South San Diego Bay Enhancement Plan

Volume One/Resources Atlas

Marine Ecological Characterization Bay History and Physical Environment

San Diego Unified Port District

California State Coastal Conservancy

South San Diego Bay Enhancement Plan

Volume One/Resources Atlas

Prepared for:

San Diego Unified Port District
3165 Pacific Highway
San Diego, CA. 92112
Contact: Tomas E. Firle, Coordinator
Environmental Management

and

California State Coastal Conservancy
1330 Broadway, Suite 1100
Oakland, CA. 94612
Contact: Elizabeth P. Riddle

226 -223

Prepared by:

Michael Brandman Associates, Inc.
4918 North Harbor Drive, Suite 205
San Diego, CA. 92106
Contact: Keith B. Macdonald, Ph. D.
Director of Ecological Research

7 4

March 1990

South San Diego Bay Enhancement Plan

Resources Atlas
Volume One

Bay History, Physical Environment and Marine Ecological Characterization

Keith B. Macdonald
Richard F. Ford
Elizabeth B. Copper
Philip Unitt
Jeffrey P. Haltiner

> "... any nation concerned about its quality of life ... must be concerned about conservation. It will not be enough to merely halt the damage we've done. Our natural heritage must be recovered and restored."
>
> President George Bush
> Wetlands Policy: No Net Loss

SECTION 2

EARLY HISTORY OF SAN DIEGO BAY; PRE-1900

2.1 INTRODUCTION

Material for the historical review that follows was assembled primarily by searching the published scientific literature and technical report literature and by obtaining copies of other unpublished reports and data sets from agencies and groups involved in marine ecological research in South San Diego Bay. In addition, an extensive search was made of material maintained by the San Diego Historical Society, the Scripps Institution of Oceanography Library, the San Diego Museum of Natural History and other sources to obtain unpublished reports, newspaper articles and other documents pertinent to the topic.

Several of these sources were particularly useful in the preparation of this review because they contain extensive historical and then current summaries of qualitative and quantitative information about environmental conditions and living marine resources of South San Diego Bay. These include San Diego Regional Water Quality Control Board (1952, 1966a-b, 1978), Newman (1958), Parrish & Mackenthun (1968), Ford (1968), Mackenthun (1969), Federal Water Pollution Control Administration (1969), Ford et al. (1970, 1971a-b, 1972), Ford & Chambers (1973, 1974), Browning et al. (1973), Peeling (1975), Kellogg (1975), San Diego Unified Port District (1976a, 1980), McGowen (1977), San Diego Gas & Electric Co. (1980), Lockheed (1979a, 1981a), Merino (1981), and Hoffman (1986). All of the pertinent references assembled as part of the historical review are considered in the text and listed in the consolidated bibliography at the end of Volume III.

2.2 SAN DIEGO BAY, PRE-1900

Very little documentation exists on the environmental conditions and living marine resources of south San Diego Bay prior to the 1950's. However, it is useful to consider earlier accounts which apply to the entire bay. Before the Spanish established the first permanent settlement on northern San Diego Bay in 1769, the bay waters and their marine habitats existed in a natural state except for what probably were limited effects of food gathering by the Indians. Most of the shoreline of the bay was bordered by extensive tidal mudflats and salt marshes. Presumably the only major perturbations at that time came from flood waters laden with silt and clay which entered the Bay through the San Diego, Sweetwater and Otay River systems, Las Chollas Creek, and other smaller water courses (Browning et al. 1973). The primary effects of these brief, infrequent flooding events on marine habitats would have been the same then as today (San Diego County Flood Control District 1980, Lockheed 1981a). Water salinity would have been reduced and turbidity increased for periods of days or weeks. These effects would have been more significant in South San Diego Bay because of its less efficient tidal circulation. The result would have been the temporary loss from the affected areas of marine species with limited tolerances for low salinity and high turbidity, just as occurs in estuarine systems today. Deposition of floodwater borne sediment would have changed the depth and extent of intertidal and subtidal marine habitats, as well as their specific sediment characteristics. Such changes would, in turn, have altered the species composition of the marine communities present in the area. These are, of course, natural ecological processes which take place in all estuarine systems.

Under such natural, pristine conditions San Diego Bay undoubtedly supported a very rich and abundant invertebrate and fish fauna in its benthic and open water habitats (Browning et al. 1973). The first account of fishing in San Diego Bay was recorded in the Juan Cabrillo log of September

28, 1542 (Davidson 1951). On that night sailors from the first european ships in California waters went ashore on Point Loma or North Island "to fish with a net". The Sebastian Viscaino record of 1602 (Davidson 1951) says of San Diego Bay: "It has very good water, many fish of all kinds, of which we caught many with seine and hooks." Later, the same record describes the visit by local Indians (Davidson 1951):

> "Viscaino and the others received them with much pleasure and, beside many other things, gave them fish which had been caught in their presence with a net. The Indians came every third day for biscuits and fish, bringing in return skins of martens, wild cats and other animals. There are in this harbor many white fish, sea fish, oysters, clams, lobsters, crabs and sardines."

During the century following the first settlement in 1769, human activities along the shoreline of outer (northern) San Diego Bay increased significantly (Browning et al. 1973). By the late 1700's San Diego Bay was an active harbor for Spanish vessels transporting animals, hides and supplies to the newly established Presidio and to the system of missions (Bentley 1961; Figure 4). In the early 1800's the whaling industry off California began to expand and by 1892 San Diego Bay was a processing and shipping center for whale products (Hoffren 1960, Federal Water Pollution Control Administration 1969, Holland 1969, Walker 1964). By the time San Diego became part of the United States in 1846, the population was only 500.

These human activities undoubtedly were accompanied by the uncontrolled discharge of a variety of wastes into the northern bay (Browning et al 1973). However, apparently this had limited effects on natural bay habitats and marine resources because tidal flushing was adequate to remove such relatively low levels of waste discharge. In addition, adverse ecological effects probably were limited because the human population of San Diego continued to remain small and the capacity for developing the shoreline was restricted by the lack of heavy machines necessary for large scale alteration of mudflat and salt marsh habitats (Browning et al. 1973).

The configuration, bathymetry and natural marine habitats of San Diego Bay and adjacent Mission Bay to the north in 1856 are shown in Figure 5. At this time the entire bay supported approximately 2,674 acres of intertidal salt marsh and 4,057 acres intertidal of mudflats. It is evident from the 1859 chart that the natural habitats of South San Diego Bay remained essentially undisturbed at this time, closely resembling those of the central portion of the bay and the area of the northern bay opposite the San Diego River entrance, shown in early lithographs such as that reproduced by Garcia (1975). Effects of human activities on these natural habitats in South San Diego Bay continued to be of a limited nature for a longer period of time than for the northern and central portions of the bay, where initial development as concentrated.

This development started in 1850 with the construction of a "T" wharf near the present position of Pacific Highway and Market Street. Thus began the era of "mudflats and long-legged wharves", which is illustrated with early photographs and described by MacMullen (1969) and Brandes (1981). It seems very likely that pier construction out over the natural mudflats, with little associated dredging or filling, had only limited ecological effects on those mudflat habitats. However, the close proximity to human activity and associated pollutants undoubtedly would have had adverse effects on some species.

During the 1800's natural processes caused changes in the course of the San Diego River, which flowed alternately into both San Diego and Mission Bays (Figure 5). By 1877 a dike was built which permanently diverted flow from the river entirely into Mission Bay (Rambo & Speidel 1969, U.S. Army Corps of Engineers 1974). This presumably changed the character of the mudflat and salt marsh habitats around the former river mouth into San Diego Bay. Disposal of domestic wastes into San Diego Bay through the first rudimentary collecting system began in 1887 (San Diego Regional Water Quality Control Board 1985). The influences these events had on marine resources were never documented.

Living marine resources apparently continued to flourish in San Diego Bay during the late 1800's. Results of marine biological studies by Professor Carl H. Eigenmann, conducted in part from the research vessel "ALBATROSS" in 1888-1889 (see, for example, Gilbert 1890, 1891), were reported briefly in a leaflet which contains quotations attributed to the U.S. Commission of Fish and Fisheries (1889). It appears that the leaflet itself may have been produced and distributed by the San Diego Chamber of Commerce. This leaflet contains the following quotation from Eigenmann's work, and provides a concise description of fish species and the fishing industry of San Diego Bay in the 1880's. The scientific species names, but not the common names, in the quotation have been updated to those currently in use to avoid confusion:

> "A discussion of the advisability of establishing a big fishing industry does not properly belong here. The Cortez banks alone, or the bay fisheries alone, would not justify the establishment of a large concern. These, however, are not the sole fishing grounds of San Diego. If the fishes of the bay as they run in are taken in their season, together with the barracuda, mackerel, etc., which also are here only at certain seasons, and the permanent rock cod fisheries of the banks skirting the shore, those about the islands and those of the Cortez banks, an industry may be established whose practical limits can only be ascertained by experience.
>
> The past year I have been interested in observing the spawning habits and seasons, the embryology, rate of growth and season of the fishes of southern California. The results of these observations properly belong to a scientific publication. It has been thought best, however, to anticipate somewhat and give here what may be of economic value, in view of the permanent establishment of a fishing company at San Diego.
>
> There are known to be 142 species of fishes belonging to the San Diego fauna, inclusive of the Cortez banks, thirty-two of which have been added since last December.
>
> The following account of the most important of the food fishes may prove of interest:
>
> The ladyfish (<u>Albula</u> <u>vulpes</u>) is sparingly found in the bay throughout the year. It is of little use for food, but has a ready sale on account of its shape, bright silvery color and clean look.
>
> The herring (<u>Clupea</u> <u>harengus</u>) enters the bay during the winter. It is caught with gill nets. It is sufficiently abundant to be of considerable importance, but only enough to supply the home market are now caught.
>
> The sardine (<u>Sardinops</u> <u>sagax</u>) is very abundant in the bay in winter and spring. Bushels of these fish are sometimes left at high tide in the small pools surrounding the piles of the Santa Fe wharf. The young remain in the bay the whole year; the full grown ones run in the bay in winter and

spring only. They are said to be of excellent flavor. No use is made of them at present. They are here in such quantities during their season that canneries would certainly pay.

The anchovies (Anchoa delicatissima, A. compressa, and Engraulis mordax). These fish are of the greatest importance, furnishing food for most of the large fish of the bay. The first is caught in quantity and dried by the Chinese. It does not exceed three or four inches in length. The last (E. mordax) looks somewhat like the sardine, and is said to be canned as such farther north.

The mullet (Mugil cephalus) is always found in the bay, never in great abundance. It is highly prized, finding ready sale at top prices.

The bottom smelt (Atherinopsis californiensis) is, during winter and spring, the most abundant and most important of the food fish. It averages three-quarters of a pound in weight and brings a high price.

The top smelt (Atherinops affinis) is found in the bay throughout the year. It is very abundant, but not of so good flavor as the bottom smelt.

The barracuda (Sphyraena argentea) is one of the most important of the food fish. It rarely enters the bay and is not found here in winter. It reaches a weight of eight or ten pounds. The quantity caught varies greatly from day to day in accordance with the wind. The greatest number caught by two men in one boat in a day was 1100. They can only be caught by trolling, and a light wind brings few fish. Many barracuda are now salted and shipped. During July and August they are most abundant. The barracuda fisheries are certainly not carried on to their full extent.

The mackerel (Scomber japonicus) is found here during the whole year. It is especially abundant during the summer and fall, and fishermen report many schools of several hundred barrels each. At present nets are not used, and it is but sparingly caught. The young, or tinkers, run in the bay in great quantities.

The spanish mackerel (Scomberomorus concolor) is common during the winter. It does not enter the bay.

The bonito (Sarda chiliensis) is abundant throughout the year. Many are dried at La Playa.

The yellow tail (Seriola dorsalis) is common during summer and fall. It attains a weight of twenty-five pounds.

The pompano (Peprilus simillimus) is present during the latter part of the summer and fall. Few are caught with seines, but many are caught off the wharves. In San Francisco this fish sells as high as $1.25 per pound.

The bass (Paralabrax chathratus, P. maculatofasciatus, P. nebulifer). There are three species of bass in the bay and from their size, abundance and

> permanence they are very important fishes of the bay. They are named in the order of their abundance.
>
> The jew fish (Stereolepis gigas) reaches a weight of three hundred pounds. It is abundant wherever white fish are found and is frequently brought to the market in winter.
>
> The China croaker (Roncador stearnsii) is common both in the bay of San Diego and False Bay (i.e., now Mission Bay). It reaches a weight of five or six pounds.
>
> The common croaker (Cheilotrema saturnum) is related to the China croaker and is equally abundant.
>
> The yellow fin (Umbrina roncador) is related to the preceding two and is abundant.
>
> The trout (Atractoscion nobillis and Cynoscion parvipinnis). Two distinct species are called trout by the fishermen. They enter the bay in the summer and are frequently brought into the market. The first reaches a length of five feet and these large ones are occasionally caught outside during the winter.
>
> The perches or surf fish. By these terms are meant all of the species of the family Embiotocidae, of which there are eleven about San Diego. They are the coarsest of the smaller fishes, and are brought into the market every day. Most of them are very abundant in the bay. All bring forth their young alive.
>
> The fat head (Pimelometopon pulchrum) is very common in shallow rocky places outside the bay. It is rarely brought into the market, being a second or third-class fish. On account of its size and abundance it is a fish of some importance. Many are dried at La Playa during the winter and spring."

It is important to note that the two "trout" species mentioned in Eigenmann's account are not trout as the term is used today; they are the white seabass and shortfin corvina, respectively, both members of the croaker family. Fishery catches of the white seabass have declined markedly over the past 20 years, but juveniles and small adults of this species still inhabit both South San Diego Bay and the outer bay. The other "trout" species, the shortfin corvina (Cynoscion parvipinnis), is now considered uncommon in California waters (Miller & Lea 1973).

Eigenmann (1892a-b) and Eigenmann & Eigenmann (1890, 1892) reported on at least 56 species of fishes collected from San Diego Bay in sampling during the late 1800's. At the present time 80 to 90 species of fishes are known to occur in the bay, of which at least ~~67 species occur in~~ South San Diego Bay (Ford 1968, Peeling 1974, Lockheed 1979, San Diego Unified Port District 1980a, 1980b, San Diego Gas & Electric Co. 1980, Hoffman 1986). Following recovery of the bay from severe effects of sewage pollution after 1963, almost all of the species originally described from the bay by Eigenmann have become re-established there. Unfortunately, we have no basis for comparing the relative abundances of these species between the 1980's and the 1880's. It seems very likely that all or nearly all of the 80-90 species now known to inhabit San Diego Bay were present there in the 1800's, their absence in Eigenmann's samples simply reflecting the limited amount of collecting he did.

Newspaper accounts of the late 1800's and early 1900's indicate that recreational fishing for finfish and shellfish was good throughout the bay. Coons (1988) describes brief accounts of fishing in southern and central San Diego Bay which appeared in issues of the San Diego Union and the Record during the 1880's. These included accounts of spearing large numbers of Pacific mackerel (Scomber japonicus) from the Santa Fe Railroad Wharf and an "invasion of sharks" in the South Bay, so many that sailing was hindered. These newspaper articles also mention the capture of skates, sea turtles and octopus in the South Bay area. Springer (1961) described his own experiences as a school boy in the early 1900's fishing from the Spreckels Coal Bunkers Wharf at the foot of F street in San Diego:

> "What did we catch in the bay? Well, sardines, smelt, sculpin, sea trout, halibut, flounders; you name it, we caught it. Yes, crabs, lobsters, even octopus. One thing I can remember were the gars - long slim fish that stayed right on the surface, depending on speed to keep away from anyone trying to catch them."

The sea trout Springer described were species of croakers, possibly Atractoscion nobilis and Cynoscion parvipinnis. The "gars" may have been California needlefish (Strongylura exilis or, less likely, California barracuda (Sphyraena argentea). The halibut undoubtedly were the California halibut (Paralichthys californicus) and the flounders presumably were the diamond turbot (Hypsopsetta guttulata) and the spotted turbot (Pleuronichthys ritteri).

Following the original 1856 edition, the next detailed San Diego Bay chart was drawn up by the U.S. Coast and Geodetic Survey in 1902 (Figures 6 and 7). While considerable development had occurred over this 46-year period, the tideflats and salt marshes that surrounded the bay (as well as Mission Bay to the north and Tijuana River Estuary to the south), still remained relatively undisturbed. Comparison of the 1856 and 1902 maps indicates that saltmarsh and intertidal flat mudflat acreages declined (by approximately 100 acres and 545 acres, respectively) while increases in very shallow (0 to 6 ft MLLW) subtidal habitats and salt marsh acreage at the mouth of the Sweetwater River and on Dutch Flats (the former mouth of San Diego River) were offset by losses due to development on the former San Diego River delta and initiation of the South Bay Salt works. Tideflat changes reflected natural bay sedimentation and nearshore dredging for increased harbor activities.

3.2 SEWAGE AND INDUSTRIAL POLLUTION

The general increase in human activity beginning in the early 1900's also saw a marked increase in use of San Diego Bay for disposal of waste materials. Both municipal sewage and a variety of toxic and nontoxic industrial wastes were discharged into the bay in untreated form from many shoreline outfalls (San Diego Regional Water Pollution Control Board 1952, Federal Water Pollution Control Administration 1969, Browning et al.. 1973). Sewage, petroleum products and other wastes were also discharged from most military and commercial vessels using the bay.

Until the 1930's the main industries were those involving food and food production. Fishing and fish canning were the most important of these. Olive and pimento packing was also an important food processing industry. The untreated wastes from these industries usually entered the bay either through the city sewers or through many separate industrial outfalls. Waste from meat packing houses and that from citrus by-products also went into the bay or its tributary streams. Efforts were made to deal with noxious wastes and pollution problems as a whole, although usually the problems were handled by each individual company (San Diego Regional Water Pollution Control Board 1952). Bacteriological sampling in San Diego Bay was conducted by the City of San Diego in 1924 and again in 1940. (San Diego Regional Water Quality Control Board 1985.) As described by the San Diego Regional Water Pollution Control Board (1952), the number of sewer systems and outfalls increased until by 1941 there were more than 26 sewage outfalls serving the San Diego area, at least 15 of which emptied into San Diego Bay. These included separate outfalls from National City, Coronado, Chula Vista and various military installations.

The older of the two Chula Vista sewage outfalls was located at the foot of G Street. According to Layden H. Delaney, Executive Officer of the San Diego Regional Water Quality Control Board (pers. comm. 1989), the outfall was first placed in service in 1926 as the terminus of the first Chula Vista sewage collector system. From that time until 1943, untreated sewage was discharged into South San Diego Bay through the G Street outfall. In 1943 an Imhoff tank with a separate sludge digester was added to provide primary treatment. Secondary treatment of sewage effluent was initiated at the G Street plant in 1948 (Layden Delaney, pers. comm. 1989). By the early 1950's, the old Imhoff tank was primarily handling waste water and domestic sewage from industries in the vicinity of the Rohr Aircraft complex (California Department of Public Health 1951). The sludge from settling tanks or septic tanks, as well as that from the Imhoff tanks serving National City and the G Street outfall in Chula Vista, was usually pumped directly into the bay on high tide. Deterioration of water quality from this and other sources began to pose truly serious problems by the mid 1930's.

With the availability of W.P.A. and P.W.A. funds, plans were made to intercept the entire sewage of San Diego proper and treat it by clarification and chlorination at one plant. Waste from National City and La Mesa was also to be treated at the plant. (San Diego Regional Water Pollution Control Board 1952.) This new treatment plant was in operation by 1943, but was overloaded almost from the start because of the great boom in population and activity during WWII. A larger sewage treatment plant on Harbor Drive was completed in 1950. A second, larger Chula Vista sewage treatment plant was put into operation near the foot of J Street in 1949. It consisted of primary and secondary "oxidizers" with separate sludge digestion. Both the raw sewage and the final effluent were chlorinated (California Department of Public Health 1951). It was of essentially the same design as the newer San Diego plant on Harbor Drive (Dennis O'Leary, former Executive Officer of the San Diego Regional Water Quality Control Board, pers. comm. 1989). During this entire period the older Chula Vista sewage treatment plant near the foot of G Street and that in Coronado continued in operation.

The locations of these and other major point sources of waste effluent in San Diego Bay during the early 1950's are shown in Figure 16. As indicated in this figure, the primary, direct sources of pollutants entering South San Diego Bay at that time were the two shoreline outfalls of the Chula Vista sewage treatment plants, which discharged disinfected intermediate effluent, and those of the adjacent aircraft manufacturing industries which discharged untreated, highly toxic chemical wastes (San Diego Regional Water Pollution Control Board 1952). These sources of pollution undoubtedly had the most direct effects on the marine environment and organisms of inner San Diego Bay.

Unfortunately, most of the specific history of these increasingly serious water pollution problems in San Diego Bay, and particularly of their effects on living marine resources, are very poorly documented from a scientific standpoint. In fact, almost all of the systematic gathering of information on the problem took place after the San Diego Regional Water Pollution Control Board was established in 1950.

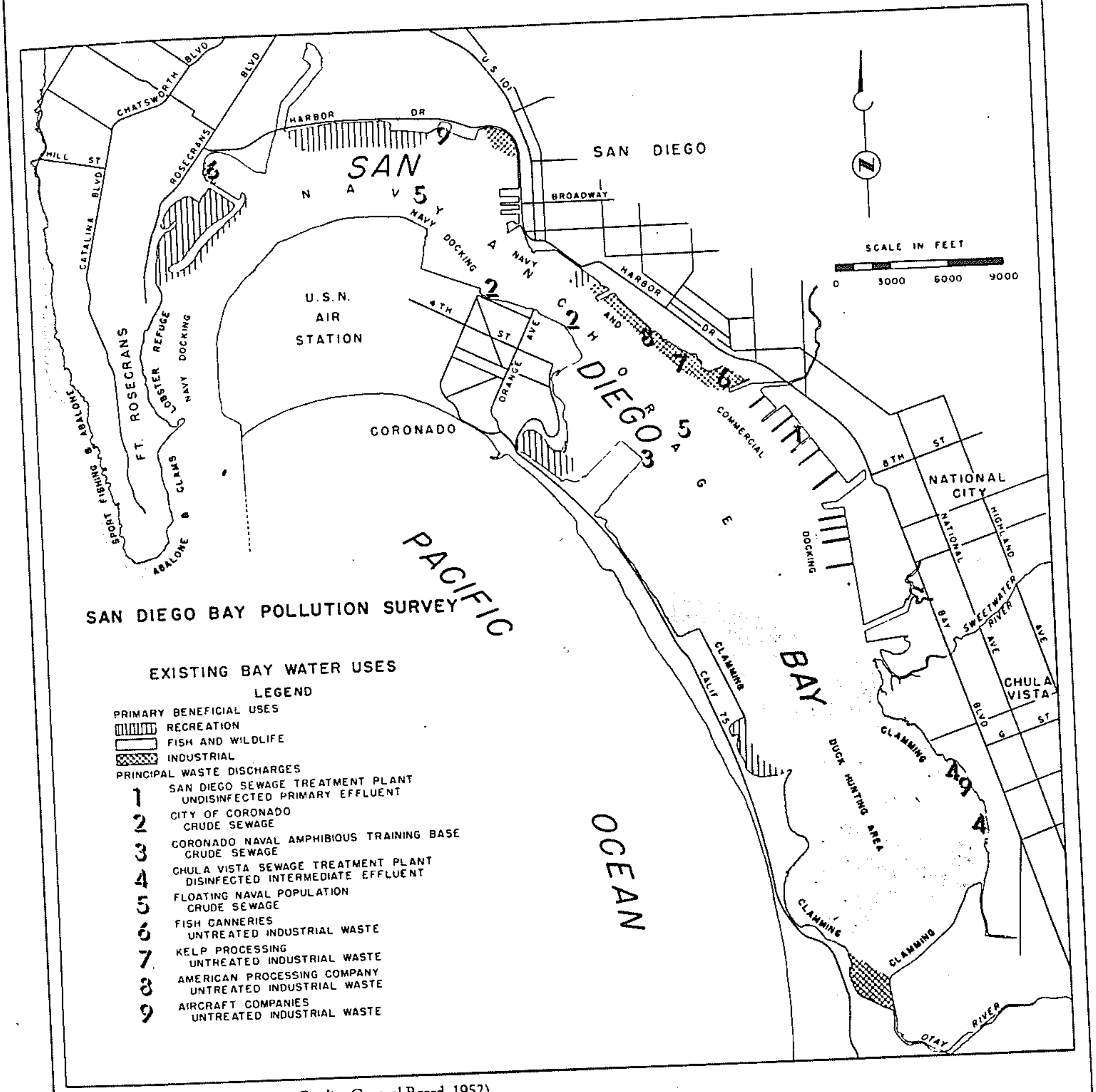
The new Board's efforts led to a series of studies on the physical and chemical problems produced by sewage and industrial effluents in the bay. The results of these studies are described primarily by California Department of Fish and Game (1951), California Department of Public Health (1951), Miller & Nusbaum (1951), San Diego Regional Water Pollution Control Board (1952, 1954), Newman (1958), Marine Advisers (1961, 1962, 1963), San Diego Regional Water Quality Control Board (1966), and Federal Water Pollution Control Administration (1969). Another relevant study by Lackey & Clendenning (1965) conducted during this period concerns the ecology of the microbiota in San Diego Bay.

Typical distributions of dissolved oxygen concentrations and coliform densities within San Diego Bay in 1951 are shown in Figures 17 and 18, respectively (San Diego Regional Water Pollution Control Board 1952). From 1951 to 1955, all of the central area of San Diego Bay and portions of its northern and southern areas had dissolved oxygen concentrations lower than 4 mg/L, which is unacceptable by present standards and lower than levels considered necessary to support most fishes and many invertebrates. Coliform bacteria counts during that period were usually in excess of 10 mpn/ml.

Water quality in the bay had continued to deteriorate while planning was underway on the new Metropolitan Sewage System. In late 1954, the Board completed another study of the pollution problem. This study documented the conditions and revealed that the turbidity and discoloration of the bay waters were not caused directly by the sewage effluent, but by blooms of marine phytoplankton, stimulated by nutrients in the discharges (San Diego Regional Water Quality Control Board 1954, 1985, Marine Advisers 1962). During the summer months severe red tide blooms caused by eutrophication existed throughout most of the bay. This evidence convinced the Regional Board that even secondary treatment and a high degree of disinfection of the treated effluent were inadequate to prevent pollution in San Diego Bay.

By 1955, the State Board of Public Health and the San Diego County Department of Public Health had declared much of the bay contaminated and in December 1955 posted quarantine and warning signs along the Coronado shoreline. By 1956 algal blooms became persistent, sometimes turning water in almost the entire bay red (San Diego Regional Water Quality Control Board 1985).

Although emergency chlorination programs in 1956 reduced coliform levels almost immediately, by 1960 water quality had again deteriorated; a greater portion of the bay was quarantined and all water contact activities were prohibited (Federal Water Pollution Control Administration 1969).



(Source: San Diego Regional Water Quality Control Board, 1952)

South San Diego Bay: Major Waste Effluent Sources And Beneficial Uses, 1951

16
Figure No.

Even under these restrictions, conditions in 1963 were as poor as those prior to the 1955 chlorination (San Diego Regional Water Quality Control Board 1966a). At this time, 56 million gallons per day (mgd) of domestic waste was being discharged into the bay (Federal Water Pollution Control Administration 1969) and the dissolved oxygen levels were still lower than 4 mg/L in 80% of its area (San Diego Regional Water Quality Control Board 1966a). This depression in dissolved oxygen concentrations resulted in the virtual disappearance of bait and game fish from the entire bay (San Diego Regional Water Pollution Control Board 1952). California Department of Fish and Game officials declared that much of the bay was a virtual "marine desert" (San Diego Regional Water Quality Control Board 1985).

Occasionally, water clarity was reduced by turbidity to secchi disk extinction depths of less than 0.3 m., and the color of the water remained various shades of green, red, and brown. Sludge beds along the eastern shore of the bay were 26,900 ft in length, 590 ft in width, and increased in thickness from 3 to 7.5 ft during the period 1951-1963 (Newman 1958, Marine Advisers 1961, Federal Water Pollution Control Administration 1969).

In their initial study of the effects of sewage pollution on marine life of the bay, California Department of Fish and Game (1951) reported that all benthic invertebrates were absent from sludge beds examined in South San Diego Bay and in other areas of the bay. Newman (1958) reported finding some benthic organisms, primarily polychaete worms, associated with this sludge in 1958. California Department of Fish and Game (1951) concluded that enough soft bottom areas in the bay, particularly in the southern and southwestern portions, were outside the direct effects of sewage effluent and sludge so that the existing soft bottom fauna would not be eliminated. The later study by Newman (1958) seemed to confirm this.

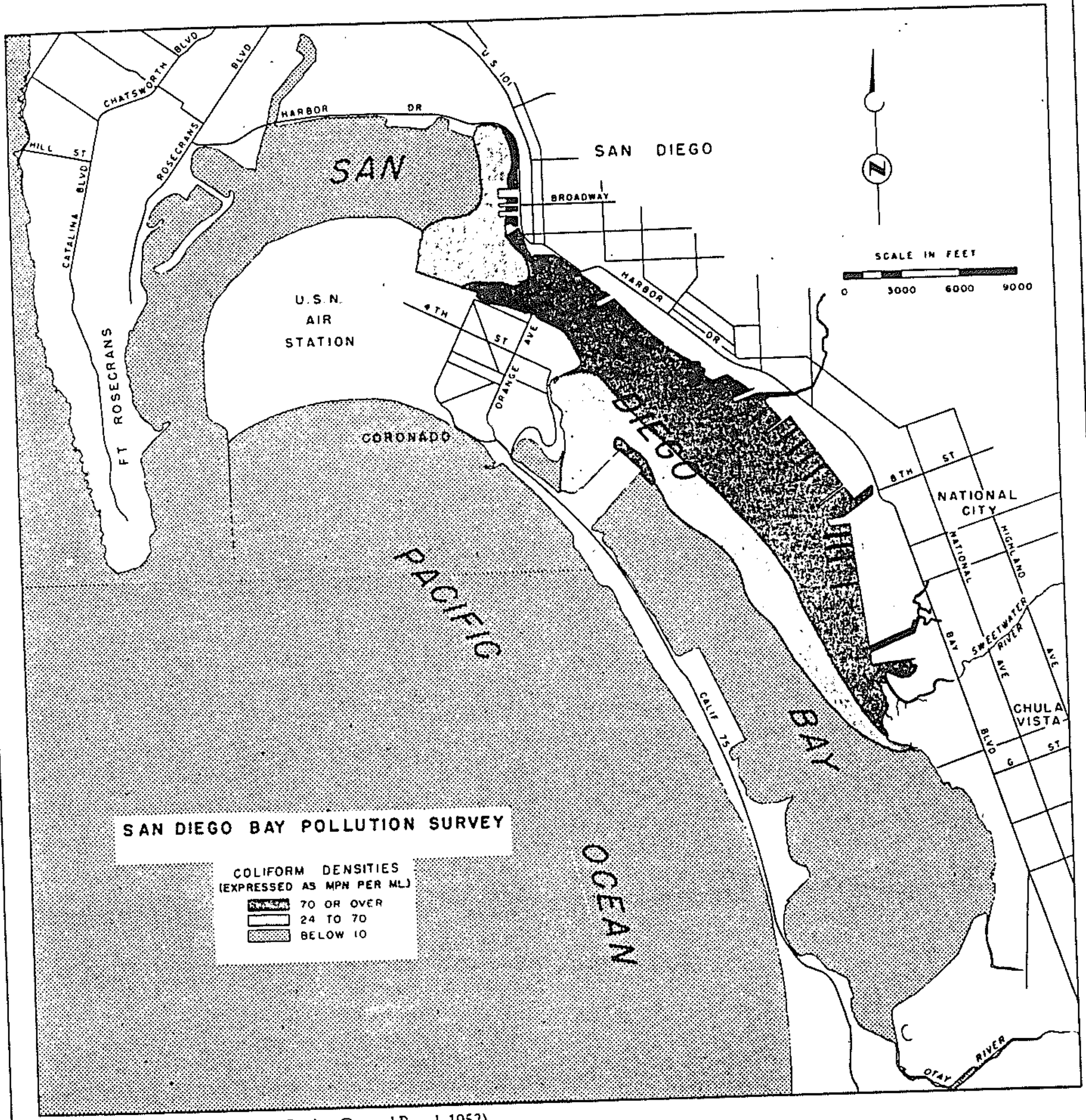
Unfortunately, none of these biological studies was detailed enough to determine what the true species composition, abundances or distribution patterns of this "existing soft bottom fauna" were during the period of heavy sewage pollution. Dennis O'Leary (pers. comm. 1989), recalled that no more detailed marine biological studies of these problems were conducted during this period because the pollution effects were so obvious. Data reported by Newman (1958) for both the inner and outer areas of San Diego Bay indicate that both the species composition and biomass of the benthic invertebrates found were very low compared to those of unpolluted bay floor communities and to those of communities present in South San Diego Bay after 1967 (Ford 1968, Ford & Chambers 1973, 1974, Lockheed 1977).

The following quotation from the San Diego Regional Water Pollution Control Board (1952) provides a good summary of the level of knowledge about the ecological effects of this pollution problem:

> "San Diego Bay is not an important food clamming area, but clamming occurs at several large beds of cockle clams located in the South Bay area where they are exposed to bacterial contamination.
>
> The low dissolved oxygen concentrations which are to be found in the bay, and the pollutional load discharged over many years, has so changed the flora and fauna of San Diego Bay that few fish of direct value are still found therein. As previously indicated, it is felt that the bay is extensively utilized by all the important forage species of fish and that it is one of the principal spawning areas for top smelt and herring, and serves as a nursery for the small species of marine fish which are important to the sports and commercial fisheries. The Department of Fish and Game experience in

> similar situations indicates that a normal fisheries environment cannot be created in marine estuaries unless the dissolved oxygen is maintained above the 4.0 ppm level. The presence of low dissolved oxygen concentrations and the effect on the fauna of the South Bay have unquestionably affected this area's suitability for migratory game birds."

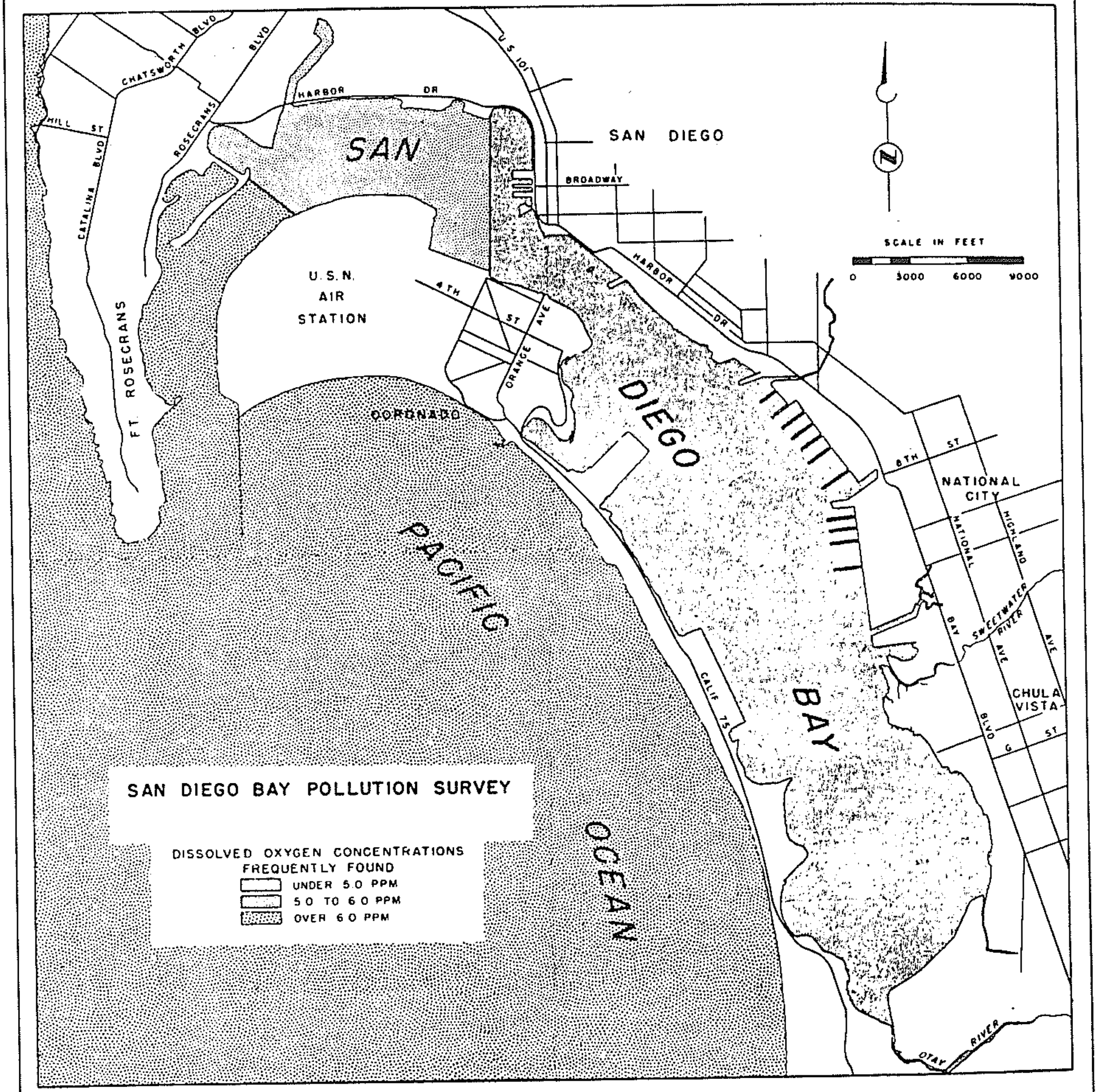
The information shown in Figure 16 suggests, perhaps over-optimistically, that in 1951 at least some of the South Bay was still considered viable for fish and wildlife and for clamming. While marine life on the western side of the South Bay (Figures 16-18) probably was less severely affected than that elsewhere, the adverse ecological effects of both sewage and industrial pollution in this area of the bay were still very significant ones. These undoubtedly included the effects of pollutants transported into the area from the central and outer bay by tidal exchange, together with the substantial direct effects of effluent from the two Chula Vista sewage treatment plants and metal processing wastes containing cyanides, hexavalent chromium, and other highly toxic materials from the Rohr Aircraft plant complex along the Chula Vista bayfront (Figure 16). The latter toxic industrial wastes may have had particularly severe effects along the Chula Vista shoreline of the South Bay, because during low tides they flowed across several hundred feet of tidal flats and thus did not undergo any dilution at the outfall (San Diego Regional Water Pollution Control Board 1952).



(Source: San Diego Regional Water Quality Control Board, 1952)

South San Diego Bay: Typical Coliform Densities, 1951

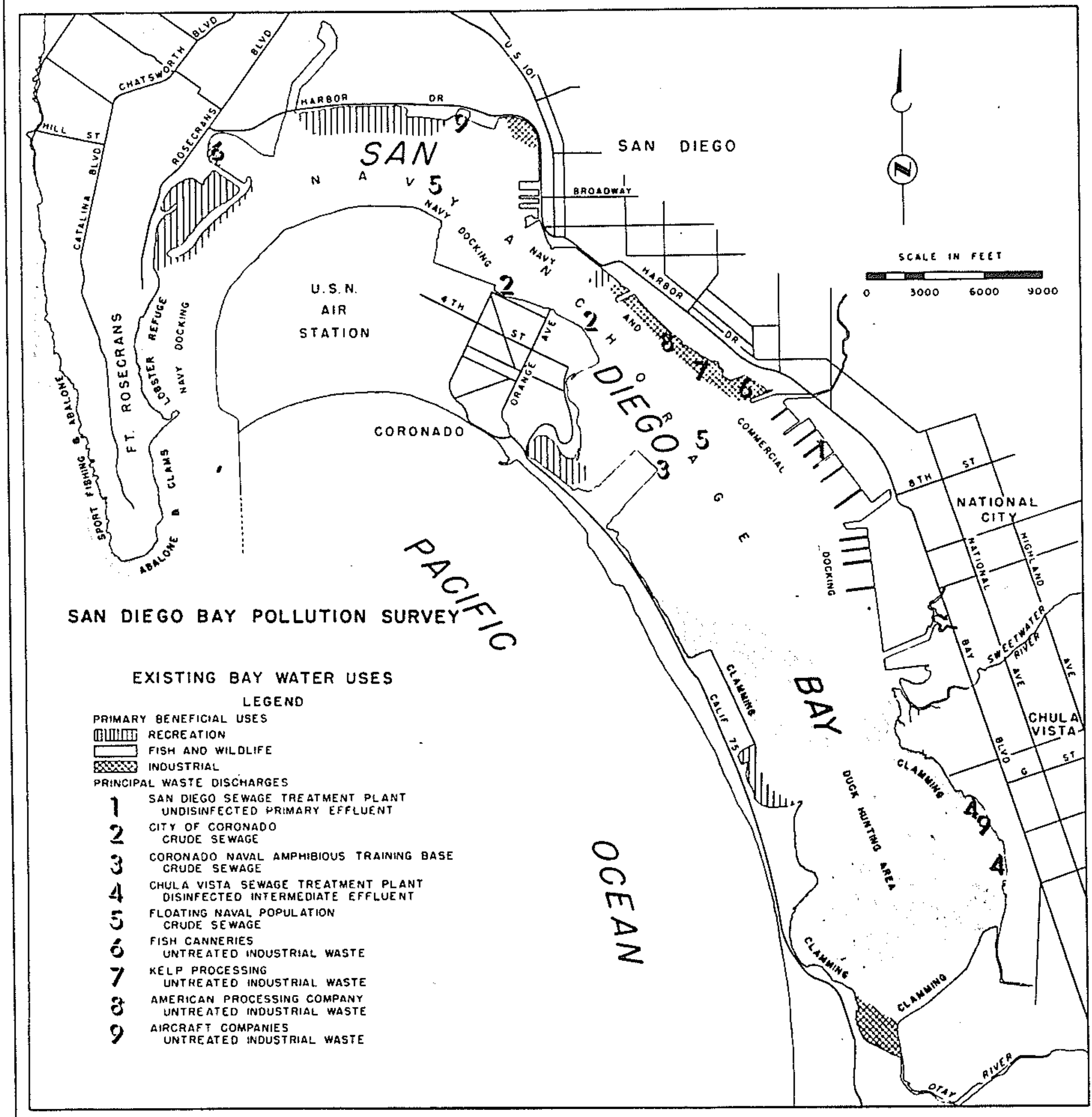
18
Figure No.



(Source: San Diego Regional Water Quality Control Board, 1952)

South San Diego Bay: Typical Dissolved Oxygen Concentrations, 1951

17
Figure No.



(Source: San Diego Regional Water Quality Control Board, 1952)

South San Diego Bay: Major Waste Effluent Sources And Beneficial Uses, 1951

Figure No. 16

4.2 SOUTH BAY POWER PLANT COOLING WATER

Much of the quantitative ecological work on marine environmental conditions, habitats and associated organisms in South San Diego Bay was stimulated by the need to learn more about physical and ecological effects caused by operation of the cooling water system of the San Diego Gas and Electric Company South Bay Power Plant. The three primary problems considered by different studies were: (1) adverse effects of thermal effluent on the adjacent habitats and their biota; (2) mortality due to impingement and trapping of fishes and larger invertebrates at the intake screen area of the cooling water system; and (3) mortality due to entrainment of ichthyoplankton and invertebrate plankton in the cooling water system.

INPUT SECT II OTHER SOURCE POLLUTION

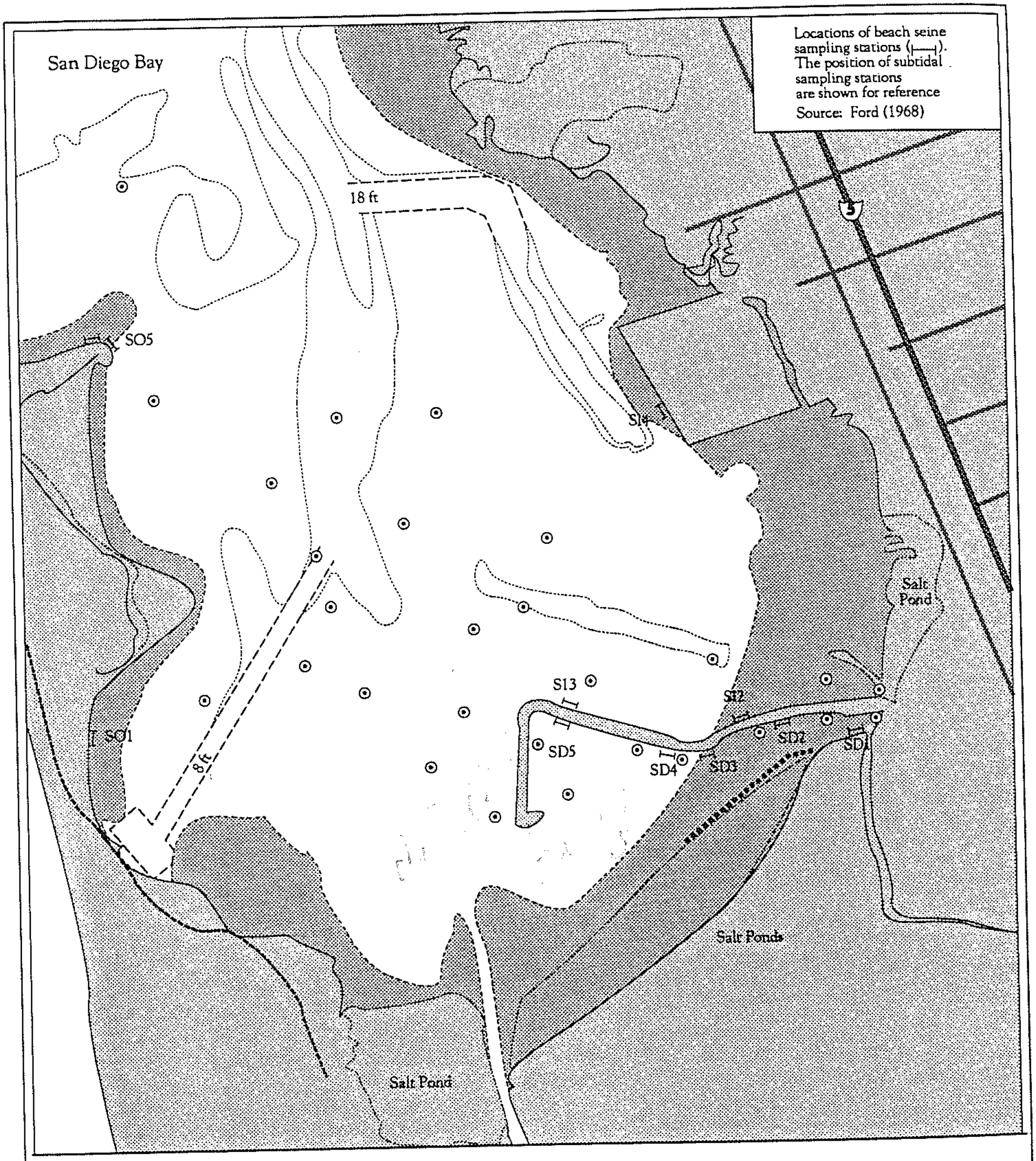
In the summer of 1960 the San Diego Gas & Electric Co. began operation of this fossil fuel generating station near the inner end of San Diego Bay approximately 14 miles from the bay entrance (Marine Advisers 1961). A second generating unit was added to the system in the summer of 1962 and a third in the summer of 1964 (Marine Advisers 1963, 1968, Ford 1968). Cooling water is drawn from the bay and the thermal effluent returned by way of a cooling channel, which is set off from the bay by an earthen dike, and discharges to the bay at a point approximately 2,000 yards from the power plant, as shown in Figure 19. With those three original generating units in operation, the maximum extent of the thermal discharge was confined to a radius of approximately 1500-2000 yards (1370-1830 m) from the outer end of the cooling channel, with its extent varying markedly both seasonally and in relation to the tidal cycle (Marine Advisers 1968, Ford 1968).

A larger, fourth generating unit was placed in service in August 1971. The maximum extent of the thermal plume with all four of these units operating is approximately 3,000 yards (2,740 m) from the point of discharge (Chambers & Chambers 1973).

According to Fred Jacobson of the Environmental Management Program at the San Diego Gas & Electric Co. (pers. comm. 1988), the maximum intake capacity of this generating station is now 600 mgd of cooling water. The plant operates year round, with the number of generating units in use changing according to energy demands and the availability of energy at lower cost from other sources. During peak periods of demand during the summer months, all four units are used at the same time. Only one unit is cleaned at a time, with one or more other units required for production remaining in operation (Fred Jacobson, pers. comm. 1988).

4.2.1 INITIAL STUDIES: SUMMER 1968

In July-August 1968 a large-scale pilot study by Ford (1968) was conducted for the San Diego Gas & Electric Co. in marine habitats adjacent to the South Bay Power Plant. The basic purposes of this pilot study were to develop reasonably comprehensive information about the South San Diego Bay ecosystem and the ecological effects of thermal effluent during the summer months. The specific aims of the study were to: (1) determine and evaluate pertinent oceanographic conditions, (2) characterize the distribution, abundance and feeding relationships of resident marine organisms, about which little was known; (3) assess the biological effects of the thermal plume through consideration of indicator organisms, species richness, species diversity and the relative abundance and biomass ("standing crop") of organisms; (4) assess effects of thermal effluent on fishes and other marine life of esthetic, recreational and commercial value to man; and (5) predict future biological changes that might result from an expanded discharge pattern and increased thermal load resulting from the planned addition of the larger, fourth generating unit. The location of the South Bay Power Plant and the stations at which biological samples and physical and chemical measurements were taken in July and August 1968 are shown in Figures 19 and 20.



Locations of beach seine sampling stations (├─┤). The position of subtidal sampling stations are shown for reference

Source: Ford (1968)

South San Diego Bay: Beach Seine Sampling Stations, 1968

Figure No. 20

Standard quantitative methods described by Ford (1968) were used to sample at these stations for: (1) invertebrates and plants associated with bottom sediments in shallow and deeper subtidal habitats (replicate grabs, diver transect counts and quadrant counts); (2) fishes associated with these same benthic habitats (beam trawls, diver transect counts and traps); (3) fishes associated with the intertidal habitats (seines); and (4) phytoplankton and zooplankton (Van Dorn bottle and plankton net samples). Bird censuses were also conducted, as described in the second volume of this report. Standard physical and chemical measurements of water and sediment characteristics were made at each of the station locations shown in Figures 19 and 20.

4.2.2 STUDIES DURING 1970-1971

Subsequently, two studies were conducted in August 1970 and February-March 1971 (Ford et al 1970, 1971a), using the same methods to sample benthic invertebrates and plants at 11 of the key stations employed in the 1968 study. In addition, fishes were sampled by trawling at these 11 stations during the February-March 1971 study (Ford et al. 1971a).

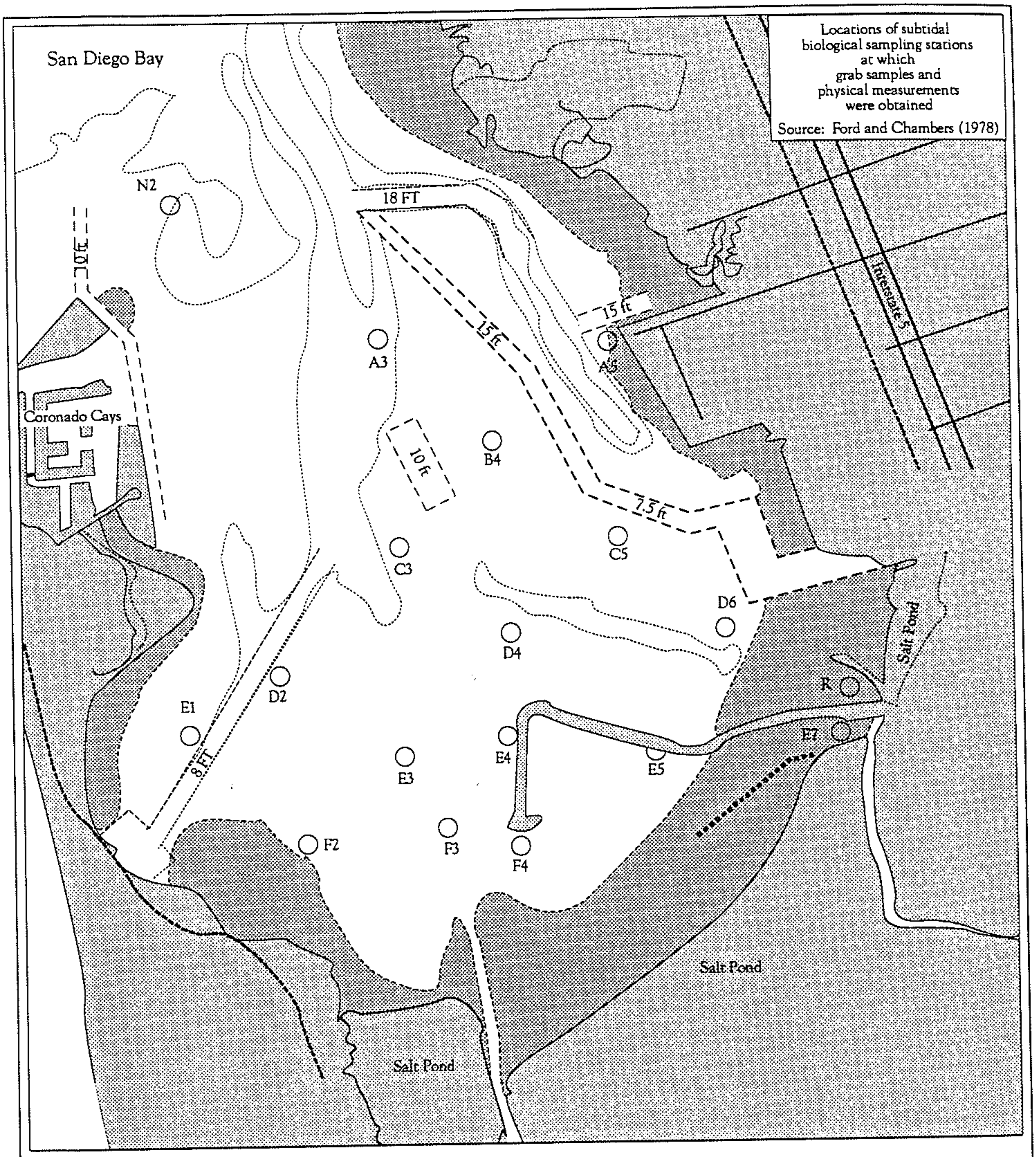
The results of these three studies during the period July 1968 - March 1971 (Ford, 1968; Ford et al. 1970, 1971a) indicated that in late summer of the two years, thermal effluent discharged from generating units 1-3 had adverse effects on marine organisms within the cooling channel, particularly within about 1,000 yards of its inner end (Figures 19 and 20). However, no significant adverse effects were evident beyond the end of this channel (Station D7) in the outer part of the discharge pattern. It also appeared that the adverse effects of thermal effluent during this initial 2.5 year study period were most severe during the high water temperature conditions of the late summer months, and diminished markedly during the winter and early spring as a function of declining ambient water temperatures and the resulting decrease in both the extent of the thermal plume and the mean temperatures at any given point within it (Ford et al. 1971a).

It is important to note in this regard that, for purposes of regulatory decisions, the cooling channel set off by the earthen dike was and still is considered to form part of the power plant discharge system, rather than a natural part of the bay. Thus, the staff of the San Diego Regional Water Quality Control Board have reasonably concluded that adverse ecological effects are allowable within all parts of the cooling channel itself.

A similar, fourth monitoring study was conducted in August 1971, just a few weeks after the fourth, larger generating unit was placed in commercial service at the South Bay Power Plant (Ford et al. 1972). The results of this study indicated that ecological effects of expanded power plant operations at that time were essentially the same as those observed during previous late summer periods in 1968 and 1970.

4.2.3 FOUR-SEASON STUDY: 1972-1973

This work was then followed by a four season study of the problem (Ford & Chambers 1973, 1974, Chambers & Chambers 1973). The benthic marine plants and invertebrates inhabiting intertidal mud flat and subtidal mud and silt bottom habitats in South San Diego Bay, their environmental conditions, and the effects on them of cooling water effluent from the South Bay Power Plant were investigated every three months during the period September 1972 - July 1973. Standardized quantitative methods of biological, physical, and chemical sampling developed in the earlier studies were employed at 18 subtidal and seven intertidal stations (Figures 21 and 22, respectively). Benthic plants and invertebrates were censused by replicate grab samples subtidally, and by replicate core samples on the intertidal mud flats.

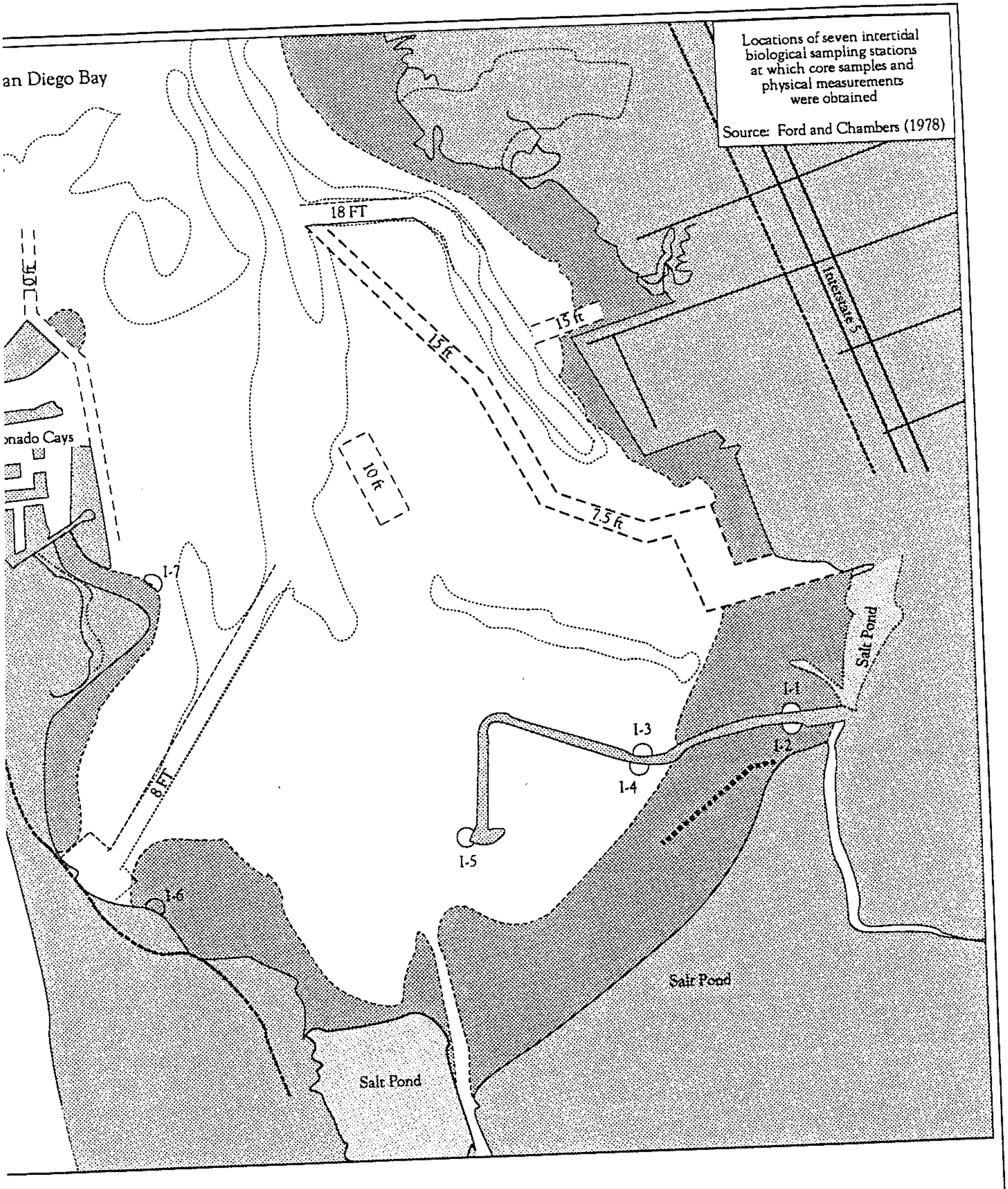


Locations of subtidal
biological sampling stations
at which
grab samples and
physical measurements
were obtained

Source: Ford and Chambers (1978)

South San Diego Bay: Subtidal Biological Sampling Stations, 1978

21
Figure
No.



South San Diego Bay: Intertidal Biological Sampling Stations, 1978

Figure No. 22

As in the pre-1972 studies, many specific lines of evidence were used to evaluate ecological effects of the thermal plume. A more comprehensive evaluation also was attempted than in previous studies of the quantitative relationships between characteristics of plant species associated with the bottom sediment, the benthic invertebrate fauna and pertinent physical environmental data, using multiple correlation analysis and statistical comparisons among stations and between years (Ford & Chambers, 1973) .

Seasonal differences in physical conditions, and primarily those of ambient and discharge induced temperature conditions of the water and sediments, were reflected by seasonal biological changes within and outside of the discharge pattern area. Evidence concerning the ecological effects of thermal effluent was obtained through specific consideration, at individual station locations and for major sectors within and outside the discharge pattern, of: (1) species composition; (2) number and diversity of species; (3) distribution, abundance and biomass of species and major groups; (4) size of individuals; and (5) the quantitative relationships of these to temperature and other environmental factors.

The results obtained indicate that the species composition of benthic plant and invertebrate associations remained moderately stable throughout the year in South San Diego Bay, although there were some evident seasonal changes. In general, numbers of species and densities were lowest during the warm water conditions of the late summer and early autumn months (Ford & Chambers 1973, 1974).

As in previous studies conducted in the South Bay, evidence obtained from both subtidal and intertidal sampling during 1972-1973 indicated that high temperatures caused by the thermal discharge in the late summer and early autumn, and to a lesser extent in July, had adverse effects on the numbers, diversity, and abundance of many groups of species within the cooling channel itself (Stations E5, E7, and F4 in Figure 21). However, these effects were much less obvious during the winter and spring periods when both ambient water temperatures and those within the thermal effluent plume were lower. Much the same general pattern seemed to hold for both the intertidal and subtidal areas, which also appeared to share a majority of their species in common. These adverse effects are allowable because, for regulatory purposes, the cooling channel forms a part of the discharge system for the power plant. During all seasonal periods, the adverse effects appeared to be confined primarily to the inner portion of the cooling channel.

The results of statistical comparisons between the control and outer discharge pattern areas suggested that during the late September-October period of 1972, and to a lesser extent in July 1973, the portion of the thermal plume beyond the end of the cooling channel (Station F4) apparently caused some adverse effects on the benthic invertebrates found there. This was reflected by lower numbers of invertebrate species, involving primarily polychaetes and crustaceans, and a lower number of species and of species diversity for all invertebrates combined. The trends in these values and associated trends in distribution and abundance were obvious within the station pattern. They suggested that the adverse effects detected by these tests were confined primarily to stations in the main part of thermal effluent flow beyond the end of the cooling channel. However, most of these differences were relatively small, suggesting that the adverse effects apparently were mild ones (Ford & Chambers 1974). The individual species involved were identified and their patterns of distribution and abundance described.

In contrast, the number of species which formed the plant mat on the bottom were significantly greater within the outer discharge area than the control area during this summer and early autumn period. If this represents a true difference, then it may suggest that conditions for plants during this warm water period were somewhat better within the outer portion of the thermal plume than they were beyond it. This might be interpreted as a "beneficial effect."

There were no statistically significant differences for numbers and diversity of species between the outer discharge and control areas in either January or April 1973. This suggested strongly that the adverse effects described above were confined only to the summer and early autumn period of high ambient and effluent water temperatures. During the cooler winter and spring periods, no such adverse effects on the number or diversity of species apparently occurred.

As in the studies of 1968-1971, numbers of species, indices of species diversity and abundances for several invertebrate groups sampled during the September-October (1972) and January (1973) periods showed significant inverse (negative) correlations with the temperatures of the sediment and the water (Ford & Chambers, 1973). The number of individual groups which showed such correlations was reduced during the January and April (1973) sampling periods of lower water temperatures. However, as for the earlier seasonal periods, the total number of invertebrate species continued to show these inverse correlations. These correlation results further indicated that, with the exception of sediment characteristics, no other physical factors considered had significant relationships to number and diversity of species, and abundance, of the kind shown for these effluent temperature characteristics. This tended to confirm that there were, in fact, meaningful temperature effects on these biological characteristics, rather than ones involving some other physical variable separately or in parallel with temperature. The fact that sediment grain size and chemical characteristics were relatively uniform throughout the South Bay study area probably explains why there were few significant correlations with these physical variables (Ford & Chambers 1973, 1974).

Also, as in pre-1972 studies, these significant inverse correlations with temperature indicated that higher sediment and water temperatures induced by the cooling water effluent had adverse effects on several major groups of benthic invertebrates by reducing the number and diversity of species and, in a few cases, their abundances at a given location. The statistical comparisons among station groups, discussed earlier, indicated that these adverse effects were restricted primarily to the area within the cooling channel and varied seasonally. In contrast, the abundances of some major groups showed significant direct correlations with temperature (Ford & Chambers 1973, 1974).

The results of statistical comparisons suggested very strongly that there were no significant adverse effects of the thermal plume on the biomass or standing crop of nearly all major groups of organisms inhabiting the outer discharge pattern area beyond the end of the cooling channel (Figure 21). Only the biomass values of decapod crustaceans and gastropod molluscs were significantly lower in the outer discharge area than at the control stations in July 1973. This generalization applied for all of the four seasonal sampling periods. In fact, the opposite appeared to be true during the winter and spring because, in all cases where there was a significant difference, the biomass values in question were greater in the outer discharge area than in the control area. The individual groups that showed this difference in addition to benthic plants were coelenterates (primarily the small sea anemone Diadumene cf leucolena), oligochaete worms, amphipods, isopods (primarily Paracerceis sculpta), ostracods, gastropod molluscs, and the brittlestar Amphipholis pugetana. Two other major groups, the polychaete worms and bivalve molluscs, did not show such significant differences, although they showed the same trend. The specific patterns involved in these differences and trends for these major groups were described in detail by Ford & Chambers (1973, 1974).

On the reasonable assumption that the control and outer discharge area stations were similar in characteristics other than temperature, then these results concerning biomass and abundances of species seem to indicate a "beneficial" or enhancing effect of the thermal plume on these groups of marine organisms. This depends somewhat on one's viewpoint and how a "beneficial effect" is defined. In any case, the effect definitely appeared to be related to temperature conditions within the plume, and was most pronounced during the winter and spring periods of low ambient water temperatures. The most probable cause of these higher biomass values is the effect of higher temperatures in enhancing the growth rates of the organisms involved. Other possible alternative explanations for both the biomass and abundance effects proposed by Ford & Chambers (1973, 1974) are enhanced reproductive success and, less likely, the attraction of these organisms to warm water.

The biomass values for several major groups showed significant, direct correlations with temperature during each of the quarterly sampling periods. This was most pronounced during the spring (March-April 1973) period. These results provide additional evidence of a possible "beneficial" effect of the thermal plume

The results of similar comparisons between station groups suggested that, as in the case of numbers and diversity of species, the biomass of many major groups was lower within the cooling channel than in the control area, presumably because of high cooling water temperatures present there. Because the cooling channel is considered a part of the power plant discharge system, rather than a natural part of the bay, the adverse effects on biomass observed were not interpreted as adverse effects on the subtidal benthic community of the bay itself.

Comparison of data between the summers of 1968-1970 and winter-early spring 1971 (Ford 1968, Ford et al. 1970, 1971a, 1972) indicated that the biomass of the algal mat overlying the sediment was markedly reduced and the condition of these plants was poor during the later period. Many of the changes in species composition, distribution, and abundance of small bottom fishes and invertebrates dependent upon this algal mat, which were observed between these two periods, were thought to be related to the decline of the algal mat.

This apparently was caused in part by seasonal lowering of water temperatures, a natural effect that is quite accentuated in South San Diego Bay. In addition, because it is a shallow area of muddy and silty sediment and much particulate matter, it experiences high water turbidity during windy periods in the winter and spring through wind wave action. This undoubtedly caused a marked reduction in the light available to benthic plants and probably contributed to the decline of the plant mat.

A comparison of total mean biomass values for benthic plants within the station pattern suggested that these data showed somewhat greater variation among stations during 1972-1973 than during 1968 and 1971. Statistical analysis used to determine if plant biomass differed significantly between the September-October, January, April and July sampling periods of 1972-1973 showed a significant difference due to lower values in July 1973. This suggested that the type of major seasonal change in the mat observed in 1968-1971 had not occurred during 1972-1973. Without additional, specific information on water turbidity and other factors, it would be difficult to assess the cause of this apparent difference between years. However, it is quite possible that seasonal changes in the algal mat may vary from year to year (Ford & Chambers 1973, 1974).

In general, the intertidal invertebrates showed trends which paralleled those of the very similar subtidal community. Analysis of the intertidal data was hampered because of the very limited numbers of stations and their placement. The difficulty of obtaining an adequate group of representative samples from this habitat, because of the soft, cohesive nature of the sediment, further compounded the problem. For these reasons, intertidal sampling was not continued beyond the April 1973 sampling period (Ford & Chambers 1974).

Statistical comparisons between 1968, 1972, and 1973 involving numbers of plant and invertebrate species, invertebrate species diversity, and biomass values for these groups obtained during July-October, suggested that these characteristics remained relatively stable over the five year period. This, in turn, provided general evidence that changes in the characteristics of the thermal discharge associated with the addition of Unit 4 had not resulted in major shifts in the numbers, diversity, or standing crop of plant and invertebrate species, which are major components of the subtidal community.

Several general conclusions can be drawn from the evidence considered above. The results of this series of seasonal monitoring studies from 1968 to 1973 showed that thermal effluent from the South Bay Power Plant had some adverse effects on benthic organisms in the area, but that these were restricted primarily to the cooling water discharge channel and to warmer periods of the year. Some effects of the thermal plume that could be interpreted as "beneficial" to the benthic community also were demonstrated. The overall conclusion by Ford & Chambers (1974) was that thermal effluent from the South Bay Power Plant had no major adverse effects on the benthic communities beyond the end of the cooling channel, and that operation of the plant was, on balance, not detrimental to these communities during July 1968 - July 1973.

4.2.4 RELATED STUDIES

At this same time, Chambers & Merino (1970) conducted a study to evaluate the effects of water discharged from an experimental desalinization plant at the South Bay Power Plant site. The biological evaluations for this report were based primarily on data from Ford (1968) and Ford et al. (1970).

Several graduate students at San Diego State University, some of whom were associated with these studies of thermal effects at the South Bay Power Plant, later conducted ecological population studies of benthic invertebrates and ichthyoplankton in South San Diego Bay. All of these studies considered basic ecological population processes and temperature tolerances as well as ecological effects of the thermal plume. Kellogg (1975) conducted such studies of the smooth cockle clam (Chione fluctifraga), McGowen (1977) investigated populations of ichthyoplankton involving many species and Merino (1981) studied the rosy razor clam (Solen rosaceus) and the California jackknife clam (Tagelus californianus).

4.2.5 NPDES MONITORING STUDIES: 1977-1988

After an interval of four years, annual monitoring concerning the effects of the thermal effluent plume from the South Bay Power Plant was resumed on a reduced scale in 1977. The results of the studies by Ford (1968), Ford et al. (1970, 1971a, 1972) and Ford & Chambers (1973, 1974) suggested that sedentary benthic organisms, in comparison to more motile forms such as fishes and plankton, best integrated environmental changes through time, provided the best indication of environmental conditions and could be studied relatively easily. In addition, these earlier, detailed studies showed that late summer was the period when the warm marine environment of the South Bay would be particularly sensitive to additional thermal stress associated with the discharge of thermal effluent. Because of this, an NPDES monitoring program was designed to sample the benthic infauna during August of each year.

APPENDIX A

RECOLLECTIONS OF LONGTIME RESIDENTS CONCERNING SAN DIGEO BAY MARINE LIFE

Interview Summaries by:

Serge Dedina
Michael Brandman Associates

Herbert L. Minshall Interview
October 4, 1988

Mr. Minshall is author of the book "Window on the Sea" (1980, Copley Books, La Jolla, California), a popular historical review of changing habitats and marine life in the San Diego Bay - Mission Bay region. Mr. Minshall's book discusses his recollections about growing up in the San Diego area during the 1920s and 30s. He discussed the state of San Diego Bay during that period along with the wetlands in San Diego, including Mission Bay and the Tijuana Estuary. During the 1920s, Mr. Minshall spent a lot of time hunting in the southern end of San Diego Bay. According to his account, the Bay was full of birds, ducks, black brant, geese, herons, clapper rails, and various types of terns. He said that the Bay was popular with hunters who were not restricted by limits of any kind. Hunters would often quit for the day when they filled their skiffs with birds. The area around Crown Cove was popular with hunters. During the morning they would wait in the sand dunes until the birds flew west into the ocean. Mr. Minshall stated that during sunrise the birds would "block out the sun". Hunters would open fire and kill as many birds as they could. Black brant were especially popular. According to Mr. Minshall, the brant were so numerous that they would walk on peoples' lawns near Mission Bay and the Silver Strand.

Mr. Minshall stated the snow geese and Canadian geese used San Diego Bay as a stopover point on their way to their wintering grounds in Mexico. The geese no longer frequent the Bay as they used to. Loss of habitat and increasing contamination from industrial sources and municipal sewers contributed to the loss of the Bay as a refuge for the geese. Herons and egrets were in abundance in the southern portion of the Bay, along with caspian terns who used the dikes of the salt ponds as nesting areas.

The southern end of the San Diego Bay was never that popular with fishermen. The population center of San Diego was located near the northern end of the Bay. according to Mr. Minshall, most people saw little reason to go south when the fishing in the northern portion of the Bay was excellent. White sea bass were very popular with commercial fishermen, but were almost decimated by jig fishing. Commercial fishermen would use jigs with up to 60 baited hooks to catch white sea bass. Although white sea bass do still exist, most of them are caught between Imperial Beach and the Coronado Islands or off Baja California. In his book, Mr. Minshall describes catching sea trout in the Bay which were rare even in the 1920s.

From 1920 until about 1935, the San Diego Bay supported a large sardine industry. Fishermen would catch large quantities of the fish inside the Bay. Overfishing and the cyclical decrease in the sardine population were responsible for the elimination of the sardine from San Diego waters. Halibut were also in abundance throughout the Bay.

Mr. Minshall stated that as late as the 1930s San Diego Bay was full of marine mammals. Porpoises were very common, along with harbor seals. Today it is very rare to see either of these ,mammals inside the Bay. While there was a whaling industry in San Diego during the 1880s, whales were not that common a sight inside the Bay during the early part of this century. Sea turtles were a common sight in the Bay up until the 1930s. While sea turtles still exist in the Bay, they are not as frequent as they used to be.

Mr. Minshall described the pollution and garbage that he can remember in the Bay in the 1920s. According to his account, pollution in the Bay was not something that people worried about then. Mr. Minshall remembers swimming around the area of the present Star of India anchorage, where his sea scout troop met, and seeing "lots of trash in the water". It wasn't until the late 1930s, however, that the contamination of the Bay became "horrible". With the advent of the Second World War, and the industrialization of the southern portion of the Bay, both industrial and municipal wastes were dumped directly into the Bay without any restrictions. Mr. Minshall recalls working for the Kelco Company in the 1930s and dumping the acid they mixed the kelp with directly into the Bay. During the war there was no attempt to clean up the Bay, which Mr. Minshall said "stunk". It was not until 1946 that an effort was made by city officials to deal with the problem. Mr. Minshall stated that along the Silver Strand "lumps of sticky stuff" would wash up along the shoreline. The "sticky stuff" was the result of the dumping of waste along the southern portion of the Bay. During periods when the wind blew from the east, the accumulated gunk would wash onto the Silver Strand.

During the interview, Mr. Minshall repeatedly emphasized how beautiful the Bay was when he was a youth, and how unspoiled the coastal wetlands were throughout San Diego. He said he felt that he was lucky to have lived when he did, because he was able to see San Diego without the development. He described the Tijuana River Estuary as having been a fantastic place, that was "..totally unspoiled.." in the early part of this century.

Frank Hollins and Al Laing Interview
October 31, 1988

Frank Hollins and Al Laing are both Cordonado residents. Mr. Hollins moved to Coronado in 1919, and Mr. Laing moved there in 1920. They both attended the same elementary school, and graduated from Coronado High School in 1928. Mr. Hollins is an avid fisherman and ran a charter fishing service out of Cordonado after the Second World War. Mr. Laing is also a fisherman and spent time hunting where the Coronado Cays are located today. Both men are now retired but are still active in Coronado community affairs.

Both men describe Coronado as a small peaceful town of about 3,000 residents during the 1920s. They spent considerable time fishing and hunting during their youth. There were plenty of fish to catch and lots of rabbits and ducks to shoot. They fished off the bridge that spanned the marsh area called Spanish Bight. Mr. Hollins spoke of catching sea trout, white sea bass of up to 10 pounds, bass, barracuda, yellowtail, bonita, sand sharks, big sardines, and mackerel from the bridge and from the area around Spanish Bight. Mr. Laing stated that the fishing in the Bay today cannot compare with what it was like in his youth.

In the 1930s, Mr. Hollins was a commercial fisherman. There was a canning industry in San Diego that would buy mackerel and sardines from local fishermen. They would only buy it by the ton. He said that in one night he caught 1,800 pounds of mackerel off of the kelp beds near Point Loma. He said that mackerel fishing was better off Newport Beach (2 to 3 miles offshore). He stated that catching 2 to 3 tons a night was common. Fishermen would use a system he referred to as "bailing". They would use large butterfly nets filled with fishmeal and wait for the nets to fill up.

Mr. Laing said that duck hunting was popular in the 1920s and 30s along the Silver Strand. He would wait in the sand dunes for the ducks to fly over the Strand from the ocean. There were lots of ducks and the hunting was easy. He referred to the types of ducks that he hunted as "coots", "loons", and "whobills". He would also hunt rabbits in the area that is now the Naval Radar Station.

In the 1920s and 30s, the people of Coronado used San Diego Bay as their main recreation area. The Spreckels Company, which ran the Tent City tourist center, also provided a free swimming pool where the Glorietta Bay Park is today. Mr. Laing said that every afternoon most of the housewives and their children would go down to the Bay and go for a swim. After the 1930s, this was not done as much -- primarily due to the pollution in the Bay.

Paul Smith Interview
November 9, 1988

Mr. Smith has lived in Imperial Beach in his Seventh Avenue home since 1926. He is 87 years old, and is Imperial Beach's oldest and longest living resident. He was an avid hunter and fisherman and spent a lot of time in the southern portion of San Diego Bay and in the Tijuana River Valley.

Mr. Smith stated that there were plenty of animals to hunt in the 1920s and 30s. He was able to hunt ducks from his front yard. Pintails and mallards were the types of ducks he was able to shoot. There were no laws in Imperial Beach at that time regarding shooting a gun, and there were only a few neighbors around. Mr. Smith said that quite a few people in the community would hunt in the area. The area near the Mexican border was a favorite place to hunt; quail, rabbits, raccoons, and possums were all fair game. Black brant, according to Mr. Smith, were not that numerous even in those days. Mr. Smith recalls seeing a bobcat with four young kittens in the Tijuana River Valley in the 1930s.

The Tijuana River Estuary was an excellent place to fish. Mr. Smith and his friends used to take flat bottomed boats out at night in the estuary and spear fish. They would catch halibut and mullet. The southern portion of San Diego Bay was also an excellent place to fish. Mr. Smith stated that it was almost impossible to go fishing without catching a lot. The southern portion of the Bay was a good place to catch black croakers and sea trout. Mr. Smith would troll for sea trout in the area near Gunpowder Point.

The Bay was filled with birds. Mr. Smith recalls the herons and egrets that inhabited the area. There were a lot more birds than there are today in the area.

Mr. Smith noticed that the Bay was polluted when he first moved to Imperial Beach in 1926. Municipal sewer lines were emptied directly into the Bay, and the water "stunk". He said that this was an ongoing problem, and that the water today is actually cleaner than it was back then.