy egrets were loafing in the Signal Oil area (census site #12). A population peak was reached in January. On January 25, 58 black-crowned night herons and 23 great blue herons were seen in the unstaked tidal marsh (census site #8).

Like waterfowl and shorebirds, herons decreased after March. By the month of May, no herons were found in Anaheim Bay.

Large numbers of terns occur in August (Figure F-6, appended). On August 8, 300 Forster's terns, 90 common terns, 18 elegant terns, and 12 Caspian terns roosted in the fill area.

Tern populations decreased rapidly through September and by October very few terns were seen.

Gull populations were relatively low and stable until late October. On October 15, 170 California gulls roosted in the fill area. In addition, another 65 California gulls, 32 ring-billed gulls, 22 Heermann's gulls and 20 Herring gulls roosted on the beach area.

Another gull population peak was reached in April. On April 7, 265 California gulls were seen. California gulls appeared to be the dominant species in Anaheim Bay.

Diving birds, which includes scoters and mergansers, were usually seen in the harbor areas or near the entrance to Huntington Harbor (Figure F-7, appended). Most common species seen were surf scoters and western grebes. Diving bird populations were greatest in November and April. On November 25, 500 surf scoters were seen in the harbor areas and the entrance to Hunting Harbor. Their numbers remained high through early April. On April 7, 630 surf scoters and 46 western grebes were observed in the harbor area. In the same area on May 11, only 45 surf scoters were seen and their numbers dropped even lower in late May.

Raptors seen during the winter months included red-tailed hawk, marsh hawk, sparrow hawk, osprey, short-eared owl, barn owl, and burrowing owls. Most of these occurred between the months of August and April. Crows, ravens and turkey vultures were often seen flying over the marsh enroute to the agricultural fields to the east and many passerines birds were observed near the marsh area.

#### Activity

Bird activity is highly dependent on the tide. Shorebirds and herons were most often observed feeding during low tides. Although gulls were rarely observed feeding, they do use the area for loafing or roosting during various tidal conditions. Terns and dabbling ducks appear to loaf and roost during extreme low tides and feed during mid to high tides.

Bird activity was slightly affected by adverse weather. During heavy winds or fog birds were usually seen on the ground; however, their ground activity is dependent on the tide. During heavy rain, bird movement would stop until after the cloudburst; movement and activity would resume.

Time of day was not a critical factor determining bird activity. Feeding occurred in the morning, afternoon, and at night. Like feeding activity, loafing and roosting occurred at all time periods.

## Endangered Species

Three of the State's endangered birds occur in Anaheim Bay. These are the light-footed clapper rail, California least tern, and California brown pelican.

### Light-footed Clapper Rail

The light-footed clapper rail is a nonmigratory bird occurring in salt marshes from Santa Barbara south to Baja California (Bent, 1926). The bird is highly secretive and extremely difficult to observe. However, on May 25, 1971, two pairs were seen feeding within 500 feet of each other. The bird is easy to identify by its call. It is not unusual to hear no less than 9 or 10 birds calling on any night during the year.

Anaheim Bay is thought to sustain the largest population of light-footed clapper rails in California. Based on territorial sizes in Bent (1926) and from personal observation of nests in Upper Newport Bay, the author estimates a population not exceeding 100 to 200 light-footed clapper rails inhabiting Anaheim Bay.

The light-footed clapper rail is endangered because of loss of habitat. It is essential that a detailed study be conducted to determine the effect of possible habitat loss at Anaheim Bay on survival of this endangered bird.

### California Brown Pelican

The plight of the California brown pelican is well documented (Gress, 1971). The California brown pelican was first seen on June 21, 1970, when 1 bird appeared in the outer harbor area. Brown pelican population increased throughout the summer reaching a peak of 112 birds on September 3. Numbers slowly decreased until November, when the last pelicans were seen. It is reasonable to assume that these birds are summer and winter visitants from Mexico.

### California Least Tern

The California least tern is the smallest of the terns. After nesting in California and Mexico, it migrates to the southern hemisphere. This bird is often seen feeding in Anaheim Bay during the summer months.

In June 1970, a colony of California least terns nested on a fill area adjacent to Anaheim Bay. This colony then was determined to be the largest breeding population of least terns in California. However, in 1971 the colony contained by 23 nests (Massey, 1972).

Like the light-footed clapper rail, the California least tern is endangered because of loss of habitat. A detailed study is now in progress to determine the status of this bird in California.

### Belding's Savannah Sparrow

Belding's savannah sparrow, although not presently on the endangered list, requires a salt marsh environment for survival.

This subspecies is a resident in Anaheim Bay. Individuals were often observed perched on tall pickleweed singing their territory. No active nests were found; however, fledglings were seen in late May and 1 in early June. Efforts should be directed towards determining its statewide status and threats to its survival.



## LITERATURE CITED

- Bent, A. C. 1926. Life histories of North American marsh birds. United States National Museum Bulletin 135. Washington, D. C.
- Bent, A. C. 1927. Life histories of North American shorebirds, parts I and II. United States National Museum Bulletin 142. Washington, D. C.
- International Bird Census Committee, 1970. Recommendations for an international standard for a mapping method in bird census work. Audubon Field Notes, Vol. 24, No. 6.
- Friis, L. 1965. Orange County through four centuries. Pioneer Press, Santa Ana.
- Fritz, E. S. 1970. The life history of the California killifish, fundulus parvipinnis girard, in Anaheim Bay, California. M. A. Thesis, California State College, Long Beach.
- Gress, F. 1970. Reproductive status of the California brown pelican in 1970, with notes on breeding biology and natural history. California Department of Fish and Game, Wildlife Management Branch Administrative Report No. 70-6.
- Grimshaw, M. A. 1937. The history of Orange County. M. A. Thesis, University of Southern California.
- Mason, H. L. 1957. A flora of the marshes of California. University of California Press. Berkeley.
- Massey, B. W. 1971. A breeding study of the California least tern. California Department of Fish and Game, Wildlife Management Branch Administrative Report No. 71-9.
- Munz, P. A. 1957. A California flora. University of California Press. Berkeley.
- Talbert, T. B. 1952. My sixty years in California. Huntington Beach News Press. Huntington Beach.
- Tasto, R. N. 1971. A study of the Pacific staghorn sculpin, leptocottus armatus girard, in Anaheim Bay, California. M. A. Thesis, California State College, Long Beach.
- Willeys, D. B. (Director). 1968. Sea water intrusion: Bolsa-Sunset area Orange County. California Department of Water Resources Bulletin No. 63-2.
- United States Naval Weapons Station, Seal Beach. 1969. Fish and Wildlife Management Plan.

## APPENDICES

### Exhibits

Anaheim Bay Census Form . . . . .	E-1
Checklist of Vertebrates and Invertebrates, Seal Beach Naval Weapons Station . . . . .	E-2
Anaheim Bay Salt Marsh Vegetation . . . . .	E-3

### Figures

Bird Use of Anaheim Bay, 1970-71 . . . . .	F-1
Large Shorebird Use of Anaheim Bay, 1970-71 . . . . .	F-2
Small Shorebird Use of Anaheim Bay, 1970-71 . . . . .	F-3
Dabbler Duck Use of Anaheim Bay, 1970-71 . . . . .	F-4
Heron Use of Anaheim Bay, 1970-71 . . . . .	F-5
Gull and Tern Use of Anaheim Bay, 1970-71 . . . . .	F-6
Diving Bird Use of Anaheim Bay, 1970-71 . . . . .	F-7

## Anaheim Bay Census

DATE: / /

WIND SPEED  
SKY

STARTING TIME

TIDE

low

high

OBSERVERS: \_\_\_\_\_

SPECIES	AOU	CENSUS SITES											
		1	2	3	4	5	6	7	8	9	10	11	12
Semipalmated plover	274												
Snowy plover	278												
Killdeer	273												
Blk-bellied plover	270												
Ruddy turnstone	283												
Black turnstone	284												
Long-bil. curlew	264												
Whimbrel	265												
Willet	258												
Gr. yellowlegs	254												
Least sandpiper	242												
Dunlin	243												
Western sandpiper	247												
Sandpiper species (?)	997												
Dowitcher species (?)	998												
Sanderling	248												
Marbled godwit	249												
Amer. avocet	225												
Blk-necked stilt	226												
Northern phalarope	223												
Gr. Bl heron	194												
Common egret	196												
Snowy egret	197												
Blk-cr. night heron	202												
Amer. bittern	190												
Tri-colored heron	199												
Ruddy duck	167												
Mallard	132												
Pintail	143												
Widgeon	137												
Red-br. merganser	130												
Shoveler	142												
Cinnamon teal	141												
Gr.-winged teal	139												
Least tern	74												
Forrester's tern	69												
Aspian tern	64												

KEY: F=feeding  
L=loafing  
R=roosting



Exhibit E-2

Checklist of Vertebrates and Invertebrates  
Seal Beach Naval Weapons Station

Vertebrates

Tunicates

*Styela plicata*  
*Styela barnharti*  
*Ciona intestinalis*  
*Molgula verrucifera*  
*Cystodytes*

Sharks and Rays

Gray smoothhound  
Shovelnose guitarfish  
Round stingray  
California butterfly ray

*Mustelus californicus*  
*Rhinobatos productus*  
*Urolophus halleri*  
*Gymnura marmorata*

Bony fishes

Pacific thread herring  
Deepbody anchovy  
Slough anchovy  
Diamond turbot  
Spotted turbot  
California halibut  
Speckled sanddab  
California tonguefish  
California killifish  
Bay pipefish  
Spotted sand bass  
Sand bass  
Shiner perch  
Black perch  
Barred surfperch  
White seaperch  
Pile perch  
Pacific staghorn sculpin  
White croaker  
Black croaker  
California corbina  
Queenfish  
Yellowfin croaker  
Striped mullet  
Cheekspot goby  
Arrow goby  
Longjaw mudsucker  
California grunion  
Topsmelt  
Slim midshipman  
Salema  
Bay blenny

*Opisthonema libertate*  
*Anchoa compressa*  
*Anchoa delicatissima*  
*Hypsopsetta guttulata*  
*Pleuronichthys ritteri*  
*Paralichthys californicus*  
*Citharichthys stigmaeus*  
*Symphurus atricauda*  
*Fundulus parvipinnis*  
*Syngnathus grisolineatus*  
*Paralabrax maculatofasciatus*  
*Paralabrax nebulifer*  
*Cymatogaster aggregata*  
*Embiotoca jacksoni*  
*Amphistichus argenteus*  
*Phanerodon furcatus*  
*Rhacochilus vacca*  
*Leptocottus armatus*  
*Genyonemus lineatus*  
*Cheilotrema saturnum*  
*Menticirrhus undulatus*  
*Seriphus politus*  
*Umbrina roncadore*  
*Mugil cephalus*  
*Illypnus gilberti*  
*Clevelandia ios*  
*Gillichthys mirabilis*  
*Leuresthes tenuis*  
*Atherinops affinis*  
*Porichthys myriaster*  
*Xenistius californiensis*  
*Hypsoblennius gentilis*

## Birds

Common loon  
Horned grebe  
Pied-billed grebe  
Eared grebe  
Western grebe  
White pelican  
Brown pelican  
Brandt's cormorant  
Great blue heron  
Green heron  
Black-crowned night heron  
Little blue heron  
Louisiana heron  
Common egret  
Snowy egret  
American bittern  
Black brant  
White-fronted goose  
Lesser snow goose  
Mallard  
Pintail  
Green-winged teal  
Cinnamon teal  
Blue-winged teal  
American widgeon  
Shoveler  
Lesser scaup  
Common golden-eye  
Bufflehead  
Oldsquaw  
White-winged scoter  
Surf scoter  
Red-breasted merganser  
Turkey vulture  
White-tailed kite  
Red-tailed hawk  
Red-shouldered hawk  
Marsh hawk  
Osprey  
Sparrow hawk  
Light-footed clapper rail  
Sora rail  
American coot  
Semipalmated plover  
Snowy plover  
Killdeer  
Mountain plover  
Black-bellied plover  
Common snipe  
Long-billed curlew  
Whimbrel  
Wandering tattler  
Willet  
Greater yellowlegs  
Lesser yellowlegs

*Gavia immer*  
*Podiceps auritus*  
*Podilymbus podiceps*  
*Podiceps caspicus*  
*Aechmophorus occidentalis*  
*Pelecanus erythrorhynchos*  
*Pelecanus occidentalis*  
*Phalacrocorax penicillatus*  
*Ardea herodias*  
*Butorides virescens*  
*Nycticorax nycticorax*  
*Florida caerulea*  
*Hydranassa tricolor*  
*Casmerodius albus*  
*Leucophoy's thula*  
*Botaurus americana*  
*Branta nigricans*  
*Anser albifrons frontalis*  
*Chen hyperborea hyperborea*  
*Anas platyrhynchos*  
*Anas acuta*  
*Anas carolinensis*  
*Anas cyanoptera*  
*Anas discors*  
*Mareca americana*  
*Spatula clypeata*  
*Aythya affinis*  
*Bucephala clangula americana*  
*Bucephala albeola*  
*Clangula hyemalis*  
*Melanitta deglandi dixonii*  
*Melanitta perspicillata*  
*Mergus serrator*  
*Cathartes aura*  
*Elanus leucurus*  
*Buteo jamaicensis*  
*Buteo lineatus*  
*Circus cyaneus*  
*Pandion haliaetus*  
*Falco sparverius*  
*Rallus longirostris*  
*Porzana carolina*  
*Fulica americana*  
*Charadrius semipalmatus*  
*Charadrius alexandrinus*  
*Charadrius vociferus*  
*Eupoda montana*  
*Squatarola squatarola*  
*Capella gallinago*  
*Numenius americanus*  
*Numenius phaeopus*  
*Heteroscelus incanum*  
*Cataptrophorus semipalmatus*  
*Totanus melanoleucus*  
*Totanus flavipes*



Birds - cont.

Short-billed dowitcher  
Long-billed dowitcher  
Marbled godwit  
Sanderling  
Knot  
Western sandpiper  
Spotted sandpiper  
Least sandpiper  
Dunlin  
American avocet  
Black-necked stilt  
Wilson's phalarope  
Northern phalarope  
Red phalarope  
Western gull  
Herring gull  
California bull  
Ring-billed gull  
Bonaparte's gull  
Heermann's gull  
Black-legged kittiwake  
Forster's tern  
Common tern  
Least tern  
Elegant tern  
Caspian tern  
Parasitic jaeger  
Barn owl  
Burrowing owl  
Short-eared owl  
Belted kingfisher  
Red-shafted flicker  
Western kingbird  
Ash-throated flycatcher  
Common crow  
Mockingbird  
Starling  
Cliff swallow  
Long-billed marsh wren  
Western meadowlark  
Brewer's blackbird  
House sparrow  
Song sparrow  
White-crowned sparrow  
Belding's savannah sparrow  
Golden-crowned sparrow  
House finch

*Limnodromus griseus*  
*Limnodromus scolopaceus*  
*Limosa fedoa*  
*Crocethia alba*  
*Calidris canutus*  
*Ereunetes mauri*  
*Actitis macularia*  
*Erolia minutilla*  
*Erolia alpina*  
*Recurvirostra americana*  
*Himantopus mexicanus*  
*Steganopus tricolor*  
*Lobipes lobatus*  
*Phalaropus fulicarius*  
*Larus occidentalis*  
*Larus argentatus*  
*Larus californicus*  
*Larus delawarensis*  
*Larus philadelphia*  
*Larus heermanni*  
*Rissa tridactyla*  
*Sterna forsteri*  
*Sterna hirundo*  
*Sterna albifrons*  
*Thalasseus elegans*  
*Hydroprogne caspia*  
*Stercorarius parasiticus*  
*Tyto alba*  
*Speotyto cunicularia*  
*Asio flammeus*  
*Megasceryle alcyon*  
*Colaptes cafer*  
*Tyrannus verticalis*  
*Myiarchus cinerascens*  
*Corvus brachyrhynchos*  
*Mimus polyglottos*  
*Sturnus vulgaris*  
*Petrochelidon pyrrhonota*  
*Telmatodytes palustris*  
*Sturnella neglecta*  
*Euphagus cyanocephalus*  
*Passer domesticus*  
*Melospiza melodia*  
*Zonotrichia leucophrys*  
*Passerculus sandwichensis*  
*Zonotrichia atricapilla*  
*Carpodacus mexicanus*

Mammals

Common opossum  
Beechey ground squirrel  
Botta pocket gopher  
Western harvest mouse

*Didelphis marsupialis*  
*Otospermophilus beecheyi*  
*Thomomys bottae*  
*Reithrodontomys megalotis*

Mammals - cont.

Black-tailed jackrabbit  
Audubon cottontail  
Long-tailed weasel  
Striped skunk  
Coyote

*Lepus californicus*  
*Sylvilagus audubonii*  
*Mustela frenata*  
*Mephitis mephitis*  
*Canis latrans*

Invertebrates

Yellow sponge  
Hydroid

Tube anemone  
Sea pen  
Sea anemone  
Flatworm  
Ribbon worms  
Bryozoans  
Phoronid worm  
Round worms  
Segmented worms  
Polychaete worms

*Hymeniacidon sinapium*  
*Corymorpha palma*  
*Obelia* sp.  
*Cerianthus* sp.  
*Stylatula elongata*  
*Diadumene franciscana*  
*Turbellaria* unid.  
*Nemertea* unid.  
*Bryozoa* unid.  
*Phoronida* unid.  
*Nematoda*  
*Annelida*  
*Ampharete artica*  
*Ampharetidae*  
*Amphicteis scaphobranchiata*  
*Armandia bioculata*  
*Axiiothella rubrocineta*  
*Boccardia* sp.  
*Capitellidae* unid.  
*Chaetopterus* sp.  
*Chone ecaudata*  
*Chone minima*  
*Cirriformia luxuriosa*  
*Cirratulidae* unid.  
*Diopatra* sp.  
*Dorvillea articulata*  
*Dorvillea* sp.  
*Eteone* spp.  
*Eudistylia polymorpha*  
*Eudistylia* sp.  
*Eulalia bilineata*  
*Eulalia* sp.  
*Eumida* sp.  
*Eunereis longipes*  
*Exogone lourei*  
*Glycera branchipoda*  
*Goniada littorea*  
*Halosydna johnsoni*  
*Haploscoloplos elongatas*  
*Lumbrineris erecta*  
*Lumbrineris minima*  
*Lumbrineris zonata*  
*Lumbrineris* sp.  
*Marphysa sanguinea*  
*Marphysa stylobranchiata*  
*Mediomastus* sp.

Polychaete worms - cont.

Megalomma sp.  
 Naineris sp.  
 Neanthes succinea  
 Nereidae  
 Nephtys succinea  
 Nereis sp.  
 Nerinides acuta  
 Notomastus tenuis  
 Ophiodromus pugettensis  
 Pectinaria californiensis  
 Phyllodocidae  
 Pista alata  
 Platynereis bicanaliculata  
 Polydora ciliata  
 Polydora sp.  
 Prionospio heterobranchia newportensis  
 Prionospio pygmaeus  
 Prionospio sp.  
 Protodorvillea gracilis  
 Pseudopotamilla socialis  
 Rhynchospio arenicola  
 Sabelliade  
 Serpula vermicularis  
 Spionidae  
 Spiophanes missioniensis  
 Streblospio benedicti  
 Syllidae  
 Syllis gracilis

Arthropods

Barnacle  
 Harpacticoid copepod  
 Cumaceans  
 Pillbugs  
 Rocklouse  
 Sow bug  
 Amphipods  
 Beach flea  
 Skeleton shrimp  
 Crab  
 Yellow shore crab  
 Crab  
 Ghost shrimp  
 Longfingered shrimp  
 Pistol shrimp  
 Seed shrimp

Terebellidae  
 Balanus concavus pacificu  
 Balanus amphitrite  
 Harpacticoida  
 Malacostraca  
 Cumacea  
 Isopoda  
 Ligia occidentalis  
 Oniscoidea unid.  
 Gammaridae  
 Amphideulepus oculatus  
 Corophium sp.  
 Talitridae  
 Stenothoidae  
 Caprellidae  
 Caprella equilibra  
 Chelifera  
 Cancer amphioetus  
 Hemigrapsus oregonensis  
 Lophopanopeus frontalis  
 Pyromaia tuberculata  
 Callianassa sp.  
 Betaeus longidactylus  
 Cragon californiensis  
 Ostracoda

## Mollusks

Murleid snail  
Barrel bubble shell snail

Sea hare  
Nudibranch  
Tetibranch  
California hornshell  
Hornmouth shell snail  
Slipper shell

Half-slipper shell  
Cup and saucer limpit  
Wentletrap  
Nudibranch  
Kellet's whelk  
Saltmarsh snail  
Dove-shell  
Channeled dog whelk  
Mud dog whelk  
Whelk

Seahare  
Rocksnail  
Olive shell  
Moon shell  
Festive rockshell  
Bay scallop  
Yellow apolymetis  
Mud piddock  
Agate chama  
Banded chione  
Wavy chione  
Smooth chione  
Cooper's clam  
Deep water gari  
Little egg cockle  
California papershell  
Bent-nose clam  
White sandclam  
Yoldia-shaped clam  
California mactra  
Bay mussel  
Taphria nut clam  
Native oyster  
Speckled scallop  
Rough-sided littleneck  
Common littleneck  
California reversed chama  
Purple clam  
Common Washington clam  
Rosey razor clam  
California jackknife clam  
Sunrise tellin  
Spiny cockle  
Gaper clam

*Acanthina spirata*  
*Acteocina culcitella*  
*Acteocina* sp.  
*Aplysia californica*  
*Archidoris* sp.  
*Bulla gouldiana*  
*Cerithidea californica*  
*Ceratostoma nuttalli*  
*Crepidula onyx*  
*Crepidula nummaria*  
*Crepidatella lingulata*  
*Crucibulum spinosum*  
*Epitonium* sp.  
*Hermisenda* sp.  
*Kelletia kelleti*  
*Melampus olivaceus*  
*Mitrella* sp.  
*Nassarius fossatus*  
*Nassarius tegulus*  
*Nassarius* sp.  
*Navanax inermis*  
*Ocenebra poulsoni*  
*Olivella biplicata*  
*Polinices recluzianus*  
*Shaskyus festivus*  
*Aequipecten circularis*  
*Apolymetis biangulata*  
*Barnea pacifica*  
*Chama pellucida*  
*Chione californiensis*  
*Chione undatella*  
*Chione fluctigraga*  
*Cooperella subdiaphana*  
*Gari edentula*  
*Laevicardium substriatum*  
*Lyonsia californica*  
*Macoma nasuta*  
*Macoma secta*  
*Macoma yoldiformis*  
*Mactra californica*  
*Mytilus edulis*  
*Nuculana taphria*  
*Ostrea lurida*  
*Plagiotenium circularis aequisulcatum*  
*Protothaca laciniata*  
*Protothaca staminea*  
*Pseudochama exogyra*  
*Sanguinolaria nuttalli*  
*Saxidomus nuttalli*  
*Solen rosaceus*  
*Tagelus californianus*  
*Tellina carpenteri*  
*Trachycardium quadragenarium*  
*Tresus nuttalli*

# Mollusks - cont.

Exhibit E-1

Ribbed horsemussel	<i>Volvella demissa</i>
Octopus	<i>Octopus bimaculatus</i>
Brittle star	<i>Ophiuroidea unid.</i>
Sand dollar	<i>Dendraster excentricus</i>

Green alga	<i>Ectocarpus imbricatus</i>
	<i>Cladophora alaroides</i>
	<i>Ulva sp.</i>

## Fascicular Plants

Red turnip	<i>Portula alba</i>	R
Soft chive	<i>Brassica oleracea</i>	R
Salicornia grass	<i>Salicornia spicata</i>	R
Stickle grass	<i>Parafolia incurva</i>	O
Cord grass	<i>Spartina foliosa</i>	VA
	<i>Spartanoclinus linearis</i>	R
Cattail	<i>Typha sp.</i>	R
Sedge	<i>Cyperus sp.</i>	R
Ice plant	<i>Sesuvium portulacastrum</i>	O
Sea fig	<i>Mesembryanthemum chilense</i>	O
Rockrose fl.	<i>Mesembryanthemum affine</i>	O
Little ice plant	<i>Mesembryanthemum uniflorum</i>	R
Salicornia	<i>Portula alba</i>	VA
Chinese quail	<i>Salicornia subterminalis</i>	R
Yellow salt-tolerant	<i>Atriplex canescens</i>	O
Yellow-flowered	<i>Salicornia virginica</i>	VA
Glasswort	<i>Salicornia subterminalis</i>	R
Sagebrush	<i>Salicornia virginica</i>	C
California sagebrush	<i>Artemisia californica</i>	C
Yucca	<i>Yucca elata</i>	R
Alkali sage	<i>Yucca brevifolia</i>	R
Salicornia dollar	<i>Chenopodium album</i>	R
Alkali bush	<i>Franklinia grandifolia</i>	R
Arrow weed	<i>Trigonotis maritima</i>	R
Beach sweeping primrose	<i>Oenothera biennis</i>	R
Sea lavender	<i>Althaea californica</i>	C

1/ Vegetative abundance indicated by the following symbols:

R-rare      O-occasional      C-common  
 A-abundant      VA-very abundant

Exhibit E-3

Anaheim Bay Salt Marsh Vegetation<sup>1/</sup>

Algae

Green algae

*Entromorpha intestinalis* C  
*Cladophora microcladoides* R  
*Ulva* sp. R

Vascular Plants

Red brome  
 Soft chess  
 Saltmarsh grass  
 Sickie grass  
 Cord grass

*Bromus rubens* C  
*Bromus mollis* C  
*Distichlis spicata* C  
*Parafolis incurva* O  
*Spartina foliosa* VA  
*Monanthochloe littoralis* O

Cattail  
 Sedge  
 Ice plant  
 Sea fig  
 Hottentot fig  
 Little ice plant  
 Saltwort

*Typha* sp. R  
*Cyperus* sp. R  
*Mesembryanthemum crystallinum* O  
*Mesembryanthemum chilense* C  
*Mesembryanthemum edule* O  
*Mesembryanthemum nodiflorum* R  
*Batis maritima* VA

Chinese pusley  
 Watson saltbush  
 Pickleweed  
 Glasswort  
 Samphire  
 California seablite  
 Jaumea

*Heliotropium curassavicum* R  
*Atriplex watsonii* O  
*Salicornia virginica* VA  
*Salicornia subterminalis* C  
*Salicornia bigelovii* O  
*Suaeda californica* C

Alkali weed  
 Saltmarsh dodder  
 Alkali heath  
 Arrow weed  
 Beach evening primrose  
 Sea lavender

*Jaumea carnosa* R  
*Cressa truxillensis* R  
*Cuscuta salina* R  
*Frankenia grandifolia* A  
*Triglochin maritima* R  
*Oenothera cheiranthifolia* R  
*Limonium californicum* C

<sup>1/</sup>Vegetative abundance indicated by the following symbols:

R-rare                      O-occasional                      C-common  
 A-abundant                      VA-very abundant



Figure F-1. Bird Use of Anaheim Bay, 1970-71

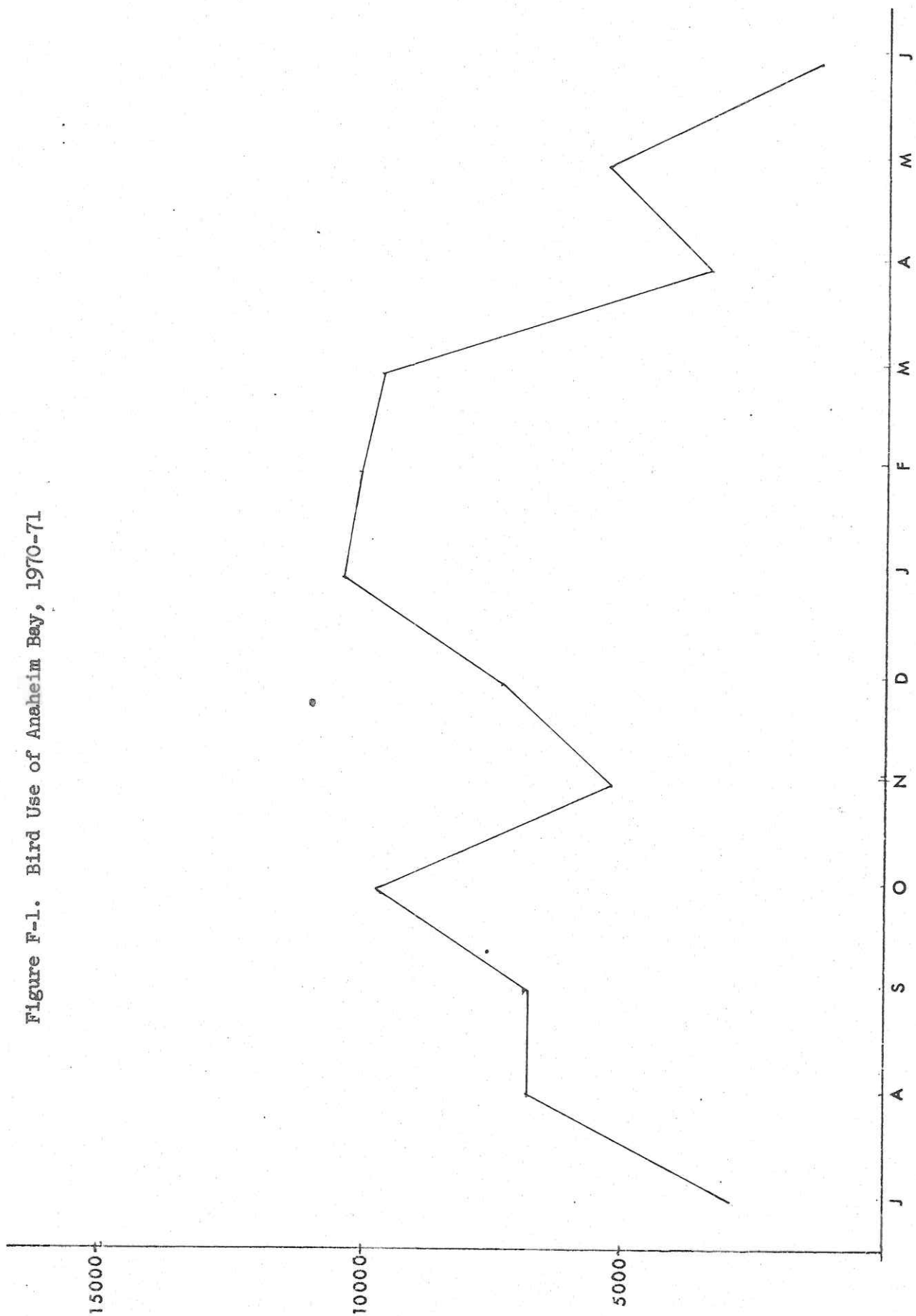


Figure F-2. Large Shorebird Use of Anaheim Bay, 1970-71  
(Birds per 100 acres)

Large shorebirds include: long-billed curlew, whimbrel, willet, greater yellowlegs, lesser yellowlegs, marbled godwit, American avocet and black-necked stilt.

..... Sandy beach  
- - - Tidal marsh  
— Mudflats-Channels

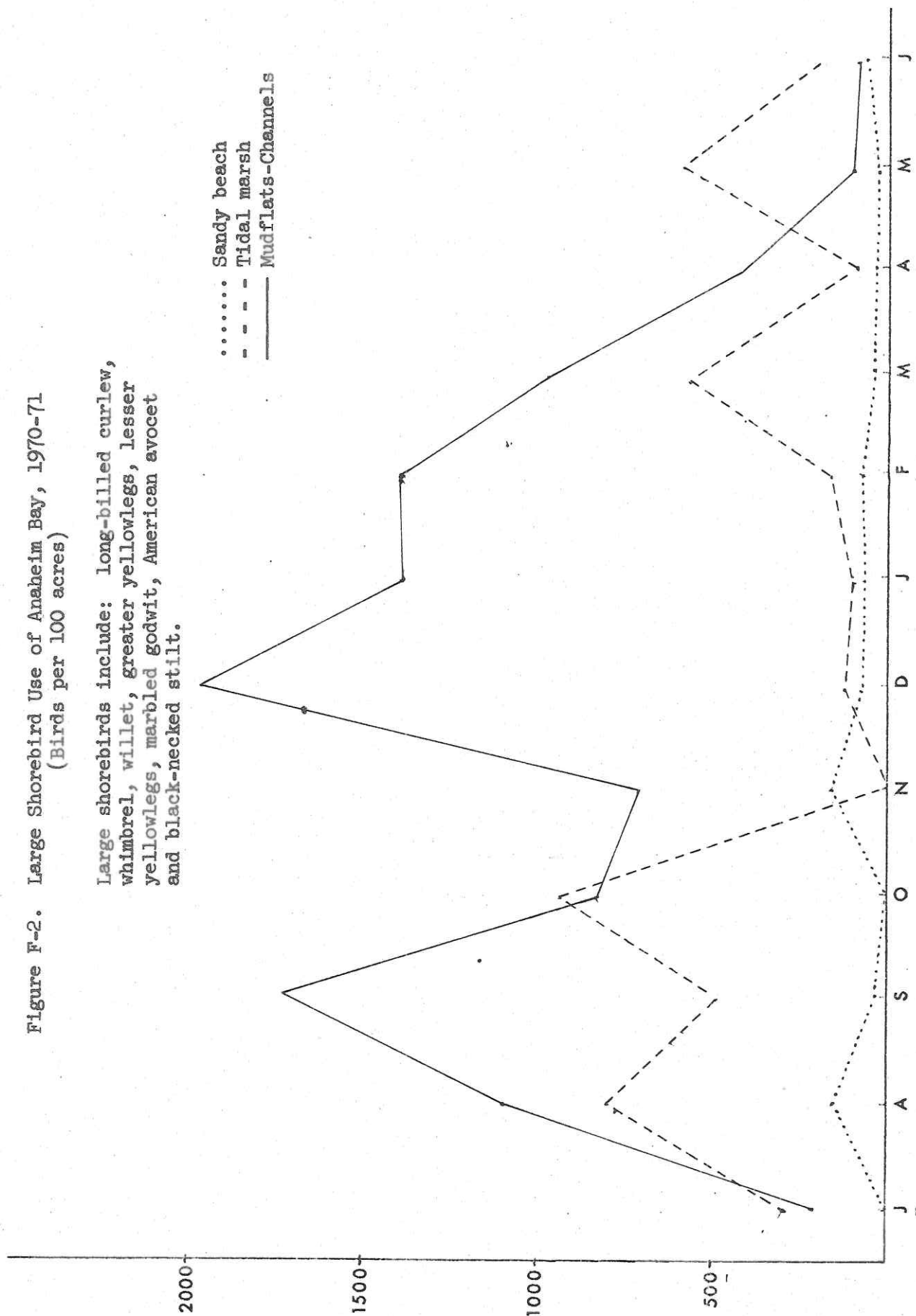


Figure F-3. Small Shorebird Use of Anaheim Bay, 1970-71  
(Birds per 100 acres)

Small shorebirds include: semipalmated plover, snowy plover, killdeer, black-bellied plover, dowitcher sp., sanderling, western sandpiper, least sandpiper and dunlin.

..... Sandy beach  
- - - Tidal marsh  
— Mudflats-Channels

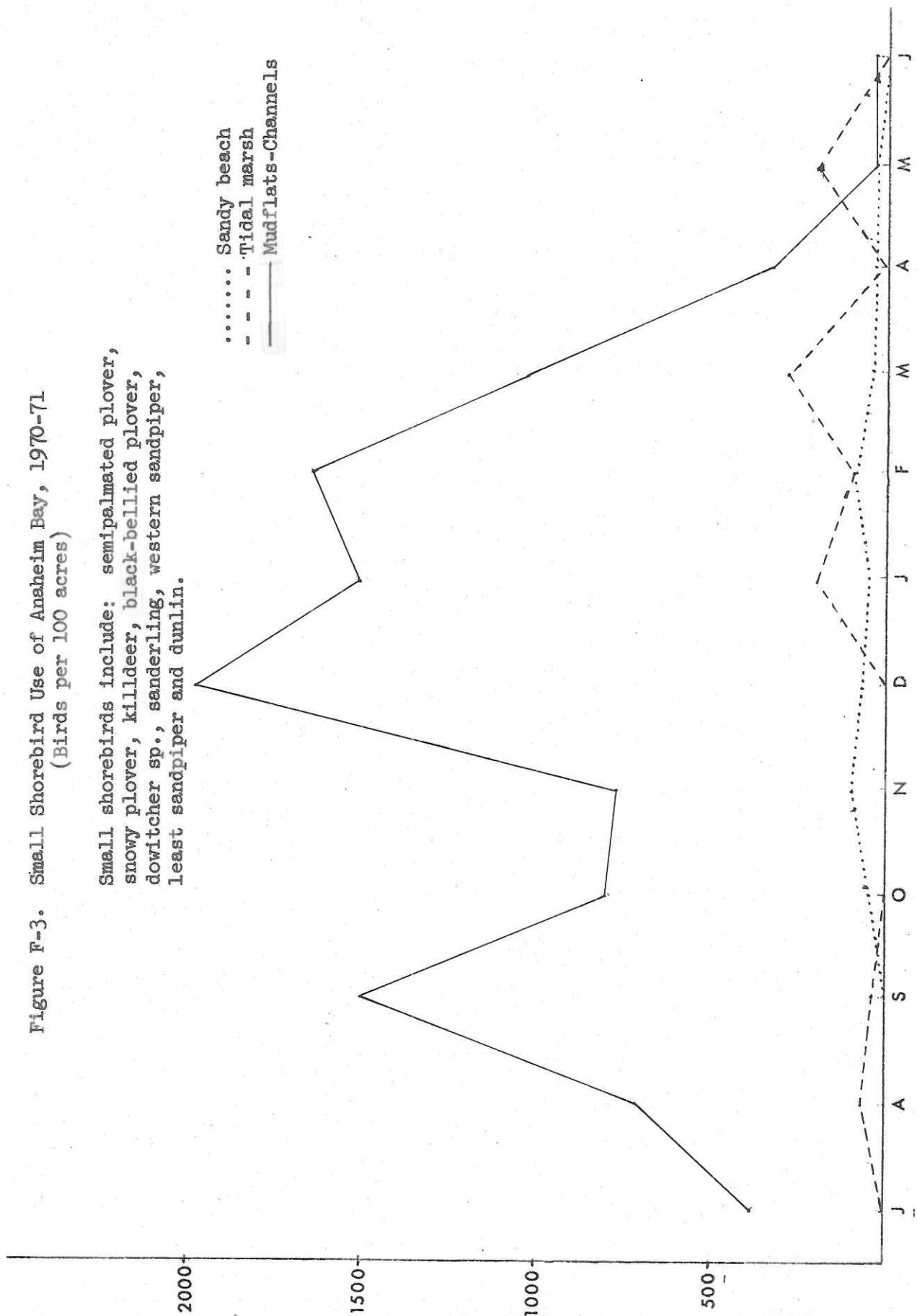


Figure F-4. Dabbler Duck Use of Anaheim Bay, 1970-71  
(Birds per 100 acres)

Dabbler ducks include: mallard, pintail, green-winged teal, cinnamon teal, American widgeon.

- - - Tidal marsh  
— Mudflats-Channels

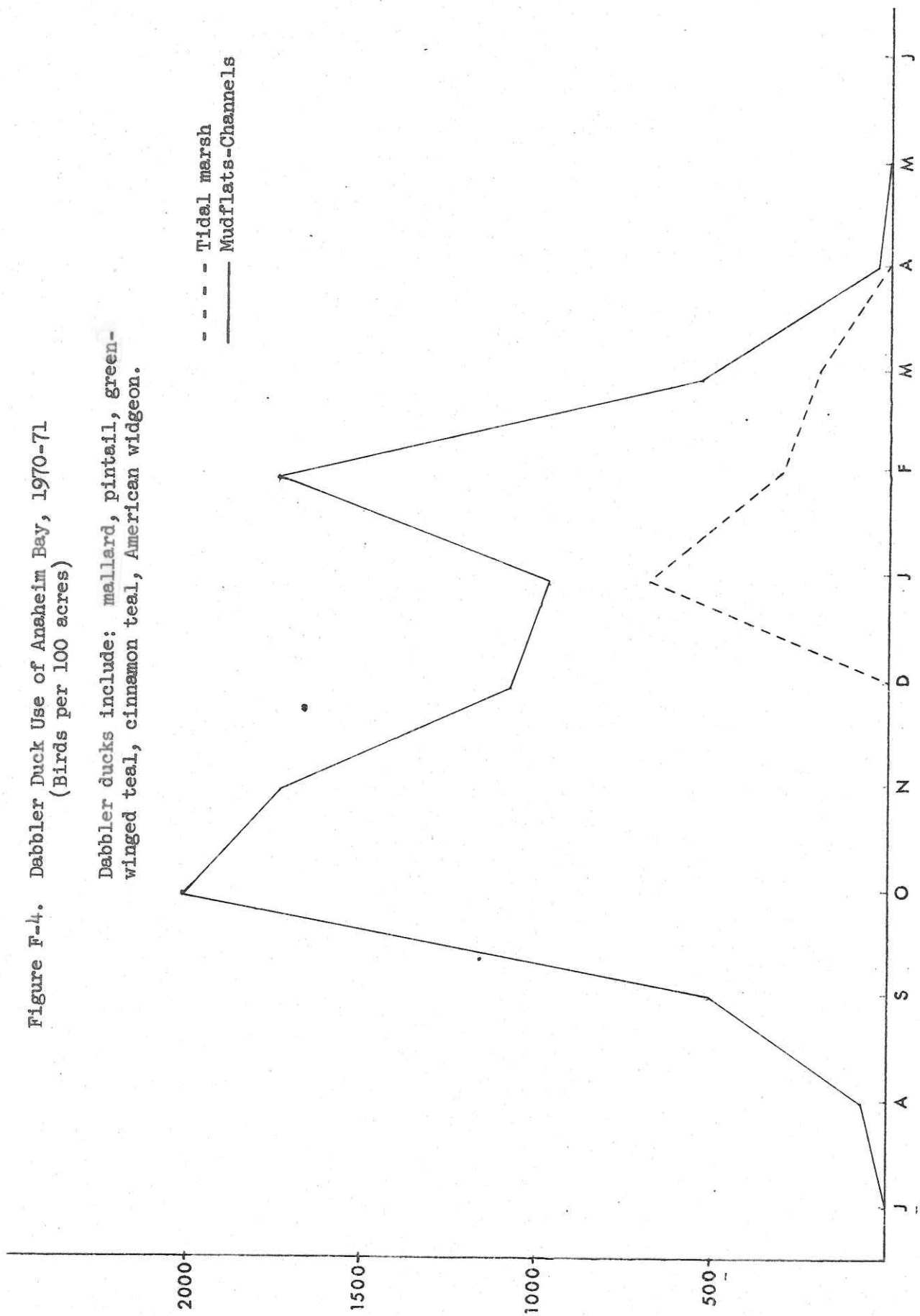


Figure F-5. Heron Use of Anaheim Bay, 1970-71  
(Birds per 100 acres)

Hérons include: great blue heron, Louisiana heron, black-crowned night heron, snowy egret, American egret.

- - - Tidal marsh  
— Mudflats-Channels

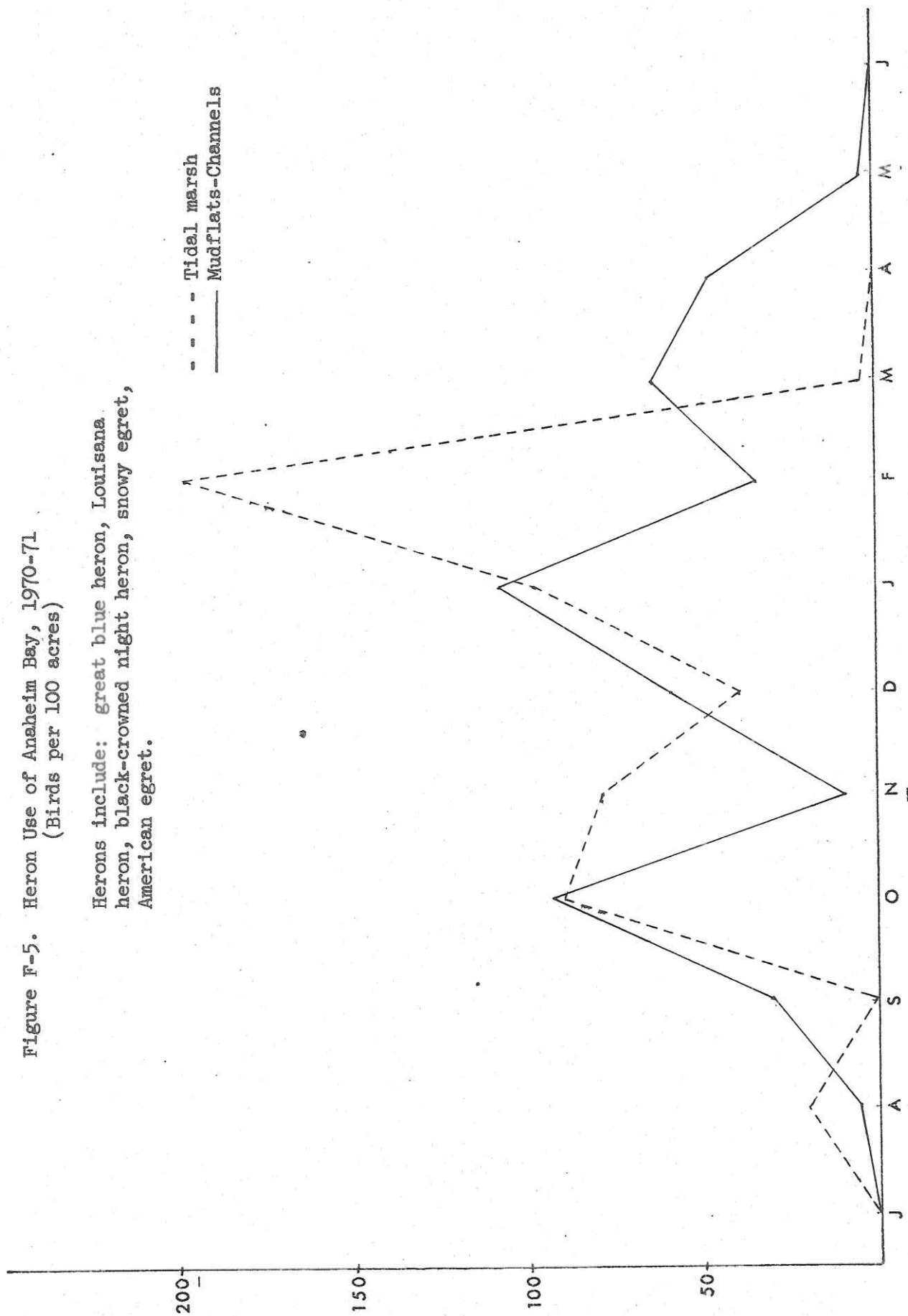


Figure F-6. Gull and Tern Use of Anaheim Bay, 1970-71  
(Birds per 100 acres)

Gulls and terns include: western gull, herring gull, California gull, ring-billed gull, Bonaparte's gull, Heermann's gull, Forster's tern, common tern, California least tern, elegant tern, Caspian tern.

..... Sandy beach  
—— Mudflats-Channels

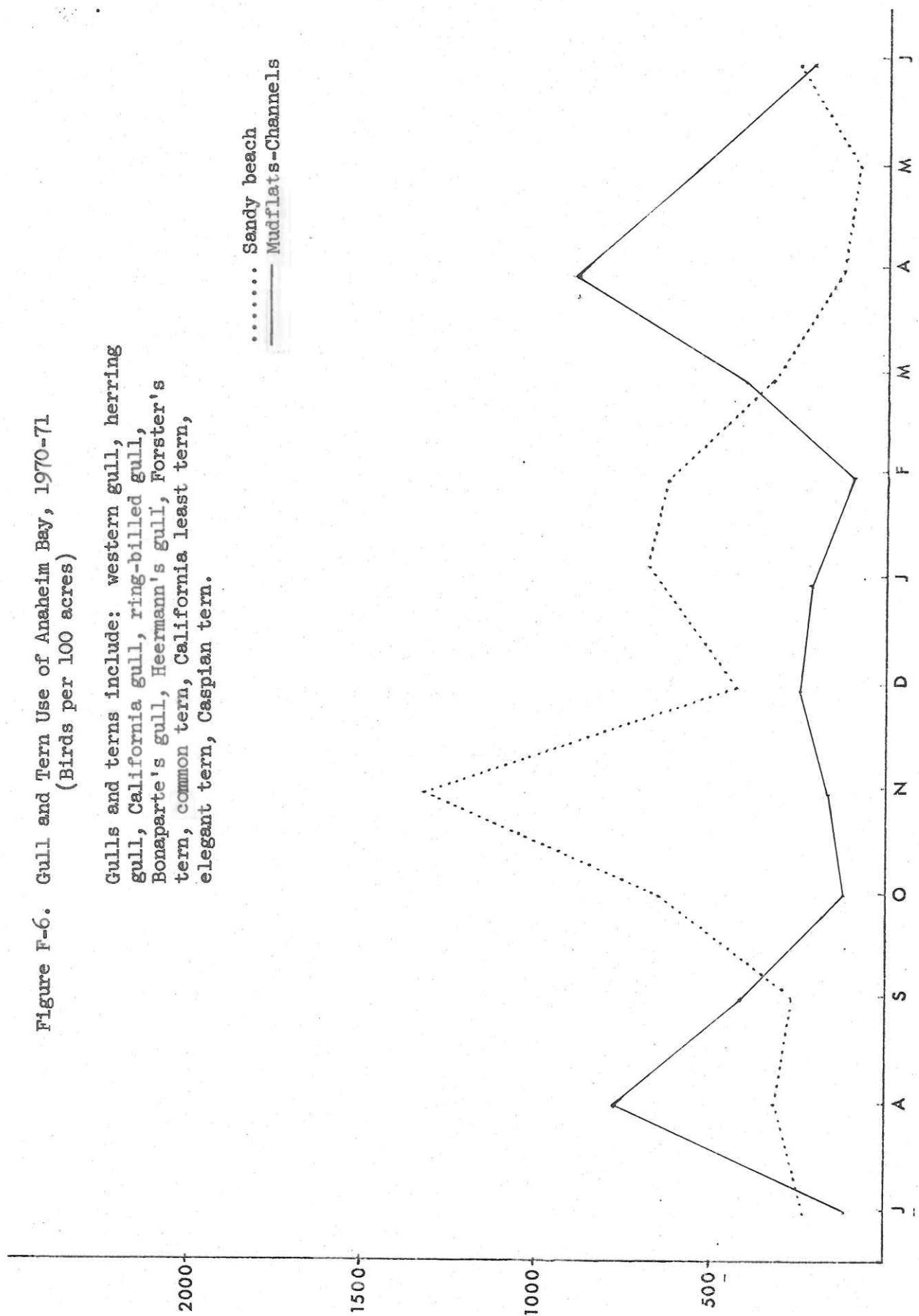




Figure F-7. Diving Bird Use of Anaheim Bay, 1970-71  
(Birds per 100 acres)

Diving birds include: white-winged scoter, surf  
scoter, red-breasted merganser, western grebe,  
pied-billed grebe, eared grebe.

..... Sandy beach  
- - - - - Open water  
—— Mudflats-Channels

