# SANTA ANA MARSH AND ADJACENT LOWLANDS
# TERRESTRIAL RESOURCES REPORT

by

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# 1.0 INTRODUCTION

The Santa Ana River rises in the San Bernardino and San Gabriel Mountains, some 75 miles inland from the ocean. It is the largest river system in southern California and occupies a basin covering some 3,200 square miles. Because the river has a long history of serious flooding and now flows through heavily urbanized areas, major flood control improvements have been proposed (U.S. Army Corps of Engineers, 1980).

Proposed changes in channel depths and alignments near the river mouth, led to mitigation measures that include restoration of 92 acres of historical marsh habitats located between the Santa Ana River Channel and Newport Mesa.

This report has been prepared in response to U.S. Army Corps of Engineers Contract No. DACW09-83-M-2581 (Requisition No. 0080) which calls for the development of a scientific report detailing in quantitative terms the significant TERRESTRIAL BIOLOGICAL RESOURCES in the Santa Ana River Marsh and adjacent lowlands (Figure 1-1). Based on both literature review and scientific field investigations, the report emphasizes those resources most likely to be impacted by the proposed flood control program. The report thus provides the Corps of Engineers with the data base necessary to develop and manage a marsh restoration program for the project area (Contract Scope of Work, 1983).

A preliminary literature review (Macdonald 1983), prepared immediately following contract initiation, summarized background information and was used to develop a scientific field studies program best suited to meet the Corps needs. Wherever possible the literature review emphasized fully documented, scientific research reports and papers from referred journals, rather than the extensive "grey" literature. Since original field data from Santa Ana River Marsh and lowlands was scarce, reports reviewing various aspects of comparable habitats at other coastal wetland sites in Orange and Los Angeles Counties were also incorporated. The locations of these sites, particularly Upper Newport Bay, Bolsa Chica lowlands and Ballona Creek, are shown in Figure 1-2.

The field studies program was initiated when a clearance for site access was granted in late November, 1983. Successive Quarterly Status Reports, submitted January 6, April 6, and July 14, 1984 (Macdonald 1984a, b, c), respectively, monitored progress of the field studies, described methods used, and presented some preliminary data and interpretations.

The information obtained from the literature review and subsequent field studies program has now been combined to create this TERRESTRIAL RESOURCES REPORT. The report begins by summarizing the historical background of the lower reaches of the Santa Ana River, and outlining the program objectives and scope of work in greater detail. The flood control modifications proposed within the study area are next outlined. Succeeding sections respectively review study-site vegetation analysis, plant biomass and production, environmental variables, and the terrestrial fauna. The remaining report sections integrate these separate data sets to address the broader topics of terrestrial trophic relationships, anticipated project impacts, mitigating measures, and marsh restoration.

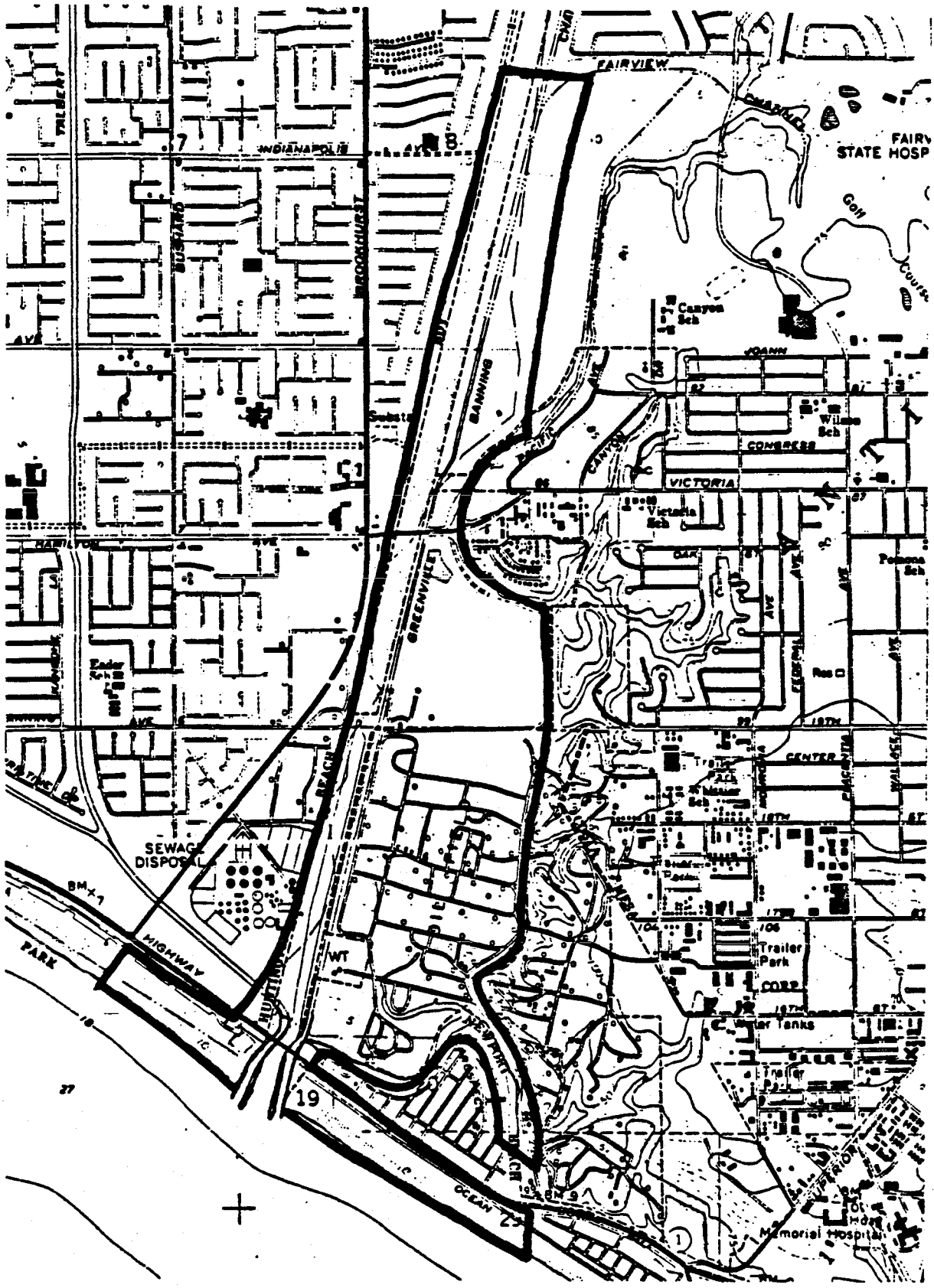


Figure 1-1. Santa Ana River Marsh and Adjacent Lowlands Study Site.

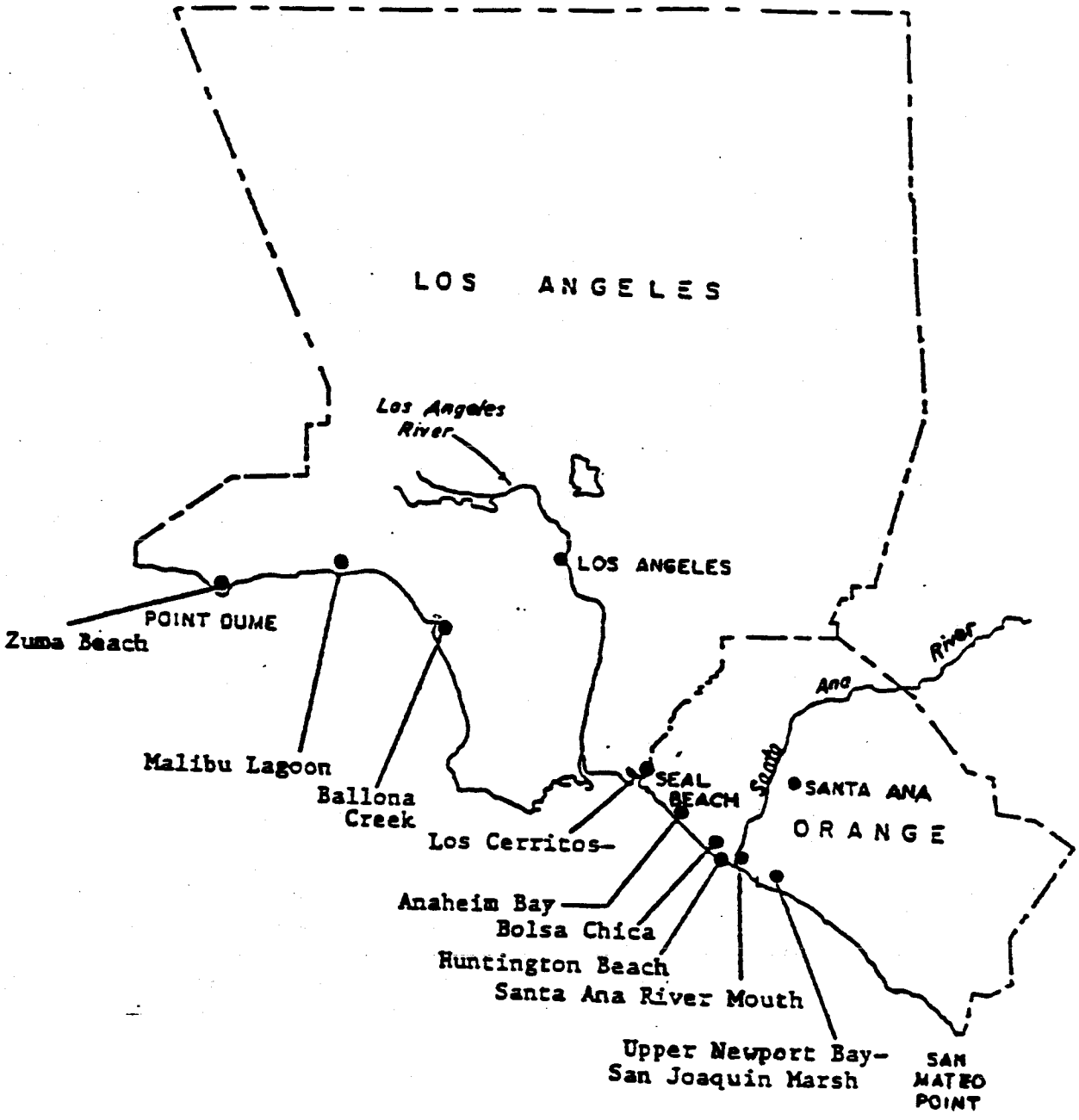


Figure 1-2. Coastal Wetland Systems remaining in the Los Angeles and Orange Counties region.

## 1.1 HISTORICAL BACKGROUND

The coastal wetlands of Orange and Los Angeles Counties have been affected by growth and change more than any others along the California coast. Comparison of their historic distribution (Figure 1-3) with the "remnant marshes" that we know today is particularly striking.

During the geological development and in filling of the Los Angeles basin the percursor of today's Santa Ana River probably changed its course several times, as it has also done within the past 100 years. The river was undoubtedly responsible for carving the present course of Newport Bay and probably the upper portion of Newport Submarine Canyon also. The date when the Santa Ana River changed course from Newport Bay remains unknown, however prior to 1825 the river emptied into the ocean at the Alamitos outlet near Seal Beach.

Major regional flooding in 1825 resulted in the Santa Ana River again being diverted, this time to its present ocean outlet in the Santa Ana Gap. A second still greater flood in 1861 carried so much sediment downriver to the ocean that the barrier sandspit that presently protects the entrance of Newport Bay from the open ocean was created. The broad lagoon formed behind this sandspit (Newport Lagoon) acted as a settling basin and fine-grained sediments accumulated rapidly.

The U.S. Geological Survey Anaheim topographic sheet of December 1901 clearly shows the Santa Ana River in the configuration described above (Figure 1-4). The marshlands that developed in lower Newport Bay following the 1861 flood must have reached equilibrium with depositional and tidal conditions relatively quickly, for Stevenson and Emery (1958) note that charts of the region made in 1875 and 1950 show that the shape of the marshes remained unchanged.

The marshes at the mouth of the Santa Ana River must have been equally stable, for the tidal channels shown in the 1901 survey are clearly similar to those remaining today.

The general pattern described above, with the Santa Ana River emptying into western Newport Bay, remained until 1920 when the river was first confined within artificial levees and forced to empty into the ocean at its present location. Detailed descriptions of the Santa Ana rivermouth as it was in the early 1900's has not been researched, however the following excerpts from Talbert (1952) provide a good overview of the region before it was cleared and drained.

> *"Originally, except for the Huntington Beach Mesa, the coastal area extending from the Newport Mesa to the Bolsa Chica Mesa and back into the county as far as Bolsa, a distance of about 7.5 miles, was considered a practically worthless swamp. This area of about 30 square miles, 8,000 acres, was so full of peat springs and artesian wells which flowed the year round that it was quite inaccessible. It had a growth of willows, sycamore, tules, water moodies, wild blackberry and other vines, grasses and shrubs that make an almost impenetrable ticket . . .*
>
> *The superabundance of surface water, swamps, natural springs and artesian wells of Gospel Swamp (Santa Ana and Bolsa Gaps) seemed inexhaustible. Many places, among them Springdale and Fountain Valley, took their names*

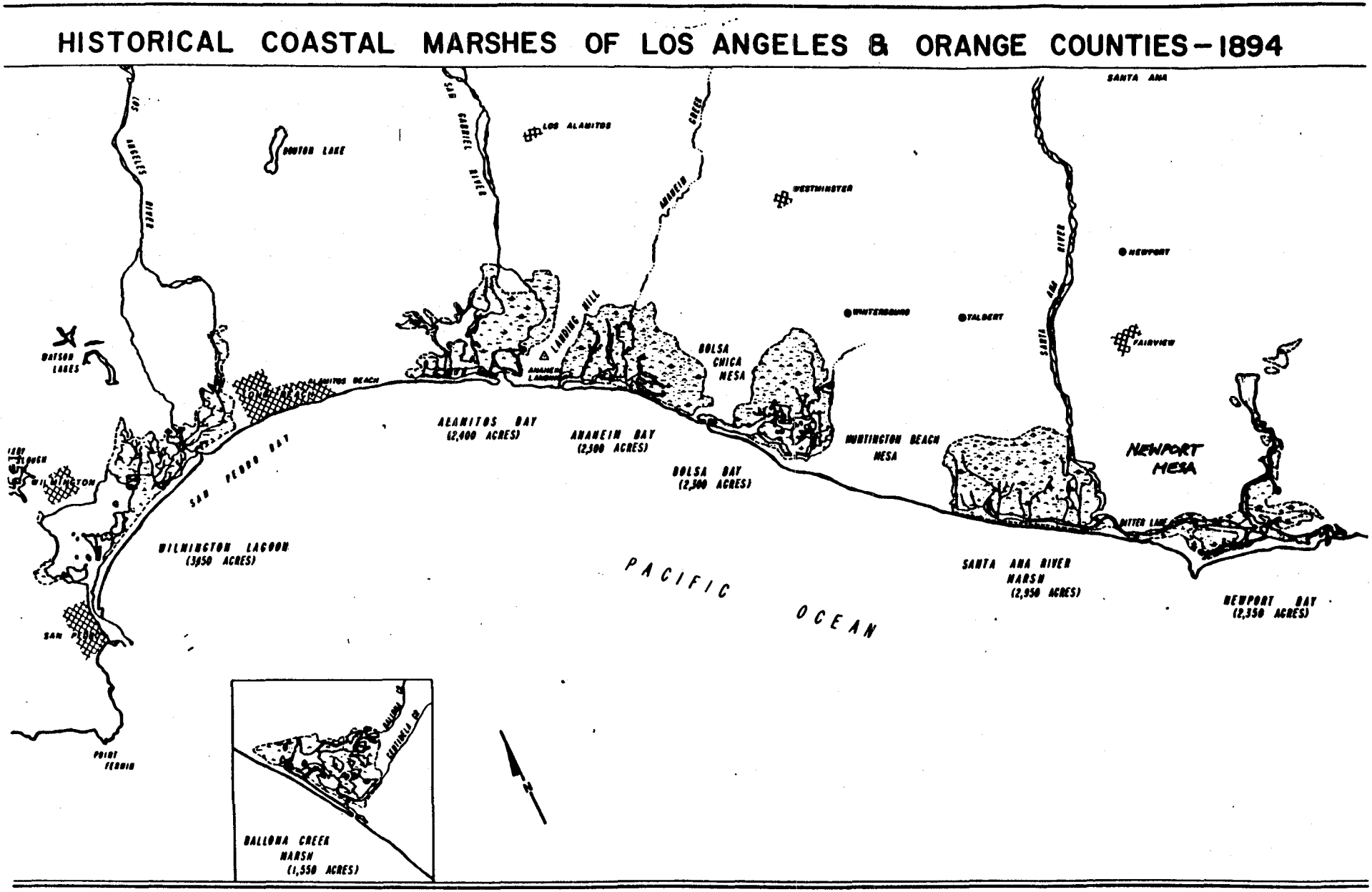


Figure I-3. Historical Coastal Marshes of Los Angeles and Orange Counties - 1894 (Speth et al, 1976)

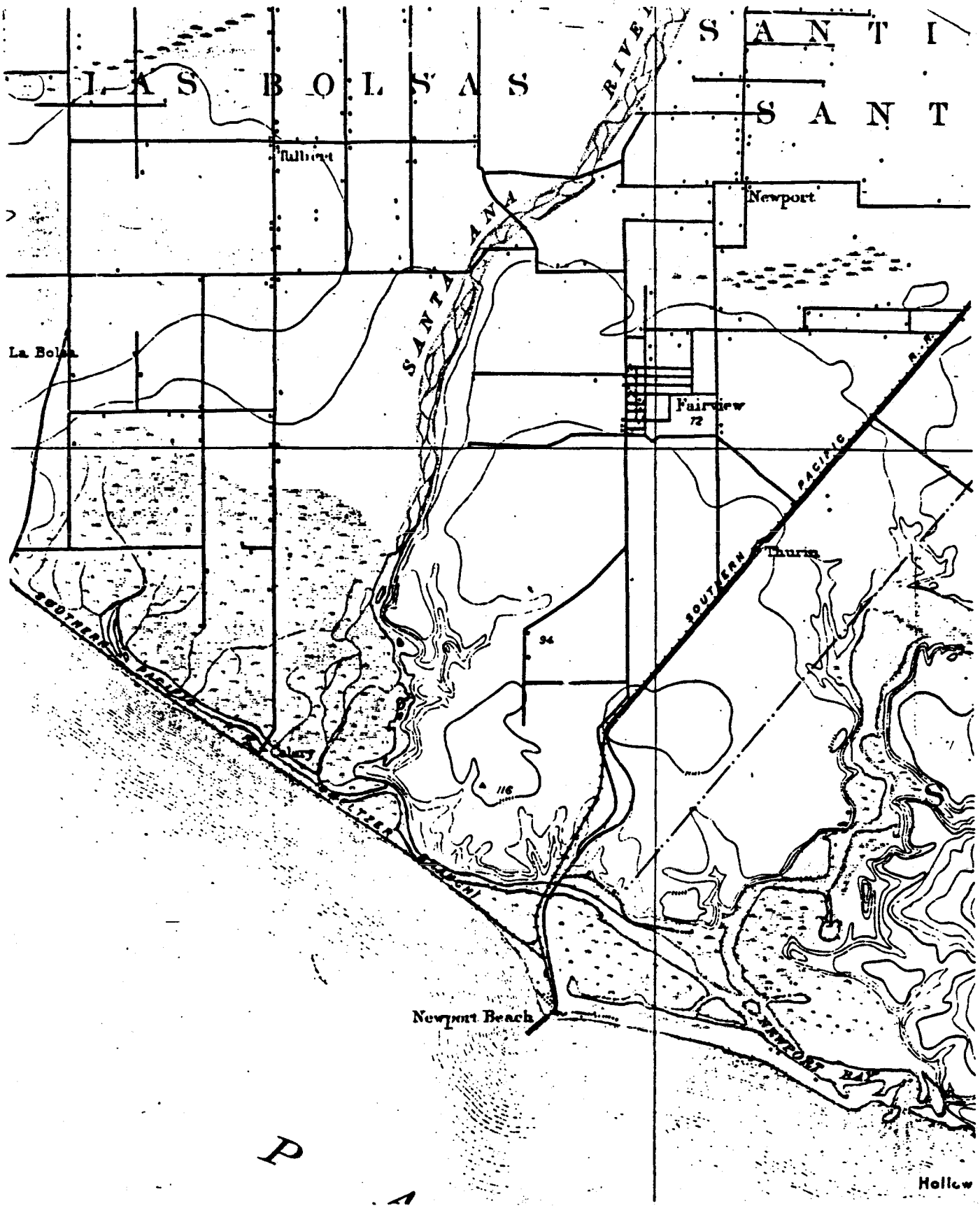


Figure I-4. U.S. Geological Survey Topographic Quadrangle, Anaheim Sheet, Edition of 1901 (Scale, one inch equals one mile).

*from natural flowing springs and wells. Peat springs bubbled and boiled out of holes in the ground, large enough to hold a good sized house without it touching the bottom or sides (Talbert, 1952)."*

It is reasonable to assume that in the 1900's areas adjacent to the Santa Ana River and closest to the coast were under tidal influence and included salt marshes. While marshes were also present further inland, they were probably largely brackish or freshwater in nature.

Figures 1-5 through 1-9 show a series of low altitude aerial photographs of the Santa Ana rivermouth area taken in 1927, October 1928, and during a period of river flooding in 1938. The tidal channels shown extending east and west of the river mouth in the 1901 USGS survey are readily recognizable in each set of photographs. The bluffline delineating the Santa Ana lowlands and Newport Beach Mesa uplands, appears almost unchanged between photos. Development of any kind near the river mouth was apparently quite limited at this time.

There is no direct evidence on the photographs of the north-south oriented tidal (?) channel shown occupying a portion of the Santa Ana River on the 1901 survey map (Figure 1-4). The 1927 and 1928 photographs do however, show stands of shrubs or trees occupying the northern portion of this former water course. While the exact nature of the vegetation present on the study site cannot be judged from these photographs, it was apparently relatively undisturbed.

Both the 1927 and 1938 photographs show free tidal connections between the Santa Ana River mainstem, the old Santa Ana River channel that formerly drained into Newport Bay, and the ocean. Apart from these tidal channels no specific aquatic habitats can be recognized on the study site in the 1927 photo. The 1938 photos show almost total flooding of lowland habitats on both sides of the Santa Ana River channel.

## 1.2 PROGRAM OBJECTIVES

The principal objective of this Terrestrial Resources Report is to provide the U.S. Army Corps of Engineers with accurate, defendable information on the TERRESTRIAL ENVIRONMENTAL RESOURCES of the Santa Ana River Marsh and Adjacent Lowlands study area (Figure 1-1).

Two important secondary objectives are as follows:

1. To fully assess probable ADVERSE ENVIRONMENTAL IMPACTS to study-area terrestrial resources, anticipated as a result of flood control alternatives presently proposed for the Santa Ana River.

2. To contribute to the data base necessary for conceptual design and planning of a MARSH RESTORATION PROGRAM for the study site and other MITIGATING MEASURES to offset unavoidable adverse impacts likely to result from the proposed flood control program.

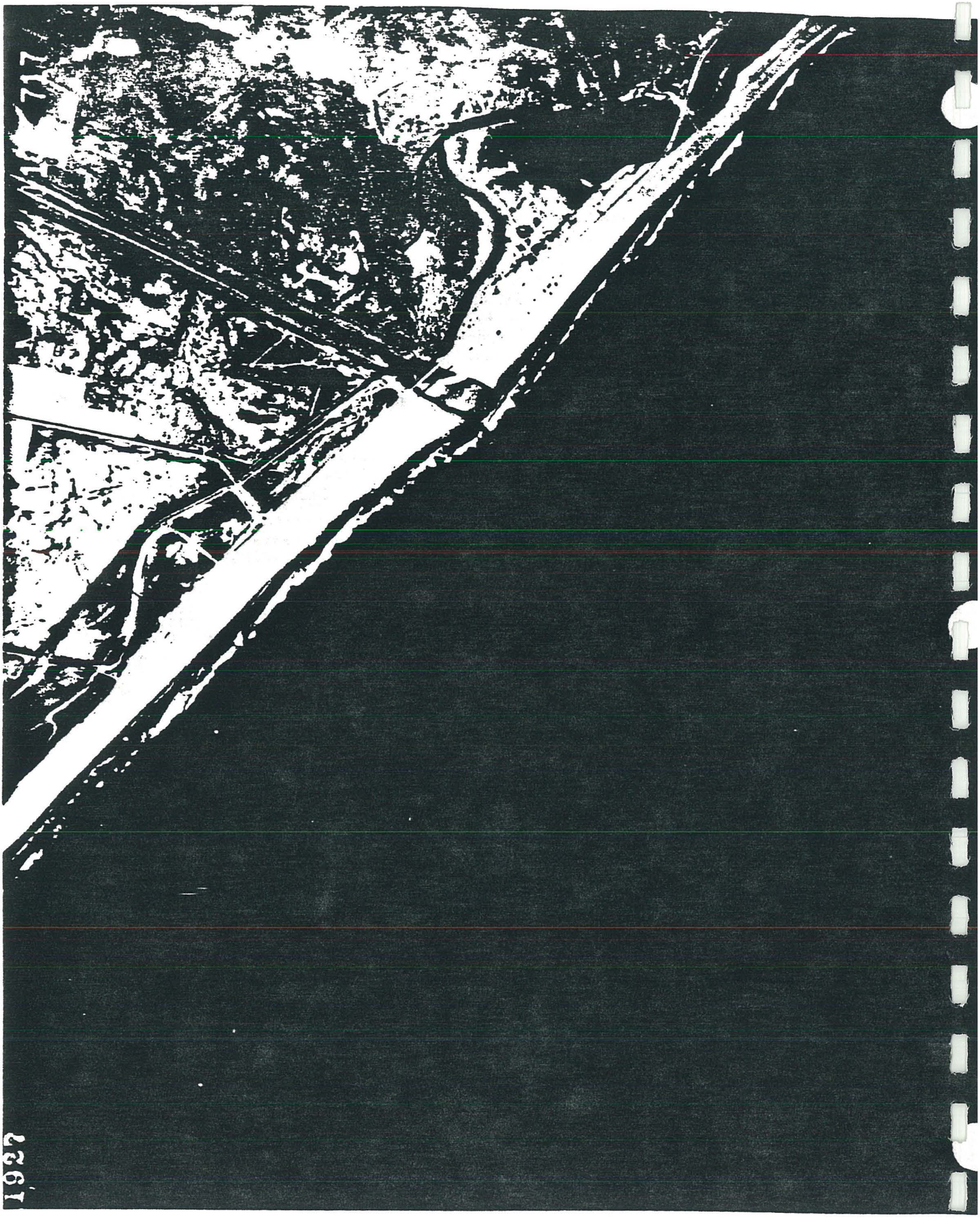


Figure I-5. Santa Ana River Mouth - 1927.

Figure I-6. Santa Ana River Region - 1927.

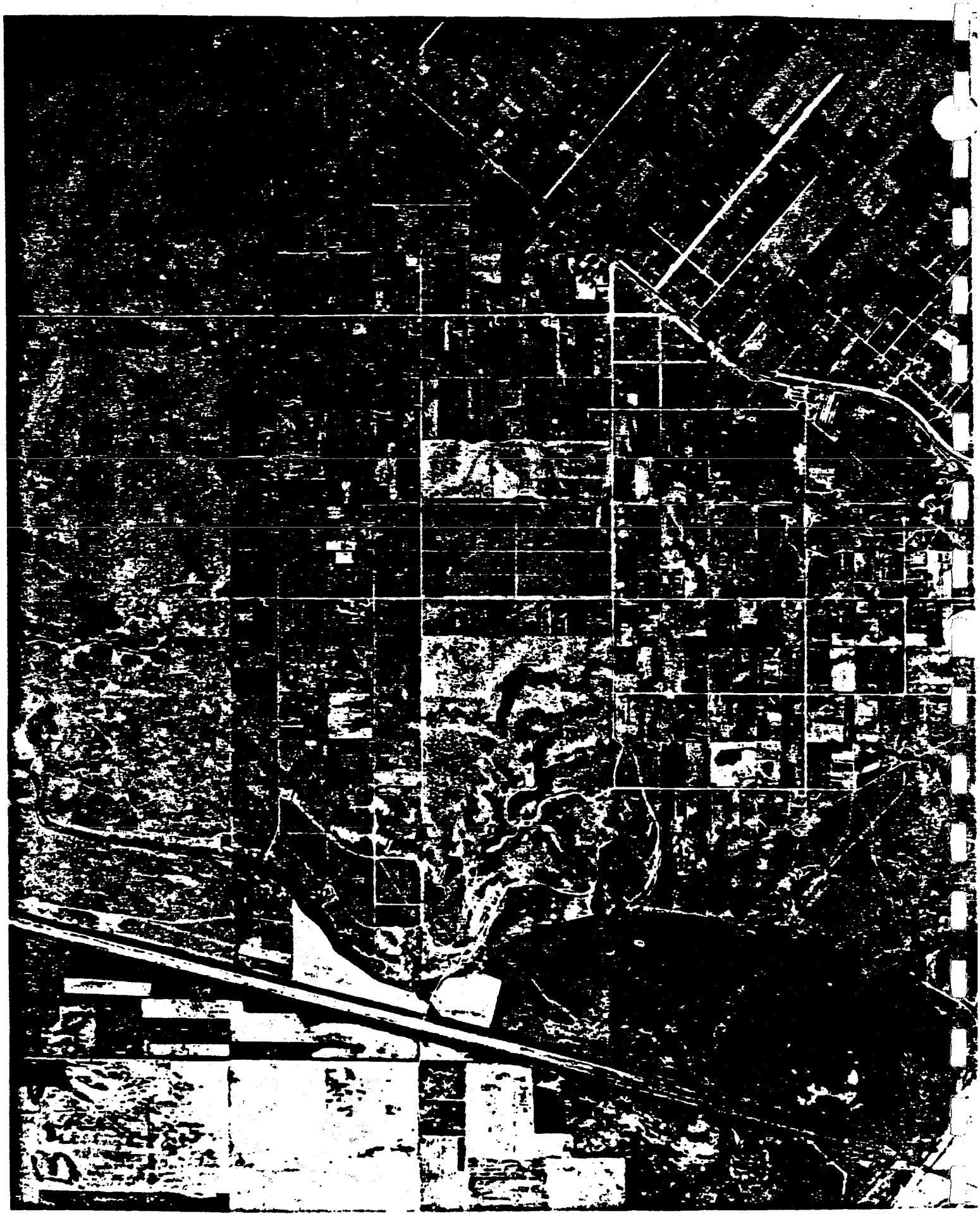

Figure I-7. Santa Ana River Study Area - October 1928.

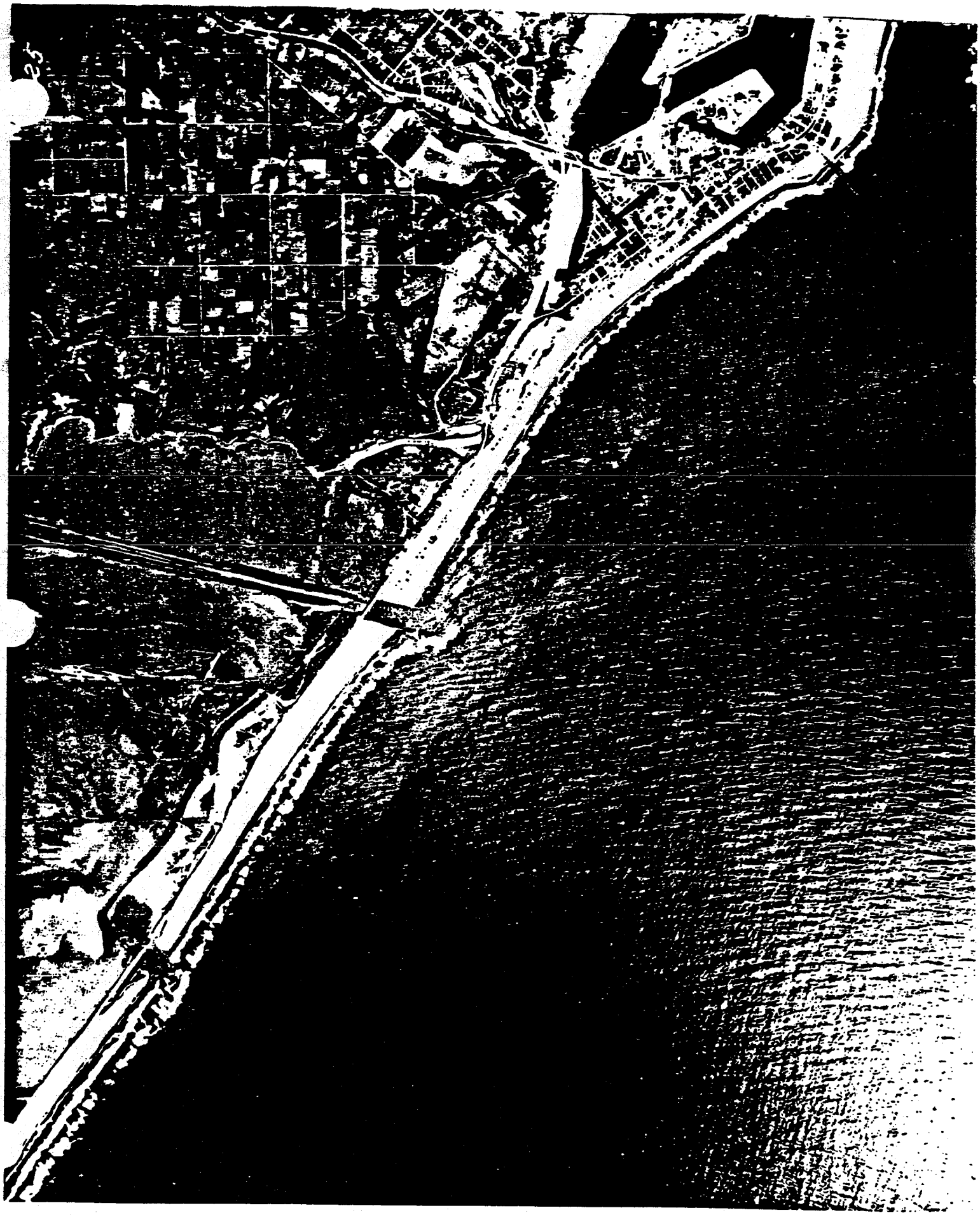

Figure I-8. Santa Ana River Mouth During 1938 Flood.

Figure I-9. Santa Ana River in Flood - 1938.

## 1.3 STUDY SCOPE

U.S. Army Corps of Engineers Contract No. DACW09-83-M-2581 (Requisition No. 0080) provides a general outline of the Scope of Work to be accomplished during this study. Emphasis was placed on the following key items:

1. Strict limitation of the Study to TERRESTRIAL ECOLOGICAL RESOURCES of the Santa Ana River Marsh and adjacent lowlands study site.

2. Literature search and synthesis, reviewing available data on the terrestrial ecology of the study area (Macdonald 1983), and leading into development of a Plan of Study for field investigations.

3. Development of a vegetation map and complete floral list for the study site.

4. Description of characteristic study-site vegetation types, supported by quantitative species composition/cover data.

5. Plant biomass data and primary production estimates for the characteristic vegetation types noted above.

6. Collection of data describing the spatial and temporal distributions of terrestrial "animals" utilizing the study area.

7. Synthesis of field and literature data oriented to trophic relationships among the important terrestrial plants and animals occurring on the study site.

8. Maintenance of a field journal; and photo-documentation of study area habitats, key species, and sample sites.

9. Preparation of a Terrestrial Resources Report, stressing quantitative resource data; identifying potential flood control associated adverse environmental impacts; and proposing practical means to avoid, mitigate, or compensate for these flood control associated impacts.

# 2.0 PROPOSED SANTA ANA RIVER FLOOD CONTROL PROGRAM

A complete account of the proposed Santa Ana River flood control program can be found in, "Santa Ana River Phase I General Design Memorandum (GDM)," published by the Los Angeles District Office of the U.S. Army Corps of Engineers, in September 1980. This 1980 GDM was refined from an earlier plan published in 1975 after an exhaustive 9-year study of the flood control and related problems in the Santa Ana River Basin. A location map and general overview of proposed flood control measures is presented in Figure 2-1.

The Santa Ana River drops steeply out of the mountains, through Santa Ana Canyon, and flows seaward across rapidly developing urban areas of the broad, flat, coastal plain. Not infrequent medium to large winter floods have caused extensive damage in the past, and broad areas of Orange County coastal plain are still vulnerable to serious flooding (Figure 2-2).

Basically, the GDM calls for construction upstream of Mentone Dam, raising the existing level of Prado Dam, flood plain management between these two dams and within the Santa Ana Canyon flood plain, and channelization of the lower Santa Ana River, to carry increased flood flows. Only those specific flood control measures proposed for the last few miles of the river channel from Adams Avenue, south to the Pacific ocean, are described in more detail below.

## 2.1 PRESENT CONDITIONS

Three separate flood control channels presently traverse the study area (Figure 1-1). The Santa Ana River Channel is, of course, the largest and has concrete side slopes that form levees about 14 feet above ground level and normally extend about 7 feet below the soft-bottom invert. The wide sandy-bottom channel is under direct tidal influence at least up to Victoria Street, although for much of the year the mouth is at least partially blocked by sandbars (Massey 1980.) The smaller Greenville-Banning storm drain channel[1], parallels the River through the study area and has its own separate ocean outlet immediately east of the river mouth (Figure 2-3). Another storm drain, the Fairview channel, joins Greenville-Banning just downstream of Adams Avenue. The Talbert or Huntington Beach Channel approaches the River from the northwest, a short distance inland of the Pacific Coast Highway[2]. Upon reaching the river it turns abruptly southward and empties into the ocean through its own outlet immediately west of the river mouth.

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[1]About one mile north of Victoria street this channel has developed into a freshwater marsh with stands of Scirpus growing on the sandy bottom (Massey 1980).

[2]A 17-acre marsh restoration was initiated between the Highway and Talbert Channel in May 1979, when culverts were installed to provide tidal flow from Talbert Channel. Plans were at least temporarily halted in October of 1979 when the culverts were removed.

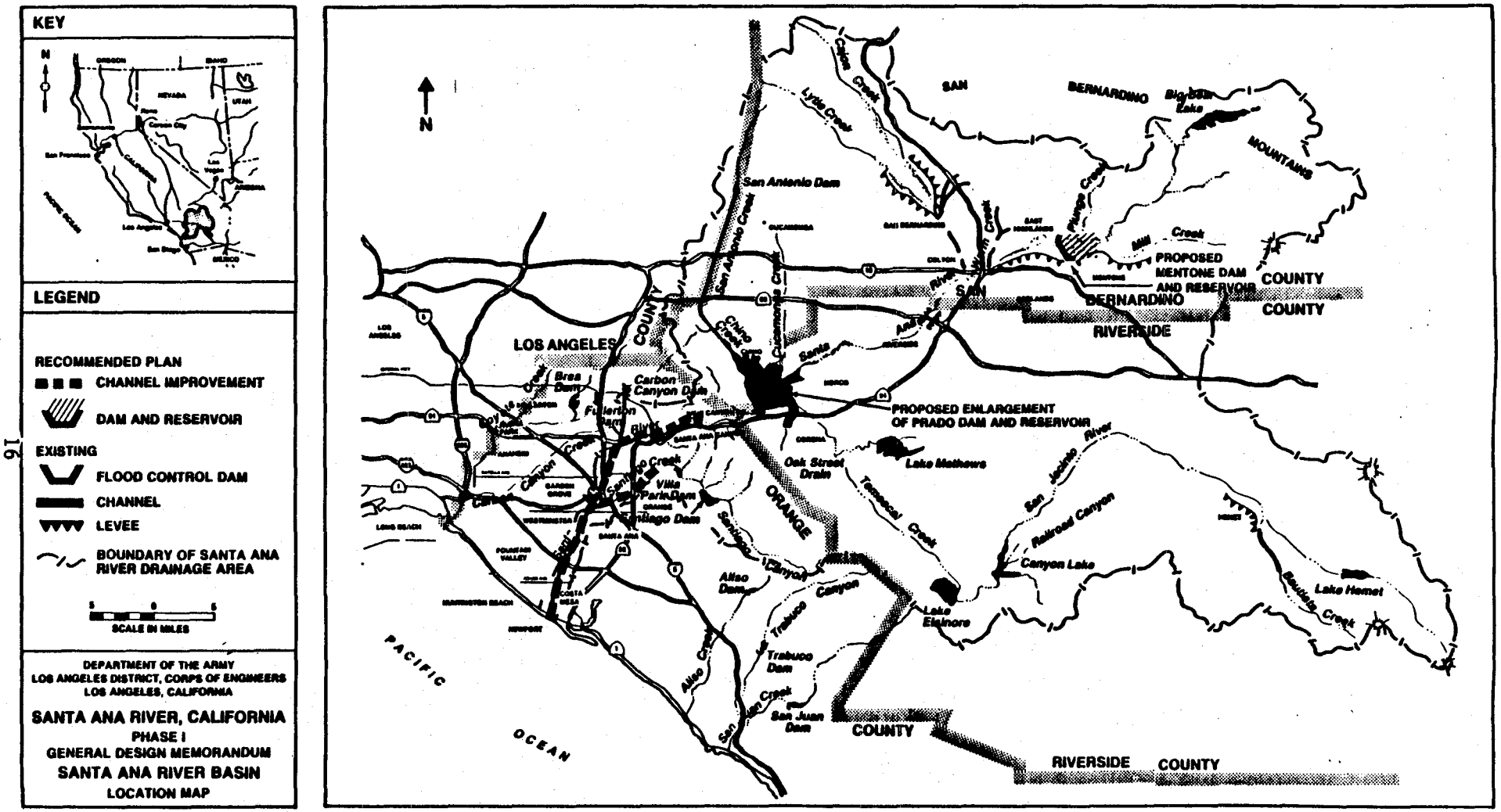



Figure 2-1. Santa Ana River Basin and proposed flood control structure (U.S. Army Corps, 1980).

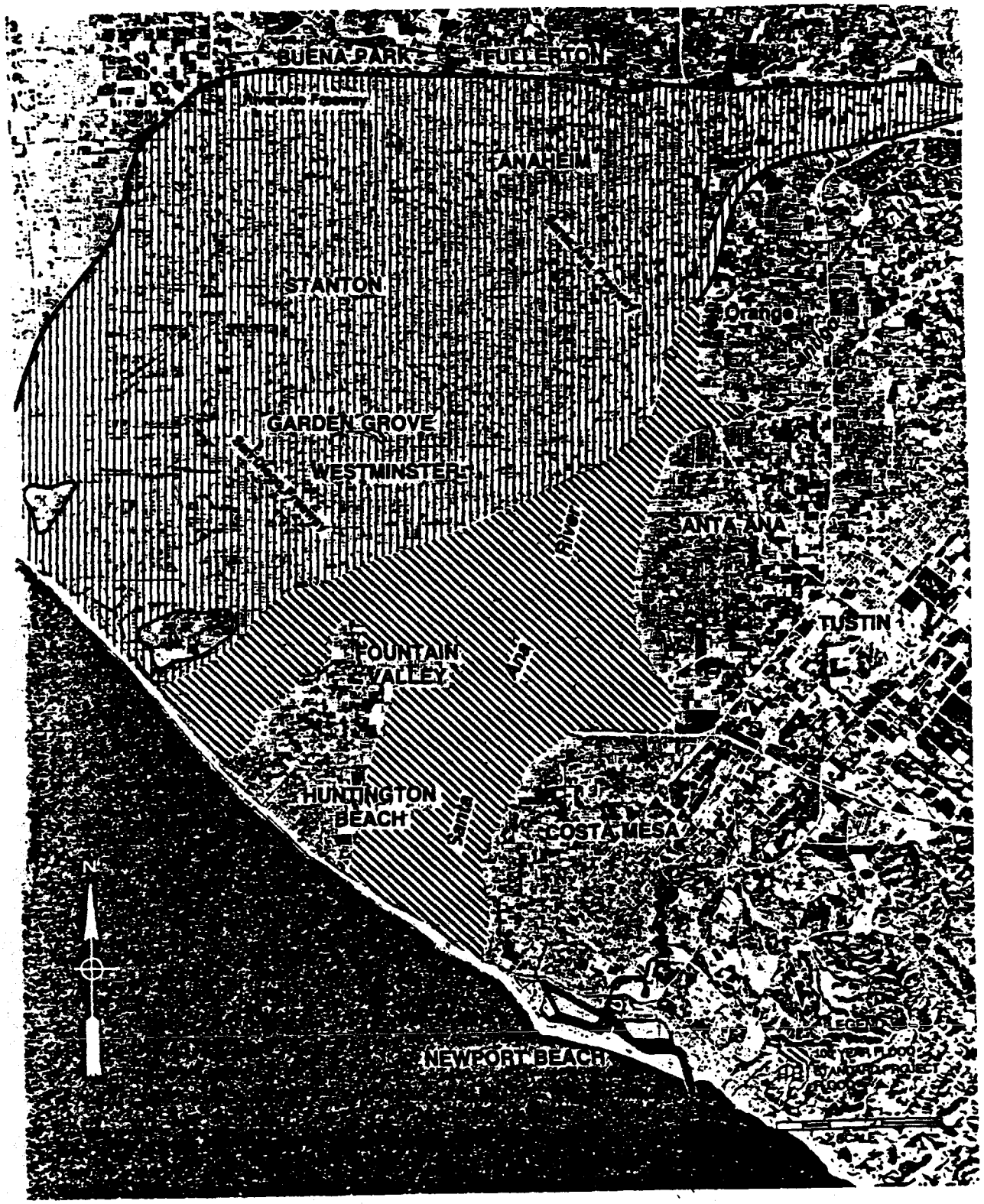



Figure 2-2. Santa Ana River Overflow Area in Orange County (U.S. Army Corps, 1980).

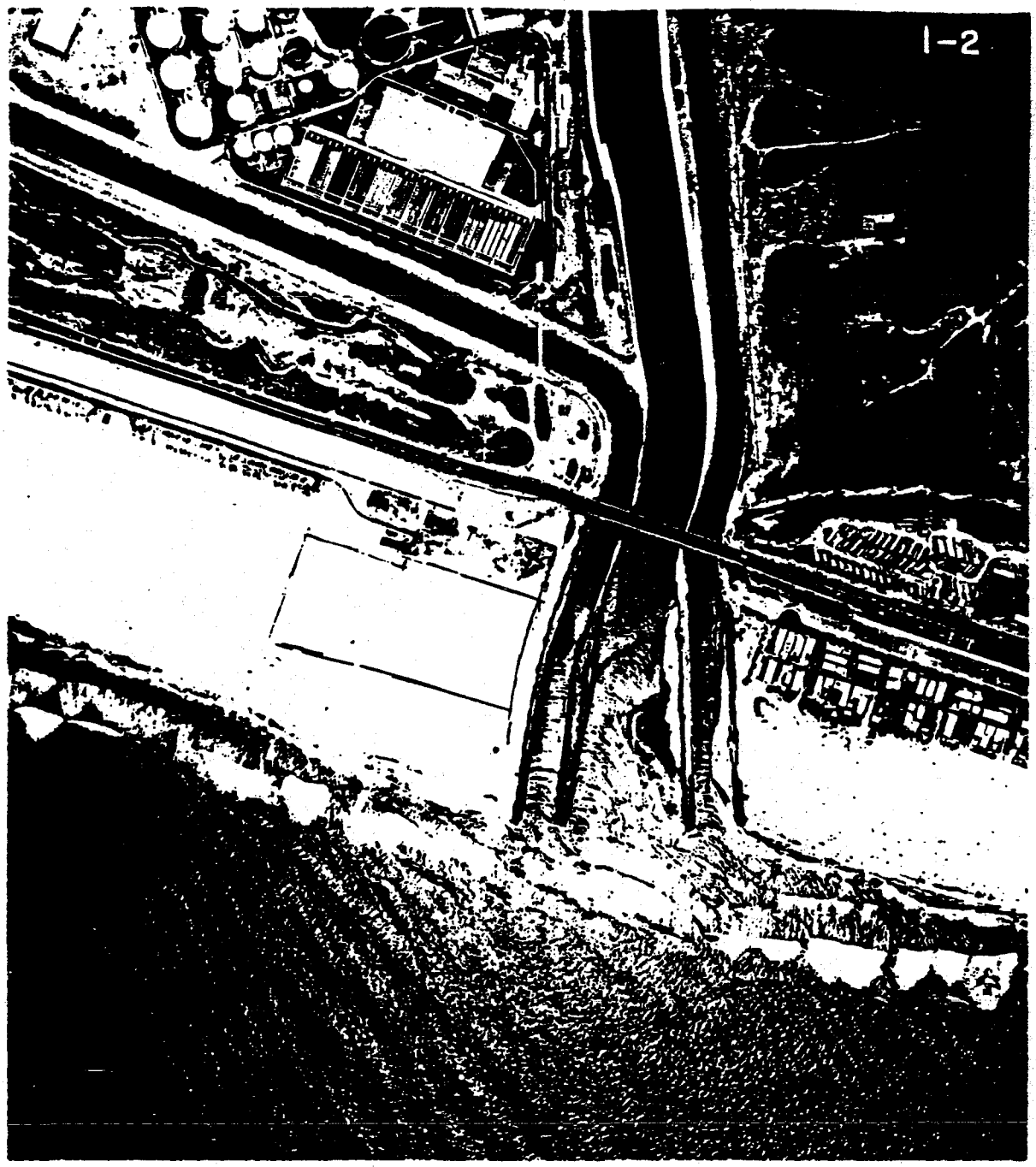



Figure 2-3. Present Configuration of Santa Ana River Mouth (July 1982).

The remnant Santa Ana River tidal channel that previously flowed into Newport Bay (Figures 1-3, 1-4) is presently connected into the Greenville-Banning Channel by means of a largely ineffective tide gate.

## 2.2 PROPOSED CHANGES

Rather than considering a single plan the 1980 GDM reviewed the relative merits and trade-offs of five different plans and the "No Action" alternative. Only one alternative -- Alternative 6, the "All-River Plan" -- proved acceptable to broad local interests, thus only the changes resulting from implementation of this plan will be discussed further.

Under the proposed All-River Plan, the Santa Ana River north of Adams Avenue (Figure 2-4) will be confined to a rectangular concrete channel 365 feet wide, with wall heights reaching 21 feet. The Greenville-Banning Channel, 60 feet wide and also fully concrete lined, will be located just 30 feet east of the river channel. Downstream from the point where Fairview Channel merges with Greenville-Banning, the Santa Ana River will transition and widen further to 450 feet. In addition, its concrete channel floor will change to a soft sediment bottom. This will allow continued growth of benthic organisms in the tidal zone of the river.

The Santa Ana River and Greenville-Banning Channels will be merged into a common channel just below the Hamilton Avenue-Victoria Street Bridge (Figure 2-4). The combined channel, now 480 feet wide and 22 feet deep (and extending 130 feet east of the present channel), will continue to within 500 feet of the ocean, at which point the vertical concrete walls will transition to rock jetties extending to the low tide line.

To make room for the widened Santa Ana River Channel the final 2,100 feet of the Talbert (Huntington Beach) Channel, west of the river, will be realigned to the ocean. The new channel will enter the ocean 400 feet west of its present location.

## 2.3 IMPACTS

The flood control changes outlined above will have a number of major environmental impacts upon habitats presently represented across the study site. The more obvious of these are bulleted below:

- Permanent elimination of soft-bottom sections of the Greenville-Banning Channel above Victoria Street, that presently contain valuable freshwater Scirpus marsh.
- Loss of about 5 acres from the east side of the presently 13-acre freshwater Victoria Pond site, immediately south of Victoria Street.
- Loss of about 8 acres of historic wetlands along the eastern riverbank, between Victoria Street and the Pacific Coast Highway.
- Loss of degraded salt marsh acreage (perhaps about 5 acres), adjacent to Pacific Coast Highway, due to realignment of Talbert (Huntington Beach) Channel outlet.

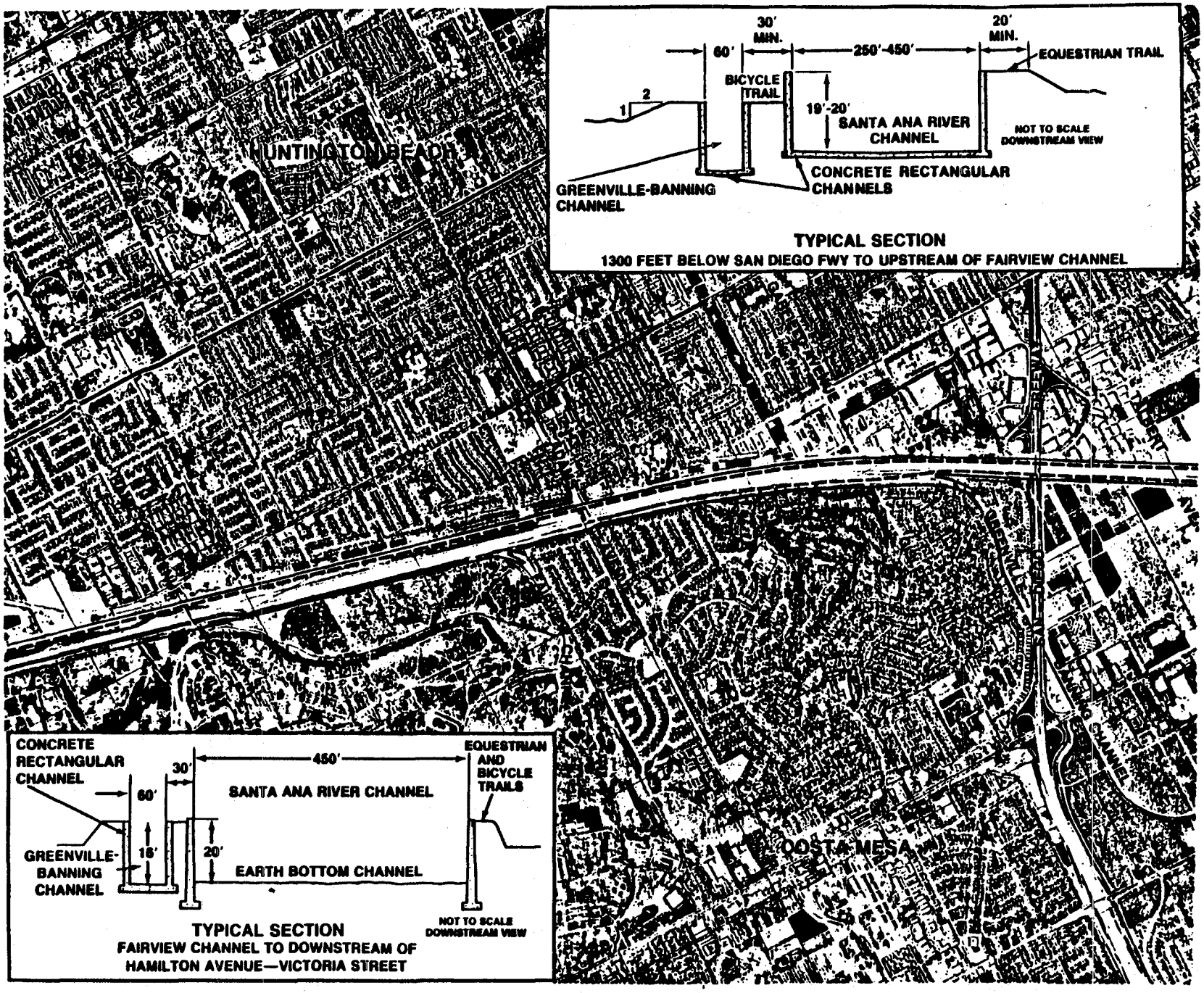



Figure 2-4. Flood Control Modifications Proposed for the Northern Portion of Study Area (U.S. Army Corps, 1980).

- Loss of both public beach and the eastern one-third (about 1.5 acres) of the endangered California least tern nesting preserve, immediately northwest of the Talbert Channel.

## 2.4 MITIGATION MEASURES

During the development and review of Alternative 6, the All-River Plan, a series of mitigation measures were proposed to balance the negative impacts listed above (see Figure 2-5). Principal among these were the following:

- The purchase and restoration of 92 acres of historic salt marsh, channel, and adjacent upland habitats between the Santa Ana River and Newport Mesa (Figure 2-5). Eight acres would replace those lost to channel widening. The remaining 84 acres would be preserved and enhanced to ensure viability for local endangered species.

- Installation of a more effective tide gate between Santa Ana River and the restored salt marsh preserve.

- Expansion of Victoria Pond to the south and east, to maintain the 13 acres of freshwater habitat presently represented.

- Expansion of the fenced California least tern nesting preserve westward, to replace the acreage lost (1.5 acres) due to the realignment of the Talbert Channel outlet.

- Addition of a large volume (over 3 million cubic yards) of sediment suitable for beach replenishment to be placed on neighboring beaches at Newport Beach.

- Development and implementation of a Construction Sequence Plan to ensure that marsh restoration and the movement of the least tern colony and Victoria Pond will be successfully accomplished before river channel improvements are begun at the Santa Ana River mouth.

The flood control program outlined above, together with the major impacts and mitigation measures that will directly effect the project study site, should be kept in mind while reviewing subsequent descriptions of the terrestrial resources of the Santa Ana River Marsh and adjacent lowlands.

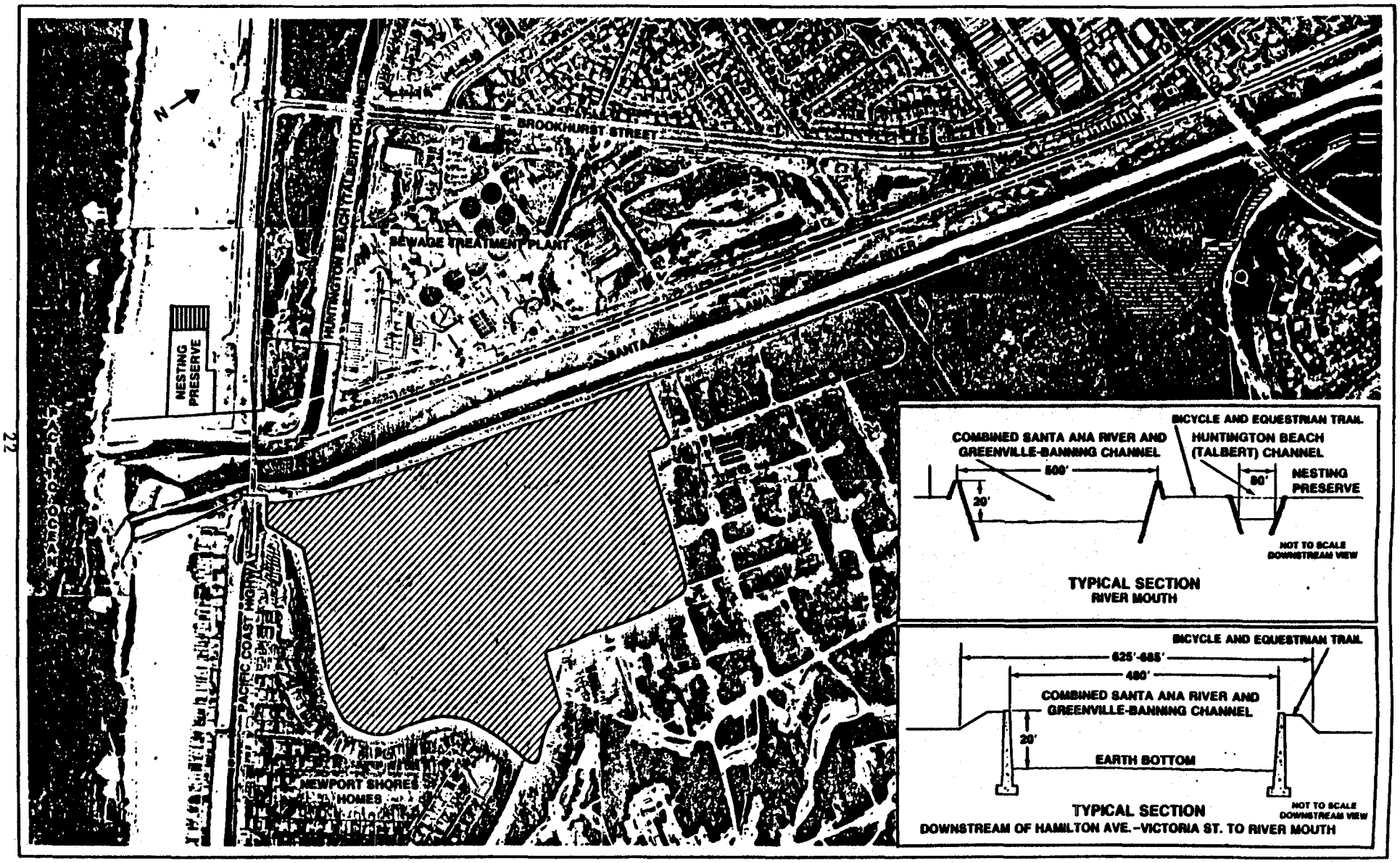



Figure 2-5. Flood Control Modifications and Mitigation Measures Proposed for the Southern Portion of the Study Area (U.S. Army Corps, 1980).

# 3.0 VEGETATION STUDIES

## 3.1 INTRODUCTION

The vegetation of the Santa Ana River Marsh and adjacent lowlands study site is composed of six plant communities: coastal salt marsh, freshwater marsh, willow riparian, riparian thickets, ruderal fields, and coastal sage scrub. Except for the coastal sage scrub, these communities occupy sites that are generally below 2.5 m above mean lower low water (MLLW). Coastal sage scrub occurs at higher elevations on the slopes of Newport Beach Mesa. Ruderal fields occur where the mesa slopes have been disturbed; willow riparian and freshwater marsh occur where there is seepage as in the side canyon near the southern tip of the mesa. Although some of these communities (coastal salt marsh, freshwater marsh, and coastal sage scrub) are described by Munz and Keck (1949) and Thorne (1976) as natural plant communities of California, on the Santa Ana River site these communities are at best, disturbed remnants of former natural communities. The willow riparian community is a phase of Riparian Woodland of Thorne (1976). The remaining communities -- ruderal fields and riparian thickets -- are not recognized by either Munz and Keck (1949) or Thorne (1976) for they represent disturbed habitats where the native species are often outnumbered by introduced species.

Several factors have contributed to the disturbance and disruption of the vegetation at the Santa Ana River site. Tide gates have drastically diminished the natural ebb and flow of the tides in the coastal salt marsh. Channelization of the Santa Ana River and other flood control measures upstream have eliminated the major source of seasonal freshwater flooding and have reduced the extent of the freshwater marsh and willow riparian communities. Erosion control with asphalt along the bluffs of Newport Beach Mesa has eliminated some of the coastal sage scrub, although it eventually reinvaded some of the asphalted areas. Past cultivation of the fields north of Hamilton Avenue and disturbances associated with the operation of the oilfield (roads, pipelines, well sites, and even oil spills) have provided suitable habitats for the establishment of introduced weedy species. Finally, mowing and removal of vegetation for fire prevention has probably had an adverse effect on the native species and increased the likelihood of establishment of introduced weedy species.

The goals of this study were to describe and map the vegetation and divide it into plant communities; compile a checklist of vascular plants; identify rare and endangered vascular plants that occur on the study site and attempt to locate them; and to discuss the flora and vegetation of this Santa Ana River study site with reference to comparable sites nearby -- the Bolsa Chica lowlands and Upper Newport Bay.

## 3.2 METHODS

Field work to compile a species checklist, field mapping of the vegetation, and extensive searches for rare and endangered species were all conducted throughout the study (December 1983 to October 1984), while quantitative vegetation sampling was performed from April to October, 1984.

### 3.2.1 QUANTITATIVE PLANT COMMUNITY ANALYSIS

Delimitation and description of the plant communities involved analyzing species cover measurements, calculation of similarity indices, and performing cluster analyses based upon similarity index values.

Absolute Cover was estimated using the point intercept method (Goodall 1952, Mueller-Dumbois and Ellenberg 1974). This method is performed by walking through the vegetation and dropping a narrow pointed rod at regular, predetermined intervals. At each interval the rod is dropped vertically at arms length in a predetermined direction which is constant for the course of the transect. The rod is dropped without looking to avoid subjective "aiming". Species intercepted by the rod when it is dropped are recorded as "hits". A species is only recorded once at each sampling point. If no plants are intercepted by the rod, then litter or bare ground are recorded, as appropriate. To minimize subjective sampling, the interval of sampling was kept constant for each transect. Generally the interval was every third step, but in some vegetation types the interval was shortened or lengthened depending on the size of the area being sampled. For the most part the transects were a set of parallel line segments separated by about five paces. Transects were walked by sighting on a distant feature to maintain a straight transect thus avoiding a biased sample. Only along channel or pond margins, where the transect was intended to reflect the vegetation along the edge of the channel or pond, were transects deliberately not straight. In willow riparian habitats and ruderal fields dominated by pampas grass or giant reed it was impossible to maintain a straight transect. The dense growth of the vegetation was impenetrable in places and sighting on a distant reference point was not always possible. In these areas the sampling was performed as objectively as possible, despite these difficulties. Cover of willows in the willow riparian community was difficult to determine because of their height. Cover in this situation was measured with the aid of a reference point held vertically, anything within the line of sight of the reference point was recorded as cover. Goodall (1952) recommends that over 200 point intercepts be sampled for each plant association being studied. In this study, each individual transect included 100 or more point intercepts, however, two or more transects were sampled within most of the plant associations. Approximate locations of the sampling transects are mapped in Figure 3-1.

Percent Cover of a Species (Y) is calculated from the transect data by:

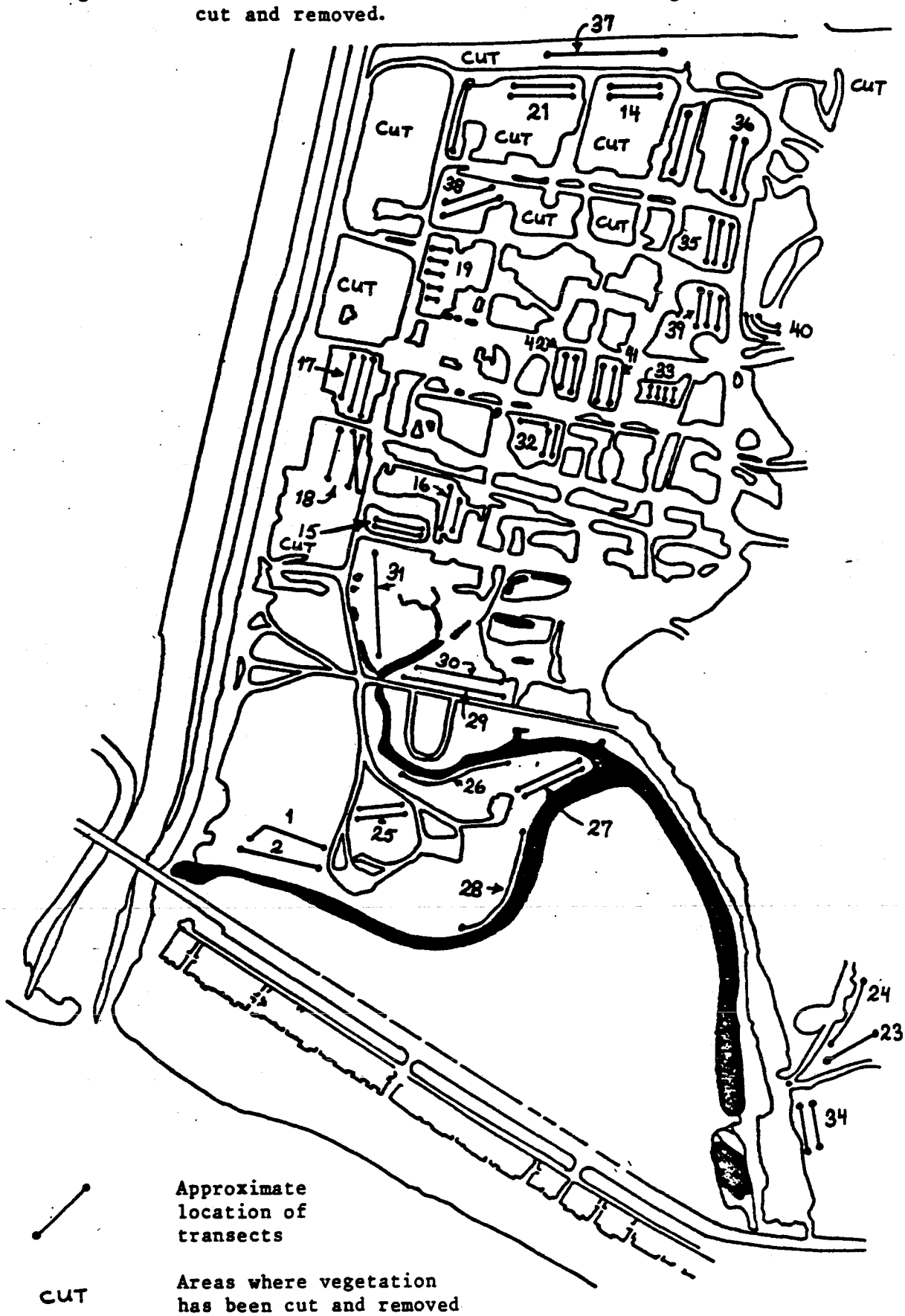
$$\frac{\text{(Number of "hits" for Species Y)}}{\text{(Total number of sampling points)}} \times 100\%$$

Similarity among transects was measured using a modification of Sørensen's community coefficient -- the Motyka similarity index (Mueller-Dombois and Ellenberg 1974) -- calculated by the following formula:

$$S_{Mo} = [2Cw / (CA + CB)] \times 100$$

Where Cw is the sum of the smaller cover values of those species common to both transects; CA is the total cover for Transect A; and CB is the total cover for Transect B.

Figure 3-1. Location of transects and areas where vegetation has been cut and removed.



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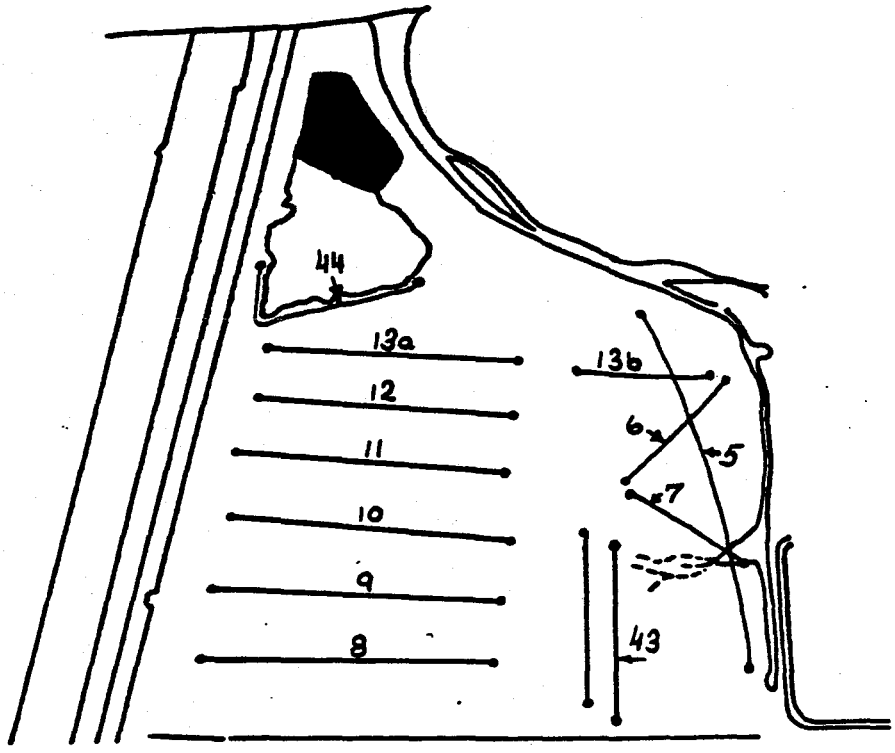

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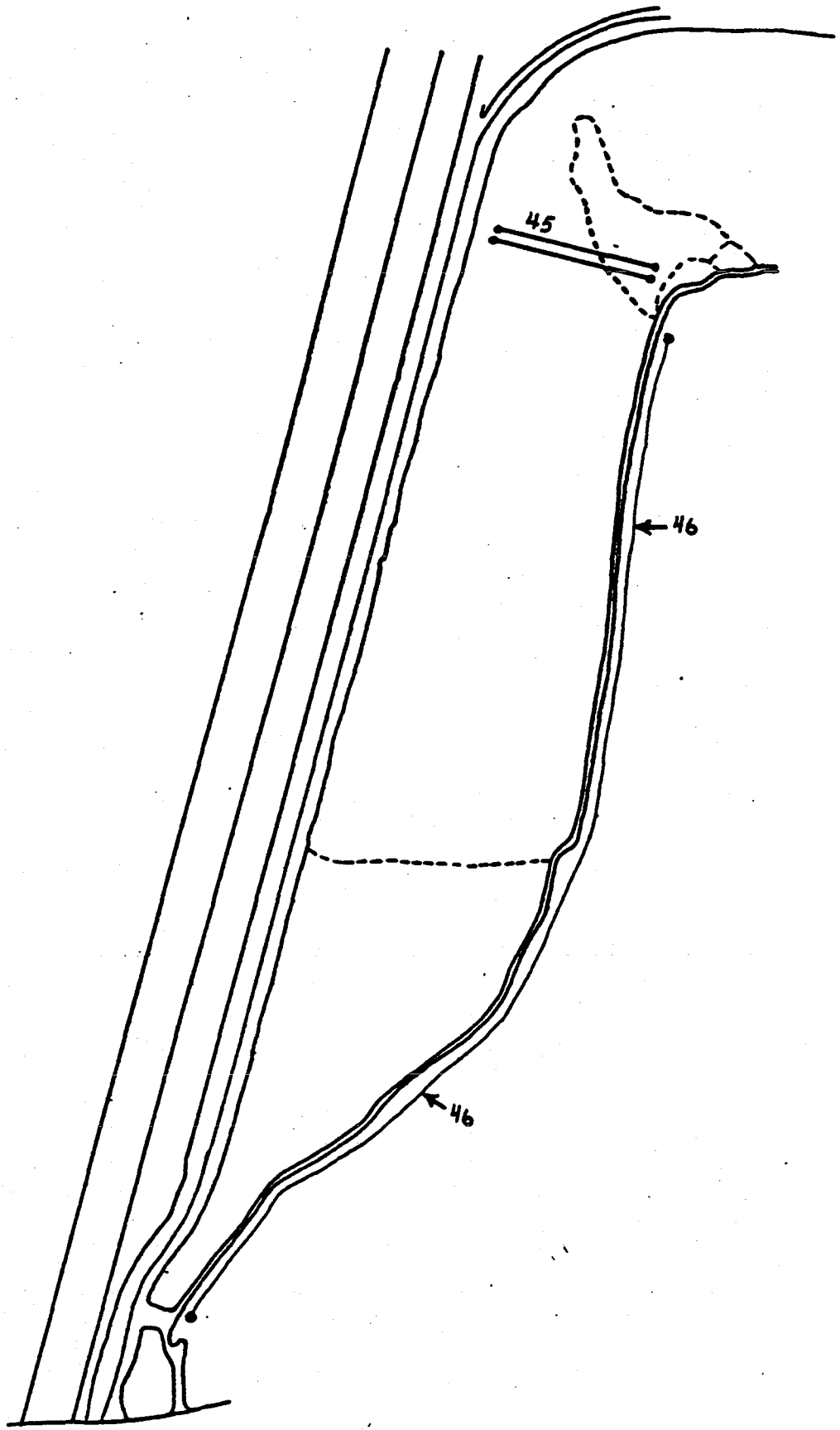


To insure subsequent clustering of all the willow riparian habitats together, all species of willow were grouped together. Without this "lumping" the willow riparian area north of 19th Street that had Cortaderia atacamensis (pampas grass) as a common understory would have clustered with the ruderal fields dominated by pampas grass. Also the willows are all Salix lasiolepis north of 19th Street while the willows south of 19th Street are primarily Salix laevigata. This is a justifiable grouping of species because these two areas of willows probably represent only minor variations of a once more extensive willow riparian community. Also these two willow species are closely related, have similar ecological preferences, and are by far the dominant species when community biomass is considered.

Annual grass species were also grouped together in the ruderal field communities dominated by Arundo donax (giant reed) because of the difficulty of determining species during the time the fields were being sampled. This is discussed in more detail below.

### 3.2.2 CLUSTER ANALYSIS

Cluster analysis of the transects sampled, based on their similarity indices, was performed using the Unpaired Group Method and Arithmetic Averages (UPGMA; Sneath and Sokal 1973). Cluster analysis successively groups together the most similar transects, or group of transects, until all transects are incorporated into a single group. The resulting dendrogram constructed from the clustering sequence is a useful aid in defining the limits of plant communities.

## 3.3 GENERALIZED PLANT COMMUNITY TYPES

Preliminary reconnaissance mapping in mid-January, 1984, resulted in the study site vegetation being tentatively divided among ten different plant communities (Macdonald 1984a). Subsequent detailed field mapping and quantitative vegetation analysis supported a simpler but more objective classification that recognized only six separate plant community types.

The general characteristics of these six plant communities are outlined below. The results of the quantitative vegetation analysis that support their objective reality are presented in Section 3.7.

### 3.3.1 COASTAL SALT MARSH

The coastal salt marsh community is composed of low vegetation that is normally under some tidal influence. At the Santa Ana River site, many areas have had tidal connections severed by roads and dikes, yet the community is still coastal salt marsh although some non-salt marsh species do occur. This community can be divided into areas with some tidal influence (although greatly diminished), and areas without any tidal connection. The former is simply "coastal salt marsh" while the latter is "remnant coastal salt marsh." Together they comprise about 64 acres. Salicornia virginica (pickleweed) is the dominant in both, and Frankenia grandiflora is the common associate. Limonium californicum (sea-lavender), Jaumea carnosa, Batis maritima (saltwort), Salicornia subterminalis, Monanthochloe littorialis (shore-grass), etc. are typical of the coastal salt marsh, but are not very frequent or are absent in the remnant coastal salt marsh. In the remnant coastal salt marsh there

are more weedy species and some freshwater species that may be responding to local freshwater seepage.

Although no quantitative attempt is made here to divide the marsh into "zones", there is a weak vertical zonation. With the lack of an adequate tidal prism there is no "lower littoral zone." Only along the tidal channel margins is there a species composition that could be considered "middle littoral." The remainder of the salt marsh is representative of the "upper littoral zone" (sensu Vogl, 1966, cf. "high marsh").

### 3.3.2 FRESHWATER MARSH

The freshwater marsh community usually occurs between the willow riparian community and either coastal salt marsh, or ruderal fields. Freshwater marsh also occurs around the perimeter of Victoria Pond, where the willow riparian community is absent. This habitat has either free standing fresh or brackish water, or at least saturated soil. The total area occupied by this community is about 21 acres. The community is composed of vegetation that reaches 6 ft. (2 m) or more tall, but also may only be as tall as 1.5 ft. (50 cm). The dominant species are Baccharis glutinosa (mule-fat), Typha latifolia (common cat-tail), Xanthium strumarium (cocklebur), Scirpus californicus (California bulrush), and Artemisia biennis. Other species with lower cover values but typical of the community are Atriplex patula, Chenopodium spp., Conyza canadensis (horseweed), Sida leprosa (alkali mallow), Rumex crispus (curley dock), Pluchea purpurascens, and Salix laevigata.

### 3.3.3 WILLOW RIPARIAN

The willow riparian community occurs along the base of Newport Beach Mesa bluffs from about the middle of the oilfield, north to halfway between 19th Street and Hamilton Avenue. It is also present in the mesa side canyon at the southern end of the study site. Total area of this community is about 12 acres. The community is obviously distinct from other communities because of the dominance of willow trees, which attain a height of 3-40 ft. (10-13 m). Freshwater is present, with vernally free standing water or very wet ground. The dominant species are Salix laevigata where there are vernal pools and Salix lasiolepis where the soil is well saturated but without pools. The understory species are Artemisia biennis, Arundo donax (giant reed), Baccharis glutinosa (mule-fat), Chenopodium spp., Cortaderia atacamensis (pampas grass), Cyperus eragrostis, Eleocharis montevidensis, Ricinus communis (castor-bean), and most of the species of the freshwater marsh with which this community intergrades.

### 3.3.4 RUDERAL FIELDS

Ruderal fields include a group of diverse plant associations that have been "lumped" into this broad category because of the dominance of weedy introduced species. The total area covered by this heterogeneous assemblage is about 295 acres, making it the most widespread across the study site. Nonetheless the community can be subdivided based on species composition.

Since there are differences between ruderal fields south of 19th Street and those between 19th Street and Hamilton Avenue, their most common species will

be listed separately. These differences may be related to salinity, soil texture, frequency of disturbance, and time since last disturbance.

For ruderal fields south of 19th Street the more common species are Atriplex patula hastata, Sida leprosa (alkali mallow), Conium maculatum (poison hemlock), Foeniculum vulgare (sweet fennel), Polypogon monspeliensis, Solidago occidentalis, Silybum marianum (milk-thistle), and Bassia hyssopifolia.

For ruderal fields between Hamilton Avenue and 19th Street the more common species are Sida leprosa (alkali mallow), Bromus diandrus (rip-gut grass), Bromus mollis (soft chess), Cirsium vulgare (thistle), Atriplex patula hastata, Conium maculatum (poison hemlock), Picris echioides, and Baccharis piluaris (coyte bush).

Ruderal fields dominated by pampas grass are characterized by wetter ground that other ruderal fields, and approached a freshwater marsh. Common species include Cortaderia atacamensis (pampas grass), Picris echioides, Sida leprosa (alkali mallow), Cyperus eragrostis, Baccharis glutinosa (mule-fat), Baccharis piluaris (coyote bush), and Eleocharis montevidensis.

Ruderal fields in the extreme southwest area of the study site, and probably north of Hamilton Avenue, are dominated by Bromus diandrus (rip-gut grass). These areas are sandier than most other ruderal fields across the study site.

Another sandy area at the extreme north end of the study site is dominated by Arundo donax (giant reed). Annual grasses, Croton californica, Salix hindsiana (sandbar willow), Oenothera californica, and Heterotheca grandiflora (telegraph weed) also occur here.

### 3.3.5 COASTAL SAGE SCRUB

The coastal sage scrub community occupies the slopes of the Newport Beach Mesa and has been impacted by the application of asphalt to the mesa slopes for erosion control. It is also being encroached upon by Carpobrotus aequilaterus (sea-fig) wherever it has taken hold. Over 25 acres of the study site are covered by coastal sage scrub. The dominant species are Encelia californica, Eriogonum fasciculatum (California buckwheat), and Opuntia littoralis. Other characteristic species include Opuntia prolifera, Isomeris arborea (bladder-pod), Rhus integrifolia, and Dudleya lanceolata.

Exotic plants are planted between the dirt access road and remnant tidal channel in the southwestern part of the study site, across the channel from the residential area. These plants receive supplemental water, without which most would not persist.

## 3.4 VEGETATION MAP

A preliminary vegetation map of the study site, prepared by Dr. Barry Prigge in January 1984 (Macdonald 1984b), included ten different plant assemblages. Subsequent field visits and the results of plant cover data analysis (Section 3.7) led Dr. Prigge to consolidate these ten assemblages into six more generalized plant communities (Section 3.3).

Field observations were transfered to map sheets photo-reduced from a blue-line topographic map set (scale 1 inch equals 50 feet) provided by the U.S. Army Corps of Engineers, Los Angeses District. This map set had been compiled by American Aerial Surveys, Inc., using stereophotogrametric methods from photography dated 3-3-1978 (Contract No. DACW09-79-C-0012). Additional information was taken from black and white vertical aerial photos (late 1983) obtained from Aerial Map Industries, Santa Ana, California.

To assist in the preparation of the final vegetation map (and more accurately estimate ground cover of shrubs and trees -- pampas grass and willow trees, for example) a plane was charted from Long Beach Airport on June 27, 1984, and the study site was photographed from altitudes of 3,000 to 4,000 feet.

The final vegetation map and its accompanying legend are reproduced here on four successive pages as Figure 3-2, at a scale of approximately one inch equals 750 feet. A larger version of the same map (scale one inch equals 500 feet) is included in the envelope at the back of this report.

## 3.5 PLANT SPECIES INVENTORY

The total vascular plant flora of terrestrial areas at the Santa Ana study site consists of 168 species and is presented in Table 3-1. Of this total species list, 60 species are naturalized introductions and 33 are exotic cultivated plants.

When exotic cultivated plants are excluded, the total number of naturalized and native species collected at Santa Ana was 135; 33 species less (coincidentially) than that collected at nearby Bolsa Chica lowlands (Hendrickson's Bolsa Chica list also exluded non-naturalized cultivated exotics and contains 168 species; Dillingham Corp. 1971). This does not necessarily mean that one should expect to find every species that was collected at Bolsa Chica at the Santa Ana site nor *vice versa*. The Bolsa Chica site is almost three times larger than the Santa Ana site, and it has more diverse habitats than the Santa Ana Site (Dillingham Corp. 1971). Nonetheless, one should be aware of some of the species *not* found. These are: *Amblyopappus pusillus*, *Ambrosia chamissonis*, *Atriplex canescens*, *A. watsonii*, *Cakile maritima*, *Calystegia soldonella*, *Cuscuta salina*, *Juncus acutus* var. *sphaerocephalus*, *Salicornia bigelovii*, and *Spartina foliosa*. *Triglochin maritima* and *Cordylanthus maritimus* subsp. *maritimus* were found nearby in the marsh at upper Newport Bay (Vogl 1966), but not in the Santa Ana Marsh.

Since there is no open connection with the ocean, absence of *Spartina foliosa* and perhaps *Salicornia bigelovii* would be expected (Macdonald 1977). Absence of the rare and endangered plants *Astragalus pycnostachys* var. *lanosissima* and *Cordylanthus maritimus* subsp. *maritimus* may also be explained by the lack of tidal flow and hence hyper-salinity.

Most of the freshwater marsh is highly dissected by roads, periodically dry, and cut during dry spells for fire control. This may account for the absence of *Scirpus olneyi* and *Juncus acutus* var. *sphaerocephalus*.

The almost complete lack of mud flats may account for the absence of *Amblyopappus pusillus*, and the absence of a dune habitat may account for the

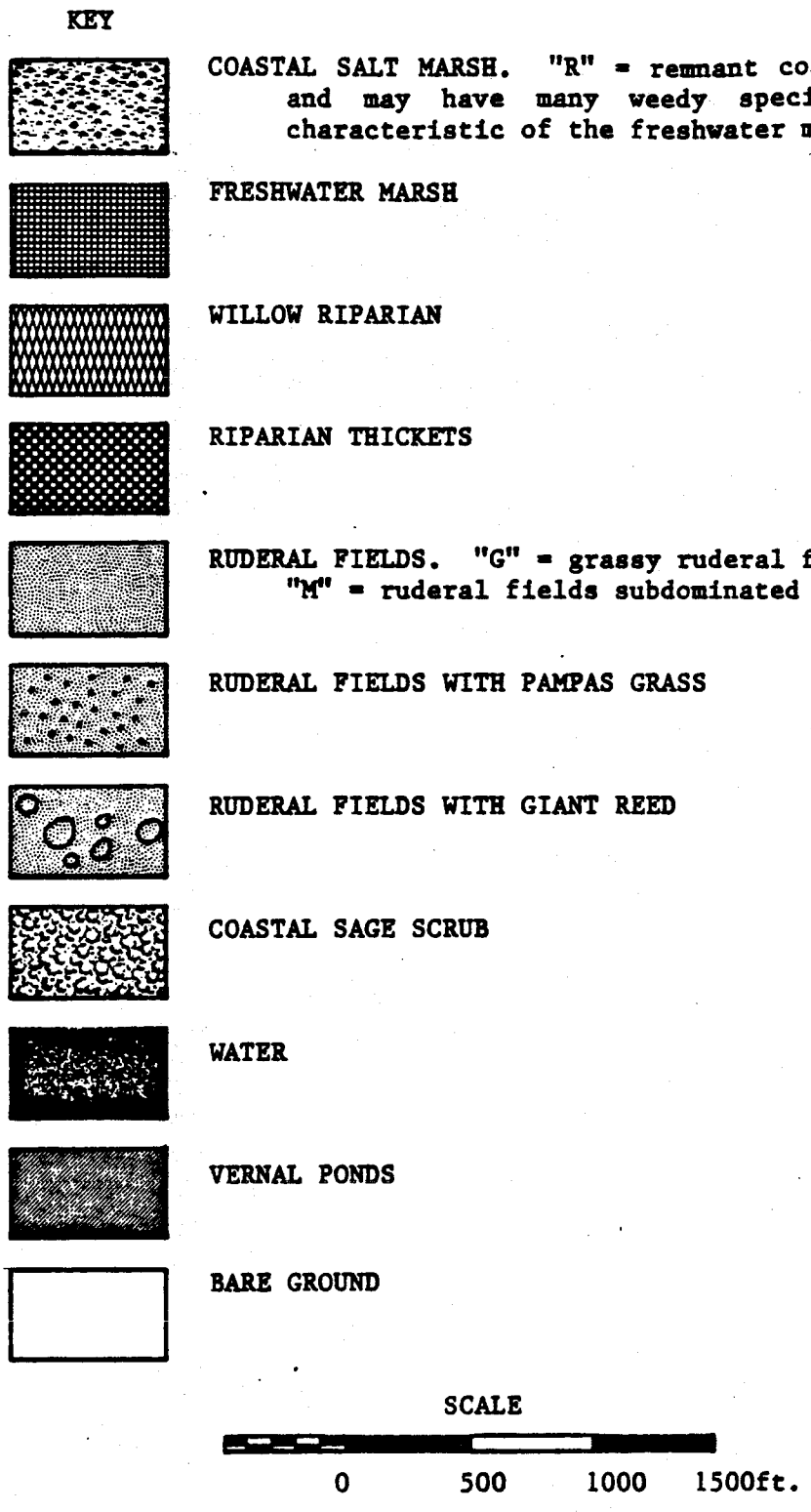



Figure 3-2. Vegetation map of the Santa Ana River marsh and adjacent lowlands.

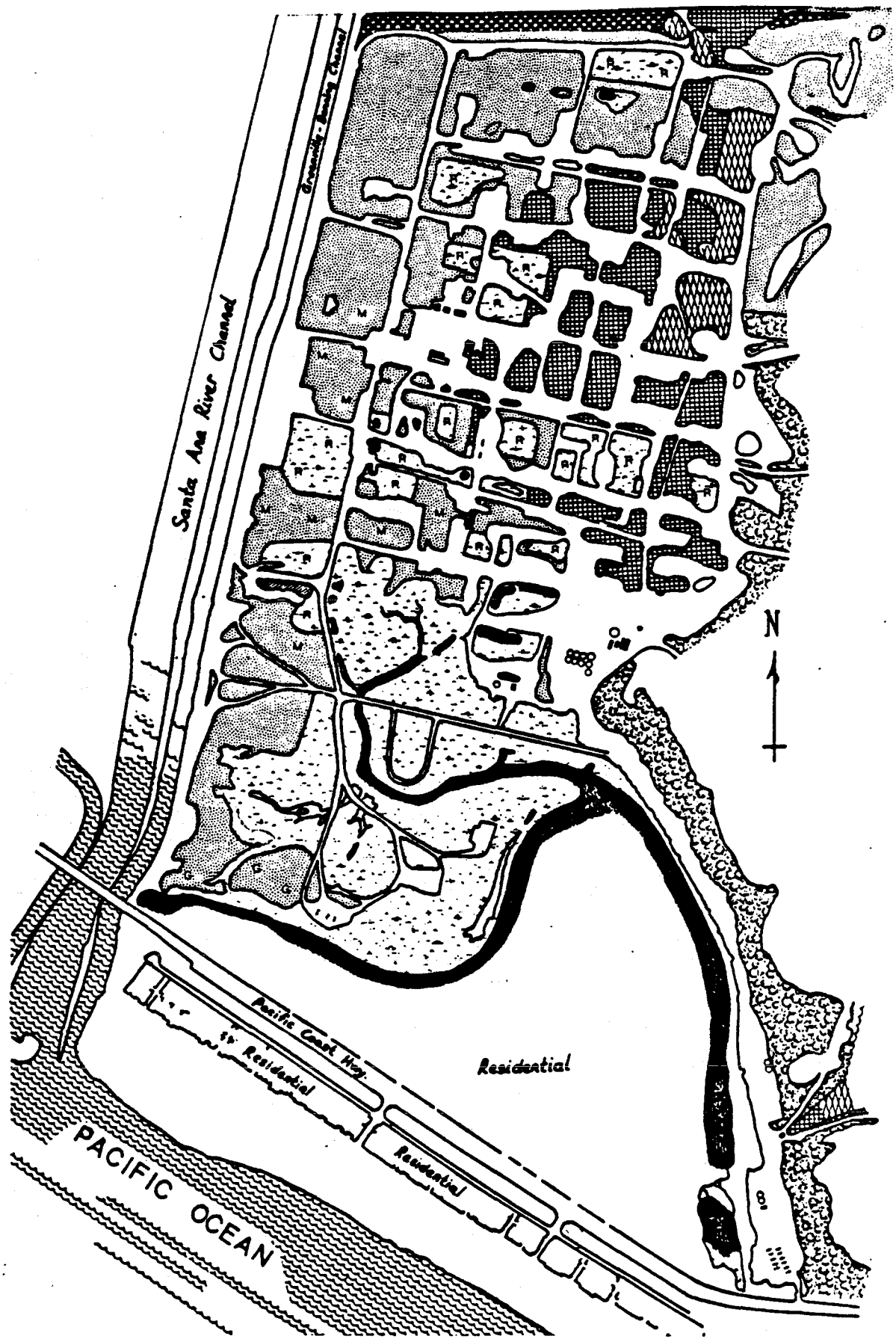



Figure 3-2 (Continued).

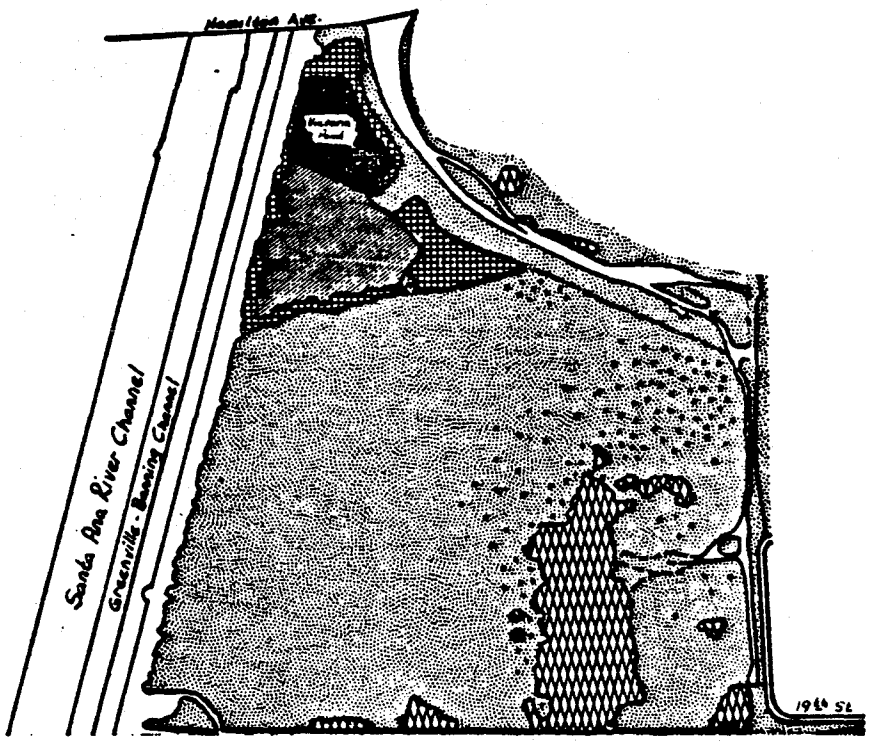



Figure 3-2 (Continued).

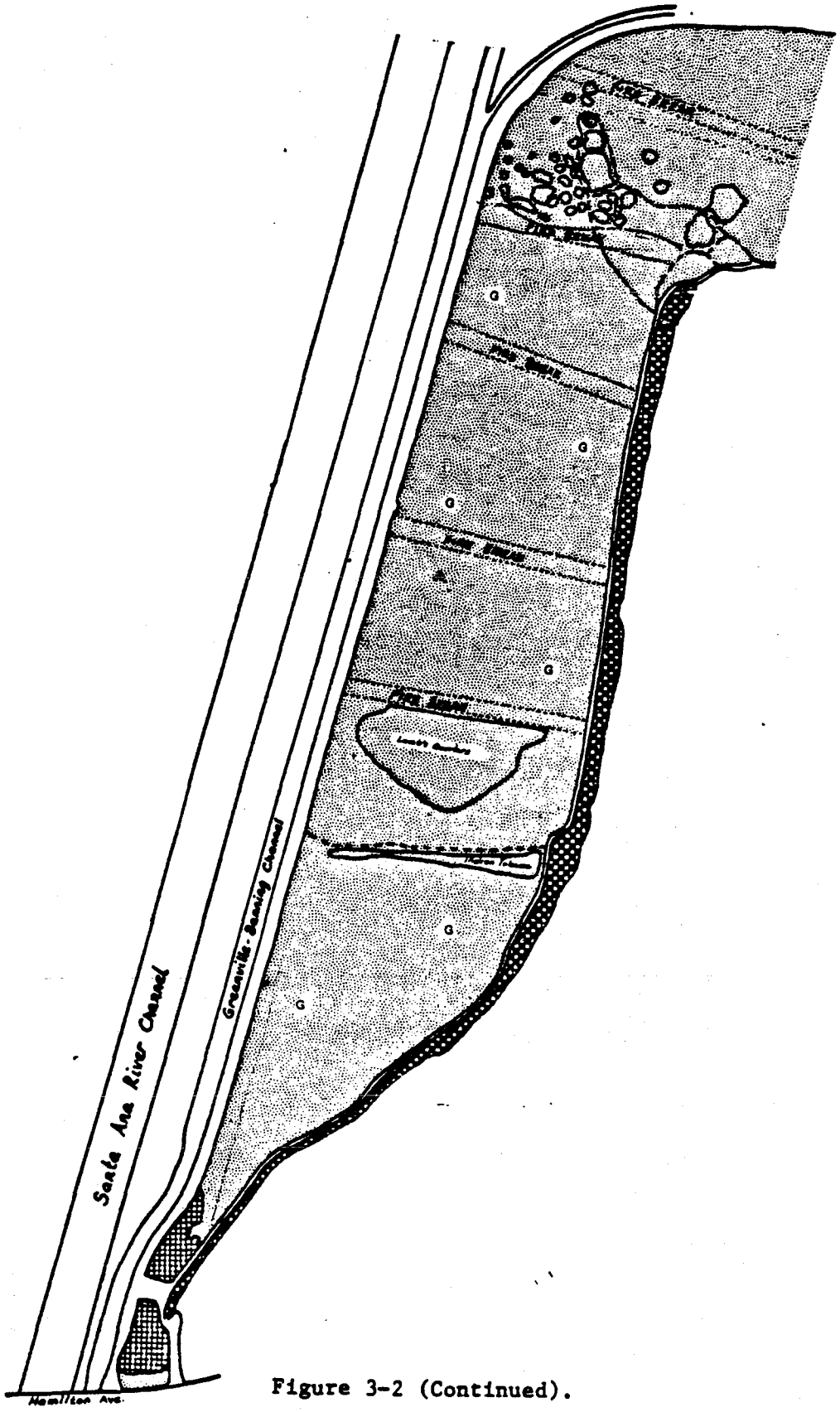



Figure 3-2 (Continued).

Table 3-1. Checklist of Vascular Plants of Santa Ana Marsh and Adjacent Lowlands. (CSM = coastal salt marsh; FM = freshwater marsh; WR = willow riparian; RT = riparian thickets; RF = ruderal fields; CSS = coastal sage scrub; and CV = cultivated. * = naturalized introduction; ‡ = non-naturalized introduction).

| Scientific Name/Common Name | CSM | FM | WR | RT | RF | CSS | CV |
|---|---|---|---|---|---|---|---|
| Abronia maritima Nutt. ex Wats. | | | | | RF | | |
| ‡Acacia longifolia Willd. Sydney Golden Wattle | | | | | | | CV |
| ‡Agave americana L. Century Plant | | | | | | | CV |
| ‡Agave attenuata Salm-Dyck. | | | | | | | CV |
| ‡Agave sp. | | | | | | | CV |
| Agropyron parishii Scribn. & Sm. | | | | RT | | | |
| ‡Aloe sp. | | | | | | | CV |
| *Amaranthus albus L. | | | | RT | RF | | |
| Ambrosia psilostachya DC. var. californica (Rydb.) Blake. | CSM | | | | RF | | |
| Amorpha californica Nutt False Indigo | | FM | | | | | |
| *Anagallis arvensis L. | | FM | | | RF | | |
| *Anagallis minimus (L.) Krause | | | | | RF | | |
| Anemopsis californica Hook. Yerba Mansa | | FM | WR | | | | |
| *Anthemis cotula L. Mayweed | | | | | RF | | |
| *Apium graveolens L. Celery | | | | RT | RF | | |
| *Arundo donax L. Giant Reed | | FM | WR | RT | RF | | |

Table 3-1 (continued).

| Scientific Name/Common Name | CSM | FM | WR | RT | RF | CSS | CV |
|---|---|---|---|---|---|---|---|
| †Araucaria heterophylla (Salisb.) Franco<br>Norfolk Island Pine<br>[A. excelsa R. Br.]. | | | | | | | CV |
| *Artemisia biennis Willd. | | FM | WR | RT | | | |
| Artemisia douglasiana Bess. in Hook. | | | | RT | RF | | |
| *Aster exilis Ell. | | FM | | | RF | | |
| Atriplex lentiformis (Torr.) Wats.<br>subsp. breweri (Wats.) Hall & Clem. | | | | RT | | | |
| Atriplex patula L.<br>subsp. hastata (L.) Hall. & Clem. | CSM | | | | RF | | |
| Atriplex rosea L.<br>Redscale | CSM | | | | RF | | |
| *Atriplex semibaccata R. Br.<br>Australian Saltbush | CSM | | | | | | |
| *Avena barbata Brot.<br>Slender Wild Oat | | | | | RF | | |
| Baccharis emoryi Gray | | | | | RF | | |
| Baccharis glutinosa Pers.<br>Mule Fat | | FM | WR | RT | RF | CSS | |
| Baccharis pilularis DC.<br>subsp. consanguinea (DC.) C.B. Wolf.<br>Coyote Bush | | | | | RF | | |
| *Bassia hyssopifolia (Pall.) Kuntze. | CSM | | | | RF | | |
| Batis maritima L.<br>Saltwort | CSM | | | | | | |
| *Beta vulgaris L.<br>Garden Beet, Sugar Beet | | | | | RF | | |
| †Bougainvillea X buttiana Holtt. & Standl.<br>Bougainvillea | | | | | | | CV |
| *Brassica geniculata (Desf.) J. Ball | | | | | RF | | |
| *Brassica nigra (L.) Koch.<br>Black Mustard | | | | | RF | CSS | |

Table 3-1 (continued).

| Scientific Name/Common Name | CSM | FM | WR | RT | RF | CSS | CV |
|---|---|---|---|---|---|---|---|
| *Bromus diandrus Roth.<br>Ripgutgrass | | | | | RF | | |
| *Bromus mollis L.<br>Soft Chess | | | | | RF | | |
| *Bromus rubens L.<br>Foxtail Chess | | | | | RF | | |
| *Bromus unioloides (Willd.) H.B.K.<br>Rescuegrass | | | | | RF | | |
| ‡Callistemon citrinus (Curtis) Skeels.<br>Bottle-Brush | | | | | | | CV |
| Carpobrotus aequilaterus (Haw.) N. E. Brown. [Mesembr. chilense Mol.]<br>Sea-Fig | CSM | | | | RF | CSS | |
| *Centaurea melitensis L.<br>Tocalote | | | | | RF | | |
| *Chenopodium album L. | | FM | | RT | RF | | |
| *Chenopodium ambrosioides L.<br>Mexican Tea | | FM | WR | RT | RF | | |
| *Chenopodium murale L.<br>Nettle-leaved Goosefoot | CSM | | | | RF | | |
| *Chenopodium rubrum L. | | | | | | | |
| *Chrysanthemum coronarium L.<br>Garland | | | | | RF | | |
| Cirsium vulgare (Savi) Teir.<br>Thistle | | | | RT | RF | | |
| Clematis ligusticifolia Nutt. in T. & G.<br>Virgin's Bower | | | | RT | | | |
| Conium maculatum L.<br>Poison Hemlock | | FM | | RT | RF | | |
| *Convolvulus arvensis L.<br>Bindweed | | | | RT | | | |
| Conyza canadensis (L.) Cronq.<br>Horseweed | | FM | | RT | RF | | |

Table 3-1 (continued).

| Scientific Name/Common Name | CSM | FM | WR | RT | RF | CSS | CV |
|---|---|---|---|---|---|---|---|
| Conyza coulteri A. Gray | CSM | FM | | | RF | | |
| *Cortaderia atacamensis (Phil.) Pilger. [C. sellanoa]. Pampas Grass | | FM | WR | RT | RF | | |
| *Cotula coronopifolia L. Brass-Buttons | | | | | RF | | |
| ‡Crassula ovata (Mill.) Druce Jade Plant | | | | | | | CV |
| Cressa truxillensis HBK. var. vallicola (Heller) Munz. Alkali Weed | CSM | | | | RF | | |
| Croton californicus var. californicus Croton | | | | | RF | | |
| Cucurbita foetidisissima H.B.K. | | | | | RF | | |
| ‡Cupaniopsis anacardioides (A. Rich) Radlkofer Carrot-Wood, Tuckeroo | | | | | | | CV |
| ‡ Cupressocyparis leylandii (A.B. Jacks. & Dallim) Dallim & A.B. Jacks. | | | | | | | CV |
| ‡Cupressus sempervirens L. Italian Cypress | | | | | | | CV |
| Cuscuta campestris Yunck. Dodder | | FM | WR | | | | |
| *Cynodon dactylon (L.) Pers. Bermuda Grass | | | | RT | RF | | |
| ‡Cyperus alternifolius L. Umbrella-Plant | | | | | | | CV |
| Cyperus eragrostis Lam. | | FM | WR | RT | RF | | |
| Datura meteloides A. DC. Jimsonweed | | | | | RF | | |
| *Dimorphotheca pluvialis Moench. | | | | | RF | | |

Table 3-1 (continued).

| Scientific Name/Common Name | CSM | FM | WR | RT | RF | CSS | CV |
|---|---|---|---|---|---|---|---|
| Distichlis spicata (L.) Greene var. spicata<br>Saltgrass | CSM | FM | | | | | |
| ‡Dodonaea viscosa (L.) Jacq. cv. 'purpurea'<br>Hopseed Tree | | | | | | | CV |
| Dudleya lanceolata | | | | | | CSS | |
| Echinochloa colona (L.) Link<br>Jungle-Rice | | | | | RF | | |
| Eleocharis montevidensis Britt. in Small.<br>Common Spike Rush | | | WR | | RF | | |
| *Elymus triticoides Buckl.<br>Alkali Rye Grass | | | | | RF | | |
| Encelia californica Nutt. | | FM | | | | CSS | |
| Eremocarpus setigerus (Hook.) Benth.<br>Turkey-Mullein | | | | | RF | | |
| Eriogonum fasciculatum Benth. subsp. fasciculatum.<br>California Buckwheat | | | | | | CSS | |
| *Erodium botrys (Cav.) Bertol<br>Filaree | | | | | RF | | |
| *Erodium cicutarium (L.) L'Her.<br>Filaree | | | | | RF | | |
| ‡Eucalyptus globulus Labill.<br>Blue Gum | | | | RT | | | CV |
| ‡Eucalyptus lehmannii (Preiss ex Schauer) Benth.<br>Bushy Yate | | | | | | | CV |
| Festuca pratensis Huds.<br>Meadow Fescue | | | | | RF | | |
| *Foeniculum vulgare Mill.<br>Sweet Fennel | | | | | RF | | |
| Frankenia grandifolia Cham. & Schlecht.<br>Alkali-Heath | CSM | FM | | | RF | | |

Table 3-1 (continued).

| Scientific Name/Common Name | CSM | FM | WR | RT | RF | CSS | CV |
|---|---|---|---|---|---|---|---|
| †Gazania cultivar<br>Gazania | | | | | | | CV |
| Gnaphalium chilense Spreng. | | | | | RF | | |
| Haplopappus venetus (HBK) Blake subsp. vernonioides (Nutt.) Hall | | | | | RF | CSS | |
| Heliotropium curassavicum L. var. oculatum (Heller) Jtn.<br>Heliotrope | CSM | FM | | | RF | | |
| Hemizonia ramosissima Benth. | | | | | RF | | |
| Heterotheca grandiflora Nutt.<br>Telegraph Weed | CSM | FM | | RT | RF | CSS | |
| *Hordeum leporinum Link | | | | | RF | | |
| Isomeris arborea Nutt. var. arborea<br>Bladderpod | | | | | | CSS | |
| Jaumea carnosa (Less.) Gray | CSM | | | | | | |
| Juncus phaeocephalus Engelm var. phaeocephalus<br>Wire-Grass, Rush | | | WR | | RF | | |
| Limonium californicum (Boiss) Heller.<br>Sea-Lavender | CSM | | | | | | |
| *Lippia incisa (Small) Tides. | | | | | RF | | |
| *Lobularia maritima Desv.<br>Sweet Alyssum | | | | | RF | | |
| *Lolium perenne L. | | | | | RF | | |
| Lotus scoparius (Nutt. in T. & G.) Ottley subsp. scoparius.<br>Dearbush | | | | | RF | | |
| †Malephora crocea<br>Ice Plant | | | | | RF | | CV |
| Marah macrocarpus (Greene) Greene<br>Wild Cucumber | | | | | | CSS | |

Table 3-1 (continued).

| Scientific Name/Common Name | CSM | FM | WR | RT | RF | CSS | CV |
|---|---|---|---|---|---|---|---|
| *Marrubium vulgare L.<br>Horehound | | | | | RF | CSS | |
| *Melilotus albus Desr.<br>Sweet Clover | | | WR | RT | RF | | |
| Mesembryanthemum crystallinum L.<br>[Gasoul crystallinum (L.) Rotm.]<br>Ice Plant | CSM | | | | | | |
| Mesembryanthemum nodiflorum L. | CSM | | | | | | |
| Monanthochloe littoralis Engelm.<br>Shoregrass | CSM | | | | | | |
| ‡Myoporum laetum Forst. f. | CSM | FM | | | RF | CSS | CV |
| *Nerium oleander L.<br>Oleander | | | | | | | CV |
| *Nicotiana glauca Grah.<br>Tree Tobacco | | FM | WR | RT | RF | CSS | |
| Oenothera californica Wats. | | | | | RF | | |
| Opuntia littoralis (Englem.)<br>Cockerell | | | | | RF | CSS | |
| Opuntia prolifera Engelm. | | | | | | CSS | |
| *Oxalis pes-caprae L.<br>Bermuda-Buttercup | | | | | RF | | |
| *Paspalum dilatatum L.<br>Knotgrass | | | | | RF | | |
| ‡Pelargonium hybrid<br>cf. X hortorum Bailey<br>Fish Geranium | | | | | | | CV |
| ‡Pelargonium peltatum Ait.<br>Ivy Geranium | | | | | | | CV |
| ‡Philodendron sp. | | | | | | | CV |
| ‡Phoenix canariensis Hort.<br>Canary Island Date Palm | | | | | | | CV |
| *Picris echioides | | FM | WR | RT | RF | | |

Table 3-1 (continued).

| Scientific Name/Common Name | CSM | FM | WR | RT | RF | CSS | CV |
|---|---|---|---|---|---|---|---|
| †Pinus cf. halapensis Mill.<br>Allepo Pine | | | | | | | CV |
| †Pinus sp. (5 needles) | | | | | | | CV |
| *Plantago major L.<br>Common Plantain | | | WR | | | | |
| Pluchea purpurascens | | FM | | | | | |
| Polygonum lapathifolium L.<br>Willow Smartweed | | FM | WR | RT | | | |
| Polygonum punctatum Ell.<br>Perennial Smartweed | | FM | WR | RT | | | |
| *Polypogon monspeliensis (L.) Desf. | CSM | FM | | | RF | | |
| *Pyracantha sp. | | | WR | | | | |
| *Raphanus sativus L. | | | | | RF | | |
| Rhus integrifolia (Nutt.) Benth. & Hook. | | | | | | CSS | |
| *Ricinus communis L.<br>Castor-Bean | | FM | WR | RT | RF | CSS | |
| Rubus ursinus C. & S.<br>California Blackberry | | FM | | RT | | | |
| Rosa californica C. & S.<br>California Rose | | | | RT | | | |
| *Rumex crispus L.<br>Curley Dock | CSM | FM | WR | RT | RF | | |
| Salicornia subterminalis Parish<br>Pickleweed | CSM | | | | | | |
| Salicornia virginica L.<br>Pickleweed | CSM | FM | | | | | |
| Salix goodingii Ball<br>var. variablis Ball | | FM | | | RF | | |
| Salix hindsiana Benth.<br>var. hindsiana<br>Sandbar Willow | | | | | RF | | |

Table 3-1 (continued).

| Scientific Name/Common Name | CSM | FM | WR | RT | RF | CSS | CV |
|---|---|---|---|---|---|---|---|
| Salix lasiolepis Benth. var. lasiolepis Arroyo Willow | | | WR | | | | |
| Salix laevigata Bebb | | FM | WR | | | | |
| *Salsola iberica Sennen & Pau. Russian-Thistle | | | | | RF | | |
| Sambucus mexicana Presl. Elderberry | | | WR | RT | | CSS | |
| ‡Schinus terebinthifolius Raddi. Brazilian Pepper Tree | | | | | | | CV |
| Scirpus californicus (C.A. Mey.) Stud. California Bulrush | | FM | WR | RT | | | |
| Scirpus robustus Pursh | CSM | FM | | | | | |
| *Sesuvium verrucosum Raf. Sea Purslane | CSM | | | | | | |
| Sida leprosa Alkali Mallow | CSM | FM | WR | RT | RF | | |
| *Silybum marianum (L.) Gaertn. Milk Thistle | CSM | FM | | | RF | | |
| Sisymbrium irio L. | | | | | RF | | |
| Solanum douglasii Dunal in DC. Nightshade | | | WR | RT | RF | | |
| *Sonchus asper (L.) Hill | | | | | RF | | |
| *Sonchus oleraceus L. Sow-Thistle | | | | | RF | | |
| Spergularia marina (L.) Griseb. | CSM | | | | | | |
| *Stenotaphrum secundatum (Walt.) Kuntze. Saint Augustine Grass | | | | | RF | | |
| Stephanomeria virgata Benth. | CSM | | | | RF | CSS | |

Table 3-1 (continued).

| Scientific Name/Common Name | CSM | FM | WR | RT | RF | CSS | CV |
|---|---|---|---|---|---|---|---|
| †Strelitzia nicoli Regel. & Koern. Giant Bird-of-Paradise | | | | | | | CV |
| Suaeda californica Wats. var. pubescens Jeps. | CSM | | | | RF | CSS | |
| *Tamarix ramosissima Ledeb. Salt-Cedar | | FM | | | | | |
| Tetragonia tetragonioides (Pallas) Kuntze New Zealand-Spinach | CSM | | | | | | |
| †Trachycarpus fortunei (Hook.) H. Wendl. Windmill Palm | | | | | | | CV |
| *Trifolium sp. | | | | | RF | | |
| †Tropaeolum majus L. Garden Nasturtium | | | | | | | CV |
| Typha latifolia L. Common Cat-tail | | FM | WR | RT | | | |
| Urtica holosericea Nutt. Nettle | | | WR | RT | | | |
| Urtica urens L. Dwarf Nettle | | | | | RF | | |
| †Vitis sp. | | | | | | | CV |
| Vulpia myuros Rydb. | | | | | RF | | |
| †Washingtonia filifera (L. Linden) H. Wendl. California Fan Palm | | | | | | | CV |
| *Xanthium strumarium L. var. canadense (Mill.) T. & G. Cocklebur | | FM | WR | RT | | | |
| †Yucca cf. elephantipes Regel. Giant Yucca | | | | | | | CV |

absence of Atriplex canescens, Cakile maritima, Calystegia soldonella, and other dune species found at Bolsa Chica.

The remaining species might be present and should be looked for at Santa Ana. Climatic conditions during this study may not have been suitable for their growth and flowering this year, or the timing of field visits may not have coincided with their flowering periods and they were overlooked.

## 3.6 RARE & ENDANGERED PLANTS

No rare and endangered plants were found on the study site during this study. However, because the extremely dry spring this year may have prevented germination of some annuals, the possibility of finding rare and endangered plants on the study site in the future, cannot be completely ruled out.

In the initial survey of the literature (Smith, et al., 1980) thirteen rare and endangered species were identified as having the potential to occur on the study site (Table 3-2). Since then, "Plant Status Reports" (Appendix A) were requested from the California Native Plant Society for seven of these 13 species. The California Native Plant Society does not have status reports on the remaining five species. Also, a search of the herbarium at the University of California, Los Angeles and the integrated herbaria of Ponoma College and Rancho Santa Ana Botanic Garden in Claremont was made. Based on the plant status reports and the herbarium searches the following species should still be looked for: Aphanisma blitoides, Astragalus pycnostachys var. lanosissimus, Helianthus nuttallii subsp. parishii, and Perideridia gairdneri subsp. gairdneri. Aphanisma blitoides was probably collected from the study site in the 1932 (at sandy base of sea-cliffs, Costa Mesa, Orange Co., Munz 12192, Pomona Herbarium). Astragalus pycnostachys var. lanosissimus is likely to still persist in coastal salt marshes and was once reported from the marshes at the mouth of the Santa Ana River (see Appendix A). Cordylanthus maritimus subsp. maritimus is also likely to still persist in the coastal salt marsh although at present it is only known from the Tijuana River Estuary and the marsh at Point Mugu; it has been collected in upper Newport Bay and Bolsas Marsh. Less likely but bossible is Helianthus nuttallii subsp. parishii in the freshwater marsh, willow riparian and riparian thickets; it has been collected from Wintersberg [(near Huntington Beach), Perison 5247, Pomona Herbarium]- and far end of Newport Lagoon (Boot 1388 Pomona, Herbarium). Perideridia gairdneri supsp. gairdner could occur on the study site; it has been collected from areas adjoining the Bolsa Chica Gun Club. One has to remember that since the marsh is within the oil field operations, it has been off-limits to plant collectors for quite a while, and so the lack of recent records for the above mentioned species from this area is not unexpected.

Chorizanthe parryi var. fernandina, Dichondra occidentalis, and both of the Dudleya species have never been collected near the Santa Ana study site and can be safely removed from further consideration.

## 3.7 QUANTITATIVE VEGETATION ANALYSIS

Two factors have precluded obtaining completely satisfactory results for these vegetation studies. The first has been the paucity of rain this spring (Table 3-3). Although the fall of 1983 was very wet, the winter and spring

Table 3-2. Rare and Endangered Vascular Plants that may occur in the Santa Ana Marsh and adjacent Lowlands (extracted from Smith, et al. 1980).

| Scientific Name | Common Name | Comments (extracted from Munz, 1974) |
|---|---|---|
| Presumed Extinct | | |
| Astragalus pycnostachyus Gray var. lanosissimus (Rydb.) Munz & McBurne | Ventura marsh milk-vetch | Coastal marshes; Ventura Co. to Orange Co.; Last collected in 1967; collected in Seal Beach Quadrangle. |
| Helianthus nuttallii T. & G. subsp. parishii (Gray) Heiser | Los Angeles sunflower | Wet ground; Los Angeles, San Bernardino, and Orange Cos.; collected in Newport Beach Quadrangle; Aug.-Oct. |
| Plants Rare and Endangered | | |
| Aphanisma blitoides Nutt. | Aphanisma | Bluffs; coastal sage scrub, coastal strand; Los Angeles Co. to L. Calif.; Apr.-May. |
| Chorizanthe parryi Wats. var. fernandiana (Wats.) Jeps. | San Fernando Valley Chorizanthe | Dry sandy places, mostly coastal sage scrub; Los Angeles Co. to San Diego Co. |
| Cordylanthus maritimus Nutt. subsp. maritimus | Salt Marsh Bird's Beak | Coastal salt marsh; May-Oct.; collected in Newport Beach Quadrangle; May-Oct. |
| Dudleya multicaulis (Rose) Moran | Many-stemmed Dudleya | Dry stony places, coastal sage scrub; May-June; collected in Laguna Beach Quadrangle. |
| Dudleya stolonifera Moran | Laguna Beach Dudleya | Cliffs in coastal sage scrub; May-July; collected in Newport Beach Quadrangle. |
| Nasturtium gambelii O.E. Schulz [Cardamine gambelii S. Wats.] | Gambel's Watercress | Occasional in swampy places at low elev.; L. Calif to Sta. Barbara Co.; Apr.-June. |
| Perideridia gairdneri (H. & A.) Math. subsp. gairdneri | Gaidner's Yampah, Squaw Root | Wet places at low elev.; Sand Diego Co. to B.C., extinct in Orange Co.; June-July. |

Table 3-2, continued.

| Scientific Name | Common Name | Comments |
|---|---|---|
| Rare but not Endangered | | |
| Dudleya blochmanae (Eastw.) Moran subsp. blochmanae | Blochman's Live Forever | Coastal sage scrub, near coast; San Luis Obispo Co. to L. Calif.; May-June; presumably extinct in Orange Co. |
| Dudley cymosa (Lem.) Britt. & Rose subsp. ovatifolia | Sta. Monica Mountain Live Forever | Rocky places, coastal sage scrub, chaparral; Los Angeles & Orange cos. |
| Rare in California, common elsewhere | | |
| Calandrinia maritima Nutt. | Seaside Calandrinia | Sandy places, sea bluff, coastal sage scrub; March-May. |
| Dichondra occidentalis House | Western Dichondra | Dry sandy banks, coastal sage scrub, s. oak wd., chaparral; coastal San Diego, Orange & Los Angeles cos., Catalina, Sta Cruz, & Sta Rosa Ids. |

Table 3-3. Rainfall data for Newport Beach Harbor: October, 1983--May, 1984 (U.S. Nat. Oceanic and Atmospheric Admins. 1983, 1984).

| | Precipitation | |
|---|---|---|
| Month | 83-84 | Normal |
| October, '83 | 0.74 | 0.15 |
| November | 2.56 | 1.32 |
| December | 2.09 | 1.51 |
| January, '84 | 0.22 | 2.56 |
| February | 0.01 | 2.07 |
| March | 0.15 | 1.69 |
| April | 0.81 | 1.15 |
| May | 0.00 | 0.20 |
| June | | 0.06 |
| July | | 0.01 |
| August | | 0.08 |
| September | | 0.29 |
| TOTAL | 6.58 | 11.09 |
| TOTAL (Dec.--May) | 1.19 | 7.67 |

were abnormally dry. The normal rainfall for the first five months of the year is 7.67 inches, but this year only 1.19 inches was recorded at nearby Newport Beach Harbor.

The lack of adequate rain during 1984 resulted in conditions that were not suitable for germination, growth, and flowering of many annual plant species and may have affected the vigor of many of perennials also. This lack of rain may also have been the reason for our inability to locate individuals of rare and endangered plant species at the study site.

The dry year resulted in a very short sampling period for the ruderal fields. By the end of April the ruderal fields were already dry and most grass species were very difficult to identify because the inflorescences had dried up and blown away and the leaves and culms were already dry and unrecognizable. Thus the ruderal fields north of Hamilton Avenue are poorly sampled and for the purpose of calculating similarity indices, the unknown grasses have been "lumped" into Bromus diandrus, which was the most abundant grass.

The cutting of ruderal fields and freshwater marsh vegetation in the oilfield area (Figure 3-1) prevented sampling of some of these areas. The oilfield manager prefers to mow, collect and remove weedy vegetation every other year for fire control. Since the last few years have been very wet and the ground too soft to support mowing equipment, 1984 was the first time they have been able to cut and remove weeds and brush in four years.

### 3.7.1 SPECIES COVER DATA

Species percent cover data from the quantitative transect studies are presented in Tables 3-4 to 3-11. Similarity values $S_{Mo}$ among transects are presented in Table 3-12. Results from the cluster analysis are presented in dendrogram form in Figure 3-3.

### 3.7.2 CLUSTER ANALYSIS

In the cluster analysis ten clusters can be recognized at the 25% similarity level. While this is an apparently low value, the Motyka index is considered to be conservative. There is nothing unique about the 25% similarity level, except that it is the level where a meaningful split of the vegetation into distinct plant communities occurs for this particular study site.

The first cluster of 9 transects in Figure 3-3 is the coastal salt marsh community. All the transects fit well into this cluster with a minimum $S_{Mo}$ of 40%. The most dissimilar transect is number 18 which was taken from a site that had the appearance of a ruderal field. Silybum marianum (Milk-Thistle) was common (Table 3-4) and obscured the Salicornia virginica (Pickleweed) and Frankenia grandiflora from casual observation. This site is transitional to ruderal fields with which it also has a reasonably high degree of similarity (Table 3-7), at least for ruderal fields south of 19th Street. The area where transect 18 was taken, and similar areas, are mapped as remnant coastal salt marsh.

Transect 28, while yielding only a modest similarity value with other salt marsh transects, is without doubt also part of the coastal salt marsh community. This transect was taken along the edge of the tidal channel

Table3-4. Percent cover for coastal salt marsh and remnant coastal salt marsh.

| Transect / Species | 14 | 18 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 38 |
|---|---|---|---|---|---|---|---|---|---|---|
| Atriplex patula hastata | 5 | | | 14 | | <1 | | | | 4 |
| Baccharis glutinosa | | 1 | | | | | | | | |
| Bassia hyssopifolia | 2 | 1 | | | | | | | <1 | 7 |
| Beta vulgaris | <1 | | | | | | | | | |
| Bromus diandrus | | | 3 | | | | | | | |
| Carpobrotus aequilaterus | | | | | | <1 | | | | |
| Cirsium vulgare | | 1 | | | | | | | | |
| Conium maculatum | | 2 | | | | | | | | |
| Conyza canadensis | | 2 | | | | | | | | |
| Cressa truxillensis | | | | | | 2 | | | | |
| Distichlis spicata | | | | | | 13 | | | 1 | |
| Foeniculum vulgare | | | | | | | | | | 1 |
| Frankenia grandiflora | 3 | 12 | 26 | 10 | 1 | 22 | 6 | 4 | 12 | 2 |
| Jaumea carnosa | | | | 1 | | | | | | |
| Limonium californicum | | | | 7 | | 14 | | | | |
| Monanthochloe littoralis | | | | | | 6 | | | | |
| Picris echioides | | 1 | | | | | | | | |
| Polypogon monspeliensis | 1 | 1 | 1 | 1 | | | | | 6 | 1 |
| Rumex crispus | | 9 | | | | | | | | |
| Salicornia subterminalis | | | 2 | | | | | <1 | 16 | |
| Salicornia virginica | 39 | 24 | 75 | 64 | 74 | 39 | 63 | 63 | 47 | 69 |
| Sida leprosa | 32 | 11 | | | | | | | | |
| Silybum marianum | | 19 | | | | | | | | |
| Solanum douglasii | | 3 | | | | | | | | |
| Solidago occidentalis | | | | | | | | | | 2 |
| Stephanomeria virgata | | | | | | | | | | 1 |
| Suaeda californica | | | | 5 | | | | | | |
| Typha latifolia | | | | | | | | | | 7 |
| Total Cover | 83 | 87 | 107 | 102 | 75 | 98 | 69 | 67 | 83 | 94 |
| Bare Ground | <1 | 3 | 10 | 5 | 9 | 10 | 12 | 3 | 3 | 8 |
| Litter | 7 | 20 | 0 | 17 | 15 | 7 | 16 | 30 | 18 | 9 |

Table3-5. Percent cover for freshwater marsh (33, 41, 42 & 44) and riparian thickets (37 & 46) areas.

| Transect / Species | 33 | 41 | 42 | 44 | 37 | 46 |
|---|---|---|---|---|---|---|
| Amaranthus albus | | | | | 4 | |
| Anagallis arvensis | | 1 | | | | |
| Artemisia biennis | 5 | 5 | | | 5 | |
| Arundo donax | | | | | | 14 |
| Aster exilis | | | 1 | 5 | | |
| Atriplex patula | | | 11 | | | 1 |
| Atriplex semibaccata | | | | 1 | | <1 |
| Baccharis glutinosa | 40 | 20 | 19 | 34 | | 11 |
| Brassica sp. | | | | | | <1 |
| Cirsium vulgare | | | | 1 | | |
| Chamaesyce | | | | | 1 | |
| Chenopodium ambrosioides | | | | | 2 | |
| Chenopodium macrospermum | | 1 | 5 | 1 | | |
| Conium maculatum | | | | | 3 | |
| Conyza canadensis | | | 18 | | | 1 |
| Cortaderia atacamensis | | | | 1 | 31 | |
| Curcurbita foetidissima | | | | | | 1 |
| Cynodon dactylon | | | | | | 9 |
| Cyperus eragrostis | | | | | 17 | <1 |
| Eleocharis montevidensis | | | | | 1 | |
| Encelia californica | | 3 | | | | |
| Frankenia grandiflora | 1 | 11 | 3 | | | |
| Melilotus indicus | | | | | | <1 |
| Myoporum laetum | | | | | | 2 |
| Nicotiana glauca | | | | | | 9 |
| Picris echioides | 1 | 1 | | | 3 | |
| Pluchea purpurascens | | | 11 | 5 | | |
| Pulicaria hispanica | | | | 18 | | |
| Ricinus communis | | | | | 7 | 47 |
| Rosa californica | | | | | | 1 |
| Rumex crispus | | | 1 | 3 | | |
| Salicornia virginica | | | | 5 | | |
| Salix laevigata | | 1 | | 12 | | 5 |
| Salsola iberica | | | | | | <1 |
| Sambucus mexicana | | | | | 2 | |
| Scirpus californicus | | | | 27 | | 4 |
| Sida leprosa | | 18 | 30 | 7 | 6 | |
| Solidago occidentalis | 2 | 1 | 5 | | 15 | 1 |
| Tamarix ramosissima | | | | 2 | | |
| Typha latifolia | 40 | 21 | 14 | 1 | | |
| Urtica holosericea | | | | | 3 | |
| Xanthium strumarium | 33 | 31 | | 1 | | |
| Total | 122 | 114 | 118 | 124 | 101 | 109 |
| Litter | 2 | 6 | 7 | 2 | 6 | 3 |
| Bare Ground | 7 | 6 | 6 | 3 | 13 | 3 |

Table 3-6. Percent cover for willow riparian.

| Species \ Transect | 23 | 35 | 36 | 39 | 43 |
|---|---|---|---|---|---|
| Artemisia biennis | | 9 | | | |
| Arundo donax | | 3 | | | |
| Atriplex patula | | | 2 | | |
| Baccharis glutinosa | 2 | 9 | 4 | 19 | |
| Brassica sp. | 1 | | | | |
| Chenopodium ambrosioides | | 7 | | | |
| C. macrospermum | | | 16 | | |
| Cortaderia atacamensis | | | 1 | 14 | 30 |
| Cyperus eragrostis | | | | | 8 |
| Distichlis spicata | 14 | | | | |
| Eleocharis montevidensis | | | | | 3 |
| Encelia californica | 1 | | | | |
| Frankenia grandiflora | 1 | | | | |
| Isomeris arborea | 1 | | | | |
| Myoporum laetum | 2 | | | | |
| Nicotiana glauca | | | 1 | | |
| Pyracantha sp. | | | | | 1 |
| Picris echioides | 1 | | | | |
| Ricinus communis | 11 | 9 | 4 | 8 | |
| Rubus ursinus | | 6 | | | |
| Salicornia virginensis | 3 | | | | |
| Salix laevigata | 11 | 39 | 36 | 20 | |
| Salix lasiolepis | | 9 | | 3 | 59 |
| Sambucus mexicana | 2 | | | | |
| Scirpus californicus | 3 | 5 | 12 | | |
| Scirpus robustus | | 1 | | | |
| Solidago occidentalis | | 5 | 15 | 4 | |
| Typha latifolia | 26 | 13 | 11 | 1 | |
| Xanthium strumarium | | 7 | | | |
| Total | 80 | 123 | 103 | 106 | 101 |
| Bare ground | 14 | 2 | 7 | 29 | 2 |
| Litter | 15 | 6 | 5 | 9 | 25 |

Table 3-7. Percent cover for ruderal fields south of 19th St.

| Species \ Transect | 15 | 16 | 17 | 19 | 20 | 21 | 22 | 32 |
|---|---|---|---|---|---|---|---|---|
| Ambrosia chamissonis | | 2 | | 2 | 1 | 4 | | |
| Atriplex patula hastata | 1 | 1 | | | 23 | 80 | 60 | 56 |
| A. semibaccata | | | | | 1 | | 3 | |
| Baccharis emoryi | | 4 | 3 | | | | | |
| B. glutinosa | | | | 1 | 9 | | 4 | 4 |
| Bassia hyssopifolia | 2 | 3 | | 9 | 8 | | | |
| Beta vulgaris | | | | | 1 | 1 | | |
| Brassica sp | 5 | 7 | 6 | 3 | | | | |
| Bromus mollis | | | 1 | | | | | |
| Centaurea melitensis | | 2 | 13 | | | | | |
| Chenopodium murale | | 2 | | | | | | |
| Conium maculatum | | | | 14 | 18 | | 2 | |
| Conyza canadensis | 8 | | | | | | | |
| Cortaderia atacamensis | | | | 1 | | | | |
| Distichlis spicata | | 2 | 15 | 25 | | | | |
| Foeniculum vulgare | | 3 | 3 | | 7 | | | |
| Frankenia grandifolia | 4 | | 1 | 12 | | | 1 | 1 |
| Grass unknown | 3 | | | | | | | |
| Heterotheca grandiflora | | 1 | | | 1 | | | |
| Haplopappus venetus | | | 5 | | | | | |
| Heliotropium curassavicum | | 3 | | 3 | | | | |
| Hemizonia ramosissima | 1 | | | | | | | |
| Lotus scoparius | | | 1 | | | | | |
| Meliolotus indicus | 18 | | | | | 13 | | |
| Mesembryanthemum crystalinum | | | | 1 | | | | |
| Myoporum laetum | | | | 1 | | | | |
| Nicotiana glauca | | | 1 | | 2 | | | |
| Picris echioides | | | | | 1 | | | |
| Polypogon monspelliensis | 27 | 12 | | | | | 5 | |
| Ricinus communis | | | | | | <1 | | |
| Rumex crispus | 1 | | 1 | 1 | 3 | | | 1 |
| Salicornia virginica | 3 | | | | | | | |
| Scirpus californicus | | | | | | | | 4 |
| Scirpus robustus | | | | | | | | 2 |
| Sida leprosa | | | | 30 | 9 | 66 | 60 | |
| Silybum marinum (dead) | 17 | 20 | 10 | 1 | | | | 12 |
| Solanum douglasii | | 1 | | 1 | 10 | | | |
| Solidago occidentalis | | 1 | 7 | 9 | 3 | 7 | | 11 |
| Sonchus asper | | 2 | 1 | | | | | |
| S. oleraceous | | | | 5 | | | | |
| Typha latifolia | | | | | | | | 16 |
| Xanthium strumarium | | | | | | <1 | | |
| Total | 90 | 79 | 62 | 105 | 103 | 167 | 142 | 107 |
| Litter | 18 | 22 | 40 | 31 | 21 | <1 | 5 | 24 |
| Bare Ground | 4 | 7 | 3 | 14 | 7 | 0 | 1 | 1 |

Table3-8. Percent cover for ruderal fields between 19th St. and Hamilton Ave.

| Species \ Transect | 8 | 9 | 10 | 11 | 12 | 13a |
|---|---|---|---|---|---|---|
| Atriplex patula hastata | 6 | 12 | 1 | | | |
| Baccharis glutinosa | | | | | 1 | 3 |
| Baccharis pilularis | | 4 | 1 | 3 | | 3 |
| Bassia hyssopifolia | 1 | 2 | 3 | | | |
| Bromus diandrus | 1 | 3 | 8 | 21 | 13 | |
| Bromus mollis | | 2 | | | 1 | 2 |
| Chenopodium murale | | | | | 1 | 1 |
| Cirsium vulgare | 2 | 4 | 6 | 4 | 5 | 13 |
| Conium maculatum | 4 | 5 | 2 | 12 | | |
| Conyza canadensis | | | | | | 1 |
| Cortaderia atacamensis | 1 | 3 | 1 | | 4 | 3 |
| Heliotropium curassavicum | | | 1 | 4 | | |
| Marrubium vulgare | | 1 | | | | |
| Nicotiana glauca | | | | 2 | 1 | |
| Picris echioides | 8 | 11 | 8 | 13 | 23 | 13 |
| Polypogon monspeliensis | 1 | | 8 | 1 | 1 | 1 |
| Ricinus communis | | | | | 2 | |
| Rumex crispus | 4 | 2 | 1 | | 1 | |
| Salix lasiolepis | | 1 | 1 | 2 | | |
| Salola pestifer | | | 1 | | | |
| Sida leprosa | 25 | 23 | 41 | 38 | 27 | 26 |
| Solanum douglasii | 1 | | 1 | | | |
| Solidago occidentalis | 1 | 3 | 1 | | 2 | |
| Sonchus asper | 1 | 1 | | 2 | | |
| S. oleraceus | | | 1 | 1 | | |
| Urtica holosericea | | | | | 1 | |
| Total Cover | 56 | 77 | 86 | 103 | 83 | 66 |
| Bare ground | 13 | 7 | 7 | 4 | 14 | 14 |
| Litter | 34 | 29 | 22 | 13 | 24 | 24 |

Table3-9. Percent cover for ruderal fields dominated by pampas grass.

| Species \ Transect | 5 | 6+7 | 13b |
|---|---|---|---|
| Aster exilis | 2 | | |
| Baccharis glutinosus | 9 | 2 | 3 |
| B. piluaris | | 15 | |
| Bromus diandrus | 2 | | |
| B. mollis | 1 | | |
| Cirsium vulgare | 2 | 5 | 1 |
| Cortaderia atacamensis | 29 | 29 | 30 |
| Cynodon dactylon | 3 | | |
| Cyperus eragrostis | 15 | 2 | 3 |
| Cressa truxillensis | 1 | | |
| Cotula coronopifolia | 1 | | |
| Eleocharis montevidensis | 7 | | 9 |
| Elymus salinus | 3 | | |
| Juncus sp. | 2 | | 3 |
| Juncus xiphioides | | 1 | |
| Lippia incisa | 1 | | |
| Lolium perenne | 2 | | |
| Paspalum dilatatum | 4 | | |
| Picris echioides | 22 | 26 | 20 |
| Raphanus sativus | 4 | | 2 |
| Rumex crispus | 1 | | |
| Salix laevigata | | | 1 |
| Salix lasiolepis | | | 1 |
| Scirpus californicus | | 5 | 4 |
| Sida leprosa | 17 | 40 | 20 |
| Total Cover | 128 | 125 | 97 |
| Bare Ground | 8 | 1 | 4 |
| Litter | 15 | 3 | 9 |

Table3-10. Percent cover data of grassy ruderal fields (1 & 2) and ruderal fields dominated by Giant Reed (45)

| Transect / Species | 1 | 2 | 45 |
|---|---|---|---|
| Ambrosia psilostachya | | | 1 |
| Arundo donax | | | 54 |
| Baccharis emoryi | | <1 | |
| Brassica sp. | | | 6 |
| Bromus diandrus | 88 | 77 | 14? |
| Bromus mollis | | <1 | |
| Centaurea melitensis | | <1 | |
| Conyza coulteri | <1 | | |
| Cressa truxillensis | <1 | | |
| Croton californica | | | 7 |
| Distichlis spicata | <1 | 8 | |
| Heliotropium curassavicum | 1 | <1 | 2 |
| Heterotheca grandiflora | | | 4 |
| Opuntia littoralis | | <1 | |
| Ricinus communis | | | 1 |
| Salix hindsiana | | | 6 |
| Sida leprosa | 4 | | |
| Total | 93 | 86 | 95 |
| Litter | 7 | 37 | 14 |
| Bare Ground | 1 | 3 | 6 |

Table 3-11. Percent cover for coastal sage scrub.

| Species \ Transect | 24 | 34 | 40 |
|---|---|---|---|
| Brassica sp. | 1 | | 1 |
| Encelia californica | 79 | 29 | 39 |
| Eriogonum fasciculatum | | 32 | 39 |
| Isomeris arborea | 13 | 5 | 2 |
| Marrubium vulgare | | | 1 |
| Nicotiana glauca | 1 | | |
| Opuntia littoralis | 19 | 18 | 8 |
| O. prolifera | 6 | | |
| Rhus integrifolia | 7 | | |
| Sambucus mexicana | 3 | | |
| Sueada californica | | 1 | |
| Total | 128 | 85 | 88 |
| Litter | 2 | 6 | 1 |
| Bare Ground | 0 | 20 | 19 |

Table 3-12. Percent similarity matrix of Sørensen community coefficients (Index of Motyka) for transects.

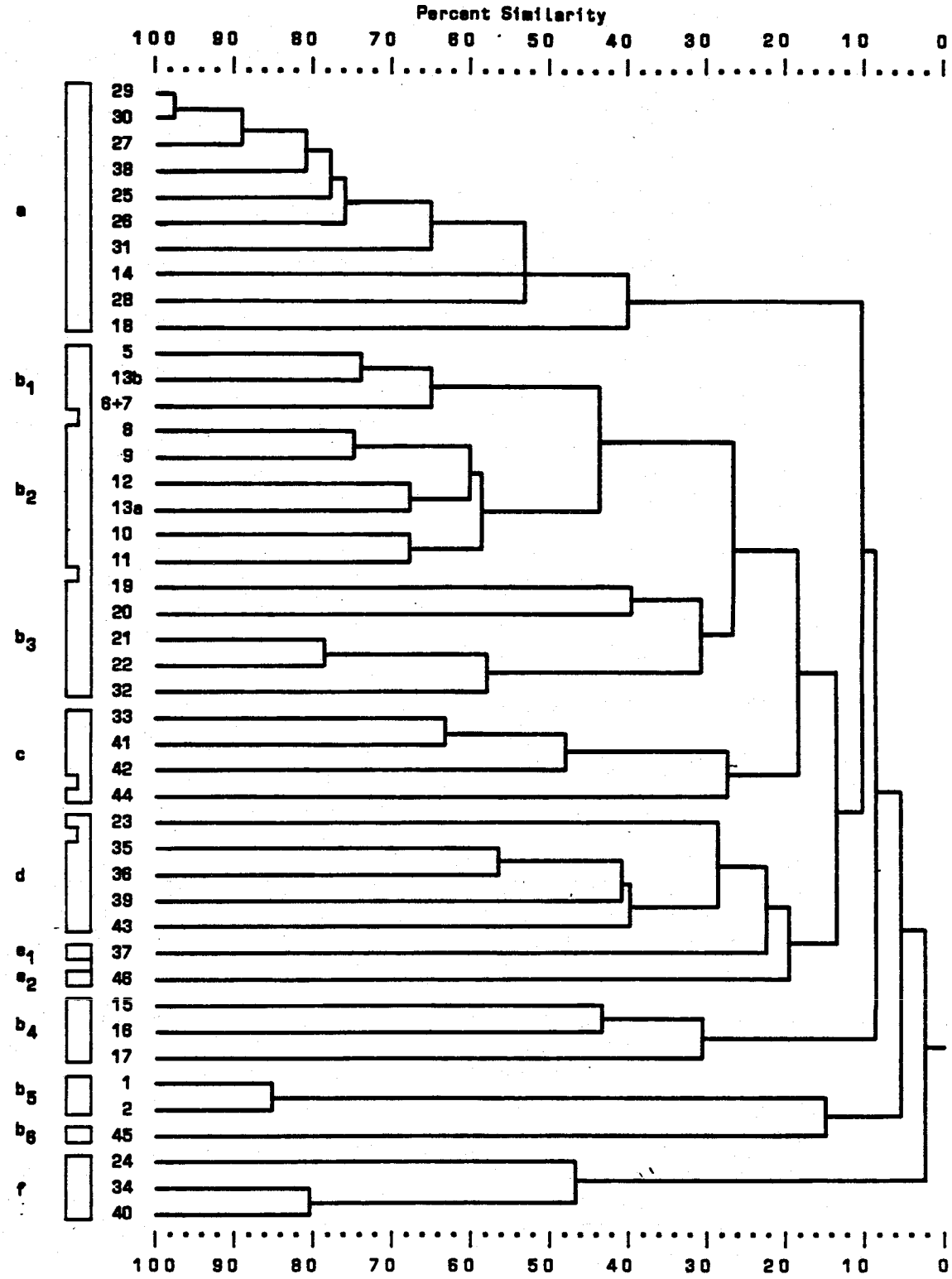
| | | $a^*$ | | | | | | | | | $b_1$ | | | $b_2$ | | | | | | $b_3$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Transect | | 30 | 27 | 38 | 25 | 26 | 31 | 14 | 28 | 18 | 5 | 13b | 6+7 | 8 | 9 | 12 | 13a | 10 | 11 | 19 | 20 | 21 | 22 |
| | 29 | 98 | 88 | 79 | 78 | 80 | 69 | 55 | 53 | 38 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 30 | | 90 | 80 | 78 | 79 | 69 | 56 | 51 | 36 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 27 | | | 82 | 82 | 73 | 60 | 50 | 45 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 38 | | | | 71 | 72 | 57 | 54 | 43 | 30 | 1 | 0 | 0 | 9 | 9 | 3 | 1 | 6 | 1 | 9 | 14 | 4 | 6 |
| | 25 | | | | | 71 | 65 | 45 | 59 | 38 | 1 | 0 | 0 | 2 | 3 | 4 | 1 | 4 | 3 | 0 | 0 | 0 | 1 |
| a | 26 | | | | | | 62 | 51 | 57 | 37 | 0 | 0 | 0 | 8 | 13 | 1 | 1 | 2 | 0 | 0 | 13 | 10 | 13 |
| | 31 | | | | | | | 53 | 57 | 45 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 8 | 1 | 3 | 1 | 0 | 5 |
| | 14 | | | | | | | | 47 | 47 | 16 | 22 | 30 | 46 | 37 | 33 | 36 | 42 | 35 | 34 | 18 | 30 | 34 |
| | 26 | | | | | | | | | 38 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 12 | 0 | 0 | 1 |
| | 18 | | | | | | | | | | 13 | 14 | 12 | 30 | 21 | 17 | 19 | 21 | 16 | 17 | 20 | 8 | 13 |
| | 5 | | | | | | | | | | | 74 | 58 | 33 | 38 | 49 | 40 | 29 | 29 | 18 | 19 | 12 | 17 |
| $b_1$ | 13b | | | | | | | | | | | | 71 | 39 | 41 | 51 | 49 | 33 | 35 | 21 | 13 | 15 | 19 |
| | 6+7 | | | | | | | | | | | | | 39 | 44 | 57 | 54 | 52 | 50 | 27 | 10 | 27 | 31 |
| | 8 | | | | | | | | | | | | | | 75 | 57 | 61 | 63 | 52 | 42 | 32 | 28 | 35 |
| | 9 | | | | | | | | | | | | | | | 60 | 64 | 58 | 56 | 39 | 37 | 31 | 36 |
| | 12 | | | | | | | | | | | | | | | | 68 | 61 | 63 | 34 | 18 | 24 | 27 |
| $b_2$ | 13a | | | | | | | | | | | | | | | | | 58 | 55 | 32 | 15 | 22 | 28 |
| | 10 | | | | | | | | | | | | | | | | | | 68 | 42 | 20 | 33 | 43 |
| | 11 | | | | | | | | | | | | | | | | | | | 44 | 23 | 28 | 33 |
| | 19 | | | | | | | | | | | | | | | | | | | | 40 | 25 | 32 |
| | 20 | | | | | | | | | | | | | | | | | | | | | 27 | 37 |
| $b_3$ | 21 | | | | | | | | | | | | | | | | | | | | | | 79 |

*a = Coastal Salt Marsh
$b_1$ = Ruderal Fields dominated by Pampas Grass
$b_2$ = Ruderal Fields between 19th St. and Hamilton Ave.
$b_3$ = Ruderal Fields south of 19th St.
$b_4$ = Ruderal Fields dominated by Milk-Thistle
$b_5$ = Ruderal Fields dominated by introduced grass species
$b_6$ = Ruderal Fields dominated by Giant Reed
c = Freshwater Marsh
d = Willow Riparian
$e_1$ = Riparian Thickets along northern boundary of oil field
$e_2$ = Riparian Thickets north of Hamilton Ave.
f = Coastal Sage Scrub

Table 3-12 (Continued).

| | Transect | 32 | 33 | 41 | 42 | 44 | 23 | 35 | 36 | 39 | 43 | 37 | 46 | 15 | 16 | 17 | 1 | 2 | 45 | 24 | 34 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | c | | | | | d | | | | | $e_1$ | $e_2$ | $b_4$ | | | $b_5$ | | $b_6$ | f | | |
| a | 29 | 1 | 1 | 6 | 3 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 30 | 1 | 1 | 4 | 3 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 27 | 1 | 1 | 1 | 1 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 38 | 13 | 9 | 9 | 14 | 5 | 12 | 8 | 11 | 2 | 0 | 2 | 1 | 9 | 9 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 25 | 0 | 0 | 9 | 2 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 1 | 1 | 3 | 3 | 2 | 0 | 0 | 0 |
| | 26 | 14 | 0 | 9 | 12 | 4 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 9 | 2 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| | 31 | 1 | 0 | 11 | 3 | 4 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 11 | 4 | 0 | 1 | 0 | 0 | 0 | 0 |
| | 14 | 18 | 0 | 21 | 38 | 11 | 4 | 0 | 2 | 0 | 0 | 6 | 1 | 11 | 4 | 1 | 4 | 0 | 0 | 0 | 0 | 0 |
| | 28 | 1 | 0 | 10 | 3 | 4 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 3 | 17 | 0 | 8 | 0 | 0 | 1 | 0 |
| | 18 | 13 | 1 | 22 | 14 | 15 | 4 | 1 | 0 | 0 | 0 | 9 | 1 | 32 | 27 | 17 | 4 | 0 | 0 | 0 | 0 | 0 |
| $b_1$ | 5 | 16 | 9 | 23 | 23 | 15 | 1 | 9 | 6 | 25 | 34 | 48 | 10 | 0 | 1 | 3 | 5 | 1 | 1 | 0 | 0 | 0 |
| | 13b | 18 | 3 | 20 | 21 | 15 | 6 | 8 | 9 | 21 | 37 | 43 | 9 | 0 | 0 | 0 | 4 | 0 | 1 | 0 | 0 | 0 |
| | 6+7 | 15 | 2 | 17 | 26 | 12 | 4 | 6 | 7 | 16 | 27 | 35 | 6 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| $b_2$ | 8 | 24 | 2 | 23 | 36 | 13 | 0 | 3 | 5 | 3 | 1 | 17 | 3 | 5 | 8 | 5 | 6 | 1 | 1 | 0 | 0 | 0 |
| | 9 | 30 | 3 | 20 | 39 | 11 | 1 | 5 | 7 | 9 | 4 | 20 | 4 | 4 | 8 | 5 | 8 | 3 | 4 | 0 | 0 | 1 |
| | 12 | 16 | 3 | 22 | 32 | 11 | 4 | 5 | 8 | 13 | 4 | 19 | 6 | 2 | 4 | 5 | 19 | 15 | 15 | 0 | 0 | 0 |
| | 13a | 17 | 4 | 25 | 33 | 13 | 2 | 4 | 5 | 8 | 3 | 14 | 5 | 2 | 2 | 1 | 5 | 0 | 0 | 0 | 0 | 0 |
| | 10 | 15 | 1 | 20 | 33 | 10 | 1 | 3 | 4 | 3 | 2 | 13 | 4 | 13 | 18 | 2 | 14 | 9 | 11 | 0 | 0 | 0 |
| | 11 | 11 | 0 | 17 | 27 | 8 | 3 | 2 | 2 | 3 | 1 | 11 | 3 | 1 | 6 | 2 | 26 | 22 | 18 | 0 | 0 | 0 |
| $b_3$ | 19 | 19 | 2 | 18 | 33 | 8 | 18 | 6 | 8 | 6 | 0 | 16 | 4 | 7 | 23 | 25 | 5 | 8 | 6 | 0 | 0 | 1 |
| | 20 | 43 | 10 | 18 | 32 | 17 | 3 | 14 | 15 | 16 | 0 | 18 | 13 | 4 | 20 | 7 | 4 | 0 | 2 | 0 | 0 | 0 |
| | 21 | 51 | 2 | 14 | 32 | 5 | 0 | 3 | 4 | 3 | 0 | 7 | 2 | 10 | 4 | 0 | 3 | 0 | 1 | 0 | 0 | 0 |
| | 22 | 64 | 5 | 18 | 39 | 9 | 2 | 6 | 10 | 7 | 0 | 12 | 5 | 6 | 11 | 1 | 3 | 0 | 0 | 0 | 0 | 0 |
| c | 32 | | 20 | 30 | 43 | 14 | 23 | 22 | 31 | 9 | 0 | 16 | 9 | 3 | 12 | 3 | 4 | 0 | 0 | 0 | 0 | 0 |
| | 33 | | | 64 | 40 | 29 | 28 | 30 | 15 | 21 | 0 | 7 | 10 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 41 | | | | 56 | 29 | 25 | 27 | 15 | 21 | 0 | 8 | 10 | 3 | 2 | 2 | 3 | 0 | 0 | 2 | 3 | 2 |
| | 42 | | | | | 26 | 17 | 36 | 24 | 25 | 0 | 14 | 11 | 4 | 8 | 3 | 3 | 0 | 0 | 0 | 0 | 0 |
| | 44 | | | | | | 19 | 22 | 27 | 33 | 11 | 8 | 18 | 3 | 0 | 1 | 3 | 0 | 5 | 0 | 0 | 0 |
| d | 23 | | | | | | | 37 | 34 | 29 | 12 | 9 | 26 | 5 | 3 | 23 | 0 | 9 | 9 | 5 | 2 | 3 |
| | 35 | | | | | | | | 57 | 42 | 41 | 17 | 26 | 0 | 5 | 1 | 0 | 0 | 9 | 0 | 0 | 0 |
| | 36 | | | | | | | | | 39 | 36 | 19 | 19 | 1 | 18 | 2 | 0 | 0 | 7 | 0 | 0 | 0 |
| | 39 | | | | | | | | | | 40 | 29 | 30 | 0 | 5 | 3 | 0 | 0 | 8 | 1 | 0 | 0 |
| | 43 | | | | | | | | | | | 38 | 8 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 |
| $e_1$ | 37 | | | | | | | | | | | | 9 | 0 | 15 | 1 | 4 | 0 | 1 | 1 | 0 | 0 |
| $e_2$ | 46 | | | | | | | | | | | | | 3 | 3 | 3 | 0 | 0 | 20 | 1 | 0 | 1 |
| $b_4$ | 15 | | | | | | | | | | | | | | 43 | 22 | 0 | 0 | 5 | 0 | 0 | 1 |
| | 16 | | | | | | | | | | | | | | | 39 | 1 | 2 | 11 | 0 | 0 | 1 |
| | 17 | | | | | | | | | | | | | | | | 0 | 10 | 7 | 2 | 0 | 1 |
| $b_5$ | 1 | | | | | | | | | | | | | | | | | 86 | 15 | 0 | 0 | 0 |
| | 2 | | | | | | | | | | | | | | | | | | 15 | 0 | 0 | 0 |
| $b_6$ | 45 | | | | | | | | | | | | | | | | | | | 0 | 0 | 1 |
| f | 24 | | | | | | | | | | | | | | | | | | | | 48 | 46 |
| | 34 | | | | | | | | | | | | | | | | | | | | | 81 |

Figure 3-3. Cluster analysis dendrogram of transect cover data. Bars along left margin unite transects placed in the same community. Letters designating the community are the same as in Table 3-12.



(Figure 3-1), at a slightly lower elevation than most coastal salt marsh transects. The species diversity is higher (Table 3-4), and this could be considered the "middle littoral zone" (sensu Vogl 1966).

Transect 14, taken in the northeast corner of the oilfield (Figure 3-1), also clusters low in relation to the other salt marsh transects. This area had a high cover of Sida leprosa, a common plant in many of the ruderal field transects. This area is mapped as remnant coastal salt marsh.

Many of the other coastal salt marsh areas are mapped as remnant coastal salt marsh even though they had high similarity values with other coastal salt marsh transects. These areas did not have tidal connections and had small pockets of non-salt marsh species within their midst. These non-salt marsh species were sparse enough that they were not often sampled.

The second group ($b_1$ to $b_3$) within the dendrogram (Figure 3-3) represents the ruderal fields. This is a complex assemblage of transects that are united by the dominance of introduced, weedy species. Also included in this community, even though they have a very low similarity and are clustered in completely different branches of the dendrogram, are groups $b_4$ to $b_6$. Although there are some differences in soil texture, salinity, and soil moisture, the frequency of disturbance and the time since the last disturbance, is believed to account for many of the differences among these areas.

Within the first cluster of ruderal field transects three subdivisions can be recognized: 1) ruderal fields dominated by pampas grass; 2) ruderal fields north of 19th Street; and 3) ruderal fields south of 19th Street. A review of the similarity values reveals that there is considerable heterogeneity between transects, especially south of 19th Street.

Cluster "c", the freshwater marsh community, is composed of transects 33, 41, 42, and 44. The first three are similar but represent only small dissected pockets of this vegetation. Transect 44, around the perimeter of Victoria Pond, is probably more representative of a freshwater marsh even though in this cluster analysis it appears to be the transect that is out of place.

In cluster "d" the transect that has the lowest similarity is transect 23. This transect included a little more than just willow riparian. It also included a somewhat freshwater marsh. The cluster would have been tighter without transect 23, or if transect 23 were to be divided between the two communities.

The riparian thickets, transects 37 and 46, are really not very similar, but both represent vegetation growing along man-made ditches. The lack of similarity between these two habitats may be a reflection of their relative age and successional development.

The last cluster in the dendrogram (Figure 3-3) is coastal sage scrub. Even when the community is well-defined, one can still get fairly low similarity values. This community sets a scale for the relative similarity values of the more "confusing" clusters. An $S_{Mo}$ similarity value of 47 should apparently not be considered very low!

## 3.8 DISCUSSION

### 3.8.1 COASTAL SALT MARSH

In the early part of this century the Santa Ana Marsh was open to the Pacific Ocean at the present Santa Ana River mouth and at the western portion of Newport Bay via the old Santa Ana River Channel (Figure 1-4). During the time of this connection, the marsh was subject to the full force of the tides, the dominating physical factor in salt marsh ecosystems. With the channelization of the Santa Ana River and the Greenville-Banning Channel around 1920, the elimination of the Newport Bay connection, and the installation of tide gates in the Greenville-Banning Channel sometime after 1927, a perennial connection with the Pacific Ocean was not only lost, but what tidal effect remained was greatly diminished. Thus the tidal effect on the marsh was practically eliminated although at present the tide gates are not completely effective and there is some tidal influence. This undoubtedly had significant effects on the vegetation, sedimentation, salinity, nutrient relations and drainage patterns of the salt marsh.

Prior to the practical elimination of the tides, the Santa Ana Marsh vegetation was probably typical of other southern California marshes with perennial ocean connections. It probably would have had a low marsh of Spartina foliosa and a high marsh dominated by Salicornia virginica; possibly a Batis maritima-Salicornia bigelovii middle marsh assemblage above the low marsh and a Salicornia subterminalis assemblage in the higher portions of the high marsh (Macdonald 1977). It is difficult to know for sure whether the marsh had a perennial ocean connection, but given the size of the old Santa Ana River Channel, its connection to the western portion of Newport Bay, plus the ocean connection at the present river mouth, it seems very likely.

Today the vegetation of the marsh is entirely high marsh, which for normal California coastal salt marshes extends from about MHHW to EHW, has continuous tidal submergence times of less than 6 hours, and continuous exposure times of two weeks to several months (Macdonald 1977). There is no low marsh, which would normally extend from about MLHW to MHHW, have tidal submergence times of greater than 6 hours, and exposure times of less than 15 days (Macdonald 1977). The Batis martima-Salicornia bigelovii assemblage that is typical of southern California salt marshes that have ocean inlets, is lacking. The Santa Ana Marsh also has a good representation of opportunistic species (see Table 3-1). All of the above characteristics are typical of southern California coastal salt marshes without a perennial connection with the ocean (Macdonald 1977).

Also typical of the high marsh zone is a high degree of intra- and inter-site variability. Although field data were not collected to measure intra-site variability, inter-site variability was fairly high as indicated by the similarity indices in Table 3-12, but the variability is probably not as high as would be obtained for marshes with ocean connections.

Another feature of many southern California salt marshes that do not abut steep bluffs is the presence of unvegetated salt flats (Macdonald 1977). There are only very small areas on the Santa Ana site that are barren (Figure 3-2). This is quite different from nearby Bolsa Chica lowlands which has rather extensive unvegetated salt flats (Dillingham Corp. 1971).

The range in elevation of the Santa Ana River salt marsh is from 86 to approximately 150 cm above MLLW. This is a narrow range, but the marsh consists of only high marsh. It is also slightly lower than other southern California salt marshes (Figure 3-4) except for Inner Bolsa Bay (Eilers 1980). Since the transition between high and low marsh occurs at about MHHW (which for the Santa Ana Marsh is ca. 0.25 m above MHW), the Santa Ana Marsh is within the elevational range normally occupied by low marsh, if there were an unrestricted ocean connection. It would appear then that the high marsh vegetation has shifted to lower elevations in response to diminished tidal flow and lowered tidal range created by the tide gates on the Greenville-Banning Channel and the sandbar that blocks the mouth of the channel. (Presumably the sandbar is reformed every year after sufficient runoff has broken through it.) It is also possible that subsidence (due to the withdrawal of oil) may have played a role in the relatively low elevation of the high marsh, in a manner similar to that described by Eilers (1980) at Bolsa Chica.

If the tide gates were completely removed from the Greenville-Banning Channel, it would lead to longer submergence of the marsh — especially if there were no sandbar across the mouth of the channel. Since present species composition is that of a high marsh, there would probably be significant disruption of the marsh and perhaps the demise of many of the plants in its lower portions. Eventually, low marsh species could become established.

Hypersalinity is also a characteristic of salt marshes without an ocean connection and the salinity readings for all the test wells within the salt marsh had hypersaline readings, even during the spring. Since freshwater input stimulates seed germination for most halophytes (Zedler 1982), the lack of spring rains and these high spring salinity values may not have been suitable for the germination of Salicornia bigelovii (Annual Pickleweed) and, perhaps, Cordylanthus maritimus subsp. maritimus. If hypersalinity is a perennial feature and normally attains even higher values, then these species and others requiring low salinity, may not occur at Santa Ana.

The remnant salt marsh areas differ from the rest of the high marsh in that they exhibited lower salinities, permitting the establishment of many weedy species. These remnant marsh areas also have a deeper water table, which some typical salt marsh species may not be able to tolerate.

### 3.8.2 FRESHWATER MARSH

Based on historical accounts (Macdonald 1983), the freshwater marsh habitats on this study site are probably not as extensive as they once were. Flood control measures have greatly diminished the source of freshwater. Now it seems that freshwater input is restricted to local runoff from storms and seepage from Newport Mesa. The latter is undoubtedly greater today than in the past because of lawn and garden watering. As the freshwater marsh exists today, most of it is characterized by seasonally intermittent, non-saline, standing water or at least enough water to saturate the soil. During abnormally wet years, there may be perennial ponds or perennially saturated soil. At present only the marsh around Victoria Pond has perennial standing water. The oilfield freshwater marsh is heavily dissected by oil field service roads and is periodically cut as part of a fire prevention program. These factors plus the small acreage account for the low number of species that have been collected from the freshwater marsh community.

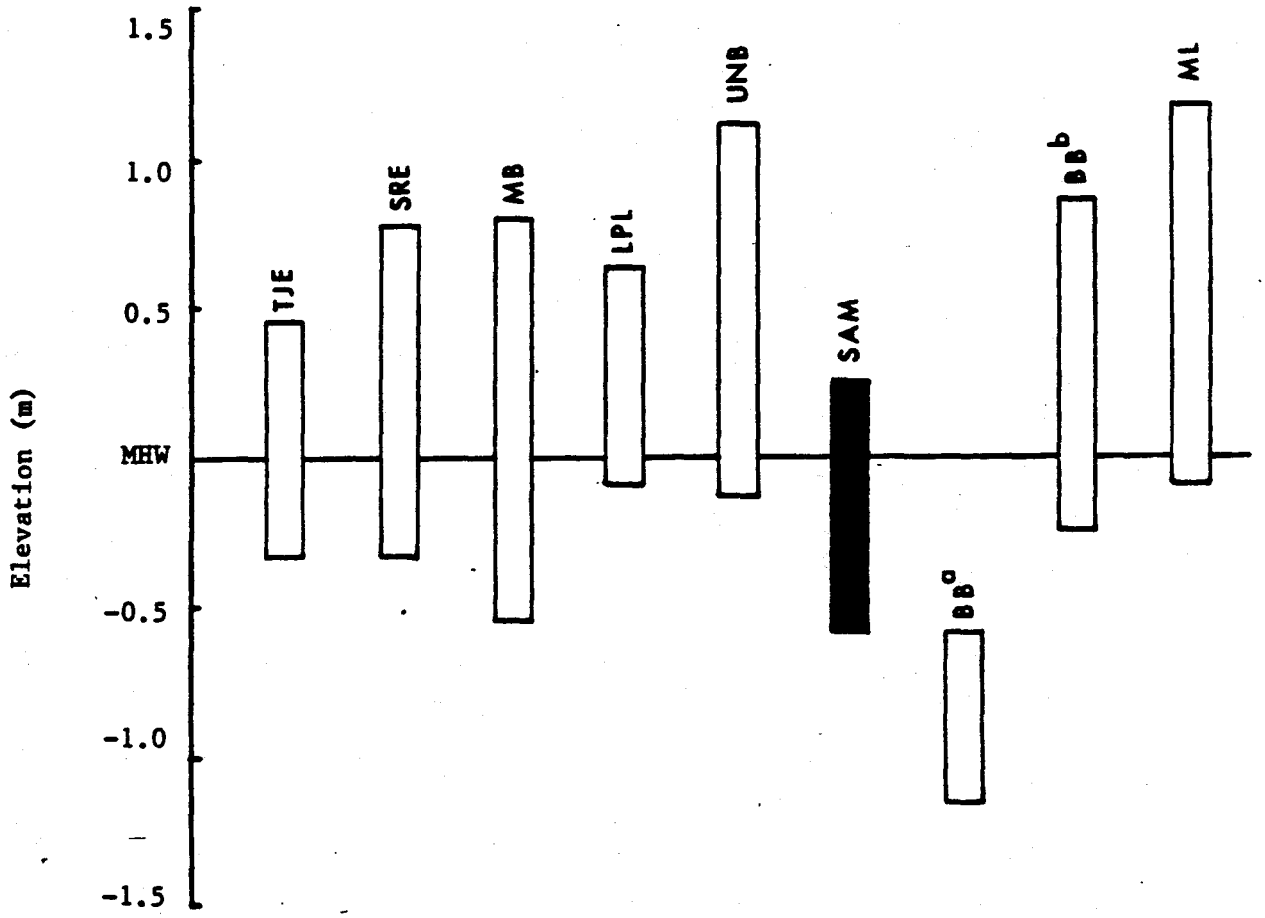



Figure 3-4. Vertical range of Santa Ana Marsh (SAM) compared with that of other southern California marshes. TJE = Tijuana River Estuary, SRE = Sweetwater River Estuary, MB = Mission Bay, LPL = Los Penasquitos Lagoon, UNB = Upper Newport Bay, $BB^a$ = Inner Bolsa Bay, $BB^b$ = Outer Newport Bay, and ML = Mugu Lagoon (modified from Eilers, 1980).

### 3.8.3 RIPARIAN COMMUNITIES

Included in the discussion here, are both the riparian thicket community and the willow riparian community. Like the freshwater marsh, these communities were previously more extensively developed along the lower Santa Ana River. It remains unknown whether there have been changes in their extent since the channelization of the Santa Ana River. The aerial photographs that are available (Figures 1-5 through 1-9) were all taken after channelization. It is probably safe to conclude that runoff from storms and the seepage of Newport Mesa presently provide adequate water to maintain these communities. The natural process of litter build up and decomposition into soil, however, will cause the elevation of these communities to increase and eventually become too high for riparian vegetation. This process is slow and may take a hundred or so years to complete. Only along drainage channels that are kept open mechanically will riparian communities persist, and these will probably develop into willow riparian communities with time.

### 3.8.4 RUDERAL FIELDS

Formerly these areas were probably part of the freshwater marsh -- or perhaps in sandier areas, part of a coastal dune community. Now, however, disturbance of much of this area is probably too frequent, or was so in the past, for the native vegetation to persist as a natural community. Now, areas with sandy soils have many characteristics of an annual grassland composed primarily of introduced European weeks (Heady 1977). Where soils are finer textured, the area is dominated by forbs and the native alkali-mallow (Sida leprosa var. hederaceae) is common. Where these finer textured soils are wetter, pampas grass (Cortaderia atacamensis) is dominant.

### 3.8.5 COASTAL SAGE SCRUB

Coastal sage scrub is one of the least known and fastest disappearing types of vegetation in California today (Kirkpatrick & Hutchinson 1977; Mooney 1977). It is only slightly better known than the freshwater marsh and riparian communities. On this study site the coastal sage scrub is quite depauperate. Many species that are typical of this community along the coast in Ventura County (Kirkpatrick & Hutchinson 1977) and San Diego County (Mooney 1977) do not occur here, or are very infrequent. Some of these species are: Artemisia californica (California sage), Rhus laurina (laurel sumac), Salvia mellifera (blacksage), Yucca whipplei (Lord's candle). Several factors may have resulted in the depauperate flora: 1) extensive use of tar for erosion control on the bluff slopes, 2) extensive erosion of the bluffs due to undercutting and over-steepening, 3) introduction of exotic species, 4) salt spray, and 5) the dirt road at the base of the bluffs where there was once an ecotone between the bluffs and adjacent marsh. Salt spray and erosion are probably the most important factors that account for the low species diversity and for the dominance of Encelia californica. Kirkpatrick and Hutchinson (1977) observed that E. californica appeared to dominate in areas subject to frequent soil movement and salt spray.

## 3.9 CONCLUSIONS

1. The vegetation of the Santa Ana Marsh and adjacent lowlands can be divided into six plant communities: coastal salt marsh, freshwater marsh, willow riparian, riparian thickets, ruderal fields, and coastal sage scrub.

2. All the communities, except the ruderal fields, are disturbed remnants of communities that existed prior to flood control programs on the Santa Ana River, urbanization of the Santa Ana flood plain, and development of the oil field.

3. The coastal salt marsh is "high marsh" and is similar to other southern California salt marshes that lack a perennial ocean connection.

4. The coastal salt marsh ranges in elevation from 86 to 150 cm above MLLW. For "high marsh" this elevational range is low and is indicative of either a downward migration of the vegetation, subsidence (due to oil removal, etc.), or both. The high marsh is presently occupying an elevational range that is more typically occupied by "low marsh."

5. The study site flora consists of 168 species of which 36% are naturalized introductions and 20% are exotic cultivated species. No rare and/or endangered species were found on the site during this study. However, Aphanisam blitoides, Astragalus pycnostachys var. lanosissimu, Helianthus nuttallii subsp. parishii, and Perideridia gairdneri are considered likely candidates that could still occur on the site.

# 4.0 PLANT BIOMASS & PRODUCTION

## 4.1 INTRODUCTION

Numerous factors effect the amount of plant biomass which can grow on a specific plot of land. The production of new organic matter in any plant community can be affected by the availability of water, soil nutrients, temperature, soil salinity, soil minerals, etc. One very important factor in southern California salt marsh production is a pattern of increasing salinity with rising elevation until the point of mean high water (MHW), and decreasing salinity thereafter (Macdonald, 1977; Zedler, 1982).

Soil moisture also decreases with increasing elevation, except during and immediately after winter rains. The combined factors of available soil moisture and salinity level allow dense, succulent salt marsh communities to develop adjacent to bays and channels, while plant biomass per unit area normally decreases with increasing elevation. At higher elevations or in areas far enough inland, soil salinities decrease to freshwater conditions; salt marsh species decline and upland plant species become dominant. In these areas, annual and perennial upland plants may produce tall, dense stands of vegetation. Plant production, or the amount of plant material able to grow on a specific area per year, was examined for selected sites of the study area. In order to understand the importance of such factors such as salinity and soil moisture in effecting plant production, measurements of water table depth and groundwater salinity were also made (see below and Section 5.0).

## 4.2 METHODS

To examine the variations in plant production in the various habitats of the Santa Ana Marsh and lowlands study site, aboveground primary production was measured using the "maximum minus minimum" standing crop harvest method. This method involves quantitative sampling of all aboveground plant material within specific harvest plots before and after the major plant growing season. New growth -- difference in standing crops -- can be assumed to be an approximation of net primary production for each particular community studied. This method of quantitative harvesting before and after the growing season is particularly of value in obtaining primary production estimates in communities dominated by perennial plant species such as salt marshes. Biomass harvesting methods were thus used in the salt marsh habitats with samples collected in January and May, 1984.

In areas dominated by annual plants, primary production can be estimated by harvesting standing crop during the peak of the growing season, before soil moisture is depleted to the point where the plants die off. The oilfield area between the fenced coastal salt marsh and 19th Street was dominated by annual plants. The oilfield operators initiated a program of mowing most of these areas of ruderal vegetation during May and June. The purpose of the mowing was to reduce fire risk and hence all cut vegetation was collected and trucked offsite. In these areas, standing crop samples were collected immediately prior to mowing.

North of 19th Street, estimates of standing crop were made in ruderal field-pampas grass (Cortaderia atacamensis) communities. Five clumps of pampas grass were measured for both diameter and height. One clump was then cut in half and placed into plastic bags. Dead material was separated from live plant material and the total live weight determined.

The willow stands located north of 19th Street were not directly sampled. Instead, color aerial photographs of the site (flown June 27, 1984) were used to provide estimates of willow cover.

In order to sample ruderal field communities north of Victoria Street and adjacent to Well 18, the standing crop weights of dominant plants were determined using a 0.25-$m^2$ harvest quadrat. The same method was employed to estimate standing crop biomass for the giant cane (Arundo donax) community at the extreme north end of the study site, near Well 20.

### 4.2.1 MARSH PRODUCTION STUDIES

The aboveground standing crop of salt marsh vegetation was first sampled on January 27, 1984. Six replicate circular 0.25 $m^2$ clip quadrats were harvested adjacent to each of the six groundwater observation wells located in the salt marsh (Figure 4-1). All standing live plant material within each quadrat was clipped to ground level, plastic bagged, and labelled. Dead plant material lying on the ground surface within each quadrant was collected, bagged, and labelled, separately. The bagged samples were returned to the laboratory, quick frozen, and stored at -25°C until they could be processed.

Each sample was thawed prior to processing. Live plant material was separated by species and wet weighed. Dead plant litter was also thawed and wet weighed, but not separated by species.

Soil salinity was measured at each of the six clip quadrat sites following the method of Mahall and Park (1976). Soil samples were obtained using a one-inch diameter standard soil corer. The first 20 cm of the sample (ground surface to -20 cm depth) was carefully removed and placed into a plastic bag, sealed and returned to the laboratory. The samples were dried at 105°C and put into rubber-stoppered 125 ml flasks. Volumes of distilled water equal to twice the original volumes of the samples were added. The flasks were shaken for three days and then allowed to settle. Samples where then centrifuged at 20,000 RPM for 20 minutes. The salinity of the clear supernatant was determined with an American Optical refractometer.

Soil moisture content was determined at three of the salt marsh sites (and at four other study area locations -- see Section 4.3.2), by collecting soil samples using the same soil corer noted above. Soil samples were immediately sealed in the field in plastic bags. They were weighed, still in the bags. in the laboratory. The samples were then dried at 105°C for 48 hours or until weight loss no longer occurred, and again weighed. The difference in wet and dry weight (corrected for bag weight) was considered to be water content. No attempt was made to water saturate these soils and hence the data are presented in terms of "percent water content," not percent saturation.

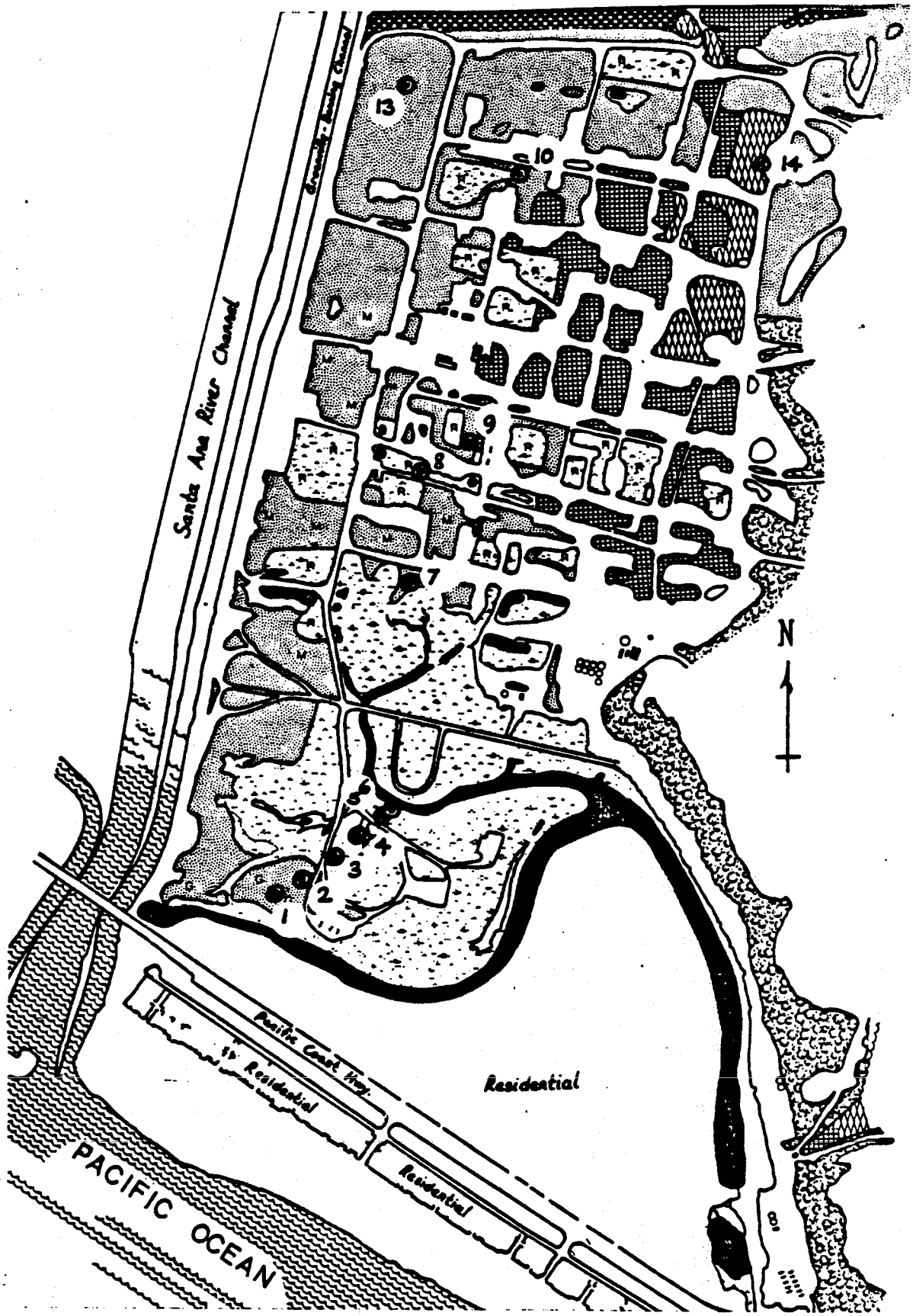



Figure 4-1. Groundwater well locations (numbered) adjacent to corresponding clip quadrat harvest stations. (See Figure 3-2 for key to vegetation types.)

## 4.3 RESULTS

### 4.3.1 MARSH BIOMASS - JANUARY 1984

Biomass data (aboveground standing crop) for salt marsh samples clipped in January 1984, are presented in Tables 4-1 through 4-6. Table 4-7 shows the mean wet weights of the six samples. In Figure 4-2, the relationship of standing crop biomass to groundwater level and salinity is presented.

Ground elevations along the salt marsh study transect decline from a high of 188 cm (6.18 ft) above MLLW at the southwest end, to 102 cm (3.35 ft) above MLLW at the northeast end. Groundwater observation well measurements taken January 17, 1984, indicated the water table was closest to the ground surface (18 cm below surface) adjacent to the remnant tidal channel at the northeast end of the transect (Well 6). From there, the ground level rose gently to the southwest so that the water table was some 119 cm (3.9 ft) below the ground surface at Well 1. In Figure 4-2, the water table can be seen to be relatively constant in elevation with a slight rise adjacent to the tidal channel (Wells 5 and 6). Groundwater salinities were lowest (5 ppt) at the higher elevations and generally increased along the transect to the northeast. Salinities dropped sharply adjacent to the channel (Well 5 - 46 ppt, Well 6 - 20 ppt), probably as a result of groundwater exchange with the less saline channel waters.

Species distributions clearly reflect the environmental gradients described above. Wells 1 and 2 -- characterized by higher elevations, sandy well-drained soils, and a deeper, less saline water table -- were dominated by plants with low salinity tolerances: Bromus diandrus (Ripgut grass), Bromus rubens (Foxtail grass), Malva parviflora (Cheeseweed), and Oxalis sp. The lower elevation, siltier, less well-drained soils, and higher, more saline (42 ppt) water table at Well 3 yielded a more typical high salt marsh assemblage of Salicornia virginica (pickleweed), Frankenia grandiflora (Alkali-heath), and Polypogon interruptus (Rabbit-foot grass).

Salicornia remained the dominant species at Wells 4, 5, and 6. Frankenia was least abundant in the drier, highly saline soils at Wells 4 and 5 but increased in biomass in moister, less saline soils adjacent to the inner tidal channel (Well 6). Polypogon dropped out after Well 4, and Limonium californicum (Sea lavender) joined the salt marsh assemblage at Well 6.

The standing crop measurements for January 1984, indicate the less salt-tolerant, high marsh-transition vegetation at Well 2 (Bromus spp. assemblage), yielded the least biomass (316 g wet weight/$m^2$) and the Salicornia-Frankenia assemblage at Well 3 yielded the highest biomass (1938 g wet wt/$m^2$).

It should be noted that the pattern of plant growth observed in the salt marsh reflected the mild, and relatively dry winter of 1983-84. Annual grasses such as Bromus and Polypogon, after a burst of growth in December and January, completed flowering and died off during March 1984. Frankenia also showed signs of significant die-back during March. Some areas of Salicornia cleared during clip quadrant harvest in January 1984, showed as much as 15 to 20 cm growth following clipping. By the end of March, however, extensive areas of previously dark green Salicornia were turning gray-green or brown and appeared

Table 4-1. Station 1: Composition of plant material (as grams wet weight) collected from six replicate 0.25 $m^2$ quadrants, January 27, 1984.

| Taxon | Replicates 1 | 2 | 3 | 4 | 5 | 6 | mean |
|---|---|---|---|---|---|---|---|
| Live Material | | | | | | | |
| Bromus spp.* | 325.1 | 333.1 | 263.1 | 321.9 | 305.1 | 289.2 | 306.4 |
| Frankenia grandifolia | - | - | - | - | - | - | - |
| Limonium californicum | - | - | - | - | - | - | - |
| Malva parviflora | - | - | - | - | - | - | - |
| Oxalis sp. | - | - | - | - | - | - | - |
| Polypogon interruptus | - | - | - | - | - | - | - |
| Salicornia virginica | - | - | - | - | - | - | - |
| Other | - | - | - | - | - | - | - |
| Total Live Material | 325.1 | 333.1 | 263.1 | 321.9 | 305.1 | 289.2 | 306.4 |
| Dead Material | - | - | - | - | - | - | - |

*Bromus diandrus and B. rubens

Table 4-2. Station 2: Composition of plant material (as grams wet weight) collected from six replicate 0.25 $m^2$ quadrants, January 27,1984.

| Taxon | Replicates 1 | 2 | 3 | 4 | 5 | 6 | mean |
|---|---|---|---|---|---|---|---|
| Live Material: | | | | | | | |
| Bromus spp.* | 78.7 | 39.6 | 58.8 | 91.1 | 38.1 | 90.1 | 66.1 |
| Frankenia grandiflora | - | 52.5 | - | - | - | - | 8.8 |
| Limonium californicum | - | - | - | - | - | - | - |
| Malva parviflora | 2.4 | - | - | 2.2 | - | 3.3 | 1.3 |
| Oxalis sp. | - | <0.1 | - | - | - | - | <0.1 |
| Polypogon interruptus | - | - | - | - | - | - | - |
| Salicornia virginica | 11.0 | - | - | - | - | - | 1.8 |
| Other | - | 5.2 | - | - | - | - | 0.9 |
| Total Live Material | 81.1 | 108.4 | 58.8 | 93.3 | 38.1 | 93.4 | 78.9 |
| Dead Material: | | | | | | | |
| Plant litter | 107.0 | 132.0 | 101.7 | 116.1 | 146.9 | 161.6 | 127.6 |

* Bromus diandrus and B. rubens

Table 4-3. Station 3: Composition of plant material (as grams wet weight) collected from six replicate 0.25 $m^2$ quadrants, January 27,1984.

| Taxon | Replicates 1 | 2 | 3 | 4 | 5 | 6 | mean |
|---|---|---|---|---|---|---|---|
| Live Material: | | | | | | | |
| Bromus spp.* | - | - | - | - | - | - | - |
| Frankenia grandifolia | 56.2 | 103.7 | 521.0 | - | 103.7 | - | 103.8 |
| Limonium californicum | - | - | - | - | - | - | - |
| Malva parviflora | - | - | - | - | - | - | - |
| Oxalis sp. | - | - | - | - | - | - | - |
| Polypogon interruptus | - | - | - | 91.1 | - | - | 18.2 |
| Salicornia virginica | 611.5 | 393.2 | - | 237.9 | 393.2 | 407.5 | 340.6 |
| Other | - | - | - | - | - | - | - |
| Total Live Material | 667.7 | 496.9 | 521.0 | 329.0 | 491.9 | 407.5 | 486.5 |
| Dead Material: | | | | | | | |
| Plant litter | 54.2 | 174.8 | 494.4 | 174.8 | 131.2 | 83.9 | 185.6 |

*Bromus diandrus and B. rubens

Table 4-4. Station 4: Composition of plant material (as grams wet weight) collected from six replicate 0.25 $m^2$ quadrants, January 27,1984.

| Taxon | Replicates 1 | 2 | 3 | 4 | 5 | 6 | mean |
|---|---|---|---|---|---|---|---|
| Live Material: | | | | | | | |
| Bromus spp.* | - | - | - | - | - | - | - |
| Frankenia grandiflora | 244.9 | 13.4 | - | - | 91.4 | - | 58.3 |
| Limonium californicum | - | - | - | - | - | - | - |
| Malva parviflora | - | - | - | - | - | - | - |
| Oxalis sp. | - | - | - | - | - | - | - |
| Polypogon interruptus | - | 10.2 | 10.8 | - | 30.5 | - | 8.6 |
| Salicornia virginica | 275.6 | 440.8 | 384.7 | 184.5 | 273.3 | 202.0 | 285.2 |
| Other | - | - | - | - | 1.1 | - | 0.2 |
| Total Live Material | 470.5 | 464.4 | 395.5 | 184.5 | 396.3 | 202.0 | 352.2 |
| Dead Material: | | | | | | | |
| Plant litter | 41.8 | 250.7 | 195.9 | 15.8 | 253.0 | 18.3 | 129.3 |

*Bromus diandrus and B. rubens

Table 4-5. Station 5: Composition of plant material (as grams wet weight) collected from six replicate 0.25m² quadrants, January 27, 1984.

| Taxon | Replicates 1 | 2 | 3 | 4 | 5 | 6 | mean |
|---|---|---|---|---|---|---|---|
| Live Material: | | | | | | | |
| Bromus spp.* | - | - | - | - | - | - | - |
| Frankenia grandiflora | - | - | 39.9 | - | 84.7 | 4.3 | 21.5 |
| Limonium californicum | - | - | - | - | - | - | - |
| Malva parviflora | - | - | - | - | - | - | - |
| Oxalis sp. | - | - | - | - | - | - | - |
| Polypogon interruptus | - | 0.1 | - | - | - | - | 0.02 |
| Salicornia virginica | 736.3 | 324.8 | 196.1 | 231.8 | 83.5 | 190.1 | 293.7 |
| Other | - | - | - | - | - | 2.3 | 0.38 |
| Total Live Material | 736.3 | 324.9 | 236.0 | 231.8 | 168.2 | 196.7 | 315.7 |
| Dead Material: | | | | | | | |
| Plant litter | 654.9 | 41.6 | 115.4 | 195.9 | 141.5 | 321.3 | 245.1 |

*Bromus diandrus and B. rubens

Table 4-6. Station 6: Composition of plant material (as grams wet weight) collected from six replicate 0.25 m² quadrants, January 27,1984.

| Taxon | Replicates 1 | 2 | 3 | 4 | 5 | 6 | mean |
|---|---|---|---|---|---|---|---|
| Live Material: | | | | | | | |
| Bromus spp.* | - | - | - | - | - | - | - |
| Frankenia grandiflora | 60.2 | 183.3 | 131.5 | 51.4 | - | 21.4 | 74.6 |
| Limonium californicum | - | 49.0 | 68.5 | - | 4.1 | 38.5 | 26.7 |
| Malva parviflora | - | - | - | - | - | - | - |
| Oxalis sp. | - | - | - | - | - | - | - |
| Polypogon interruptus | - | - | - | - | - | - | - |
| Salicornia virginica | 134.8 | 196.6 | - | 170.1 | 99.2 | 116.6 | 119.6 |
| Jaumea carnosa | - | - | - | - | 305.3 | - | 50.9 |
| Other | - | - | - | - | - | - | - |
| Total Live Material | 195.0 | 428.9 | 200.0 | 221.5 | 408.6 | 176.5 | 271.8 |
| Dead Material: | | | | | | | |
| Plant litter | 599.2 | 214.4 | 353.8 | 332.0 | - | 29.4 | 254.8 |

*Bromus diandrus and B. rubens

Table 4-7. Mean composition (grams wet weight/0.25 $m^2$) of plant material collected from salt marsh sample sites, January 27,1984.

| Taxon | Station 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Live Material: | | | | | | |
| Bromus spp.* | 306.4 | 66.1 | - | - | - | - |
| Frankenia grandiflora | - | 8.8 | 136.2 | 4.5 | 14.7 | 121.6 |
| Limonium californicum | - | - | - | - | - | 24.5 |
| Malva parviflora | - | 1.3 | - | - | - | - |
| Oxalis sp. | - | <0.1 | - | - | - | - |
| Polypogon interruptus | - | - | 18.2 | 7.0 | - | - |
| Salicornia virginica | - | 1.8 | 330.0 | 336.7 | 206.0 | 165.7 |
| Other | - | 0.9 | - | - | 0.8 | - |
| Total Live Material: | 306.4 | 78.9 | 484.4 | 348.1 | 221.5 | 311.8 |
| Dead Material: | | | | | | |
| Plant litter | - | 127.6 | 196.4 | 154.1 | 210.9 | 406.8 |

*Bromus diandrus and B. rubens

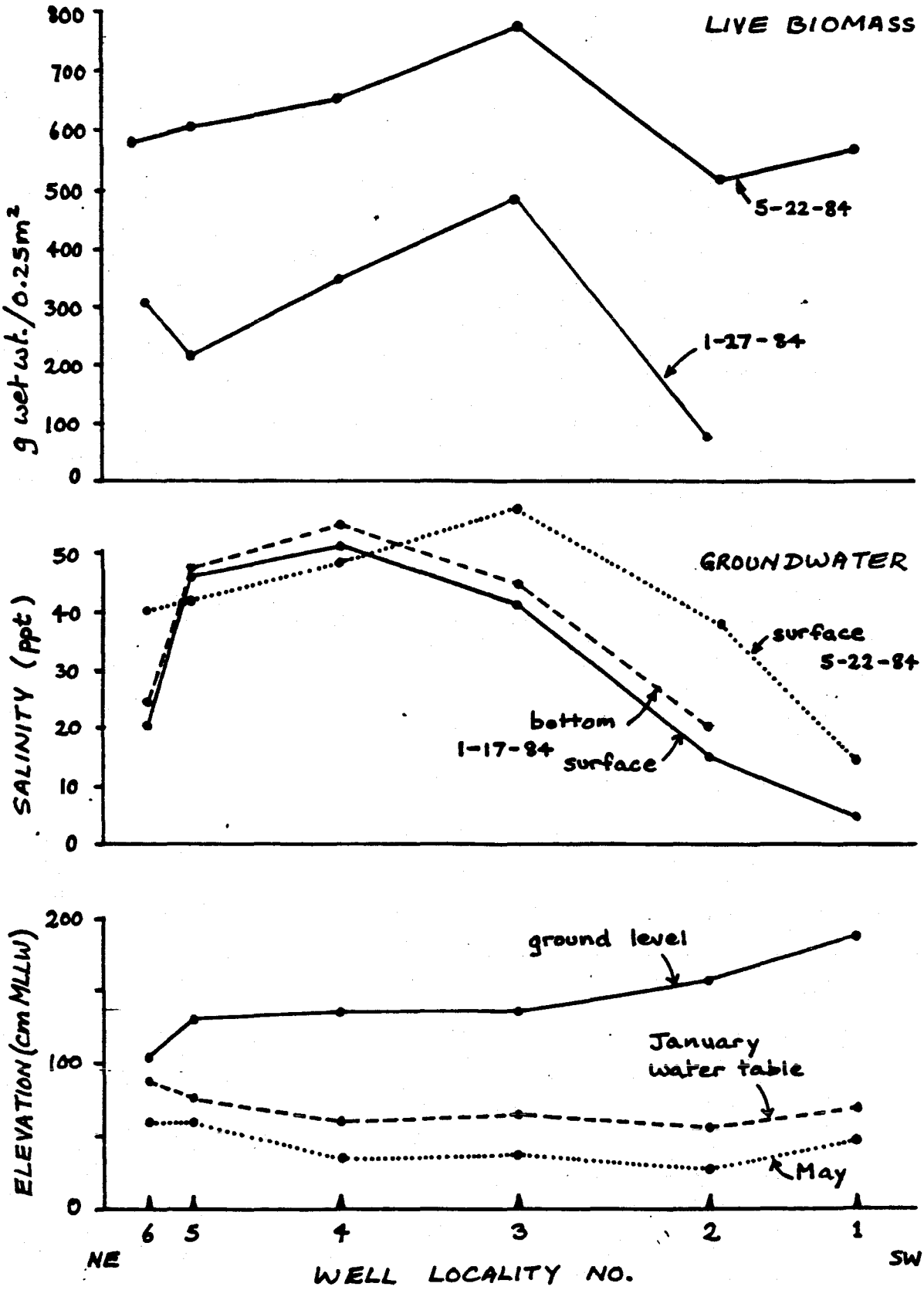



Figure 4-2. Santa Ana Marsh Transect: mean aboveground live plant biomass, groundwater salinity, and water table depths relative to the ground surface, January and May, 1984.

to be dying back. In more normal, wetter years, salt marsh growth follows rapidly after winter rains but extends for a longer period into the spring and early summer.

### 4.3.2 MARSH BIOMASS - MAY 1984

The biomass (aboveground standing crop) of salt marsh vegetation harvested from the six study sites in May 1984 are presented in Table 4-8. Net annual primary production was calculated using the maximum-minus-minimum harvest method, with sampling taking place in January 1984, before most of the seasonal growth occurred and in late May 1984, after the major period of plant growth. Normally, plant growth in southern California salt marsh communities continues through the summer months. During the winter of 1983-84, however, the rainfall came early, mainly during the fall months. The dry and relatively mild winter conditions allowed for a much earlier growth period and by late May soil moisture levels were quite low. For these reasons, harvesting of vegetation in late May probably allowed for the best estimate of annual net primary production to be made.

### 4.3.3 MARSH NET PRODUCTION

Net annual primary Production (NAPP) estimates for the six study sites in the salt marsh are presented in Table 4-9. Plant harvest wet weight data (Tables 4-1 through 4-8) have been converted to dry weight production values for comparison with production estimates for other southern California salt marsh habitats. Values ranged from 273.4 $g/m^2/yr$ for the grassy upland habitat around Well 1, to 807.7 $g/m^2/yr$ for the dense pickleweed-alkali heath stands adjacent to Well 4 (Figure 4-1).

#### Soil Salinities

Soil salinities were lowest (6-8 ppt) in the sandy soils of Station 1 and 2 (adjacent to Wells 1 and 2) in the dune and grassland habitat of the coastal salt marsh (Table 4-10). Stations 3 through 6 had salinities which ranged from 30 to 42 ppt (sea water is 34 ppt). Station 7, located in the remnant salt marsh, had a soil salinity of 24 ppt.

#### Soil Moisture Content

Soil moisture, expressed as percent water content, was determined for soil samples collected adjacent to Wells 2, 4, 6, 7, 10, 12 and 14 (Table 4-11). The mean percent water content for Station 2, which was the high marsh-grassland transition area, was 9.4%. The sandy soils of this location apparently hold much less moisture than the siltier soils of the salt marsh (Station 4 - 19.8%, Station 6 - 26.4%). Station 7, in the remnant salt marsh, had a similar mean moisture content of 25.8%. Station 12, located in the drier soils of the western part of the oilfield had a mean water content of 15.7%; Station 14 located near the willow riparian habitat held more moisture (28.8%); and Station 10 which is between Stations 12 and 14, had an intermediate moisture content of 10.9%.

Table 4-8. Santa Ana River Lowlands: Plant Biomass, by Station and Species (as grams wet weight) collected from six replicate 0.25 $m^2$ quadrants, May 22, 1984. Station locations shown in Figure 4-1.

Station 1

| Taxon | 1 | 2 | 3 | 4 | 5 | 6 | mean |
|---|---|---|---|---|---|---|---|
| Heliotropium curassavicum L. var. oculatum | 298.3 | 29.0 | 91.3 | 186.5 | 227.1 | 30.1 | 143.7 |
| Dead grass (Bromus diandrus) | 209.6 | 487.5 | 408.5 | 301.5 | 322.4 | 211.1 | 323.4 |
| Total Live Material | 507.9 | 516.5 | 499.8 | 987.8 | 549.5 | 241.2 | 550.5 |

Station 2

| Taxon | 1 | 2 | 3 | 4 | 5 | 6 | mean |
|---|---|---|---|---|---|---|---|
| Frankenia grandifolia | 86.6 | - | - | - | - | - | 16.1 |
| Cressa truxillensis HBK. var. vallicola | 176.7 | 116.0 | 116.5 | 81.5 | 120.0 | 96.5 | 117.9 |
| Salicornia virginica L. | - | - | 122.0 | 258.2 | - | - | 63.4 |
| Dead grass (Bromus diandrus) | 264.2 | 158.9 | 264.2 | 128.1 | 418.3 | 557.9 | 298.6 |
| Total Live Material | 527.5 | 274.9 | 502.7 | 467.8 | 538.3 | 654.4 | 494.3 |

Station 3

| Taxon | 1 | 2 | 3 | 4 | 5 | 6 | mean |
|---|---|---|---|---|---|---|---|
| Frankenia grandifolia | 133.6 | 250.8 | 293.2 | 110.9 | - | 622.2 | 235.1 |
| Cressa truxillensis HBK. var. vallicola | 6.3 | 0.4 | - | 16.6 | 41.5 | 38.1 | 17.2 |
| Salicornia virginica L. | 308.8 | 358.7 | 411.7 | 950.6 | 754.2 | - | 464.0 |
| Dead Material | 51.4 | 67.7 | 107.7 | 248.7 | 93.9 | 88.6 | 109.7 |
| Total Live Material | 500.1 | 677.6 | 812.6 | 1326.8 | 889.6 | 748.9 | 825.9 |

Station 4

| Taxon | 1 | 2 | 3 | 4 | 5 | 6 | mean |
|---|---|---|---|---|---|---|---|
| Salicornia virginica L. | 450.7 | 220.2 | 477.0 | 80.0 | 1011.0 | 308.7 | 424.6 |
| Frankenia grandifolia | - | 165.5 | 173.3 | 264.3 | - | - | 197.5 |
| Heliotropium curassavicum L. var. oculatum | - | 14.2 | - | - | 110.0 | - | 20.7 |
| Polypogon monospeliensis | - | 1.8 | - | - | - | - | 0.3 |
| Dead material | 206.1 | 51.6 | 143.4 | - | 187.4 | 117.1 | 117.6 |
| Total Live Material | 656.8 | 453.3 | 793.7 | 326.3 | 1308.4 | 425.8 | 66.7 |

Table 4g (Continued).

| Station 5 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Taxon | 1 | 2 | 3 | 4 | 5 | 6 | mean |
| Salicornia virginica | 368.2 | 669.6 | 645.2 | 532.2 | 551.5 | 372.6 | 523.2 |
| Frankenia grandifolia | 91.5 | - | - | - | 156.1 | - | 41.3 |
| Cressa truxillensis HBK. var. vallicola | 0.4 | - | - | - | - | - | 0.1 |
| Dead material | 108.3 | - | - | - | 72.1 | 101.6 | 47.0 |
| Total Live Material | 568.4 | 669.6 | 645.2 | 532.2 | 779.7 | 474.2 | 41.6 |

| Station 6 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Taxon | 1 | 2 | 3 | 4 | 5 | 6 | mean |
| Salicornia virginica L. | 26.7 | 79.5 | 197.2 | 248.3 | 251.9 | 346.3 | 191.7 |
| Frankenia grandifolia | 84.2 | 247.9 | 10.3 | 14.4 | 13.9 | 53.7 | 170.7 |
| Limonium californicum | 477.1 | 134.0 | 292.5 | - | 46.9 | 77.4 | 171.3 |
| Chenopodium murale L. | - | - | - | 118.3 | - | - | 19.7 |
| Jaumea carnosa | - | - | - | - | 383.7 | - | 64.0 |
| Dead material | 21.8 | - | 104.1 | 37.1 | 53.9 | 261.7 | 79.8 |
| Total Live Material | 609.8 | 461.4 | 604.1 | 418.1 | 750.3 | 739.1 | 597.1 |

Table 4-9. Santa Ana River Marsh, net annual aboveground primary production (NAPP) estimates. (See Figure 4-1 for station locations, and text for additional explanation.)

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Standing Crop Biomass in January ($g/0.25m^2$) | 306.4 | 78.9 | 486.5 | 129.3 | 245.1 | 271.8 |
| Standing Crop Biomass in May ($g.0.25m^2$) | 550.5 | 494.3 | 825.9 | 660.7 | 611.6 | 597.1 |
| Increase in Standing Crop ($g/0.25m^2$) | 244.1 | 415.4 | 339.4 | 531.4 | 366.5 | 325.3 |
| Net Annual Primary Production $g/m^2$ (wet weight) | 976.4 | 1661.6 | 1357.6 | 2125.6 | 1466.0 | 1301.2 |
| Net Annual Primary Production $g/m^2$ (dry weight) | 273.4 | 631.4 | 515.9 | 807.7 | 557.1 | 494.5 |

1. Dry weight calculated using a conversion factor for Bromus spp. grasses of 72% water. Determined by drying samples for 3 days at 105°C in a forced draft oven.

2. Conversion factor of 67% water determined for approximately half Frankenia and half Bromus spp. grasses using the above methods.

3. Conversion factor for Salicornia and Frankenia was 62% water.

Table 4-10. Santa Ana River Marsh, soil core salinity samples, May 22, 1984. (Soil salinity determined after the method of Mahall and Park, 1976.)

| Marsh Well No. | Soil Salinity (ppt) |
|---|---|
| 1 | 6 |
| 2 | 8 |
| 3 | 30 |
| 4 | 34 |
| 5 | 42 |
| 6 | 33 |
| 7 | 24 |

Table 4-11. Santa Ana River Marsh and lowlands, soil core mean water content (percent), May 22, 1984. (See text for description of methods.)

| Well No. | Depth (cm) | Weight (g) Wet | Weight (g) Dry | Percent Water | Mean Water Content (%) |
|---|---|---|---|---|---|
| 2 | 0-12 | 58.60 | 53.60 | 8.9 | 9.4 |
| | 12-24 | 32.48 | 29.51 | 9.1 | |
| | 24-36 | 44.04 | 39.58 | 10.1 | |
| 4 | 0-12 | 39.49 | 30.80 | 22.0 | 19.8 |
| | 12-24 | 34.12 | 28.37 | 17.0 | |
| | 24-36 | 48.32 | 38.39 | 20.5 | |
| 6 | 0-12 | 31.22 | 23.32 | 25.3 | 26.4 |
| | 12-24 | 40.65 | 29.58 | 27.2 | |
| | 24-36 | 45.71 | 33.45 | 26.8 | |
| 7 | 0-12 | 47.53 | 35.67 | 24.9 | 25.8 |
| | 12-24 | 47.05 | 34.64 | 26.3 | |
| | 24-36 | 57.59 | 42.48 | 26.2 | |
| 10 | 0-12 | 30.09 | 23.68 | 21.3 | 20.9 |
| | 12-24 | 42.00 | 33.10 | 21.2 | |
| | 24-36 | 41.85 | 33.39 | 20.2 | |
| 12 | 0-12 | 47.72 | 40.2 | 15.7 | 15.7 |
| 14 | 0-12 | 32.40 | 22.88 | 29.4 | 28.8 |
| | 12-24 | 45.32 | 32.50 | 28.3 | |
| | 24-36 | 48.99 | 34.93 | 28.7 | |

## Discussion

Generally, coastal salt marshes are considered to be among the most productive natural ecosystems. They are normally inundated regularly by tides but also acquire nutrients from terrestrial runoff and hence have an abundant supply of both nutrients and water.

The present restricted tidal flow into the Santa Ana River salt marsh prevents inundation of most of the pickleweed at high tide. At low tide, little mud flat is exposed and no cordgrass (Spartina foliosa) is present. Most of the channels have steep banks so that even the succulent salt marsh vegetation growing adjacent to the water-filled channels, becomes dry and virtually dormant during the dry summer months.

Primary productivity for a tidally restricted salt marsh such as developed at the Santa Ana River will be dependent upon rainfall for moisture and flooding which may occur during and immediately after heavy winter rains. During the dry spring and summer months the soils become progressively drier, and plant growth becomes limited.

Estimates of net annual primary production (NAPP) for the salt marsh indicate rates which are lower than most of the tidal salt marshes in southern California. Zedler, et al., (1980) and Winfield (1980) found NAPP rates for the Tijuana Estuary of about 1000 $g/m^2/yr$. Onuf, et al., (1978) found similar values for Mugu Lagoon. Kibby et al., (1980) estimated NAPP in an Oregon salt marsh dominated by Salicornia virginica to be 1644 g dry $wt/m^2/yr$.

In a comparative study of Salicornia productivity in wet soil and dry soil habitat at nearby Bolsa Chica lowlands, Feldmeth (unpublished data) found NAPP rates to be 1052 g dry $wt/m^2/yr$ for a dense pickleweed plot in wet soils, compared with only 267 g dry $wt/m^2/yr$ for a dry, alkaline pickleweed flat area.

It thus appears that the NAPP estimates for the Santa Ana Salt Marsh (Table 4-9) are intermediate between fully functional tidal salt marshes such as Tijuana Estuary and Mugu Lagoon, and dry, alkaline sparsely-vegetated pickleweed flats as at Bolsa Chica. The NAPP value of 808 g dry $wt/m^2/yr$ for the area adjacent to Well 4 appears to approach values for fully tidal salt marshes in southern California.

The relationship between live aboveground salt marsh vegetation biomass, groundwater salinities and water table levels for the May 1984 sampling period can be seen in Figure 4-2. Salinity increased between January and May 1984, especially at Well 6. The water table dropped an average of 17.5 cm for the 6 wells in the salt marsh between the January and May sampling periods (Figure 4-2). Although the water table remained below the root zone (estimated to be about 25 cm for Salicornia virginica [Macdonald, unpublished data]) throughout the study, soils above it remained moist, especially during the winter months. With the dry spring and summer months, however, soil moisture levels decreased. By mid-August 1984, soils throughout the marsh were extremely dry (see Section 5.0 on soil moisture availability as measured with the Scholander pressure bomb).

### 4.3.4 ADDITIONAL BIOMASS/NET PRODUCTION VALUES

Additional seasonal peak biomass samples harvested during May 1984 in other areas of the Santa Ana lowlands study site north (landward) of the salt marsh, are presented in Table 4-12. These additional samples provide estimates of net annual aboveground annual production values for characteristic examples of remnant salt marsh (Wells 7 and 8), ruderal fields (Wells 9, 10, and 13) and willow riparian habitats (Well 14).

The amount of willow cover for the willow riparian areas across the study site, as plotted from aerial photographs, was estimated at 10.4 acres, total. The comparable study site area covered by dense clumps of giant cane (Arundo donax) was plotted and measured at 1.6 acres, total. Cane clumps near Well 20 yielded an aboveground live standing crop of approximately 37.7 kg wet wt/$m^2$.

Clump diameter and height measurements for pampas grass clumps adjacent to Well 15 (north of 19th Street), are listed in Table 4-13. Assuming our one aboveground live biomass measurement is representative, then our "average pampas clump," diameter 3.2 m, would yield approximately 23 kg (wet weight) of live plant material. (This, of course, is a standing crop estimate and doesn't allow calculation of NAPP values.) Standing crop data for ruderal community species adjacent to Well 18 (north of Victoria Street) are also included in Table 4-13.

When elevation is plotted against biomass for areas landward of the coastal salt marsh, a relationship of generally decreasing biomass with increased elevation can be observed (Figure 4-3). Station 8 appears to be an exception to this pattern. Closer examination of the data however, revealed that a single clump of Frankenia (wet weight biomass 4456 g/$m^2$) pushed the mean value for this station well above the other two clip quadrat biomass values for Station 8.

## 4.4 SUMMARY

The Santa Ana River and adjacent lowlands study area supports a wide range of plant communities which are generally determined by soil moisture and soil salinities. In areas where soil salinities are high and ground water remains relatively close to the surface, salt marsh vegetation is present with net annual aboveground production rates ranging from 495 to 808 g dry wt/$m^2$/yr. Adjacent areas with higher elevations, sandy soils, and a lower water table, had lower soil salinities and were vegetated principally by grasses. The net annual primary production rates for these grassland areas (273 g dry wt/$m^2$/yr) was lower than those of the coastal salt marsh.

For the oilfield and south of 19th Street, standing crop biomass means ranged from 1212 to 4392 g wet wt/$m^2$. The highest biomass values occurred in remnant salt marsh areas such as Well 7 (4392 g wet wt/$m^2$) and Well 8 (2932 g wet wt/$m^2$) and in the willow riparian habitat near Well 14 (3336 g wet wt/$m^2$). Ruderal field areas (Wells 9, 10, and 13) supported smaller standing crop values. Soil moisture appears to be the most important factor effecting vegetative productivity in this oilfield area.

Table 4-12. Species composition and standing crop data (May 1984) -- as aboveground NAPP estimates for six stations in the Santa Ana River Lowland. (See Figure 5-1 for station locations.)

Station 7

| Elevation in cm above mllw | Taxon | 1 | 2 | 3 | mean |
|---|---|---|---|---|---|
| 86 | Salicornia virginica L. | - | 1368.7 | 1866.9 | |
| | Frankenia grandifolia | - | - | 58.7 | |
| | Total Live Material | 0 | 1368.7 | 1925.6 | 1098.1 |

Station 8

| Elevation in cm above mllw | Taxon | 1 | 2 | 3 | mean |
|---|---|---|---|---|---|
| 161 | Chenopodium murale | 293.6 | 628.3 | 10.1 | |
| | Sonchus asper | 12.0 | - | - | |
| | Polypogon monospeliensis | 13.4 | 2.9 | - | |
| | Melilotus indicus | - | 6.2 | - | |
| | Frankenia grandifolia | - | - | 1114.2 | |
| | Dead material | 27.3 | 92.3 | - | |
| | Total Live Material | 346.3 | 729.7 | 1124.3 | 733.4 |

Station 9

| Elevation in cm above mllw | Taxon | 1 | 2 | 3 | mean |
|---|---|---|---|---|---|
| 156 | Rumex crispus L. | 85.6 | 8.8 | - | |
| | Melilotus indicus | 40.1 | 65.1 | 359.1 | |
| | Aster exilis Ell. | 47.8 | - | - | |
| | Polypogon monospeliensis | 19.4 | 62.8 | 24.7 | |
| | Sida leprosa | 387.9 | 363.6 | 21.3 | |
| | Chenopodium murale L. | 4.8 | 4.7 | - | |
| | Brassica nigra | - | - | 35.6 | |
| | Sonchus asper | - | - | 134.9 | |
| | Dead material | 21.7 | - | - | |
| | Total Live Material | 607.3 | 505.0 | 575.6 | 562.6 |

Table 4-12(Continued).

Station 10

| Elevation in cm above mllw | Taxon | 1 | 2 | 3 | mean |
|---|---|---|---|---|---|
| 137 | Sida leprosa | 13.1 | 5.5 | 15.1 | |
| | Polypogon monospeliensis | 16.1 | 15.6 | 3.2 | |
| | Chenopodium murale | 322.3 | 506.4 | 275.4 | |
| | Dead material | 59.4 | 307.0 | 13.3 | |
| | Total Live Material | 411.6 | 559.4 | 307.0 | 426.0 |

Station 13

| Elevation in cm above mllw | Taxon | 1 | 2 | 3 | mean |
|---|---|---|---|---|---|
| 196 | Chenopodium murale | - | 24.7 | - | |
| | Polypogon monospeliensis | - | 3.9 | - | |
| | Rumex crispus L. | - | 4.8 | - | |
| | Bassia hyssopifolia | - | 110.5 | 88.7 | |
| | Salicornia virginica L. | - | - | 620.7 | |
| | Heliotropium curassavicum L. var. oculatum | - | 24.1 | - | |
| | Dead material | - | 16.7 | 15.6 | |
| | Total Live Material | 0 | 184.7 | 725.0 | 303.2 |

Station 14

| Elevation in cm above mllw | Taxon | 1 | 2 | 3 | mean |
|---|---|---|---|---|---|
| 125 | Sida leprosa | 135.2 | 39.7 | 23.9 | |
| | Chenopodium murale | 293.0 | 624.9 | 456.4 | |
| | Bassia hyssopifolia | 10.7 | 13.8 | - | |
| | Aster exilis | - | - | 816.7 | |
| | Dead material | 77.6 | 11.1 | - | |
| | Total Live Material | 516.5 | 689.5 | 1297.0 | 834.3 |

Table 4-13. Standing crop measurements for Pampas grass (Well 15) and ruderal community (Well 18) species.

Well 15 - Pampas grass clumps

| Clump No. | Clump Diameter | Clump Height |
|---|---|---|
| 1 | 2.5 m | 2.2 |
| 2 | 4.9 | 6.0 |
| 3 | 2.1 | 2.4 |
| 4 | 3.0 | 2.3 |
| 5 | 3.4 | 3.2 |
| Mean | 3.2 | 3.2 |

Aboveground Live Biomass of Clump No. 1: 14.12 kg (wet wt.)

Well 18 - Ruderal Plant Community

| Species | Wet wt/kg/$m^2$ |
|---|---|
| Baccharis pilularis consaguinea | 14.70 |
| Nictoniana glauca | 8.54 |
| Ricinus communis | 12.30 |

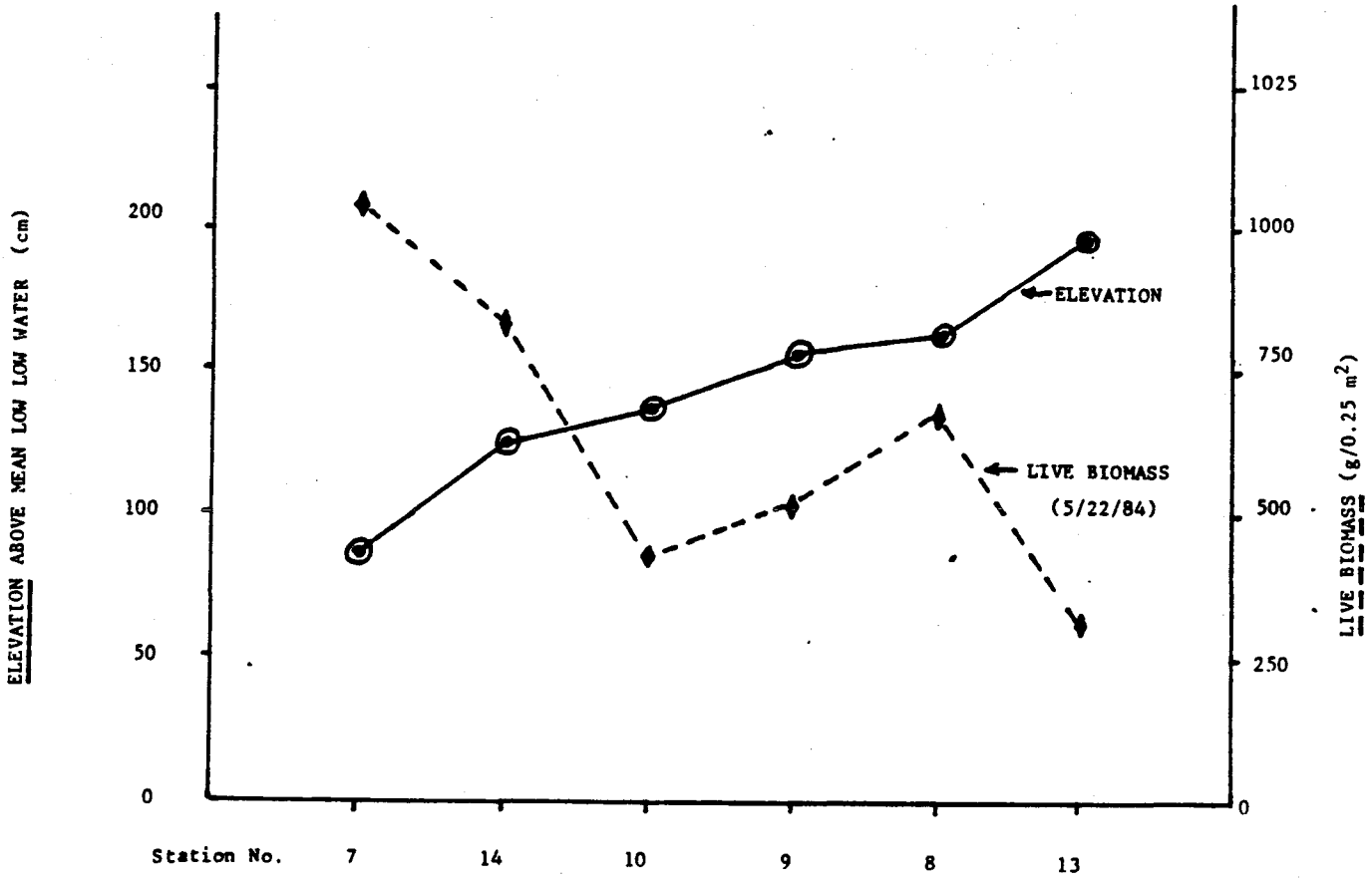



Figure 4-3. Relationship between surface elevation (cm above MLLW) and aboveground live plant biomass (g wet wt/0.25m$^2$) at selected Santa Ana River lowland locations. (See Figure 4-1 for station locations.)

North of 19th Street, in what appears to be a remnant of the original Santa Ana River Channel, willow riparian habitat is present where freshwater remains close to the soil surface. Adjacent areas with drier soils support ruderal field vegetation. North of Victoria Street, the water table was well below the soil surface even during the winter months. Occasional stands of perennials such as tree tobacco, coyote bush and giant reed are present, along with introduced grasses and weedy species common to ruderal areas throughout coastal southern California.

# 5.0 ENVIRONMENTAL VARIABLES

A preliminary reconnaissance of the entire study site conducted (Macdonald, Feldmeth, Guthrie, and Prigge) December 2, 1983, indicated that vegetation patterns were very complex and possibly reflected both north-south and east-west salinity gradients. Since seasonal patterns of groundwater availability (depth) and salinity are likely to play a key role in both the species composition and primary production of site-vegetation, a groundwater monitoring program was initiated.

Monitoring wells were installed in locations selected to address the following questions:

- How does groundwater depth and salinity change -- from the coastal salt marsh, northward to Fairview Channel? -- And westward from Newport Beach Mesa bluffs to the Santa Ana River Flood Control Channel?
- How do groundwater parameters change along an elevational gradient within the Salicornia-dominated salt marsh, and across the wetland/upland bondary?
- Are groundwater depths and salinities across the study site characterized by distinctive seasonal changes?

This section of the report describes the results of these studies of environmental variables as they affect plant distributions and primary production (see Section 4.0 also). First, the direct groundwater observations are described (5.1.2) and their qualitative reflection in vegetation patterns noted (5.1.3). Next, possible quantitative correlelations between species cover data and environmental variables are examined (5.2). Finally, the results of Scholander pressure bomb tests -- designed to assess soil moisture availability to Salicornia plants growing under different site conditions -- are presented and discussed (5.3).

## 5.1 GROUNDWATER ELEVATION AND SALINITY

### 5.1.1 METHODS

Twenty-two ground water monitoring wells (peizometers) were installed throughout the study site (see Figures 5-1 and 5-2) during the course of the program. A nine-inch (23 cm) diameter soil auger (post hole digger) was utilized to bore a hole in the soil at each test site to a depth of approximately 4.5 ft (137 cm). A length of two-inch (5.1 cm) diameter, 5 ft (152 cm) long PVC pipe was inserted into the hole. The bottom end of the pipe was capped, and the pipe slotted with a narrow-blade hacksaw at 6 inch (15 cm) intervals. The entire pipe was also wrapped in fiberglass screening and the bore hole was back filled with sand (Figure 5-3).

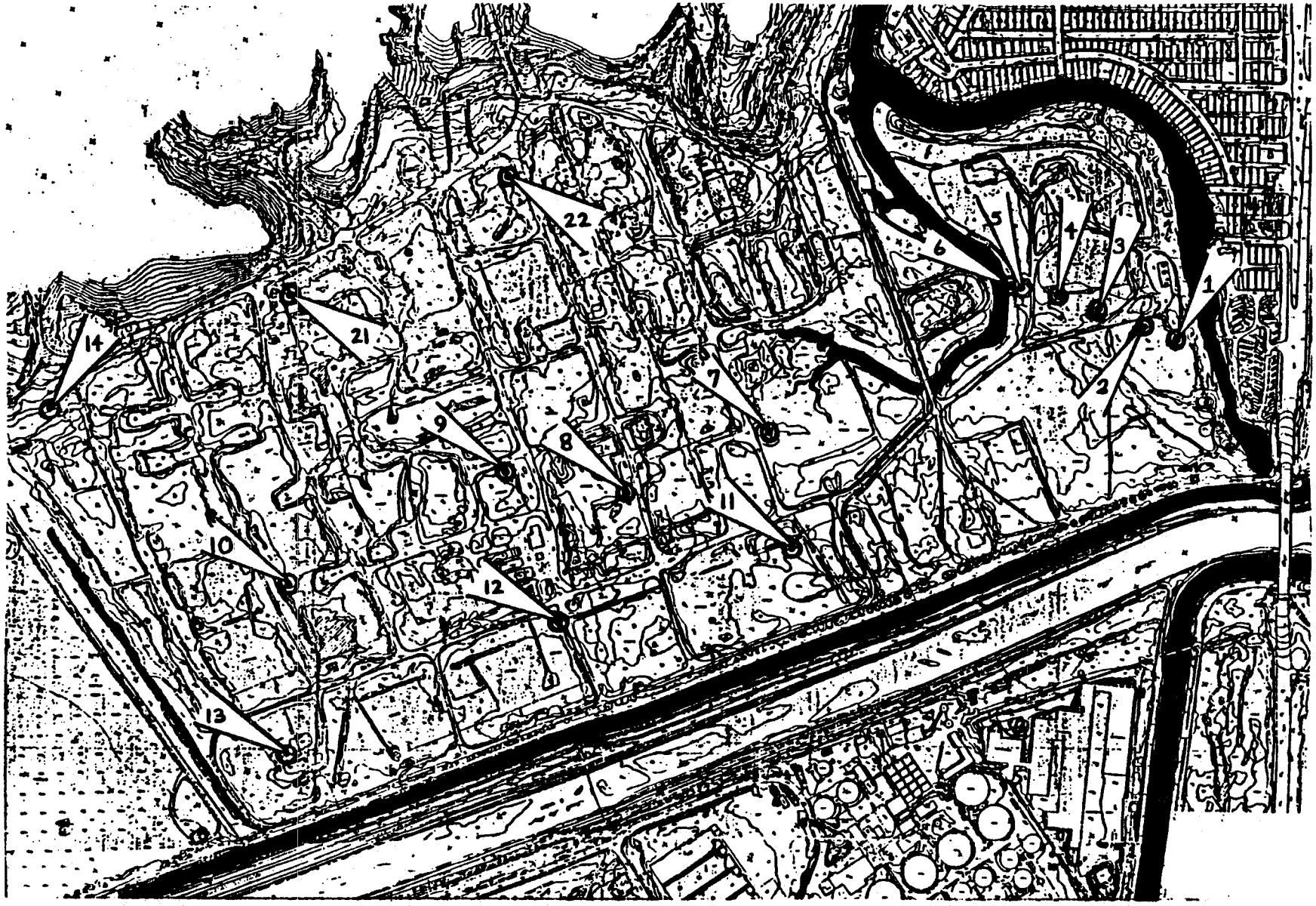



Figure 5-1. Groundwater observation wells installed across the salt marsh (1 through 6) and in the oilfield area.

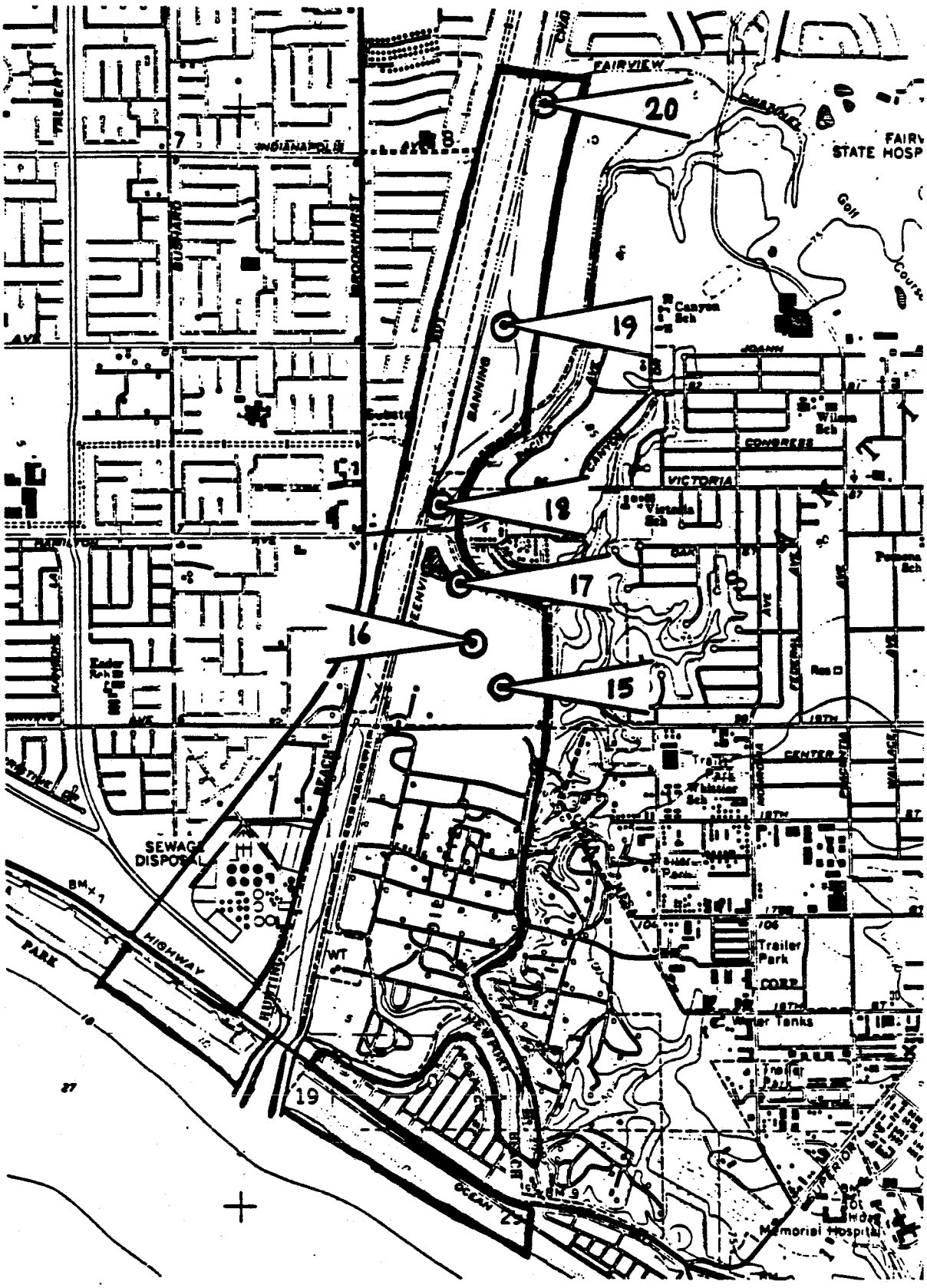



Figure 5-2. Groundwater observation wells installed north of 19th Street.

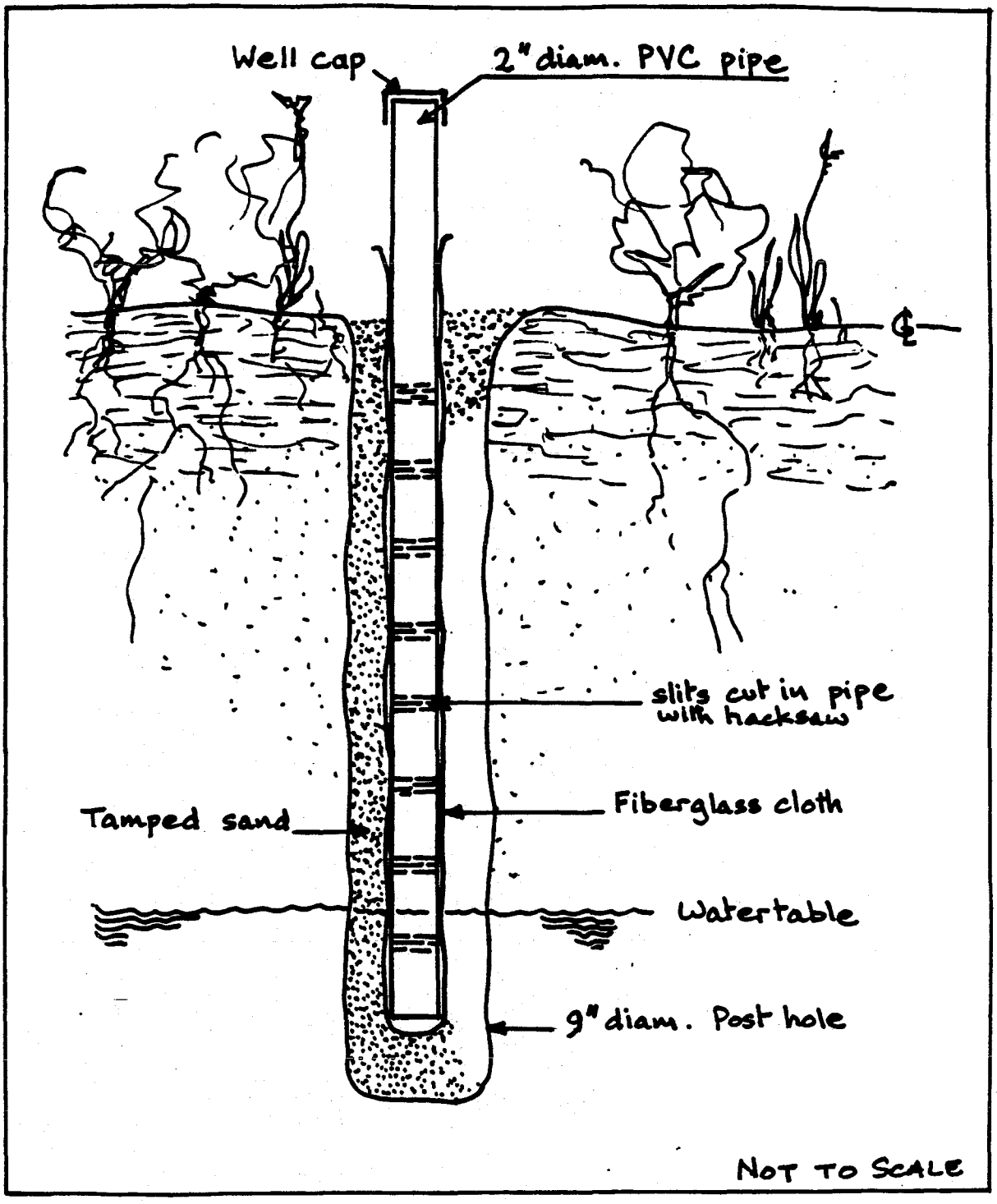



Figure 5-3. Diagrammatic cross section showing the general structure of the groundwater observation wells.

A specially designed dip stick (Figure 5-4) was used to measure the depth samples from the surface and bottom of the standing water. The calibrated dip stick was slowly lowered into the well; by gently blowing down the tube, the observer immediately sensed increased resistance when the tube reached water level and a bubbling sound occurred. The height of the well casing above ground level was subtracted from the measured depth of standing water below the top of the casing -- thus yielding the depth to standing water below the ground surface. Since the ground elevation at each well site is known -- relative to mean lower low water (MLLW), tidal datum -- water table depth can be corrected to MLLW and contoured.

A "surface" well water sample was obtained by lowering the plastic sample cup at the end of a dip stick just beneath the water surface and withdrawing the sample. The "bottom" water sample (collected after the surface sample to minimize mixing) was obtained by re-lowering the dip stick after the sample cup has been cleaned and sealed with a rubber stopper. When the dip stick reached the bottom of the well, the stopper was gently pulled, the sample cup filled up, and the dip stick and water sample were retrieved. Water sample salinities (ppt) were immediately measured in the field using an American Optical Refractometer, Sea Water Model.

While the surface water samples were essentially undisturbed and should have yielded accurate salinity measurements, the bottom samples could have been diluted or mixed as they were withdrawn through the water column. The effects of such potential mixing were minimized by pouring off most of the water and taking the salinity measurement from water at the very bottom of the sample cup only. The adequacy of this procedure was tested in the field by measuring continuous salinity/well depth profiles using a Yellow Springs Instruments, Conductivity-Salinity Meter. Salinity measurements obtained by lowering the salinity probe down each of several test wells were identical with those obtained from refractometer measurements of dip stick water samples.

Since many of the observation wells exhibited a marked salinity stratification, it was important to eliminate both evaporation and surface runoff as potential influences of well-water conditions. All of the wells were tightly capped between sampling visits, thus evaporation from the wells was eliminated. The top of each well casing stood 15 to 20 cm above the ground surface and the first slots within the casing (Figure 5-3) were 20 to 25 cm below the surface. This effectively precluded surface runoff from directly entering the wells.

Each groundwater observation test well acted as a piezometer and reflected conditions within the groundwater table that underly the study site. The salinity values measured at each site should have accurately reflected soil water conditions within or beneath the root zones of the various plant assemblages developed across the study site.

### 5.1.2 RESULTS

#### 5.1.2.1 January through March, 1984

Ground surface elevations at each observation well (as cm above MLLW), depths to standing water in each well (as cm below ground surface), and surface and bottom salinity values (ppt) for January through March, 1984, are presented in Table 5-1.

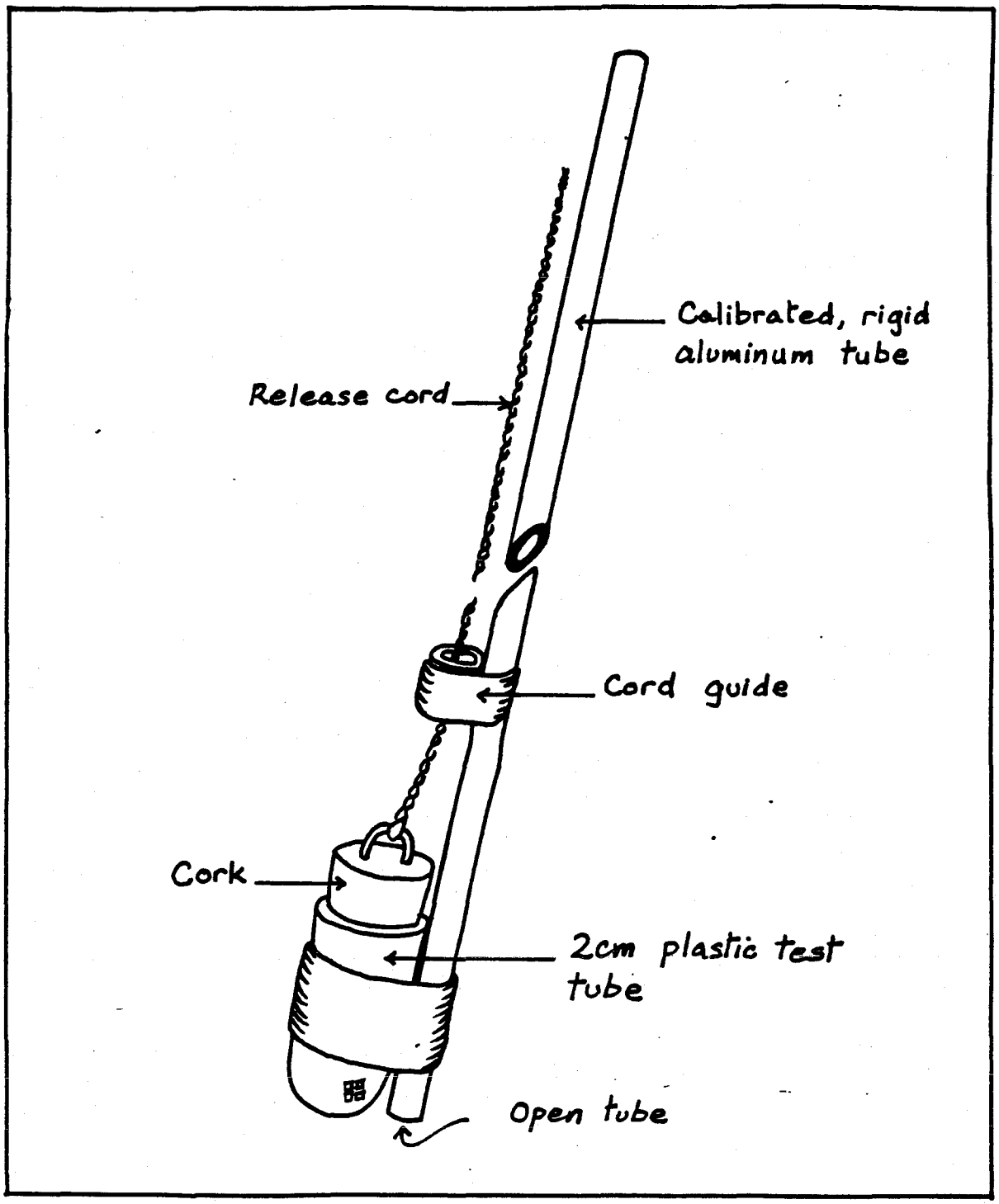



Figure 5-4. Sketch of dip stick used to measure groundwater depths and obtain salinity samples.

Table S-1. Ground elevation, depth to standing water, and standing water salinities (ppt) measured at different well locations, January through March, 1984.

| Well No. | Well Elev. | 1-17-84 Depth | 1-17-84 S o/oo Sur. | 1-17-84 S o/oo Bot. | 1-27-84 Depth | 2-3-84 Depth | 2-3-84 S o/oo Sur. | 2-3-84 S o/oo Bot. | 2-10-84 Depth | 2-10-84 S o/oo Sur. | 3-2-84 Depth | 3-2-84 S o/oo Sur. | 3-2-84 S o/oo Bot. | 3-23-84 Depth | 3-23-84 S o/oo Sur. | 3-23-84 S o/oo Bot. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 188 | 119 | 5 | - | 123 | 127 | 10 | 10 | - | - | 138 | 10 | - | 139 | 11 | - |
| 2 | 155 | 101 | 15 | 20 | 112 | 112 | 22 | 24 | - | - | 121 | 25 | 25 | 122 | 14 | 15 |
| 3 | 134 | 72 | 42 | 45 | 83 | 82 | 44 | 46 | - | - | 93 | 46 | 47 | 93 | 45 | - |
| 4 | 134 | 75 | 51 | 55 | 68 | 90 | 56 | 58 | - | - | 99 | 56 | 57 | 101 | 56 | 58 |
| 5 | 130 | 56 | 46 | 47 | 68 | 59 | 45 | 48 | - | - | 91 | 42 | 48 | 90 | 45 | 50 |
| 6 | 102 | 18 | 20 | 24 | 55 | 35 | 25 | 29 | - | - | 49 | 24 | 28 | 50 | 28 | 30 |
| 7 | 86 | 35 | 39 | 42 | - | 51 | 44 | - | - | - | 50 | 42 | 44 | 95 | 43 | 45 |
| 8 | 161 | 25 | 18 | 18 | - | 40 | 20 | 20 | - | - | 62 | 17 | 20 | 95 | 20 | 22 |
| 9 | 156 | 15 | 0 | 0 | - | 48 | 2 | 2 | - | - | 55 | 2 | - | 102 | 2 | - |
| 10 | 137 | 32 | 27 | 29 | - | 53 | 31 | 32 | - | - | 61 | 26 | - | 107 | 30 | 34 |
| 11 | 123 | - | - | - | - | 102 | 20 | - | - | - | - | - | - | 120 | 33 | 37 |
| 12 | 121 | - | - | - | - | 94 | 11 | - | - | - | 114 | 12 | - | 118 | 12 | 13 |
| 13 | 196 | - | - | - | - | 107 | 46 | 48 | - | - | 128 | 45 | - | 133 | 45 | 46 |
| 14 | 125 | - | - | - | - | 30 | 15 | - | - | - | 48 | 12 | - | 60 | 12 | 15 |
| 15 | 189 | - | - | - | - | 21 | 1 | - | - | - | 35 | - | - | - | 2 | - |
| 16 | 207 | - | - | - | - | 35 | 2 | - | - | - | 38 | 3 | - | - | - | - |
| 17 | 223 | - | - | - | - | - | - | - | 42 | 6 | 57 | 10 | - | 59 | 10 | - |
| 18 | 143 | - | - | - | - | - | - | - | 135 | 7 | 145 | 6 | - | 147 | 7 | - |
| 19 | - | - | - | - | - | dry | - | - | dry | - | dry | - | - | dry | - | - |
| 20 | - | - | - | - | - | dry | - | - | dry | - | dry | - | - | dry | - | - |

Well Elev. - Ground surface elevation at well site, as cm above MLLW (30.48cm = 1ft)

Depth - Depth to standing water in well, as cm below ground surface elevation.

S o/oo - Salinities (ppt) at surface (Sur.) and bottom (Bot.) of standing water in well.

"-" - No measurement taken.

Two general conclusions are apparent from inspection of the data in Table 5-1. First, while individual wells exhibit temporal fluctuation of ground water levels (Wells 5 and 6 adjacent to the salt marsh tidal channel, for example), a general trend of declining groundwater level was apparent throughout the study site between mid-January and late March, 1984. Second, in the majority (83%) of cases where paired "surface" and "bottom" groundwater samples were available, salinity values showed an increase with depth.

Temporal trends of absolute salinity values at individual wells are harder to characterize. Salinity in Well 1, for example, increased steadily from 5 ppt in mid-January, to 11 ppt in late March. Well 4 salinity increased from 51 ppt to 57 ppt during January, then remained constant through late March. Well 5 showed a decline in salinity from 46 ppt in mid-January to 42 ppt in early March, then increased again to 45 ppt.

An approximate aerial plot of groundwater surface salinities for March 23, 1984, (Figure 5-5, showing salinities above and below 20 ppt), indicates that the higher values tend to occur south of 19th Street -- particularly in the salt marsh habitats -- and to the west of the study site, away from the Newport Beach Mesa Bluffs. This overall pattern might partly reflect shallow, salt water intrusion, inland from the Santa Ana River's ocean entrance.

A similar plot showing the elevation of the groundwater surface relative to MLLW (Figure 5-6), indicates an irregular pattern suggestive of uneven or impeded subsurface flow. The three wells located between 19th and Victoria Streets, for example, indicate a groundwater surface lying a meter or more higher than that immediately to the north or south. The two northernmost wells (Wells 19 and 20) are in coarse, sandy soil and they remained dry since their installation in early February 1984.

5.1.2.2 April through August, 1984

Two additional ground water monitoring wells were installed at the foot of the Newport Beach Mesa Bluffs along the historic course of the Santa Ana River Channel (Figure 5-1). The more northerly well (Well 21), yielded freshwater (0 ppt) at 66 cm below the ground surface. The more southerly well (Well 22), yielded more saline water (14 ppt) -- but only 20 cm below the ground level.

Groundwater monitoring data collected during May, June, and July 1984 are presented in Table 5-2. Ground surface elevations at each observation well (as cm below ground surface), and surface and bottom salinity values (ppt), are all presented in Table 5-2.

Inspection of data from wells installed south of 19th Street, indicates that groundwater levels generally continued to fall and salinities increased throughout the spring and summer months. This probably reflects increasing evaporation and an almost total lack of precipitation as the spring and summer progressed. Groundwater salinities declined at Wells 15 and 17 located between 19th and Victoria Streets. This may reflect an increase in freshwater runoff from landscape watering of residential developments bordering adjacent bluffs. Well 16, nearby, and all three wells located north of Victoria Street (Wells 18, 19, and 20) were dry in July and August, 1984 -- indeed Wells 19 and 20 were dry throughout the study. Here the groundwater level is apparently substantially deeper than the bottoms of the wells.

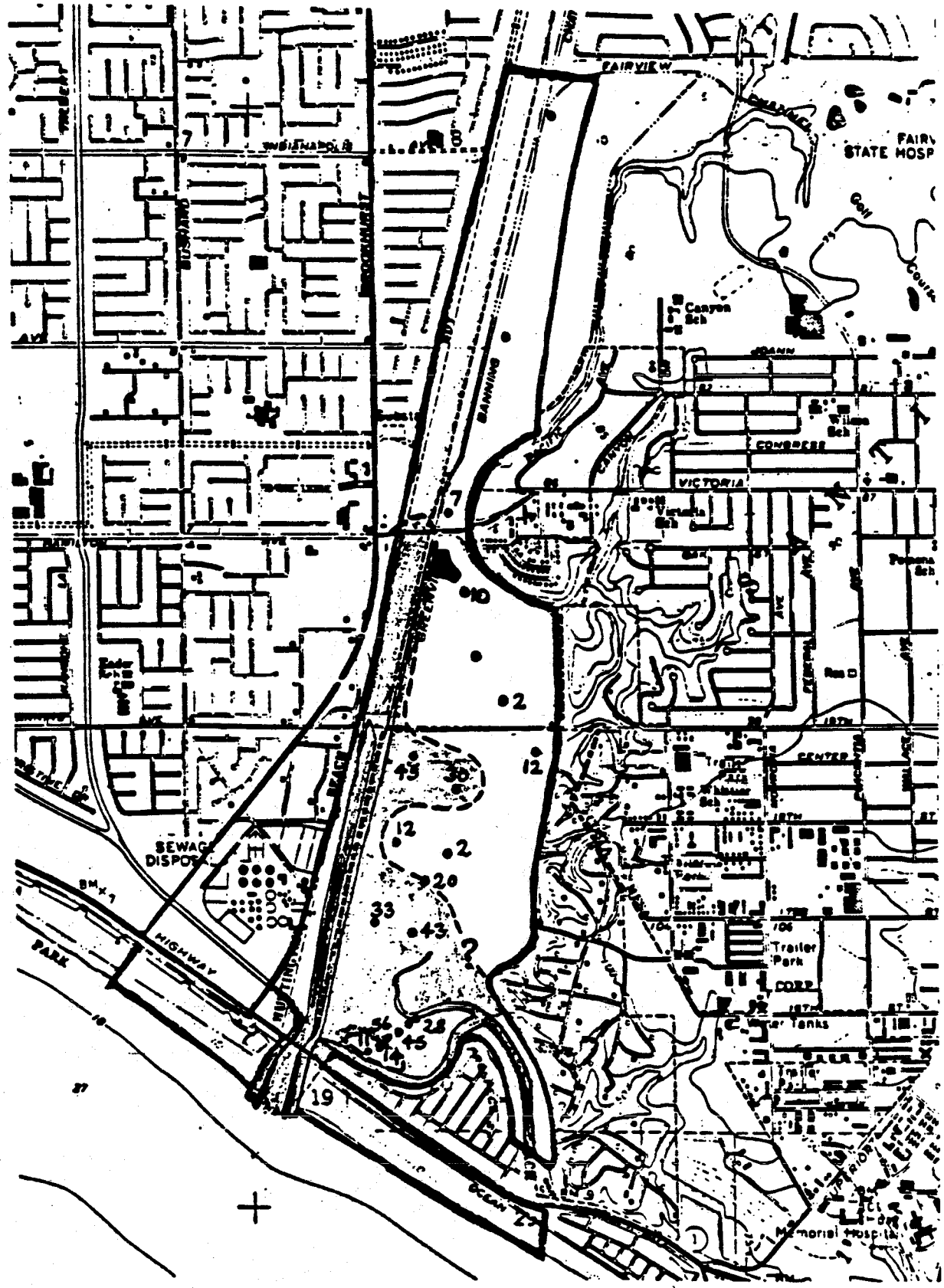



Figure 5-5. Groundwater surface salinities measured on March 23, 1984. Contoured at 20 o/oo.

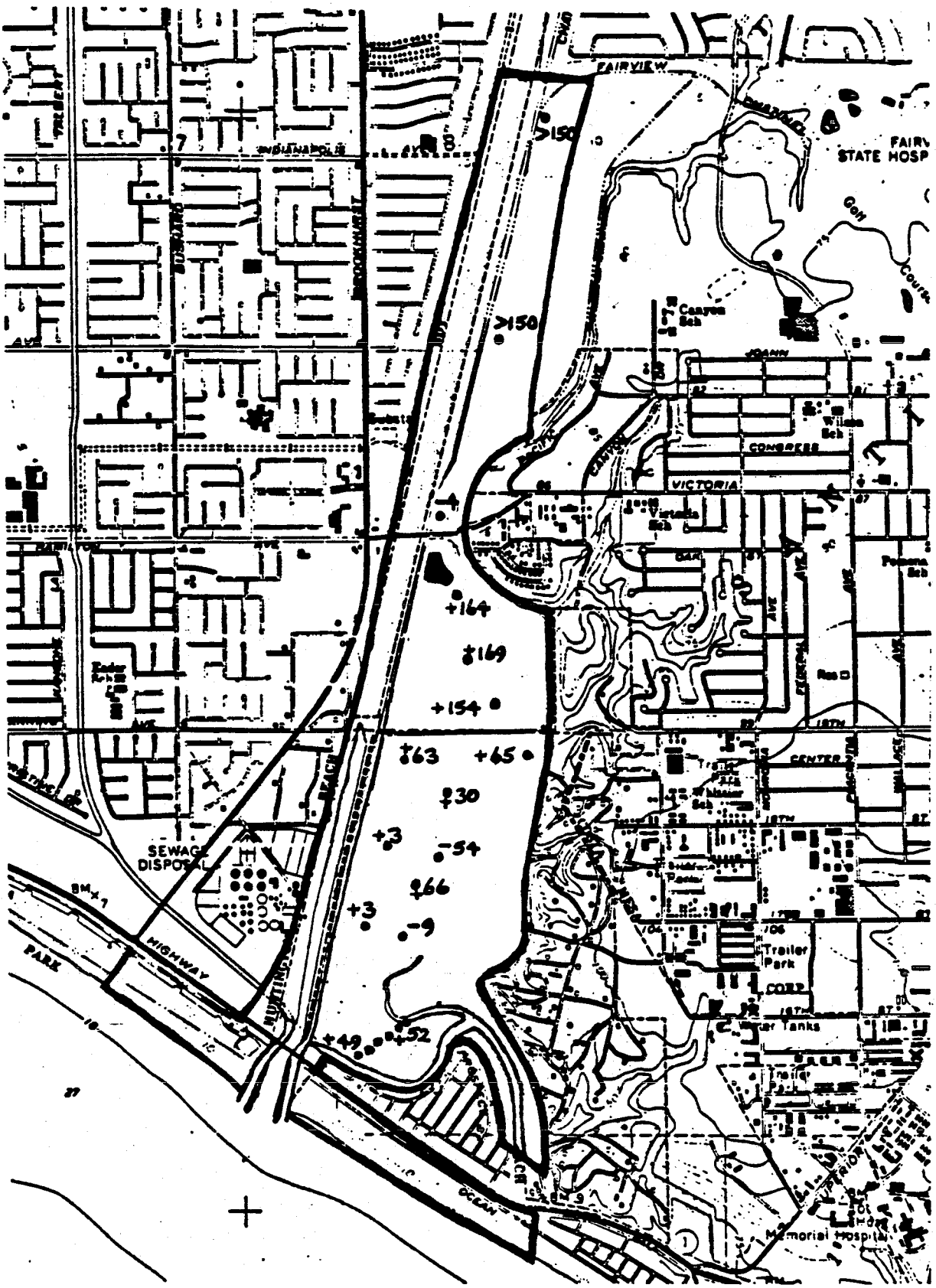



Figure 5-6. Groundwater surface elevations (as cm above MLLW) measured on March 23, 1984.

Table 5-2. Ground elevation, depth to standing water, and standing water (ppt) measured at different well locations, May through July, 1984.

| Well No. | Well Elev. | May 22, 1984 | | | June 19, 1984 | | | July 3, 1984 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Salinity o/oo | | | Salinity o/oo | | | Salinity o/oo | |
| | | Depth | Sur. | Bot. | Depth | Sur. | Bot. | Depth | Sur. | Bot. |
| 1 | 188 | 124 | 14 | - | - | - | - | 143 | 14 | - |
| 2 | 155 | 120 | 35 | - | - | - | - | 133 | 34 | - |
| 3 | 134 | 88 | 42 | 44 | - | - | - | 98 | 41 | 43 |
| 4 | 134 | 92 | 55 | 55 | - | - | - | 106 | 55 | 56 |
| 5 | 130 | 74 | 45 | 48 | - | - | - | 90 | 50 | 50 |
| 6 | 102 | 48 | 39 | 42 | - | - | - | 32 | 46 | 48 |
| 7 | 86 | 19 | 42 | 46 | - | - | - | 71 | 45 | 48 |
| 8 | 161 | 90 | 19 | 21 | - | - | - | 101 | 22+ | 20 |
| 9 | 156 | 113 | - | -* | - | - | - | 105 | - | -* |
| 10 | 137 | 122 | 32 | - | - | - | - | dry | - | - |
| 11 | 123 | 104 | 36 | - | - | - | - | 92 | 42 | 41 |
| 12 | 121 | 118 | 10 | - | - | - | - | 107 | 13 | 15 |
| 13 | 196 | 140 | - | -* | - | - | - | 133 | - | -* |
| 14 | 125 | 90 | - | -* | - | - | - | 87 | 15+ | 13 |
| 15 | 189 | - | - | - | 124 | 0 | 0 | - | - | - |
| 16 | 207 | - | - | - | dry | - | -* | - | - | - |
| 17 | 223 | - | - | - | 117 | 6 | 6 | - | - | - |
| 18 | 144 | - | - | - | 140 | - | -* | - | - | - |
| 19 | - | - | - | - | dry | - | - | - | - | - |
| 20 | - | - | - | - | dry | - | - | - | - | - |
| 21 | 152 | - | - | - | 66 | 0 | 0 | - | - | - |
| 22 | 156 | - | - | - | 20 | 14 | 14 | - | - | - |

Well Elev. - Ground surface elevation at well site, as cm above MLLW (30.48cm = 1ft)
Depth - Depth to standing water in well, as cm below ground surface elevation.
S o/oo - Salinities (ppt) at surface (Sur.) and bottom (Bot.) of standing water in well.
"-" - No measurement taken.
"*" - Wet soil at bottom, no sample.
"+" - Well cap disturbed, salinity value probably increased by evaporation.

An approximate aerial plot of groundwater surface salinities across the study site for June and July 1984, is presented in Figure 5-7. Groundwater salinities for mid-August (Figure 5-8) showed similar results. The pattern of higher salinities nearer the ocean entrance and westward toward the Santa Ana Flood Control Channel, remains generally similar to that developed for March 1984 (Figure 5-5).

### 5.1.3 GROUNDWATER & VEGETATION PATTERNS

Two sources of groundwater are present at the Santa Ana River Marsh and lowlands site: saline waters which are present south of 19th Street and in the western portion of the property adjacent to the Greenville-Banning Channel, and freshwater present along what appears to be a remnant of the old Santa Ana River Channel which lies adjacent to the Newport Mesa Bluffs (see Figure 1-4). The southern and western portions of the site are thus characterized by saline soils which mainly support halophytes at elevations lower than 150 cm MLLW. Higher sites in both the remnant salt marsh and oilfield area are vegetated with weedy species more characteristic of upland plant communities.

The northern and eastern portions of the study area are characterized by riparian plants along with numerous annual species characteristic of areas of low soil salinities.

The transition zone from freshwater to salt water appears to remain in about the same location throughout the dry summer season. Groundwater salinities contoured at 20 ppt in March (Figure 5-6) indicate a definite pattern which remained generally similar through August (Figure 5-8), although groundwater levels dropped and salinities generally increased. As evaporation and transpiration by plants occur, the water table falls, but sea water apparently does not intrude landward of the 20 ppt contour.

The six wells located on a transect line across the coastal salt marsh revealed an interesting pattern. Ground elevation gradually rises from +102 cm above MLLW at Station 6 adjacent to the remnant tidal channel to +188 cm at Station 1. The later area is an old dune characterized by upland vegetation. This transect begins in a typical highmarsh assemblage of Salicornia virginica, Salicornia subterminalis, Limonium californicum and Frankenia grandiflora. The transect passes through an almost solid stand of Salicornia virginica (Wells 3 to 5) and at Well 2 it transitions to upland plant species (see Figure 5-1).

Groundwater salinities ranged from 5 ppt for Station 1 in January, to 58 ppt for Station 4 in March 1984. Consistently, salinities were higher in the areas vegetated by salt marsh plant species. Groundwater at Station 6 adjacent to the tidal channel, was only 18 cm below the ground level in mid-January (Table 5-1) and gradually dropped to a level that was 56 cm below the ground surface in mid-August. The salinity at this location showed an increase from 20 ppt to 52 ppt over this same time period. Salinities lower than seawater (34 ppt) were present at Well 6 for the period of January through March 1984. These values corresponded to lowed salinities in the adjacent tidal channel due to winter rains.

Salinities for Wells 3 through 5 remained high (42-56 ppt) through the entire study. The fine-grained marsh soils apparently prevent much lateral movement

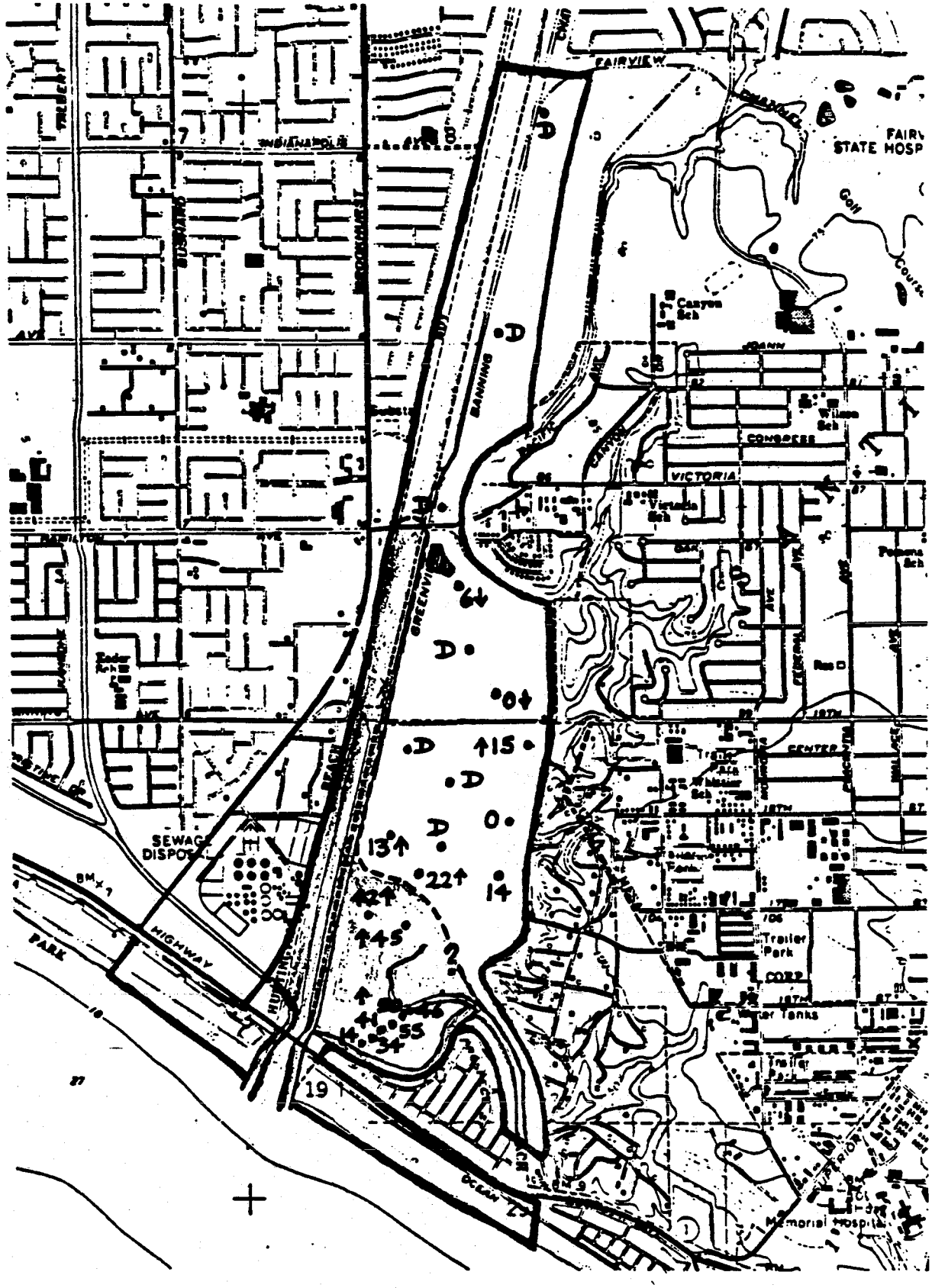



Figure 5-7. Groundwater surface salinities measured June/July 1984. Arrows indicate increase (↑) or decrease (↓) in salinity since March 1984; D = well bottom dry. Contoured at 20 o/oo.

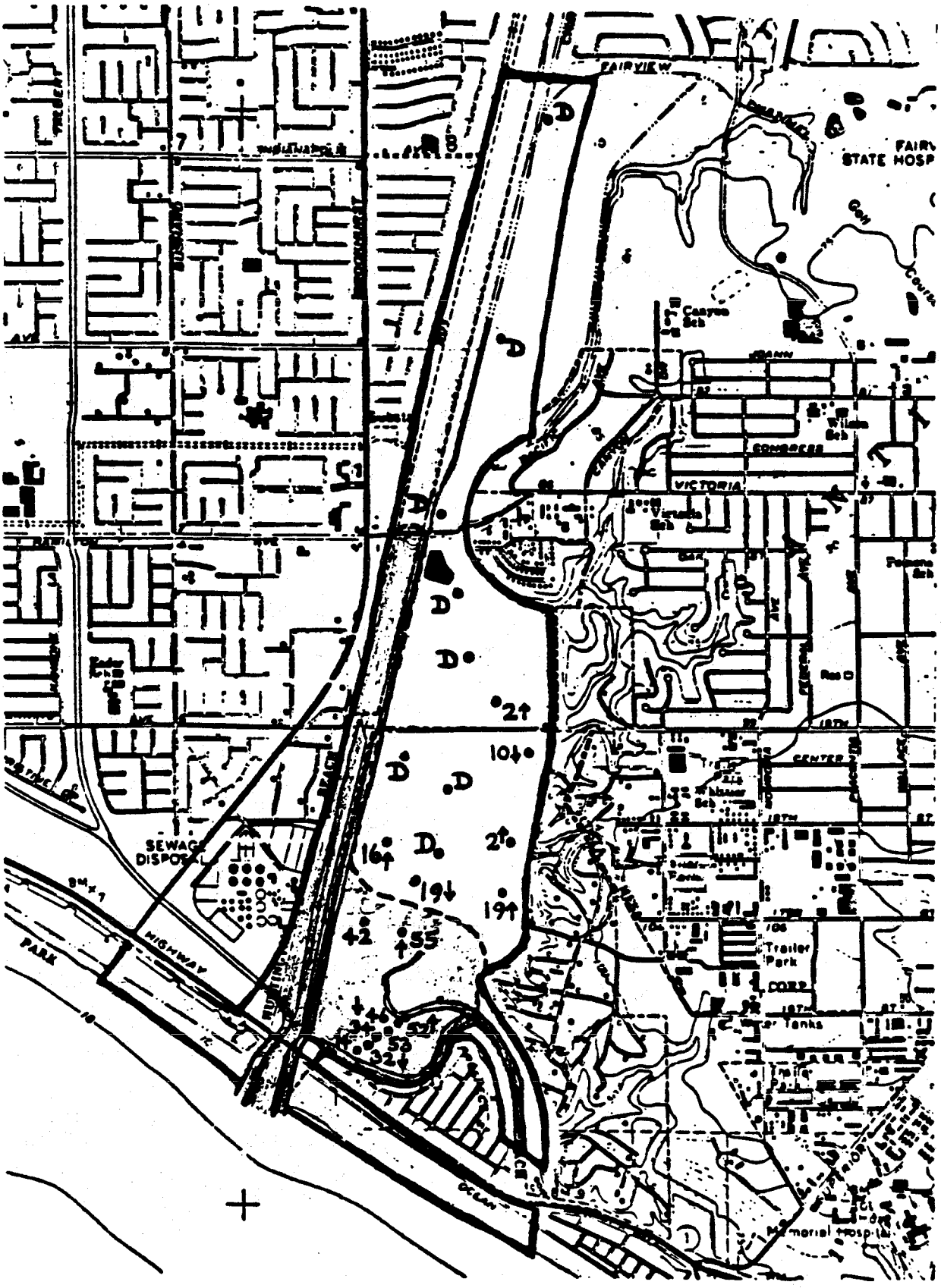



Figure 5-8. Groundwater surface salinities measured August 1984. Arrows indicate increase (↑) or decrease (↓) in salinity since June/July 1984; D = well bottom dry. Contoured at 20 o/oo.

of groundwater, so that salinities are determined more by evaporation rather than intrusion of sea water from adjacent tidal channels.

Another factor which appeared to be important in determining groundwater and soil salinities was elevation. Stations 1 and 2 lie more than 150 cm above MLLW and had salinities less than sea water. The same pattern occurs in the wells north of the oilfield and south of 19th Street. Areas of elevation higher than 150 cm generally have sandy soils. Precipitation apparently percolates downward through this more porous soil and groundwater salinities remain lower.

In contrast, areas of elevation below 150 cm MLLW are characterized by fine-grained, very compact soils characteristic of mid- and high marsh environments. Rainfall apparently pools on the surface and eventually evaporates, with very little percolation occurring. Wells 3, 4, and 5 had surface salinities in January of 42-51 ppt. These same wells show only a slight increase in salinity by August, 1984. The water table apparently rises during the cooler, wetter winter months, probably due to very gradual sea water intrusion and because of the lower evaporation and transpiration rates during the winter months.

In conclusion, groundwater salinity distribution at the Santa Ana River Marsh and lowlands is reflected in vegetation patterns. Salt marsh plants are present in areas where groundwater salinities are equal to, or greater than, sea water. In areas of lower salinities, upland plant species occur. There was also a gradual decline in groundwater levels throughout the study. In January only two of the wells were dry; by mid-August, eight of 22 wells were dry and water levels in all wells containing water had dropped.

The gradual lowering of groundwater levels in test wells located at ground elevations above 150 cm MLLW generally resulted in increases in salinity. Groundwater in these areas appears to be almost entirely dependent upon rainfall and freshwater runoff for recharge. The salt marsh portions of the site appear to be less influenced by precipitation.

## 5.2 PLANT COVER/ENVIRONMENTAL VARIABLES CORRELATIONS

The results from some of the vegetation quantitative species cover transects and groundwater monitoring wells have been integrated into Tables 5-3 to 5-7 to facilitate interpretation. Only species that contribute more than one percent cover to any transect are listed. The species are grouped into non-halophytes and halophytes. The non-halophyte group is loosely defined since many of the species placed in this group can grow in both saline and non-saline conditions. The halophyte group are the more restricted salt marsh species.

Interpretation of the data requires caution since the monitoring well data are not necessarily from exactly the same areas sampled for plant cover; some data came from wells adjacent to these sampling areas. The correlations are also diminished by the fact that not all the wells have data for the same dates. For example, Well 21 was not installed until June, 1984, so there are no data for earlier dates to compare with other wells. This is particularly a problem for "minimum depth to groundwater" records.

Table 5-3. Elevation of monitoring wells and plant cover.

| Elevation (cm above MLLW) | 88 | 102 | 121 | 123 | 125 | 134 | 134 | 137 | 152 | 156 | 188 | 189 | 207 | 223 | — |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well Number | 7 | 6 | 12 | 11 | 14 | 3 | 4 | 10 | 21 | 2 | 1 | 15 | 16 | 17 | 20 |
| Transect Number | 31 | 29* | 17 | 18 | 36 | 25 | 25 | 38 | 33 | 1 | 2 | 43 | 10 | 44 | 45 |
| **Non-halophytes** | | | | | | | | | | | | | | | |
| Artemisia biennis | | | | | | | | | 5 | | | | | | |
| Arundo donax | | | | | | | | | | | | | | | 54 |
| Aster exilis | | | | | | | | | | | | | | 5 | |
| Atriplex semibaccata | | | | | | | | | | | | | | 2 | |
| Atriplex patula | | 14 | | | 2 | | | 4 | | | | | 1 | | |
| Baccharis spp. | | | 3 | 1 | 4 | | | | 40 | | 1 | | 1 | 34 | |
| Bassia hyssopifolia | 1 | | | 1 | | | | 7 | | | | | 3 | | |
| Brassica spp. | | | 6 | | | | | | | | | | | | 6 |
| Bromus diandrus | | | | | | 3 | 3 | | | 88 | 77 | | 8 | | 14 |
| Centaurea militensis | | | 13 | | | | | | | | <1 | | | | |
| Chenopodium macrospermum | | | | | 16 | | | | | | | | | 1 | |
| Cirsium vulgare | | | | 1 | | | | | | | | | 6 | 1 | |
| Conium maculatum | | | | 2 | | | | | | | | | 2 | | |
| Conyza canadensis | | | | 2 | | | | | | <1 | | | | | |
| Cortaderia stacamensis | | | | | 1 | | | | | | | 30 | 1 | 1 | |
| Croton californica | | | | | | | | | | | | | | | 7 |
| Cyperus eragrostis | | | | | | | | | | | | 8 | | | |
| Distichlis spicata | 1 | | 15 | | | | | | | <1 | 8 | | | | |
| Eleocharis montevidensis | | | | | | | | | | | | 3 | | | |
| Foeniculum vulgare | | | 3 | | | | | 1 | | | | | | | |
| Haplopappus venetus | | | 5 | | | | | | | | | | | | |
| Heterotheca grandiflora | | | | | | | | | | | | | | | 4 |
| Picris echioides | | | | | | | | | | | | | 8 | | |
| Pluchea purpurascens | | | | | | | | | | | | | | 5 | |
| Polypogon monospeliensis | 6 | 1 | | 1 | | 1 | 1 | 1 | | | | | 8 | | |
| Pulicaria hispanica | | | | | | | | | | | | | | 18 | |
| Ricinus communis | | | | | 4 | | | | | | | | | | 1 |
| Rumex crispus | | | 1 | 9 | | | | | | | | | 1 | 3 | |
| Salix spp. | | | | | 36 | | | | | | | 59 | 1 | 12 | 6 |
| Scirpus californicus | | | | | 12 | | | | | | | | | 27 | |
| Sida leprosa | | | | 11 | | | | | | 4 | | | 41 | 7 | |
| Silybum marianum | | | 10 | 19 | | | | | | | | | | | |
| Solanum douglasii | | | | 3 | | | | | | | | | 1 | | |
| Solidago occidentalis | | | 7 | | 15 | | | 2 | 2 | | | | 1 | | |
| Tamarix ramosissima | | | | | | | | | | | | | | 2 | |
| Typha latifolia | | | | | 11 | | | 7 | 40 | | | | | 1 | |
| Xanthium strumarium | | | | | | | | | 33 | | | | | 1 | |
| **Halophytes** | | | | | | | | | | | | | | | |
| Frankenia grandifolia | 12 | 10 | 1 | 12 | | 26 | 26 | 2 | 1 | | | | | | |
| Limonium californicum | | 7 | | | | | | | | | | | | | |
| Salicornia subterminalis | 16 | | | | | 2 | 2 | | | | | | | | |
| Salicornia virginica | 47 | 84 | 5 | 24 | | 75 | 75 | 69 | | | | | | | |
| Suaeda californica | | 5 | | | | | | | | | | | | | |

*Transects that are underlined were from sites that had a well; other transects used data from adjacent wells.

Table 5-4. Minimum depth to ground water at monitoring wells and plant cover.

| Minimum depth to ground water (cm) | 19 | 20 | 21 | 30 | 32 | 35 | 42 | 66 | 72 | 74 | 92 | 94 | 101 | 119 | Dry |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well Number | 7 | 6 | 15 | 14 | 10 | 16 | 17 | 21 | 3 | 4 | 11 | 12 | 2 | 1 | 20 |
| Transect Number | 31 | 26* | 43 | 36 | 38 | 10 | 44 | 33 | 25 | 25 | 18 | 17 | 1 | 2 | 45 |
| **Non-halophytes** | | | | | | | | | | | | | | | |
| Artemisia biennis | | | | | | | | 5 | | | | | | | |
| Arundo donax | | | | | | | | | | | | | | | 54 |
| Aster exilis | | | | | | | 5 | | | | | | | | |
| Atriplex semibaccata | | | | | | | 2 | | | | | | | | |
| Atriplex patula | | 14 | | 2 | 4 | 1 | | | | | | | | | |
| Baccharis spp. | | | | 4 | | 1 | 34 | 40 | | | 1 | 3 | | 1 | |
| Bassia hyssopifolia | 1 | | | | 7 | 3 | | | | | 1 | | | | |
| Brassica spp. | | | | | | | | | | | | 6 | | | 6 |
| Bromus diandrus | | | | | | 8 | | | 3 | 3 | | | 88 | 77 | 14 |
| Centaurea militensis | | | | | | | | | | | | 13 | | <1 | |
| Chenopodium macrospermum | | | | 16 | | | 1 | | | | | | | | |
| Cirsium vulgare | | | | | | 6 | 1 | | | | 1 | | | | |
| Conium maculatum | | | | | | 2 | | | | | 2 | | | | |
| Conyza canadensis | | | | | | | | | | | 2 | | <1 | | |
| Cortaderia atacamensis | | | 30 | 1 | | 1 | 1 | | | | | | | | |
| Croton californica | | | | | | | | | | | | | | | 7 |
| Cyperus eragrostis | | | 8 | | | | | | | | | | | | |
| Distichlis spicata | 1 | | | | | | | | | | | 15 | <1 | 8 | |
| Eleocharis montevidensis | | | 3 | | | | | | | | | | | | |
| Foeniculum vulgare | | | | | 1 | | | | | | | 3 | | | |
| Haplopappus venetus | | | | | | | | | | | | 5 | | | |
| Heterotheca grandiflora | | | | | | | | | | | | | | | 4 |
| Picris echioides | | | | | | 8 | | | | | | | | | |
| Pluchea purpurascens | | | | | | | 5 | | | | | | | | |
| Polypogon monospeliensis | 6 | 1 | | | 1 | 8 | | | 1 | 1 | 1 | | | | |
| Pulicaria hispanica | | | | | | | 18 | | | | | | | | |
| Ricinus communis | | | | 4 | | | | | | | | | | | 1 |
| Rumex crispus | | | | | | 1 | 3 | | | | 8 | 1 | | | |
| Salix spp. | | | 59 | 36 | | 1 | 12 | | | | | | | | 6 |
| Scirpus californicus | | | | 12 | | | 27 | | | | | | | | |
| Sida leprosa | | | | | | 41 | 7 | | | | 11 | | 4 | | |
| Silybum marianum | | | | | | | | | | | 19 | 10 | | | |
| Solidago occidentalis | | | | 15 | 2 | 1 | | 2 | | | | 7 | | | |
| Solanum douglasii | | | | | | 1 | | | | | 3 | | | | |
| Tamarix ramosissima | | | | | | | 2 | | | | | | | | |
| Typha latifolia | | | | 11 | 7 | | 1 | 40 | | | | | | | |
| Xanthium strumarium | | | | | | | 1 | 33 | | | | | | | |
| **Halophytes** | | | | | | | | | | | | | | | |
| Frankenia grandifolia | 12 | 10 | | | 2 | | | 1 | 26 | 26 | 12 | 1 | | | |
| Limonium californicum | | 7 | | | | | | | | | | | | | |
| Salicornia subterminalis | 16 | | | | | | | | 2 | 2 | | | | | |
| Salicornia virginica | 47 | 64 | | | 69 | | | | 75 | 75 | 24 | 5 | | | |
| Suaeda californica | | 5 | | | | | | | | | | | | | |

*Transects that are underlined were from sites that had a well; other transects used data from adjacent wells.

Table 5-5. Maximum depth to ground water at monitoring wells and plant cover.

| Maximum depth to ground water (cm) | 50 | 66 | 90 | 96 | 98 | 106 | 117 | 118 | 120 | 124 | 133 | 143 | Dry | Dry | Dry |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well Number | 6 | 21 | 14 | 7 | 3 | 4 | 17 | 12 | 11 | 15 | 2 | 1 | 10 | 18 | 20 |
| Transect Number | 26* | 33 | 38 | 31 | 25 | 25 | 44 | 17 | 18 | 43 | 1 | 2 | 38 | 10 | 45 |
| **Non-halophytes** | | | | | | | | | | | | | | | |
| Artemisia biennis | | 5 | | | | | | | | | | | | | |
| Arundo donax | | | | | | | | | | | | | | | 54 |
| Aster exilis | | | | | | | 5 | | | | | | | | |
| Atriplex semibaccata | | | | | | | 2 | | | | | | | | |
| Atriplex patula | 14 | | 2 | | | | | | | | | | 4 | 1 | |
| Baccharis spp. | | 40 | 4 | | | | 34 | 3 | 1 | | | 1 | | 1 | |
| Bassia hyssopifolia | | | | 1 | | | | | 1 | | | | 7 | 3 | |
| Brassica spp. | | | | | | | | 6 | | | | | | | 6 |
| Bromus diandrus | | | | | 3 | 3 | | | | | 88 | 77 | | 8 | 14 |
| Centaurea militensis | | | | | | | | 13 | | | | <1 | | | |
| Chenopodium macrospermum | | | 16 | | | | 1 | | | | | | | | |
| Cirsium vulgare | | | | | | | 1 | | 1 | | | | | 6 | |
| Conium maculatum | | | | | | | | | 2 | | | | | 2 | |
| Conyza canadensis | | | | | | | | | 2 | | <1 | | | | |
| Cortaderia atacamensis | | | 1 | | | | 1 | | | 30 | | | | 1 | |
| Croton californica | | | | | | | | | | | | | | | 7 |
| Cyperus eragrostis | | | | | | | | | | 8 | | | | | |
| Distichlis spicata | | | | 1 | | | | 15 | | | <1 | 8 | | | |
| Eleocharis montevidensis | | | | | | | | | | 3 | | | | | |
| Foeniculum vulgare | | | | | | | | 3 | | | | | 1 | | |
| Haplopappus venetus | | | | | | | | 5 | | | | | | | |
| Heterotheca grandiflora | | | | | | | | | | | | | | | 4 |
| Picris echioides | | | | | | | | | | | | | | 8 | |
| Pluchea purpurascens | | | | | | | 5 | | | | | | | | |
| Polypogon monospeliensis | 1 | | | 6 | 1 | 1 | | | 1 | | | | 1 | 8 | |
| Pulicaria hispanica | | | | | | | 18 | | | | | | | | |
| Ricinus communis | | | 4 | | | | | | | | | | | | 1 |
| Rumex crispus | | | | | | | 3 | 1 | 9 | | | | | 1 | |
| Salix spp. | | | 38 | | | | 12 | | | 58 | | | | 1 | 8 |
| Scirpus californicus | | | 12 | | | | 27 | | | | | | | | |
| Sida leprosa | | | | | | | 7 | | 11 | | 4 | | | 41 | |
| Silybum marianum | | | | | | | | 10 | 19 | | | | | | |
| Solidago occidentalis | | 2 | 15 | | | | | 7 | | | | | 2 | 1 | |
| Solanum douglasii | | | | | | | | | 3 | | | | | 1 | |
| Tamarix ramosissima | | | | | | | 2 | | | | | | | | |
| Typha latifolia | | 40 | 11 | | | | 1 | | | | | | 7 | | |
| Xanthium strumarium | | 33 | | | | | 1 | | | | | | | | |
| **Halophytes** | | | | | | | | | | | | | | | |
| Frankenia grandifolia | 10 | 1 | | 12 | 26 | 26 | | 1 | 12 | | | | 2 | | |
| Limonium californicum | 7 | | | | | | | | | | | | | | |
| Salicornia subterminalis | | | | 16 | 2 | 2 | | | | | | | | | |
| Salicornia virginica | 64 | | | 47 | 75 | 75 | | 5 | 24 | | | | 69 | | |
| Suaeda californica | 5 | | | | | | | | | | | | | | |

*Transects that are underlined were from sites that had a well; other transects used data from adjacent wells.

Table B-6. Maximum salinity at surface of monitoring wells and plant cover.

| Maximum surface salinity (ppt) | ? | 0 | 2 | 3 | 10 | 13 | 14 | 15 | 32 | 35 | 42 | 45 | 46 | 46 | 56 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well | 20 | 21 | 15 | 16 | 17 | 12 | 1 | 14 | 10 | 2 | 11 | 7 | 3 | 6 | 4 |
| Transect | 45* | 33 | 43 | 10 | 44 | 17 | 2 | 36 | 38 | 1 | 18 | 31 | 25 | 26 | 25 |
| **Non-halophytes** | | | | | | | | | | | | | | | |
| Artemisia biennis | | 5 | | | | | | | | | | | | | |
| Arundo donax | 54 | | | | | | | | | | | | | | |
| Atriplex semibaccata | | | | | 2 | | | | | | | | | | |
| Atriplex patula | | | | 1 | | | | 2 | 4 | | | | | 14 | |
| Aster exilis | | | | | 5 | | | | | | | | | | |
| Baccharis spp. | | 40 | | 1 | 34 | 3 | 1 | 4 | | | 1 | | | | |
| Bassia hyssopifolia | | | | 3 | | | | | 7 | | 1 | 1 | | | |
| Brassica spp. | 6 | | | | | 6 | | | | | | | | | |
| Bromus diandrus | 14 | | | 8 | | | 77 | | | 88 | | | 3 | | 3 |
| Centaurea militensis | | | | | | 13 | <1 | | | | | | | | |
| Chenopodium macrospermum | | | | | 1 | | | 16 | | | | | | | |
| Cirsium vulgare | | | | 6 | 1 | | | | | | 1 | | | | |
| Conium maculatum | | | | 2 | | | | | | | 2 | | | | |
| Conyza canadensis | | | | | | | | | | <1 | 2 | | | | |
| Cortaderia atacamensis | | | 30 | 1 | 1 | | | 1 | | | | | | | |
| Croton californica | 7 | | | | | | | | | | | | | | |
| Cyperus eragrostis | | | 8 | | | | | | | | | | | | |
| Distichlis spicata | | | | | | 15 | 8 | | | <1 | | 1 | | | |
| Eleocharis montevidensis | | | 3 | | | | | | | | | | | | |
| Foeniculum vulgare | | | | | | 3 | | | 1 | | | | | | |
| Haplopappus venetus | | | | | | 5 | | | | | | | | | |
| Heterotheca grandiflora | 4 | | | | | | | | | | | | | | |
| Picris echioides | | | | 8 | | | | | | | | | | | |
| Pluchea purpurascens | | | | | 5 | | | | | | | | | | |
| Polypogon monospeliensis | | | | 8 | | | | | 1 | | 1 | 6 | 1 | 1 | 1 |
| Pulicaria hispanica | | | | | 18 | | | | | | | | | | |
| Ricinus communis | 1 | | | | | | | 4 | | | | | | | |
| Rumex crispus | | | | 1 | 3 | 1 | | | | | 9 | | | | |
| Salix spp. | 8 | | 58 | 1 | 12 | | | 36 | | | | | | | |
| Scirpus californicus | | | | | 27 | | | 12 | | | | | | | |
| Sida leprosa | | | | 41 | 7 | | | | | 4 | 11 | | | | |
| Silybum marianum | | | | | | 10 | | | | | 19 | | | | |
| Solidago occidentalis | | 2 | | 1 | | 7 | | 15 | 2 | | | | | | |
| Solanum douglasii | | | | 1 | | | | | | | 3 | | | | |
| Tamarix ramosissima | | | | | 2 | | | | | | | | | | |
| Typha latifolia | | 40 | | | 1 | | | 11 | 7 | | | | | | |
| Xanthium strumarium | | 33 | | | 1 | | | | | | | | | | |
| **Halophytes** | | | | | | | | | | | | | | | |
| Frankenia grandifolia | | 1 | | | | 1 | | | 2 | | 12 | 12 | 26 | 10 | 26 |
| Limonium californicum | | | | | | | | | | | | | | 7 | |
| Salicornia subterminalis | | | | | | | | | | | | 16 | 2 | | 2 |
| Salicornia virginica | | | | | | 5 | | | 69 | | 24 | 47 | 75 | 64 | 75 |
| Suaeda californica | | | | | | | | | | | | | | 5 | |

*Transects that are underlined were from sites that had a well; other transects used data from adjacent wells.

Table 5-7. Maximum salinity at bottom of monitoring wells and plant cover.

| Maximum bottom salinity [ppt] | ? | 0 | 0 | - | 6 | 10 | 15 | 15 | 25 | 34 | 41 | 47 | 48 | 48 | 58 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well Number | 20 | 21 | 15 | 16 | 17 | 1 | 12 | 14 | 2 | 10 | 11 | 3 | 7 | 6 | 4 |
| Transect Number | 45* | 33 | 43 | 10 | 44 | 2 | 17 | 36 | 1 | 38 | 18 | 25 | 31 | 26 | 25 |
| **Non-halophytes** | | | | | | | | | | | | | | | |
| Artemisia biennis | | 5 | | | | | | | | | | | | | |
| Arundo donax | 54 | | | | | | | | | | | | | | |
| Aster exilis | | | | | 5 | | | | | | | | | | |
| Atriplex semibaccata | | | | | 2 | | | | | | | | | | |
| Atriplex patula | | | | 1 | | | | 2 | | 4 | | | | 14 | |
| Baccharis spp. | | 40 | | 1 | 34 | 1 | 3 | 4 | | | 1 | | | | |
| Bassia hyssopifolia | | | | 3 | | | | | | 7 | 1 | | 1 | | |
| Brassica spp. | 8 | | | | | | 8 | | | | | | | | |
| Bromus diandrus | 14 | | | 8 | | 77 | | | 88 | | | 3 | | | 3 |
| Centaurea militensis | | | | | | <1 | 13 | | | | | | | | |
| Chenopodium macrospermum | | | | | 1 | | | 16 | | | | | | | |
| Cirsium vulgare | | | | 6 | 1 | | | | | | 1 | | | | |
| Conium maculatum | | | | 2 | | | | | | | 2 | | | | |
| Conyza canadensis | | | | | | | | | <1 | | 2 | | | | |
| Cortaderia stacamensis | | | 30 | 1 | 1 | | | 1 | | | | | | | |
| Croton californica | 7 | | | | | | | | | | | | | | |
| Cyperus eragrostis | | | 8 | | | | | | | | | | | | |
| Distichlis spicata | | | | | | 8 | 15 | | <1 | | | | 1 | | |
| Eleocharis montevidensis | | | 3 | | | | | | | | | | | | |
| Foeniculum vulgare | | | | | | | 3 | | | 1 | | | | | |
| Haplopappus venetus | | | | | | | 5 | | | | | | | | |
| Heterotheca grandiflora | 4 | | | | | | | | | | | | | | |
| Lotus scoparius | | | | | | | 1 | | | | | | | | |
| Picris echioides | | | | 8 | | | | | | | | | | | |
| Pluchea purpurescens | | | | | 5 | | | | | | | | | | |
| Polypogon monospeliensis | | | | 8 | | | | | | 1 | 1 | 1 | 8 | 1 | 1 |
| Pulicaria hispanica | | | | | 18 | | | | | | | | | | |
| Ricinus communis | 1 | | | | | | | 4 | | | | | | | |
| Rumex crispus | | | | 1 | 3 | | 1 | | | | 9 | | | | |
| Salix spp. | 8 | | 59 | 1 | 12 | | | 36 | | | | | | | |
| Scirpus californicus | | | | | 27 | | | 12 | | | | | | | |
| Sida leprosa | | | | 41 | 7 | | | | 4 | | 11 | | | | |
| Silybum marianum | | | | | | | 10 | | | | 19 | | | | |
| Solidago occidentalis | | 2 | | 1 | | | 7 | 15 | | 2 | | | | | |
| Solanum douglasii | | | | 1 | | | | | | | 3 | | | | |
| Tamarix ramosissima | | | | | 2 | | | | | | | | | | |
| Typha latifolia | | 40 | | | 1 | | | 11 | | 7 | | | | | |
| Xanthium strumarium | | 33 | | | 1 | | | | | | | | | | |
| **Halophytes** | | | | | | | | | | | | | | | |
| Frankenia grandifolia | | 1 | | | | | 1 | | | 2 | 12 | 28 | 12 | 10 | 28 |
| Limonium californicum | | | | | | | | | | | | | | 7 | |
| Salicornia subterminalis | | | | | | | | | | | | 2 | 16 | | 2 |
| Salicornia virginica | | | | | | | 5 | | | 88 | 24 | 75 | 47 | 84 | 75 |
| Suaeda californica | | | | | | | | | | | | | | 5 | |

*Transects that are underlined were from sites that had a well; other transects used data from adjacent wells.

It would have been desirable for the monitoring wells and vegetation transects to coincide better, but time limitations required installation of wells before the sites for transects were determined. Some wells were located where the vegetation was representative and suitable for sampling, but the vegetation was subsequently cut for fire prevention before it could be sampled!

### 5.2.1 ELEVATION

Ground elevation above MLLW (Table 5-3) appears to make little difference to the non-halophytes as long as they are 120 cm above MLLW or higher, and there does not appear to be any subset of non-halophytes that are correlated with elevation. However, the elevational range of the halophytes is well delimited with an abrupt upper limit between 137 and 152 cm above MLLW. This upper limit for the salt marsh vegetation can be refined to approximately 150 cm above MLLW, using survey elevations from maps provided by the U.S. Army Corps of Engineers. The lower elevational limit for the salt marsh species is 86 cm above MLLW.

### 5.2.2 DEPTH TO GROUND WATER

Correlations with minimum- and maximum-depth to ground water are presented in Tables 5-4 and 5-5, respectively. There appears to be no pattern with respect to maximum depth, except that the halophytes are in areas where the ground water is high year-round (within 120 cm of surface). Some remnant marsh areas which have a water table deeper than 140 cm are indicated by monitoring at Well 10.

Minimum depth to the water table is critical for emergent aquatic species (Cyperus eragrostis, Eleocharis montevidensis, Scirpus californicus, Typha latifolia, etc.) and where these species occur, the ground water is within 66 cm of the surface -- or less, since the measurement of 66 cm was recorded from Well 21 which was not installed until June 1984.

### 5.2.3 SALINITY

Salinity data, whether from the surface or bottom of test wells (Tables 5-6 and 5-7), reveal that salt marsh species are strikingly absent from low salinity sites. These species occur where the salinity is greater than about 30 ppt (except at Well 12 where the plant association is remnant marsh that approaches a ruderal field). Salinity of Well 10 is approximately that of sea water; remaining wells had hypersaline (>40 ppt) groundwater.

There are two classes of non-halophytes apparent from Tables 5-6 and 5-7: those that cannot tolerate saline conditions, especially freshwater marsh and riparian species, and those plants that have a broad spectrum of salinity tolerance, especially Atriplex patuala hastata, Bassia hyssopifolia, Distichlis spicata, Polypogon monspeliensis, and Sida leprosa.

## 5.3 SALICORNIA/SOIL MOISTURE RELATIONSHIPS

Scholander pressure bomb tests were used to compare soil moisture availability for Salicornia virginica plants in mid-marsh and high marsh/upland transition habitats. The habitat areas studied were located between two tidal channels

in the coastal salt marsh (Figure 5-9). The mid-marsh station was adjacent to the more northerly tidal channel (groundwater Well 6), while the high marsh station was in an area transitional to upland vegetation (groundwater Well 2). The latter site was characterized by scattered Salicornia virginica and Frankenia grandiflora plants, as well as annual grasses. These two sites were chosen to represent areas of maximal and minimal soil moisture availability for the salt marsh plant community, respectively.

### 5.3.1 METHODS

The procedure for determining stem pressures using the Scholander pressure bomb was carried out in the following manner. A small branch was cut from a Salicornia plant and fitted through the cover of the pressure chamber. The branch and leaves were thus enclosed within the bomb while the cut end of the stem protruded from the chamber to allow observation (Figure 5-10). Nitrogen gas was forced into the chamber. As the gas pressure increased, stem fluid (basically water from the xylem) was forced out of the branch and its presence was observed at the cut end of the stem (Figure 5-10). The gas pressure which caused liquid to first appear at the end of the stem was recorded. This recorded value corresponds to the xylem (transport system) negative pressure within the plant required to supply water to its leaves. As soil moisture decreases, the plant has to "work harder" not only to extract water from the soil, but also to hold onto water to prevent wilting. Lower soil moisture levels require increases in negative xylem pressure for plants to maintain sufficient internal water supplies for physiological maintenance.

Twelve readings, each from separate Salicornia branches, were made for the mid-marsh habitat. Fifteen pressure measurements were made for the high marsh/transition area. All branches selected were green and fleshy with a brown semi-woody portion at their base. The woody stem was robust enough to insert through the rubber stopper which fit into the cover of the pressure bomb chamber. No crushed or broken plant stems or branches were used.

All pressure values are recorded in bars; one bar is 1.01325 atmospheres. Hence if 60 bars of gas pressure inside the bomb was required to induce a flow of stem fluid, it follows that the forces within the plant xylem required to draw water from the soil also would be approximately 60 atmospheres.

### 5.3.2 RESULTS

The Scholander pressure bomb values obtained for Salicornia branches from the two study areas are presented in Table 5-8. The mean pressure reading for mid-marsh tests was 49.5 atmospheres, with a standard deviation of 15.5. Nine of the twelve readings for this location ranged from 53 to 65 atmospheres. Three readings, however, were well below the mean, ranging from 20 to 26 atmospheres.

The ground at the mid-marsh location appeared dry and the vegetation was a gray-green color, characteristic of most Salicornia virginica stands in late summer. Ground level elevation at Well 6 was 102 cm (3.35 ft) above MLLW; groundwater level was 38.3 cm (1.26 ft) below the soil surface at the time of the tests.

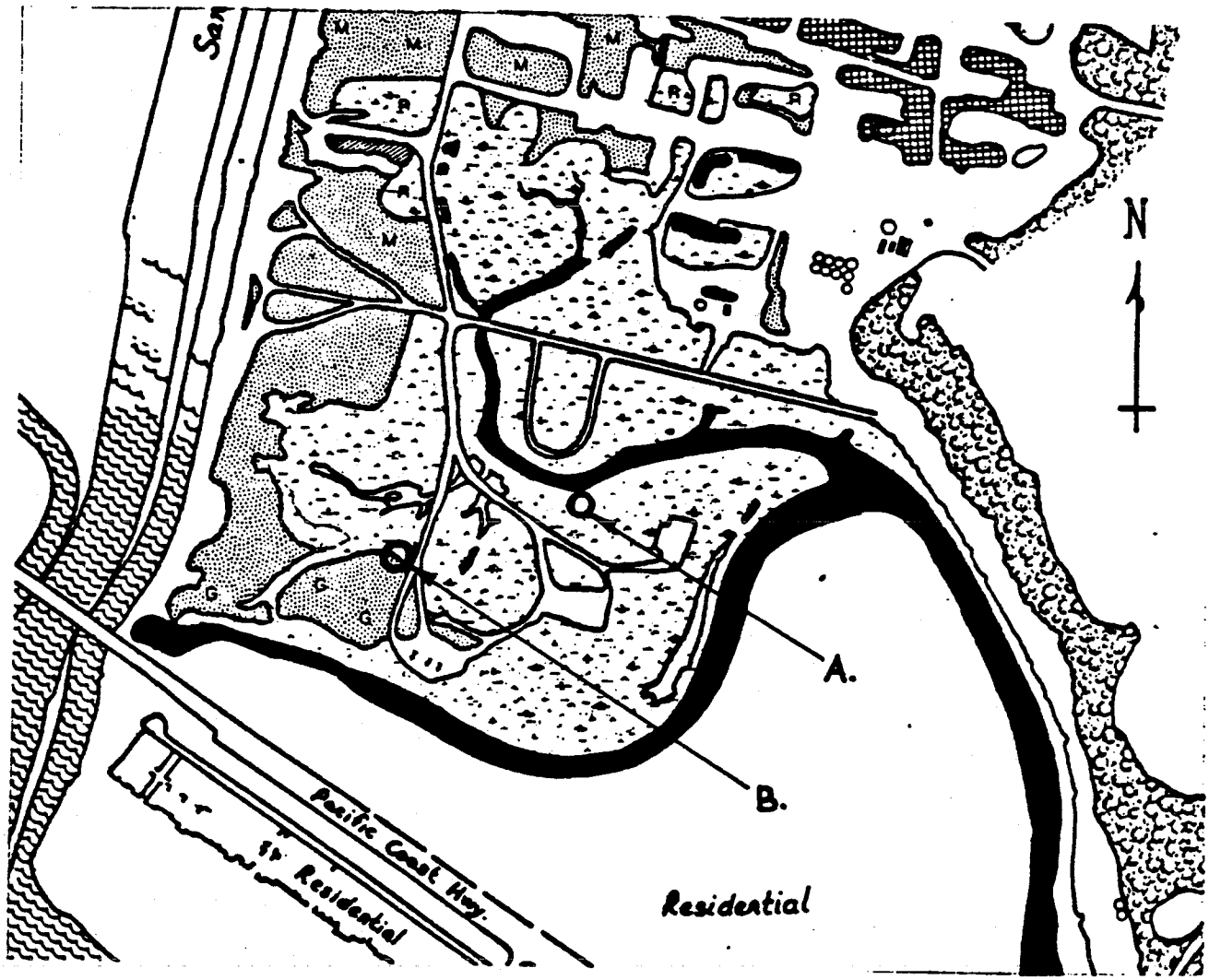



Figure 5-9. Sampling locations for Salicornia virginica plants typical of mid-marsh (A) and the high marsh/upland transition (B).

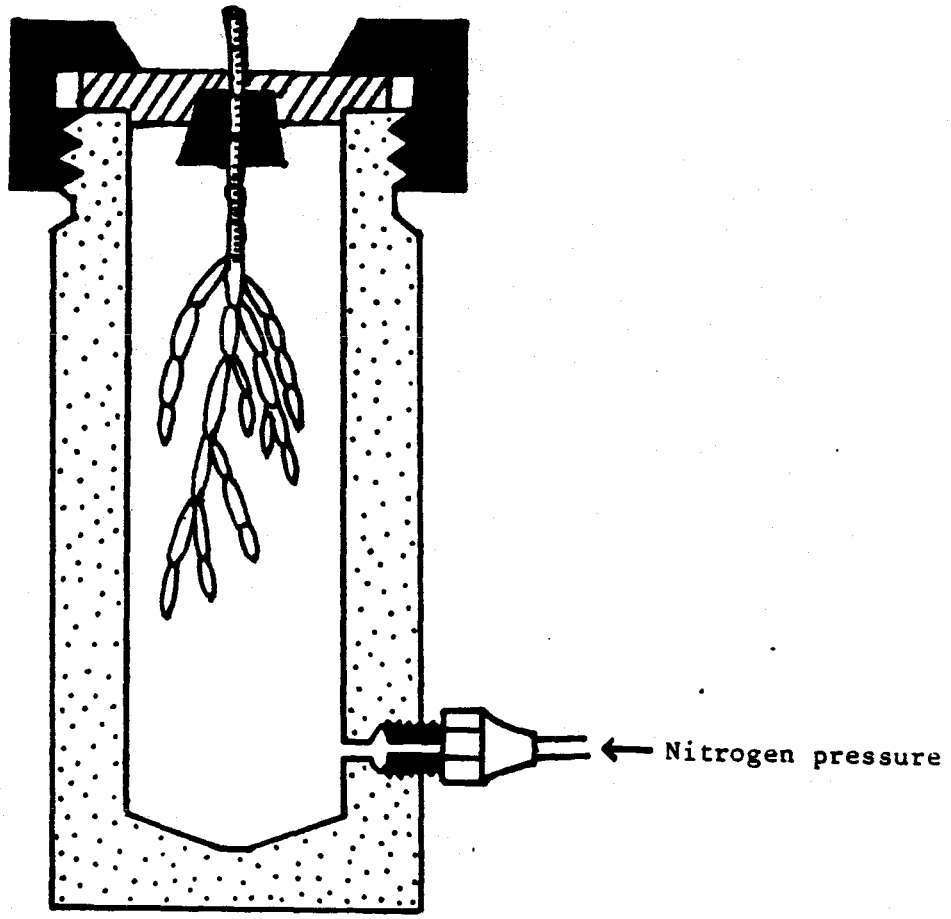



Figure 5-10. Vertical cross-section of Scholander pressure bomb chamber showing Salicornia branch in place for testing.

Table 5-8. Scholander Pressure Bomb Test Results for *Salicornia virginica*, September 21, 1984. Results as negative pressures, in bars.

| Test Replicates | Salicornia Branches | |
|---|---|---|
| | Mid-Marsh | High Marsh Transition |
| 1 | 58 | 54 |
| 2 | 57 | 65 |
| 3 | 65 | 56 |
| 4 | 52 | 55 |
| 5 | 60 | 44 |
| 6 | 57 | 62 |
| 7 | 62 | 65 |
| 8 | 53 | 65 |
| 9 | 60 | 65 |
| 10 | 24 | 53 |
| 11 | 26 | 65 |
| 12 | 20 | 65 |
| 13 | | 55 |
| 14 | | 45 |
| 15 | | 50 |
| Mean ± Standard Deviation | 49.5 ± 15.5 | 57.6 ± 7.3 |
| Standard Error | ± 4.5 | ± 1.9 |

The pressure bomb values for the high marsh/transition zone tests ranged from 45 to 65 atmospheres with a mean of 57.6 atmospheres (standard deviation, +7.3). At Well 2, depth to groundwater was 145 cm (4.76 ft) and the elevation was 155 cm (5.09ft) above MLLW. Although the mean pressure value for this site was higher than for the mid-marsh site, the two means are not significantly different (student's test: $p > 0.05$).

### 5.3.3 DISCUSSION

The pressure measurements obtained using a Scholander bomb indicate the force required within a plant to draw water from the soil and deliver it to the leaves. When a branch is cut and placed into the pressure bomb chamber, water in the xylem moves away from the cut end up the stem toward the leaves. The force exerted on the stem and its branches by the nitrogen gas inside the bomb's chamber is then increased until the water in the xylem is forced back to its original position before the stem was cut. At this pressure, when fluid first appears at the cut stem, the pressure within the chamber equals the negative pressure within the plant growing in the soil, before it was disturbed or cut. This pressure reading is thus equivalent to the force or negative pressure required within the plants' conducting system to supply water to the leaves.

Scholander et al., (1965) found this negative pressure in salt marsh halophytes such as Salicornia, Distichlis and Batis to range from -40 to -60 atmospheres, while desert plants such as Larrea (creosote bush) had xylem pressures as high as -60 to -80. Moist soils such as those found in salt marsh habitats should not require the high negative pressures found in desert plants. In salt marshes however, halophytes such as Salicornia must be able to obtain water against an osmotic potential of about -25 atmospheres in sea water (Scholander et al., 1965). In mid- and high marsh habitats, ground water and soil paste salinity can be as high as 60 ppt, or almost twice the concentration of sea water (Zedler, 1982).

The negative pressure values obtained for Salicornia virginica in mid-marsh and high marsh/transition habitats at the Santa Ana River Marsh are thus within the range of values previously reported for this species. The soil was very dry in both habitats. The dull gray-green color of the leaves and stems indicated that no new plant growth had occurred for some time. Because the mean negative pressure for both habitats (Table 5-8) was near the upper end of the range determined by Scholander et al., (1965) and soil moisture appeared to be minimal, Salicornia plants in both habitats examined are probably stressed to some extent at this time of the year.

For comparison, Salicornia virginica plants growing in wet soil at Bolsa Chica had a mean negative pressure of 33 atmospheres, as compared with a mean pressure of -58 atmospheres for Salicornia virginica plants in dry soil conditions in a high marsh situation (Feldmeth, unpublished). The latter pressure values were obtained from Bolsa Chica at the same time of the year (21 September, 1981) as the Santa Ana River Marsh tests.

It would thus appear that in the Santa Ana River salt marsh, relatively dry soils, and high soil- and groundwater salinities, result in conditions that are near the upper end of the tolerance range for Salicornia virginica in terms of the ability of this plant to obtain sufficient water from the soil.

The lower elevation of the mid-marsh site adjacent to the remnant tidal channel (Well 6, 102 cm above MLLW), as compared to the high marsh transition area (Well 2, 155 cm above MLLW) had no significant effect upon availability of soil moisture. Although three pressure readings for this site were low (20-26 bars), the mean value was not significantly different from that of the high marsh/transition site.

Soil moisture in the Santa Ana River salt marsh appears to depend to a great extent upon winter rains. As groundwater levels decrease through the dry summer and fall months, soil moisture is utilized by plants until its availability limits additional plant growth. Salicornia virginica, the dominant plant in the salt marsh, remains green and is able to persist until fall and winter rains replenish the soil moisture.

The steep channel banks and existing elevations apparently prevent sea water from either flooding or seeping easily into the salt marsh soil. High soil salinities persist and hence a remnant salt marsh continues to occur here. Once established, halopytes such as Salicornia virginica, Frankenia grandiflora and Distichilis spicata apparently do not require water saturated soils, but rather they continue to remain the dominant species in highly saline soils of the study area.

# 6.0 TERRESTRIAL FAUNA

## 6.1 THE INSECT FAUNA

Terrestrial arthropods -- insects and spiders -- probably form important links in the terrestrial community developed at the Santa Ana River Marsh and lowlands study site. Largely unknown and ignored until quite recently, the insects and spiders of coastal lowlands and marshes are now beginning to be studied and their ecological role elucidated. Recent relevant publications include Lane (1969), Cameron (1972), Nagano et al, in Schreiber (1981), Nagano (1982), and Nagano and Hogue (1982).

### 6.1.1 METHODS

In late June and early July 1982, a reconnaissance level survey of insects and spiders from four different Santa Ana River study site vegetation types was carried out. Sampling locations were selected adjacent to some of the groundwater monitoring wells shown in Figure 5-1, as follows: Coastal salt marsh -- Well 1, 3, and 6; remnant salt marsh -- Well 4; ruderal fields -- Well 10; and willow riparian -- Well 14. Three replicate samples were collected at each well location. Each sample consisted of 50 consecutive "sweeps" with an insect sweep net, within and above the vegetation being samples. The area sampled in each set of 50 sweeps was approximately $50m^2$.

The collected specimens were carefully removed from the sweep net in the field, bottled in alcohol, and returned to the laboratory. A total wet-weight biomass (grams/$50m^2$ sample) determination was made for each sample replicate in the laboratory. The specimens from each sample were then divided among classes and orders to provide a general overview of the taxonomic composition of the insect fauna associated with each vegetation type sampled.

### 6.1.2 RESULTS & DISCUSSION

Data summarizing the general taxonomic composition of the arthropod fauna at each sample site, as well as the wet-weight biomass results, are presented in Tables 6-1 and 6-2.

The lowest arthropod biomasses were collected from coastal salt marsh and remnant salt marsh habitats. Sweeping adjacent to Wells 3, 6 and 7 yielded mean biomass values ranging from 0.13 to 0.25 g/$50m^2$. Most of the arthropods found on the succulent salt marsh vegetation were leaf hoppers and small spiders. The more elevated, grassy dune habitat near Well 1 yielded a mean biomass of 0.36 g/$50m^2$, while ruderal field habitat around Well 10 produced 0.27 g/$50m^2$. Both areas were quite dry when sampled and most plants had passed their peak growing season and died back.

The highest arthropod biomass was collected in the willow riparian thicket near Well 14. There, soil moisture remains closer to the ground surface longer and insects, especially grasshoppers, beetles, and leaf hoppers, were more abundant. The mean biomass for this area was 0.72 g/$50m^2$.

Table 6-1 . Terrestrial Arthropods collected from Coastal Salt Marsh vegetation (Well Nos. 1, 3, & 6) at the Santa Ana River study site, June 20, 1984.

| Well Number | | 1 | | | 3 | | | 6 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sample Replicate | | A | B | C | A | B | C | A | B | C |
| Class | | | | | | | | | | |
| Arachnida | - spiders | X | X | X | X | X | X | X | X | X |
| Class | | | | | | | | | | |
| Insecta | - insects | | | | | | | | | |
| Order | | | | | | | | | | |
| Orthoptera | - grasshoppers | | | | | | | | | |
| Coleoptera | - beetles | X | X | X | | | X | | X | |
| Homoptera | - leafhoppers | X | X | X | X | X | X | X | X | X |
| Hymenoptera | - bees | | | X | | | | | | |
| | - ants | X | X | X | X | | | | | |
| Diptera | - flies | X | X | | X | | X | | X | |
| Lepidoptera | - moths | | | X | | | | | | |
| | - caterpillar | | | | X | | | | | |
| Heteroptera | - true bugs | X | X | X | | | | | | |
| Wet-weight Biomass ($g/50m^2$) | | .55 | .20 | .35 | .13 | .04 | .30 | .18 | .28 | .29 |
| Mean Biomass ($g/50m^2$) | | | .36 | | | .16 | | | .25 | |

Table 6-2. Terrestrial Arthropods collected from Remnant Salt Marsh (Well 7), Ruderal Field (Well 10), and Willow Riparian (Well No. 14) vegetation at the Santa Ana River study site, July 7, 1984.

| Well Number | | 7 | | | 10 | | | 14 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sample Replicate | | A | B | C | A | B | C | A | B | C |
| Class | | | | | | | | | | |
| Arachnida | - spiders | X | X | X | X | X | X | X | X | |
| Class | | | | | | | | | | |
| Insecta | - insects | | | | | | | | | |
| Order | | | | | | | | | | |
| Orthoptera | - grasshoppers | | | | | | | | X | |
| Coleoptera | - beetles | X | X | X | X | X | | X | X | X |
| Homoptera | - leafhoppers | | | X | X | X | X | X | X | X |
| Hymenoptera | - bees | | | | | | X | | X | |
| | - ants | | | | | X | X | | X | X |
| Diptera | - flies | X | X | X | X | X | X | X | X | X |
| Lepidoptera | - moths | | | | X | | | | | |
| | - caterpillar | | | | | | | | | |
| Heteroptera | - true bugs | | | | | | | | | |
| Wet-weight Biomass ($g/50m^2$) | | .05 | .12 | .24 | .06 | .16 | .58 | .37 | 1.26 | .54 |
| Mean Biomass ($g/50m^2$) | | | .13 | | | .27 | | | .72 | |

The low arthropod biomass recorded from the salt marsh vegetation probably reflects the relatively few species that can tolerate the saline contents of the halophytic plants of this particular habitat. In the ruderal field and willow riparian habitats, both insects and spiders are more abundant and a greater diversity of species was collected. These plants apparently provide a more desirable food source and general environment for arthropods. Soil moisture, which effected plant productivity, also appears to subsequently influence arthropod biomass, with the highest values present in the green, more productive willow riparian habitats.

## 6.2 TERRESTRIAL VERTEBRATES

Surveys of terrestrial vertebrates, including amphibians, reptiles, birds, and mammals, were conducted in the Santa Ana Marsh and adjacent lowlands from December 16, 1983 through August 24, 1984. For the purposes of these surveys, the approximately 585-acre study area was subdivided into the eight units listed below and mapped in Figure 6-1.

1. Santa Ana River Channel - 55 acres
2. Greenville-Banning Channel - 58 acres
3. Coastal Salt Marsh - 78 acres
4. Canyon and Mesa bluffs - 26 acres
5. The Oilfield -157 acres
6. 19th Street to Victoria Street - 78 acres
7. North of Victoria Street - 81 acres
8. Ocean Beach and Mouth of Santa Ana River - 52 acres

The study area was subdivided into these units as each is either an ecological unit or is separated from the other units by barriers (fences, highways, etc.) that may inhibit the movement of terrestrial vertebrates. Brief descriptions of each of these eight areas and the changes that occurred in them during the study period are presented below.

### Santa Ana River Channel

This channel is concrete sided with a sand bottom. Surveys covered the length of the channel from the Pacific Coast Highway to Victoria Street . At high tide the channel bottom is covered with water for about three-fourths of this length. Small amounts of fresh water from storm drains flowed into the upper reaches of the channel throughout the study period. Some flooding due to upstream rainfall occurred before the beginning of the study period and scoured all vegetation from the bottom of the channel. As the year progressed, algae and some marine fauna developed in the bottom of the channel and terrestrial vegetation developed in the areas near Victoria Street. The presence of well-used biking and hiking trails along the margins of the Santa Ana River Channel did not seem to bother birds sitting within the channel, but dogs were regularly observed chasing birds resting there.

### Greenville-Banning Channel

Surveys of this area included the dirt bottom and sides of this channel from the Pacific Coast Highway to the Fairview Channel. Tidal fluctuation was minimal during the study period due to blockage of the channel mouth. Vege-

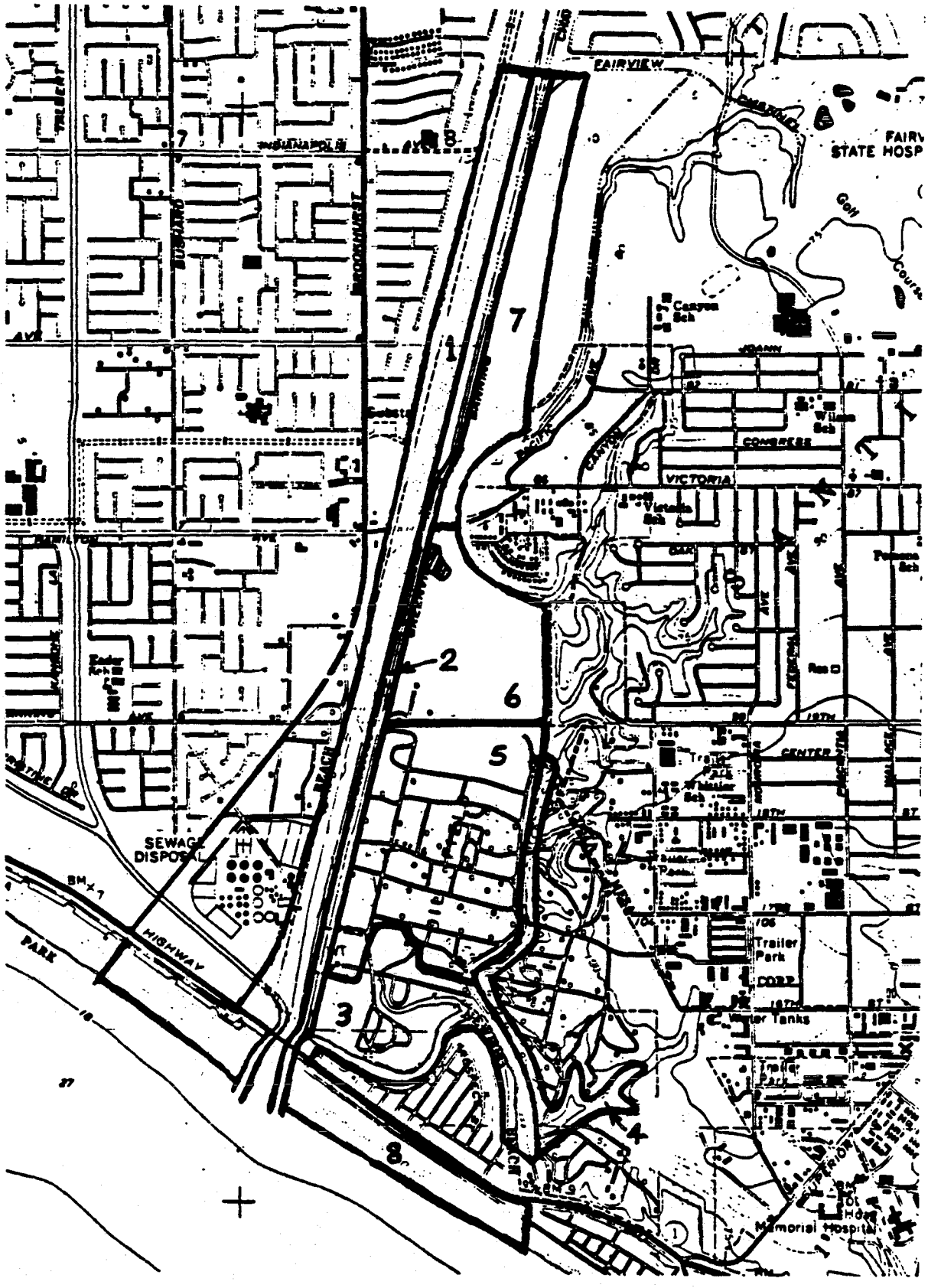



Figure 6-1 Boundaries of habitat units used during the vertebrate censuses.

tation was absent in the channel between the Pacific Coast Highway and Victoria Street, but above Victoria Street the channel was heavily overgrown with bulrush (Scirpus sp.). Fish were present in the channel and crayfish also occured in the freshwater upstream portions.

Coastal Salt Marsh

The area delineated here as coastal salt marsh includes remnant marsh lands and the open water along the remnant Santa Ana River Channel (Figure 6-1). Some dune development and oilfield-related road building and fill result in higher weedy areas that are not characteristic of salt marsh. The area experiences some tidal fluctuation; low lying areas of the marsh are extensively flooded during very high tides. The marsh area is fenced and therefore protected from most disturbance. A section of cleared, higher ground in the northwest corner of the marsh is used by the City of Newport Beach as a compost pile.

Canyon and Mesa Bluffs

This unit contains the only remnants of coastal sage scrub habitat remaining in the study area. The mesa bluffs have been heavily disturbed, both by excavation for sand for use as fill in the oilfield and by asphalt poured over the bluffs in an attempt to reduce soil erosion. The canyon area has experienced flooding during rains, as shown by the heavy wash of sand in its bottom, but no such flooding occurred during the study period. In an attempt to control weeds and clear oil pipelines, about half the canyon area was mowed in June, 1984. This mowing did not disturb the heaviest cactus patches but did destroy much coastal sage vegetation.

The Oilfield

Except for some salt marsh habitat, the oilfield study unit includes all of the area within the oilfield boundary fence, between 19th Street and the salt marsh (Figure 6-1). This area has been heavily disturbed by oilfield operations and is criss-crossed by numerous dirt roads which are elevated above the surrounding vegetation. At the beginning of the survey many of the low lying areas in this unit were filled with fresh water, the result of early winter rains. The ditch paralleling 19th Street was also filled with fresh water. Cattail marshes developed in many of these areas, but as the study progressed and no more rain occurred they gradually dried up. By June, 1984 no more fresh water remained in this study unit and much of the area had been mowed.

19th Street to Victoria Street

This is the most diverse of the study areas, containing Victoria Pond (freshwater), dry ruderal fields and willow riparian habitat. The area has been treated as a unit in past breeding and wintering bird censuses (Allan, 1982; Hayes, 1983a, 1983b) and is bounded by roads, fences or channels that may act as barriers to the dispersal of terrestrial vertebrates. At the beginning of the study period Victoria Pond was very full and much of the area within the willow stands was marshy. As the season progressed, the area became very dry. By the end of August, 1984 the only water remaining was in a storm-drainage ditch leading to Victoria Pond and in the pond itself, now reduced to one-

third of of its former size. Except for Victoria Pond, which is fenced and posted as an ecological preserve, the area is open to the public and is heavily used for jogging and dog walking. The willows were also heavily impacted during the year by people who chopped down many trees and partied there on weekends.

North of Victoria Street

Like the preceding unit, the area north of Victoria Street is bounded by roads, channels and bluffs that may act as barriers to the dispersal of terrestrial vertebrates. Ruderal fields predominate within this unit. Some riparian vegetation occurs at the bottom of the Newport Beach Mesa bluffs along the east side of the unit. The area is used sparingly by joggers and people walking dogs. Firebreaks were mowed across the area in July, 1984.

The Ocean Beach

This unit consists of the beach area between the Pacific Coast Highway and the Pacific Ocean. It includes, from west to east, the mouths of Talbert Channel, the Santa Ana River, and the Greenville-Banning Channel, as well as the public beach on both sides of these channels. There is a fenced enclosure for California least tern nesting in this unit which was also included in the surveys. This area is heavily disturbed by human use throughout the year.

### 6.2.1 AMPHIBIANS & REPTILES

Prior to this study the only information available on the amphibians and reptiles of Santa Ana River Marsh and lowlands was a list of "probable" species presented in Environmental Impact Reports, Inc. (1974; Table 6-3). Only the side-blotched lizard (Uta stansburiana) was noted as actually being sighted. The City of Costa Mesa General Plan (1978, p. IV-5) inferred that the coast horned lizard (Phrynosoma loronatum) while rare, may also occur at the site, but no data source was identified.

More complete herpetofauna information is available from studies of comparable habitats at Upper Newport Bay (Thompson, 1977), Bolsa Chica (Dillingham Corp., 1971), and Ballona Creek (Hayes and Guyer, in Schreiber, 1981). A list of species positively identified from these sites is presented in Table 6-3. Clearly the herpetofauna is generally similar between all three sites, minor differences probably reflecting habitat diversity. The greater frequency of moist freshwater habitats at Upper Newport Bay -- verses extensive, seasonally dry, open flats at Bolsa Chica, for example.

#### 6.2.1.1 Field Methods

Visual daytime censuses of amphibians and reptiles were conducted at monthly intervals from December, 1983 through August, 1984. The censuses were conducted along permanent transects within each of the principal vegetation/habitat types represented across the study site. In addition, six pit traps were installed across the site (Figure 6-2) and monitored during the warm summer months, when reptiles are more active. Each trap, approximately 12-inches in diameter and depth, was buried flush with the ground surface, and had associated drift lines and a protective cover. They were baited with peanut butter or meat.

Table 6-3. Herpetofauna previously reported from the Santa Ana Lowlands and Comparable Sites Nearby. (X - Positively Confirmed; * - Probably Present.)

| Species | Upper Newport Bay[1] | Santa Ana River[2] | Bolsa Chica[3] | Ballona Creek[4] |
|---|---|---|---|---|
| AMPHIBIANS | | | | |
| Pacific slender salamander (Batrachoseps pacificus) | | | | X |
| California slender salamander (Batrachospepes attenuatus) | X | * | | |
| Western toad (Bufo boreas) | | * | | X |
| Pacific treefrog (Hyla regilla) | X | * | X | X |
| TURTLES | | | | |
| Western pond turtle (Clemmys marmorata) | | | X | |
| LIZARDS | | | | |
| California legless lizard (Anniella pulchra) | | | X | |
| Southern alligator lizard (Gerrhonotus multicarinatus) | X | * | X | X |
| Western fence lizard (Sceloporus occidentalis) | X | * | X | X |
| Side-blotched lizard (Uta stansburiana) | X | X | X | X |
| Coast horned lizard (Phyrnosoma coronatum) | | | X | |
| SNAKES | | | | |
| Common kingsnake (Lampropeltis getulus | X | | X | X |
| Gopher snake (Pituophis melanoleucus) | X | * | X | X |
| Western rattlesnake (Crotalus viridis) | X | | | |
| Common whipsnake (Masticophis flagellum) | X | | | |
| Striped racer (Masticophis lateralis) | X | | | |

[1]Thompson (1977); [2]Environmental Impact Reports, Inc. (1974); [3]Dillingham Corp. (1971); and [4]Hayes & Guyer, in Schreiber (1981).

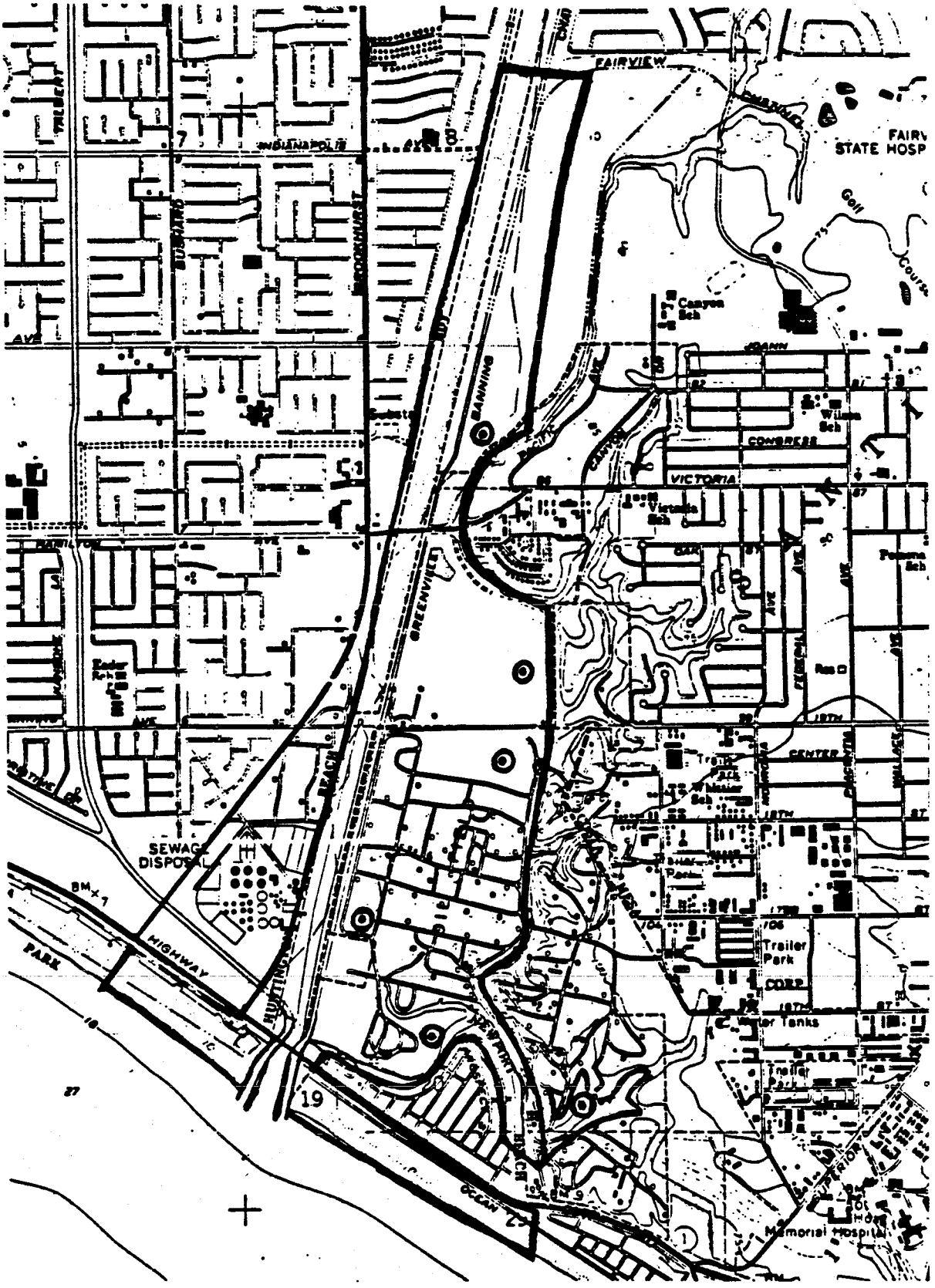



Figure 6-2. Location of pit traps used to sample reptiles and small animals.

Besides the daytime censuses and pit traps, several evening trips were made to the site in March, 1984 to check for nocturnal amphibian activity.

6.2.1.2 Results & Discussion

The amphibians and reptiles captured and/or positively identified during the study are listed in Table 6-4. The two species of amphibians were found in the early spring and were confined to the three study areas that contained fresh- water ponds -- the oilfield, the riparian willow thickets, and Victoria Pond. By April, standing freshwater was unavailable except for the few intermittent storm ditches and the amphibians had disappeared. Lizards and snakes were more widespread, occurring even in the drier portions of the salt marsh habitat. One sighting of a gopher snake swimming in the salt marsh tidal channel was recorded. All the species observed are considered to be common in the study area.

While seasonal occurrence and behavioral data are not available for amphibians and reptiles at the Santa Ana River site, they should be similar to those described for the Ballona Creek herpetofauna by Hayes and Guyer (in Schreiber 1981; Figure 6-3).

Population Density

On the basis of visual sightings and pit trap captures, the lizard population for the Santa Ana River study area seems lower than usual for coastal sage habitat, while the snake and amphibian populations are about normal for this habitat. Possible causes for the low numbers of lizards observed may be poor habitat quality, a high number of predators, or the relatively limited extent and isolated nature of the habitat. Since the lizards found are typical coastal sage species, the majority of the study area is not their natural habitat type; this is considered to be the main cause of low lizard populations in the area.

Amphibian and Reptilian Diversity

Comparison of Tables 6-3 and 6-4 confirms that the amphibian and reptile fauna of the Santa Ana River Marsh and lowlands is less diverse than that confirmed from other generally comparable regional sites. Counting recent, positively confirmed species only, the species richness at each site is as follows: Upper Newport Bay, 11 species; Bolsa Chica, 10 species; Ballona Creek, 9 species; and the Santa Ana River study site with the least diverse fauna of 7 species.

The list of "probably present," put forward by Environmental Impact Reports, Inc. (1974), can now be confirmed -- with the single exception that no evidence of the California slender salamander (Batrachospepes attenuatus) was found during this study. In addition, the common kingsnake (Lampropeltis getulus) can be added to the list of confirmed species at Santa Ana.

Several other species of lizards and snakes known to occur at Upper Newport Bay and Bolsa Chica (Table 6-3) were not found at the Santa Ana River site. These include the coast horned lizard (Phrynosoma coronatum) and western diamondback rattlesnake (Crotalus viridis), for which special searches were conducted. These "missing species" are all characteristic of coastal sage habitats. The limited extent of coastal sage at the Santa Ana River, the

Table 6-4. Herpetofauna Confirmed from the Santa Ana River Marsh and Adjacent Lowlands.

| Species | Coastal Salt Marsh | Canyon & Mesa Bluffs | The Oilfield | 19th-Victoria Street | North of Victoria Street |
|---|---|---|---|---|---|
| AMPHIBIANS | | | | | |
| Western toad (*Bufo boreas*) | | | X | X | X |
| Pacific tree frog (*Hyla regilla*) | | | X | X | X |
| LIZARDS | | | | | |
| Southern alligator lizard (*Gerrhonotus multicarinatus*) | X | X | X | X | X |
| Western fence lizard (*Sceloporus occidentalis*) | X | X | X | X | X |
| Side-blotched lizard (*Uta stansburiana*) | X | X | X | X | X |
| SNAKES | | | | | |
| Common kingsnake (*Lampropeltis getulus*) | | | X | X | X |
| Gopher snake (*Pituophis melanoleucus*) | X | X | X | X | X |

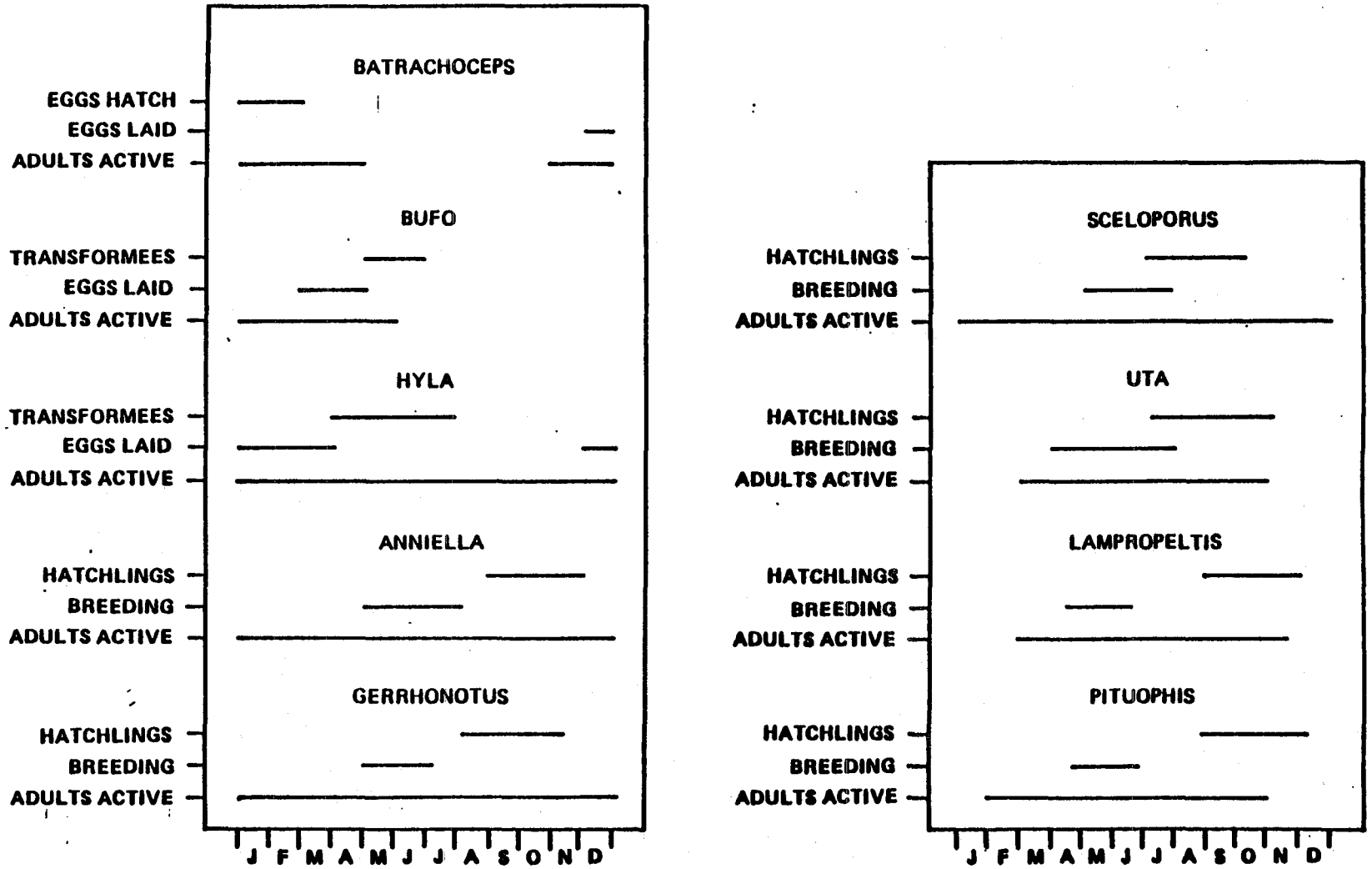



Figure 6-3. Seasonal activity patterns of the Ballona Creek herpetofauna (Hayes and Guyer in Schreiber, 1981).

disturbed nature of the rest of the study site, and its unsuitability as habitat for these species make it unlikely that they still exist in the area. The species that were observed, are those known to be most readily adaptable to change and shown most able to persist in suburban or disturbed areas.

Food Requirements

All of the amphibians and reptiles confirmed from the Santa Ana River site are largely or wholly carnivorous. The smaller species (amphibians, lizards) feed on ground invertebrates, including worms, insects, etc. The larger species (snakes) feed on invertebrates when young and upon small lizards and mammals when adult.

Martin, Zim, and Nelson (1951) include extensive information and references on food requirements of amphibians and reptiles. Hayes and Guyer's excellent study of the Ballona Creek herptofauna (in Schreiber 1981) provides useful prey-predator data that can probably be transferred to Santa Ana populations, as follows:

Tadpoles of the western toad scrape algae and detritus from pool bottoms, while the adults feed principally on carabid beetles, ants and lycosid spiders. Wading birds such as herons and egrets take the tadpoles, as occasionally does the southern alligator lizard. Western toad adults possess parotiod glands that secrete a neurotoxin, which protects them from predations.

Tadpoles of the Pacific tree frog also take pond algae and detritus. The adults eat beetles, flies, leafhoppers and true bugs. Predators, while not all confirmed at Ballona, probably include cats, rats, opossum, egrets, herons and white-tailed kites.

The southern alligator lizard, the largest lizard at Santa Ana, depends principally on arthropods for food -- carobid beetles, grasshoppers, larvae of moths and butterflies, spiders, and ants. Vertebrate prey are not uncommon however, with other lizards, juvenile birds and mammals, and birds eggs, all being taken. Suspected predators include cats, rats, opossum, possibly gopher snakes, burrowing owls, sparrow hawks and shrikes.

Beetles, orthopterans and ants are common prey of the western fence lizard. This is a very common species and it has a long list of known predators including other reptiles (southern alligator lizard, kingsnake, gopher snake), mammals (dogs, cats, rats, opossum), and birds (American kestrel, white-tailed kite, loggerhead shrike, burrowing owl, egrets and herons).

The side-blotched lizard shares a list of prey items and suspected predators almost identical to that of the somewhat larger western fence lizard.

The common kingsnake is a mobile predator that takes other reptiles (lizards), birds or their eggs, and small mammals. Nest robbing may provide a significant portion of the diet. Kingsnake predation is probably infrequent, but potential predators include while-tailed kite, marsh hawk, sparrow hawk, opossum, cats, dogs, and man.

The gopher snake, larger than the kingsnake, is also an active, mobile predator. It is unusual in its ability to dig through dirt burrow-plugs to pursue burrowing mammals. It take principally small mammals, up to the size of a cottontail rabbit; with lesser numbers of birds, eggs and reptiles. Species present at Santa Ana River that have been reported as gopher snake prey include pocket gophers, meadow voles, mice, western fence and side-blotched lizards. Potential predators include the kingsnake, red-tailed hawk, barn own, and coyote.

### 6.2.2 BIRDS

#### 6.2.2.1 Previous Studies

The birds of Santa Ana River Marsh and adjacent lowlands have received considerable attention (Environmental Impact Reports, Inc., 1974; Massey 1980). Coverage is very uneven however, for while the three endangered species recorded from the river mouth -- the California least tern (Sterna albifrons), Light-footed clapper rail (Rallus longirostris levipes), and Belding's savannah sparrow (Passerculus sandwichensis beldingi), -- have received a great deal of attention (Collins et al., 1979; Massey 1979, Massey and Atwood, 1982; and numerous included references), the species composition and abundance of other local bird populations are much less well known. Similarly, while several studies of site utilization and feeding requirements of the three endangered species have been conducted, little is known about what other terrestrial and water-associated birds are "doing" on the site, or what their prey-predator relationships might be. Obviously, broad generalizations can be developed based on studies elsewhere, particularly for any migratory shorebirds and waterfowl present, but the role of local terrestrial species remains particularly poorly known. The importance of the study site to wider-ranging, regional raptor populations is also unknown.

General regional avifaunal references of interest include: for San Diego -- Dawes (1975), Jorgensen (1975), Wright (1978), Sitko (1979), and Boland (1981). For Bolsa Chica -- Dillingham Corp. (1971), Sully (1979), and Novak (1983); for Ballona Creek -- Dock and Schreiber, in Scheiber (1981); and for Mugu Lagoon to the north, Onuf (1983). Other useful references include: Moffitt (1941), Reeder (1951), Recher (1966), Bollman and Thelin (1970), Gerstenberg and Jurek (1972), Varoujean (1972), Jurek (1973), and Woodward (1980).

A late summer site reconnaissance performed in 1980 (K.B. Macdonald, unpublished data) revealed large numbers of mourning doves feeding on dove weed, near riparian associations on the mesa adjacent to the marsh. Additionally, several turkey vultures were seen soaring over the mesa; red-tailed hawks, white-tailed kites and American kestrels were likewise noted. All other birds seen were in the lowlands, primarily in the area of the salt marsh. Species observed included a marsh hawk, osprey, and Cooper's hawk, black-necked stilts, great blue herons, killdeers, a loggerhead shrike, and a belted kingfisher.

Massey (1980) reports seventy-five species of birds observed in the area of the Santa Ana River salt marsh in the course of intermittent winter and spring censusing conducted over an eight-year period (An annotated species list included with her 1980 report is reproduced here as Appendix B). Species

reported as commonly occurring residents include the American kestrel, white-tailed kite, belted kingfisher, long-billed marsh wren, loggerhead shrike, mourning dove, meadowlark, house finch, and song sparrow. Species reported as regular winter visitors include the cinnamon teal, double-crested cormorant, canvasback, bufflehead, greater yellowlegs, long-billed dowitcher, dunlin, long-billed curlew, and white-crowned and Lincoln's sparrows.

Coastal marshes of southern California -- including marsh vegetation, tideflats and channels -- serve as permanent or temporary habitat for a variety of avian groups. A very few highly specialized species have become adapted exclusively to this habitat and rely solely upon it for their existence. A larger group consists of resident, mostly terrestrial, species which move freely between the marsh and upland habitats. Much larger still, in terms of numbers of individuals, is a group of migratory water-associated birds which winters in southern California and further south, and uses the coastal salt marsh habitat as stopover resting and/or feeding grounds during the course of migration.

Though the salt marsh habitat at the Santa Ana River (again including marsh vegetation, tideflats and channels) serves all these groups of avian marsh-users, it does so only to a limited extent due to its comparatively small size and relatively disturbed condition. Numbers of individual birds reported by Massey (1980) as utilizing the salt marsh habitat at any one time have normally been relatively small. The maximum reported number is approximately 400, whereas by contrast a less disturbed area of marsh, tideflats and channels the size of the southern lowlands could normally be expected to host several thousand birds.

As noted above, much more extensive research is available describing utilization of the Santa Ana Study site by endangered species of birds. Use by Light-footed clapper rails appears minimal and no nesting has been recorded. The absence of cord grass, a preferred feeding and nesting habitat, may partly but not completely explain the rail's scarcity. A list of the rails' food items (Massey 1980), all characteristic of a healthy functioning coastal salt marsh, is presented in Table 6-5.

Small numbers of Belding's savannah sparrows winter in the pickleweed marsh, but apparently find the site unsuitable for nesting and move to other locations (perhaps Bolsa Chica or Upper Newport Bay) from April through the end of the breeding season. No detailed study of food eaten by the Belding's sparrows has been conducted, however field observations suggest that small insects form the preferred diet and are supplemented with the succulent tips of Salicornia and Suaeda plants (Massey, 1979).

The California least tern is by far the most abundant endangered species to use the study site, which clearly forms a vital portion of its foraging area (Collins et al, 1979). A large and relatively successful nesting colony of least terns is located on a fenced off section of the ocean beach at Huntington Beach State Park, immediately northwest of the Santa Ana River mouth. The terns, of course, are aerial fishers (See Table 6-6, for list of fish species taken (Massey 1980)) and they apparently forage over all aquatic habitats represented across the study site. This includes the Santa Ana River and all associated flood control channels, Victoria Pond, and the remnant salt marsh tidal channels. Some of the smaller, more protected, water bodies may be

Table 6-5. Foods of the Light-Footed clapper rail (Massey, 1980).

| | |
|---|---|
| Shore crab | Hemigrapsus oregonensis |
| Rock crab | Pachygrapsus crassipes |
| Fiddler crab | Uca crenulata |
| Horn snail | Cerithidea californica |
| Saltmarsh snail | Melampus olivaceous |
| Garden snail | Helix sp. |
| Crayfish | Astacus sp. |
| Tadpole | Hyla sp. |
| California killifish | Fundulus parvipinnis |
| Saltmarsh mouse | Microtus californicus |

* A large portion of the Rails' diet consists of small saltmarsh invertebrates that have not been identified.

Table 6-6. Foods of the California least tern (Massey, 1980).

The following species of fish have been collected from Least Tern nesting areas during the nesting season.

| | |
|---|---|
| Northern anchovy | Engraulis mordax |
| Topsmelt | Atherinops affinis |
| Shiner perch | Cymatogaster aggregata |
| Walleye surfperch | Hyperprosopon argenteum |
| White surfperch | Phanerodon furcatus |
| Dwarf surfperch | Micrometrus diminimus |
| Deepbody anchovy | Anchoa compressa |
| California killifish | Fundulus parvipinnis |
| Treefish | Sebastes serriceps |
| Rockfish spp. | Sebastes spp. |
| Threadfin shad | Dorosoma petenense |
| Halfmoon | Medialuna californiensis |
| Opaleye | Girella nigricans |
| Staghorn sculpin | Leptocottus armatus |
| Cabezon | Scorpaenichthys marmoratus |
| Arrow goby | Clevelandia ios |
| Yellowfin goby | Acanthogobius flavimanus |
| Carp | Cyprinus carpio |
| Queenfish | Seriphus politus |
| Kelp Greenling | Hexagrammos decagrammus |
| Pacific butterfish | Peprilus simillimus |
| Mosquito fish | Gambusia sp. |

* Identification made by John Fitch, California Department of Fish and Game.

particularly important during the breeding season, for they seem more likely to harbor the small size-class fishes necessary for the terns to feed their young. The Santa Ana River site remains one of the few natural, historical sites where the California least tern continues to breed successfully.

The local birding community has shown particular interest in willow riparian habitats adjacent to the northern boundary of the oilfield and near Victoria Pond. It is well known that vagrant eastern species of birds often winter in dense stands of riparian vegetation along the California coast and such areas are therefore often visited by birders. An outgrowth of this interest has been the compilation of an annotated 7-year species list for birds of the "Talbert Park Extension," the area between 19th Street and Victoria Street (Hays, 1984 - unpublished). Breeding and wintering bird censuses for this same area have been published also (Allan, 1982; Hays, 1983a, 1983b). For convenience, these several brief publications and Hays' previously unpublished species list are reproduced here as Appendix C.

Finally, for easy reference, species lists for the birds recorded at nearby Upper Newport Bay (Frey et al., 1970), and the Bolsa Chica lowlands (Dillingham Corp., 1971) are included here as Appendices D and E, respectively.

6.2.2.2 Field Methods & Limitations

Study site field censuses were carried out at approximately biweekly intervals from December 16; 1983 through August 24, 1984. Each census was conducted by Dr. Daniel Guthrie in the early morning hours on days when the weather was optimal for bird sightings. During each census, each of the eight different habitat types/study areas shown in Figure 6-1, was visited. The Santa Ana River Channel, coastal salt marsh, oilfield and ocean beach, were each surveyed on bicycle and on foot. The remaining areas -- the Greenville-Banning Channel, canyons and mesa bluffs, 19th Street to Victoria Street, and the area north of Victoria Street -- were all surveyed entirely on foot.

Census Sampling Variation

A number of variables can significantly effect visual censusing of birds. These include tide level, weather conditions, time of day, time of year, survey route, length of survey, observer experience, and irregular movements of birds. The observations presented here were conducted so that length of survey, observer experience, weather conditions and time of day were held constant. Other variables, however, did effect census results and some of these deserve some comment.

Tide Level -- Mudflats in the remnant tidal channels of the coastal salt marsh area were exposed at low tide but completely covered at high tide. The effect of this tidal fluctuation was noticeable in shorebird counts for this habitat. In other areas, tidal fluctuation had no effect. Although there was tidal action in the Santa Ana River Channel, there were always areas available to shorebirds and the only effect of rising and falling tides was to cause shorebirds to move up and down within the channel, rather than in and out of it. Tidal fluctuation was minimal in the Greenville-Balling Channel and, since mudflats were never exposed, did not seriously affect bird counts.

Census Survey Route -- In order to insure that every portion of each study area was visited, survey routes were varied somewhat during the study period. This resulted in only minor variations in observations, but occasionally a new route produced species that had previously been overlooked. An example of this is the observation of burrowing owls in the salt marsh area. These owls are resident in the area but were only discovered in late summer of 1984, after a change in survey route.

Irregular Movements of Birds -- Although some species of birds are resident in the study area, many use the area for only a portion of their daily activities and move in and out of it on an irregular basis. Observed numbers for these species can vary dramatically from day to day. The Bonaparte's gulls wintering in the study area present such a case. This species forages widely at sea and also feeds on the sewer ponds at the nearby Orange County water treatment facility. On some occasions large numbers of Bonaparte's gulls were found resting in the study area but on other visits they were entirely absent.

In order to determine the magnitude of these differences between the biweekly census counts, site consuses were conducted on three successive days (February 24, 25, and 26, 1984) under as closely similar conditions as possible. The complete results obtained from these three censuses are included in Tables 6-9 through 6-24. A summary of total individuals, species, and percent variation (measured as the minimum value as a percentage of the maximum value) for the three successive censuses is presented in Table 6-7, by habitat.

Inspection of the complete results of these three censuses confirms that important differences can occur on a day to day basis. The Santa Ana River Channel, for example, yielded 600 Bonaparte's gulls and nine additional species of gulls and terns of February 25th. The following day, however, only 40 Bonaparte's gulls and two additional species were present. Despite these individual species differences, the overall species composition and relative abundance of bird populations within each habitat type remained generally similar during the three consecutive censuses.

Census Error

The accuracy of visual censusing of birds varies according to species, as some types of birds are more difficult to observe than others. Also, some species move about more frequently than others and may be counted more than once.

In general, it is felt that the censuses for water birds, raptors (both hawks and owls), and the larger and more obvious land birds, such as crows, ravens, shrikes, kingfishers and kingbirds, are very accurate. These species occur in open habitat and are not hidden by vegetation. The census routes used in this survey were such that it is felt that 100% of the individuals of these species occurring in the study site were counted. Also, movement of these birds between census areas was taken into account to insure that each individual was counted only once.

For other land birds, census counts are less accurate. In terms of coverage, the routes through the larger terrestrial study areas, the oilfield, and the areas between 19th and Victoria Streets and north of Victoria Street, were such that only about 40% of the smaller land species in these habitats were counted on individual surveys. Coverage for the two smaller terrestrial

Table 6-7. Total individuals, species, and percent variation* by habitat, recorded during bird censuses conducted on three successive days.

| Habitat | February 1984 | | | Percent Variation* |
|---|---|---|---|---|
| | 24 | 25 | 26 | |
| Santa Ana River | | | | |
| Species | 17 | 22 | 21 | 77% |
| Individuals | 669 | 933 | 345 | 37% |
| Greenville-Banning | | | | |
| Species | 8 | 7 | 9 | 78% |
| Individuals | 67 | 67 | 95 | 71% |
| Coastal Marsh | | | | |
| Species | 35 | 36 | 33 | 92% |
| Individuals | 198 | 251 | 291 | 68% |
| Bluffs & Canyons | | | | |
| Species | 20 | 18 | 13 | 65% |
| Individuals | 145 | 133 | 68 | 47% |
| Oilfield | | | | |
| Species | 34 | 36 | 40 | 85% |
| Individuals | 348 | 315 | 314 | 90% |
| 19th To Victoria St. | | | | |
| Species | 48 | 42 | 38 | 79% |
| Individuals | 865 | 843 | 694 | 80% |

*Minimum value as a percentage of maximum value.

habitats, the canyon and the marsh, was more complete and it is thought that between 80 and 100% of the individual land birds in these areas were counted on each census.

For most land species, counts were most accurate when the presence of male birds was indicated by their singing to court and/or defend territory. At other times, when birds were not singing, many of the more secretive birds were missed. For example, common yellowthroat numbers reached a high of 26 individuals during the breeding season when males were singing, but dropped to only 4 individuals in winter. This species is non-migratory and usually moves only relatively short distances; it is unlikely therefore, that the population really changed much during the study period. Similar fluctuations in observed numbers also occurred for song sparrow and American goldfinch.

6.2.2.3 Census Results

The main body of data collected during our studies of birds of the Santa Ana River Marsh and adjacent lowlands are the results of the 18 field censuses.

A summary of observations for the entire study site is presented in Table 6-8. Table 6-8 lists all bird species observed during the entire study period; gives the highest number of individuals of each species observed during each season (winter, spring, and summer, as defined below); and indicates the status of each species (i.e., winter visitor, summer visitor, migrant, resident, irregular visitor, breeding).

For both ease of discussion, and to permit assessment of the relative roles of different habitat-areas within the overall study site, the census results are presented below, broken down by both habitat-area and season. The census results for each of the eight habitat-areas are grouped into winter (December 16, 1983 to March 18, 1984, censuses), Spring (March 23 to June 21, 1984 censuses), and summer (July 10 to August 24, 1984 censuses) periods (Tables 6-9 through 6-32). As a result of contract timing, no observations were made during the fall.

Breeding bird censuses were conducted during spring and summer, 1984, in the coastal salt marsh, the canyon and mesa bluffs area, and in the area between 19th Street and Victoria Street. Evidence of breeding in other areas of the study site was also noted. The results of these breeding censuses are presented in Table 6-33.

6.2.2.4 Discussion

In the discussion that follows, the seasonal census data for each of the eight habitat-areas surveyed are presented separately, and avian use of each area is summarized. Subsequent discussion topics include avian diversity, population densities, breeding birds, feeding relationships, and finally, rare and endangered species.

Santa Ana River Channel

Seasonal census data for this study area are presented in Tables 6-9, 10, and 11. Birds observed in the Santa Ana River Channel were, with a few exceptions, fish eating birds, shorebirds or gulls. The fish eating birds,

Table 6-8. Birds observed on the Santa Ana Marsh and Adjacent Lowlands (Maximum number of individuals observed during each season)

Status: W - winter visitor; S - Summer visitor; M - Migrant; R - Resident; i - Irregular visitor; B - breeding

| Species | Season | | | Status |
|---|---|---|---|---|
| | Winter | Spring | Summer | |
| Red-throated Loon | 2 | 1 | - | W |
| Common Loon | 1 | - | - | W |
| Pied-billed Grebe | 26 | 8 | 6(3) | W,R |
| Eared Grebe | 5 | 6 | 1 | W |
| Western Grebe | 13 | 3 | - | W |
| Brown Pelican | 15 | - | - | W |
| Double-cr. Cormorant | 28 | 18 | - | W |
| American Bittern | 2 | 1 | - | W |
| Least Bittern | - | 2(2) | - | R,B |
| Great Blue Heron | 18 | 9 | 9 | R,W |
| Great Egret | 43 | 4 | 28 | W |
| Snowy Egret | 20 | 6 | 6 | W |
| Little Blue Heron | - | 1 | - | I |
| Green-backed Heron | 3 | 7 | 4 | R |
| Black-cr. Night Heron | 32 | 12 | 16 | R |
| White-faced Ibis | - | 1 | 1 | I |
| Canada Goose | 4 | - | - | W |
| Green-winged Teal | 6 | - | - | W |
| Mallard | 54 | 24(12) | 24 | R,W |
| Northern Pintail | 16 | 3 | - | W |
| Cinnamon Teal | 42 | 18 | - | W |
| Northern Shoveller | 10 | 6 | - | W |
| Gadwall | 21 | - | - | W |
| American Wigeon | 18 | - | 1 | W |
| Canvasback | 10 | - | - | W |
| Redhead | 2 | - | - | W |
| Lesser Scaup | 6 | 4 | - | W |
| American Goldeneye | 2 | - | - | W |
| Bufflehead | 3 | - | - | W |
| Red-breasted Merganser | 124 | 15 | - | W |
| Ruddy Duck | 42 | 10 | 1 | W,R |
| Turkey Vulture | 5 | 5 | 1 | R |
| Osprey | - | - | 1 | M |
| Black-shouldered Kite | 4 | 6 | 7(7) | R |
| Northern Harrier | 1 | 1 | - | M |
| Sharp-shinned Hawk | - | 1 | - | M |
| Cooper's Hawk | 3 | 2 | 1 | W |
| Red-shouldered Hawk | 1 | 2 | 2 | R |
| Red-tailed Hawk | 6 | 2 | 2 | W,R |
| American Kestrel | 11 | 6(3) | 7 | R |
| Sora Rail | 14 | 7 | - | R,? |
| Common Moorhen | 1 | 1 | - | W |

Table 6-8(cont.). Birds Observed on the Santa Ana Marsh and Adjacent Lowlands (Maximum number of individuals observed during each season)

Status: W - winter visitor; S - Summer visitor; M - Migrant; R - Resident; i - Irregular visitor; B - breeding

| | Season | | | Status |
|---|---|---|---|---|
| Species | Winter | Spring | Summer | |
| American Coot | 56 | 15 | 16(3) | W,R |
| Black-bellied Plover | 7 | 7 | 15 | W,M |
| Snowy Plover | - | 2 | - | M |
| Semipalmated Plover | - | 11 | 32 | M |
| Killdeer | 52 | 19 | 17 | W,R |
| Black-necked Stilt | 93 | 71 | 52(5) | R |
| American Avocet | 6 | 16 | 5 | M |
| Greater Yellowlegs | 5 | 4 | 7 | M |
| Willet | 58 | 60 | 48 | M |
| Spotted Sandpiper | 2 | 3 | 2 | W,M |
| Whimbrel | 1 | 2 | 3 | M |
| Long-billed Curlew | - | - | 1 | M |
| Marbled Godwit | 53 | 12 | 49 | M,W |
| Ruddy Turnstone | 2 | 7 | - | M |
| Black Turnstone | - | 6 | - | M |
| Surfbird | - | 5 | - | M |
| Sanderling | 74 | 70 | 52 | M,W |
| Western Sandpiper | 40 | 100 | 57 | M |
| Least Sandpiper | 83 | 58 | 30 | M,W |
| Short-billed Dowitcher | 50 | 46 | 45 | M |
| Long-billed Dowitcher | - | 4 | - | M |
| Common Snipe | 13 | 6 | 1 | M |
| Bonaparte's Gull | 2801 | 950 | - | W |
| Heerman's Gull | 2 | 1 | 55 | I |
| Mew Gull | 18 | - | - | W |
| Ring-billed Gull | 167 | 32 | 46 | R |
| California Gull | 45 | 40 | 90 | W,M |
| Herring Gull | 2 | - | 1 | W |
| Western Gull | 70 | 60 | 281 | R |
| Glaucous-winged Gull | 1 | - | - | W |
| Caspian Tern | 2 | 8 | 1 | R |
| Forster's Tern | 7 | 3 | 19 | W,M |
| California Least Tern | - | 45 | 19 | S,B |
| Rock Dove | - | - | 36 | R,B |
| Spotted Dove | 2 | 15 | 14 | R |
| Mourning Dove | 54 | 69 | 136 | R,B |
| Common Barn Owl | - | 2 | 3 | R,B |
| Burrowing Owl | - | - | 2(2) | R |
| Vaux's Swift | - | 14 | - | M |
| Black-chinned Hummingbird | 2 | 9 | 1 | M,R? |
| Anna's Hummingbird | 16 | 18 | 34 | R,B |
| Costa's Hummingbird | - | - | 2 | S,B |
| Allen's Hummingbird | 3 | 7 | 7 | R,B |

Table 6-3 (cont.). Birds Observed on the Santa Ana Marsh and Adjacent Lowlands (Maximum number of individuals observed during each season)

Status: W - winter visitor; S - Summer visitor; M - Migrant; R - Resident; I - Irregular visitor; B - breeding

| Species | Season | | | Status |
|---|---|---|---|---|
| | Winter | Spring | Summer | |
| Rufous Hummingbird | - | - | 5 | M |
| Belted Kingfisher | 5 | 2 | 3(1) | W,R,B |
| Northern Flicker | 7 | 2 | - | W |
| Western Wood Pewee | - | 1 | - | M |
| Hammond's Flycatcher | - | 1 | - | M |
| Western Flycatcher | 1 | 3 | - | M |
| Black Phoebe | 13 | 2 | 4 | W,R,B? |
| Say's Phoebe | 4 | - | - | W |
| Ash-throated Flycatcher | - | 2 | 2 | M,R? |
| Western Kingbird | 4 | 5 | 1 | M |
| Tree Swallow | 3 | - | - | M |
| Northern Rough-winged Swallow | 18 | 13 | - | M |
| Cliff Swallow | 2 | 82 | 28 | S,B |
| Barn Swallow | 1 | 17 | 14 | S |
| American Crow | 56 | 45 | 8 | R |
| Common Raven | - | 2 | 3 | I |
| Plain Titmouse | - | 1 | - | M |
| Common Bushtit | 64 | 29 | 37 | R,B |
| Cactus Wren | 4 | 2(3) | 3 | R,B |
| Marsh Wren | 7 | 1 | - | W |
| Ruby-crowned Kinglet | 11 | 2 | - | W |
| Blue-grey Gnatcatcher | 5 | 1 | - | W,R? |
| Black-tailed Gnatcatcher | 5 | 3(3) | 2 | R,B |
| Swainson's Thrush | - | 2 | - | M |
| Hermit Thrush | 5 | 4 | - | W |
| American Robin | 1 | - | - | W |
| Northern Mockingbird | 6 | 10 | 13 | R,B |
| Water Pipit | 5 | 4 | - | W |
| Cedar Waxwing | - | 2 | - | W,I |
| Loggerhead Shrike | 12 | 8(7) | 10 | R,B |
| European Starling | 18 | 109 | 3 | R |
| Warbling Vireo | - | 3 | - | M |
| Orange-crowned Warbler | 12 | 11 | 2 | W,R? |
| Nashville Warbler | - | 1 | - | M |
| Yellow Warbler | - | 1 | - | M |
| Yellow-rumped Warbler | 85 | 38 | - | W |
| Black-throated Gray Warbler | - | 1 | - | M |
| Townsend's Warbler | 2 | 1 | - | W,M |
| Black-throated Green Warbler | 1 | - | - | W,I |
| Common Yellowthroat | 20 | 26 | 11 | R,B |
| Wilson's Warbler | 1 | 7 | - | M |
| Western Tanager | - | 3 | - | M |
| Rose-breasted Grosbeak | 1 | - | - | W,I |

Table 6-8 (cont.). Birds Observed on the Santa Ana Marsh and Adjacent Lowlands (Maximum number of individuals observed during each season)

Status: W - winter visitor; S - Summer visitor; M - Migrant; R - Resident; I - Irregular visitor; B - breeding

| Species | Season | | | Status |
|---|---|---|---|---|
| | Winter | Spring | Summer | |
| Black-headed Grosbeak | - | 17 | 5 | S,B |
| Blue Grosbeak | - | 1 | 1 | S |
| Rufous-sided Towhee | 1 | - | - | I |
| Brown Towhee | 6 | 12 | 2 | R |
| Green-tailed Towhee | - | 1 | - | M |
| Chipping Sparrow | - | 6 | - | M |
| Black-chinned Sparrow | - | 1 | - | M |
| Savannah Sparrow | 24 | 13 | - | W |
| Song Sparrow | 156 | 121 | 94 | R |
| Lincoln's Sparrow | 7 | 8 | - | W |
| Golden-crowned Sparrow | 45 | 6 | - | W |
| White-throated Sparrow | - | 1 | - | W,I |
| White-crowned Sparrow | 626 | 15 | - | W |
| Red-winged Blackbird | 400 | 64 | 185 | W,R,B |
| Western Meadowlark | 99 | 53 | 1 | W |
| Yellow-headed Blackbird | - | 2 | - | M |
| Brown-headed Cowbird | 5 | 23 | 6 | R,B |
| Brewer's Blackbird | - | - | 200 | |
| Northern Oriole | - | 7 | 3 | S,B |
| Purple Finch | 15 | - | - | W |
| House Finch | 2280 | 191 | 142 | W,R,B |
| Lesser Goldfinch | 20 | - | 6 | W |
| American Goldfinch | 34 | 111 | 44 | R,B |
| House Sparrow | 18 | 14 | - | R |

TOTALS species : 114

Table 6-9. Winter Bird Observations for the Santa Ana River Channel.

| | dates. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| species | 12-16 | 1-22 | 1-27 | 2-18 | 2-24 | 2-25 | 2-26 | 3-16 |
| Pied-billed Grebe | - | - | - | - | - | 1 | 1 | - |
| Eared Grebe | - | - | - | 1 | - | 2 | 1 | - |
| Western Grebe | 2 | - | - | 1 | - | - | - | - |
| Brown Pelican | 9 | - | - | - | - | - | 1 | - |
| Double-cr. Cormorant | - | - | - | 1 | - | - | - | - |
| Great Blue Heron | - | 1 | - | - | - | - | - | - |
| Snowy Egret | - | - | - | - | - | 1 | 1 | 4 |
| Green-backed Heron | 1 | - | - | 1 | - | - | - | - |
| Black-cr. Night Heron | 1 | - | - | - | - | - | - | - |
| Northern Pintail | - | - | - | - | - | 3 | 3 | 2 |
| Canvasback | - | - | - | - | 2 | - | - | - |
| Lesser Scaup | - | - | - | - | - | 2 | 7 | - |
| American Goldeneye | - | - | - | 2 | - | - | - | - |
| Bufflehead | - | - | - | 3 | - | - | 2 | - |
| Red-br. Merganser | - | - | - | - | - | - | 2 | 9 |
| Ruddy Duck | 2 | - | - | - | 1 | - | - | - |
| American Coot | - | 1 | - | - | - | 5 | - | - |
| Black-necked Stilt | 24 | 10 | 32 | 93 | 13 | 8 | 31 | 52 |
| American Avocet | 3 | - | - | - | - | - | 1 | 6 |
| Killdeer | - | - | - | 52 | 4 | - | 18 | - |
| Black-bellied Plover | 1 | - | - | - | 1 | 4 | 7 | - |
| Ruddy Turnstone | - | - | - | - | - | - | 2 | - |
| Greater Yellowlegs | - | - | - | 1 | - | - | - | - |
| Spotted Sandpiper | - | - | - | - | - | - | - | 1 |
| Willet | 12 | 5 | 10 | 46 | 16 | 27 | 28 | 22 |
| Marbled Godwit | 1 | - | 4 | 2 | 2 | 11 | - | 3 |
| Whimbrel | 1 | - | - | - | - | - | - | - |
| Sanderling | 49 | 10 | 15 | 17 | 53 | 70 | 30 | 15 |
| Western Sandpiper | - | - | - | 19 | - | - | - | - |
| Least Sandpiper | 3 | - | 5 | 12 | - | - | 61 | 83 |
| Sh.-billed Dowitcher | - | - | - | 3 | 50 | 21 | 43 | 33 |
| Bonaparte's Gull | 2000 | 300 | 250 | 450 | 400 | 600 | 40 | 175 |
| Heerman's Gull | - | - | - | - | - | 2 | - | - |
| Mew Gull | 12 | 2 | 6 | 2 | 12 | 14 | 18 | - |
| Ring-billed Gull | 60 | 16 | 40 | 10 | 60 | 80 | 46 | 1 |
| California Gull | - | - | - | - | 32 | 45 | - | - |
| Herring Gull | - | - | - | - | 1 | 2 | - | - |
| Western Gull | 30 | 2 | 3 | 1 | 15 | 25 | - | - |
| Glaucous-winged Gull | - | - | - | - | - | 1 | - | - |
| Caspian Tern | - | - | - | - | 2 | 2 | - | 1 |
| Forster's Tern | 1 | - | - | - | 5 | 7 | - | 1 |
| Belted Kingfisher | 2 | - | 1 | 1 | - | - | 2 | 2 |
| Totals, indiv. | 2214 | 347 | 366 | 718 | 669 | 933 | 345 | 410 |
| species | 19 | 9 | 10 | 20 | 17 | 22 | 21 | 16 |

Tide was low on 1-22 and 3-16

Table 6-10. Spring Bird Observations for the Santa Ana River Channel

| species | dates 3-23 | 4-14 | 5-2 | 5-22 | 6-5 | 6-21 |
|---|---|---|---|---|---|---|
| Western Grebe | - | - | 2 | 1 | 1 | - |
| Snowy Egret | 1 | - | - | - | - | - |
| Green-backed Heron | - | - | - | - | 1 | - |
| Cinnamon Teal | 4 | - | 8 | 2 | - | - |
| Mallard | 2 | - | - | - | - | 1 |
| Red-breasted Merganser | 5 | 1 | 1 | - | - | - |
| Black-necked Stilt | 32 | 25 | 48 | 40 | 44 | 20 |
| American Avocet | 16 | 6 | - | 1 | 2 | - |
| Black-bellied Plover | 7 | 4 | 3 | - | - | - |
| Snowy Plover | - | 2 | 1 | - | - | - |
| Semipalmated Plover | - | 11 | 1 | - | - | - |
| Killdeer | - | 3 | 2 | 4 | 3 | 19 |
| Greater Yellowlegs | - | - | - | - | - | 1 |
| Spotted Sandpiper | - | 1 | 3 | - | - | - |
| Willet | 24 | 18 | 6 | 4 | 4 | 36 |
| Whimbrel | 8 | 1 | - | - | - | - |
| Marbled Godwit | 8 | 4 | 2 | - | - | 3 |
| Ruddy Turnstone | - | 7 | - | - | - | - |
| Sanderling | 52 | 70 | 48 | 12 | - | - |
| Western Sandpiper | - | 100 | 21 | - | - | - |
| Least Sandpiper | 58 | 37 | - | - | - | - |
| Short-billed Dowitcher | 10 | 46 | 6 | - | - | - |
| Bonaparte's Gull | 700 | 128 | 13 | - | - | - |
| Ring-billed Gull | 10 | 26 | 2 | 5 | - | - |
| California Gull | - | 30 | - | 2 | - | - |
| Western Gull | 2 | - | - | - | - | - |
| Caspian Tern | 4 | 7 | 3 | 2 | - | - |
| Common Tern | - | - | 2 | - | - | - |
| Forster's Tern | 2 | 3 | - | - | - | - |
| California Least Tern | - | - | 1 | 4 | - | - |
| TOTALS; individuals: | 945 | 530 | 173 | 77 | 55 | 80 |
| species : | 18 | 21 | 19 | 11 | 6 | 6 |

Table 6-11. Summer bird observations for the Santa Ana River Channel

| species | dates 7-10 | 7-20 | 8-9 | 8-24 |
|---|---|---|---|---|
| Great Blue Heron | - | - | - | 1 |
| Snowy Egret | - | - | - | 4 |
| Green-backed Heron | - | - | 1 | - |
| Black-necked Stilt | 18(2) | 6 | 19 | 9 |
| Black-bellied Plover | - | 4 | 10 | 15 |
| Semipalmated Plover | 6 | - | 32 | 14 |
| Killdeer | 15 | - | 17 | 2 |
| Greater Yellowlegs | - | 3 | 1 | - |
| Willet | 26 | 10 | 17 | 16 |
| Marbled Godwit | 18 | 2 | 9 | 10 |
| Sanderling | - | - | 22 | 16 |
| Western Sandpiper | 28 | 57 | 52 | - |
| Least Sandpiper | 6 | 10 | 3 | 9 |
| Short-billed Dowitcher | - | - | 8 | 22 |
| Ring-billed Gull | - | - | 33 | 6 |
| California Gull | - | - | 35 | - |
| Herring Gull | 1 | - | 1 | - |
| Western Gull | - | - | 1 | - |
| Forster's Tern | - | - | - | 1 |
| Belted Kingfisher | - | - | - | 2 |
| TOTALS individuals: | 118(2) | 92 | 261 | 127 |
| species: | 8 | 7 | 16 | 14 |

including grebes, pelicans, cormorant, herons, terns, red-breasted merganser and belted kingfisher, were found only in small numbers in the Santa Ana River Channel. However, those few birds that were observed fed successfully, indicating the presence of an adequate food supply.

Shorebirds, except for black-necked stilt and killdeer, were migratory and/or wintering species. Some feeding by these birds was observed, but most feeding involved picking insects from the edge of the water rather than probing the bottom. The larger shorebirds -- godwit, willet, and black-bellied plover -- spent little of their time feeding in the channel. Only the smaller shorebirds and stilt fed regularly. Except for the resident stilt, numbers of shorebirds were lower than would be expected on a mudflat of comparable size. It is felt that scouring of the channel bottom by winter floods has made it a rather poor area for shorebird foraging.

Up to 50 black-necked stilts were present in the Santa Ana River Channel throughout the year, yet only one pair nested. Dr. Guthrie believes that this is a resident population that in a wetter year would nest in ephemeral ponds of the oilfield area. Due to the dry year they were unable to nest in 1984, but did not leave the area to seek other nesting sites. Killdeer are also considered resident in the area. A flock of killdeer numbering between 30 and 50 individuals roosted at various places in the Santa Ana River Channel and along the dike between this channel and the Greenville-Banning Channel. During the spring this flock broke into nesting pairs, many of which nested in the gravel along the dike between the two flood control channels, or in the channel bottom above the Victoria Street Bridge.

Gulls regularly nested in the channel, reaching large numbers during the winter. Many of these were individuals that usually rest on the ocean beaches but moved into the Santa Ana River Channel when the public beaches were in heavy use. A large flock of Bonaparte's gulls wintered in the area, resting in the channel when they were not at sea or feeding on the settling ponds in the nearby Orange County sewage treatment plant.

The sewage plant just west of the channel, although not in the study area, was the nesting site for a colony of barn swallow that regularly foraged over the study area.

## Greenville-Banning Channel

Seasonal census data for this study are presented in Tables 6-12, 13, and 14. The Greenville-Banning Channel differs from the Santa Ana River Channel in that its bottom is never exposed and therefore there is no area where shorebirds can forage or gulls can rest (a few shorebirds did roost on the channel banks at night). The avifauna in the channel proper is thus mostly restricted to fish-eating species: grebes, loons, herons, pelican and cormorant. Except for pied-billed grebe, use of the channel by these birds occurred in winter. However, on occasion a flock of up to 40 egrets fed in the bulrushes (Scirpus sp.) in the upper channel. This area is brackish and supports crayfish and amphibian larvae, in addition to the fish found in the lower salt water portion of the channel. It is suspected that the night herons that roosted at Victoria Pond during the winter also fed in this channel, as on several occasions night herons were observed leaving the channel in the early morning hours.

Table 6-12. Winter Bird Observations for the Greenville - Banning Channel

| species | dates. 12-16 | 1-22 | 1-27 | 2-18 | 2-24 | 2-25 | 2-26 | 3-16 |
|---|---|---|---|---|---|---|---|---|
| Pied-billed Grebe | 2 | 2 | 1 | 2 | 2 | 7 | 4 | - |
| Western Grebe | 1 | 1 | 3 | 2 | 3 | 3 | 3 | - |
| Brown Pelican | 1 | - | - | - | - | - | - | - |
| Double cr. Cormorant | - | - | 1 | - | - | - | - | - |
| Great Blue Heron | 2 | 1 | - | - | - | - | - | 2 |
| Great Egret | 22 | 3 | 32 | - | 35 | 40 | 38 | 1 |
| Snowy Egret | - | - | 8 | - | 10 | 12 | 10 | 1 |
| Bufflehead | - | 1 | 3 | - | - | - | - | - |
| Red-br. Merganser | - | - | - | - | 3 | - | - | - |
| Ruddy Duck | - | - | 1 | - | - | - | - | 2 |
| American Coot | - | - | 2 | 1 | 4 | - | 7 | 2 |
| Killdeer | - | - | - | - | - | - | 30 | - |
| Spotted Sandpiper | 1 | - | 2 | - | 2 | 1 | 1 | - |
| Willet | 2 | 3 | - | 1 | 8 | 2 | - | 1 |
| Marbled Godwit | - | 3 | - | - | - | - | - | - |
| Common Snipe | - | - | - | - | - | - | 1 | - |
| Caspian Tern | 1 | 1 | - | - | - | - | - | - |
| Red-throated Loon | 1 | - | - | 2 | - | 2 | 1 | - |
| Belted Kingfisher | - | 1 | - | - | - | - | - | - |
| Totals, indiv. | 33 | 17 | 53 | 8 | 67 | 67 | 95 | 9 |
| species | 9 | 9 | 9 | 5 | 8 | 7 | 9 | 6 |

Table 6-13. Spring Bird Observations for the Greenville - Banning Channel

| species | dates 3-23 | 4-14 | 5-2 | 5-22 | 6-5 | 6-21 |
|---|---|---|---|---|---|---|
| Pied-billed Grebe | 4 | - | - | 1 | - | 1 |
| Double-crested Cormorant | 1 | 1 | 2 | - | - | - |
| Great Blue Heron | 1 | - | 1 | 1 | - | - |
| Great Egret | 4 | 2 | - | - | - | - |
| Snowy Egret | 2 | - | - | - | - | - |
| Green-backed Heron | - | 1 | - | 1 | 1 | 4 |
| Black-crowned Night Heron | 1 | 1 | 2 | 1 | - | 1 |
| Cinnamon Teal | - | 2 | - | - | - | - |
| Mallard | - | 2 | - | 2 | - | 1 |
| Northern Pintail | - | - | - | 1 | - | - |
| Red-breasted Merganser | 1 | - | - | - | - | - |
| Ruddy Duck | 1 | - | 2 | - | - | - |
| American Coot | 3 | - | 1 | - | - | - |
| Black-necked Stilt | 2 | 2 | 1 | - | - | - |
| Killdeer | - | - | 2 | 2 | - | - |
| Spotted Sandpiper | - | 2 | - | - | - | - |
| Willet | 1 | 7 | 3 | - | - | - |
| Western Sandpiper | - | 1 | - | - | - | - |
| Least Sandpiper | - | 11 | - | - | - | - |
| Ring-billed Gull | 1 | - | - | - | - | - |
| Caspian Tern | 4 | 1 | 1 | - | 2 | - |
| California Least Tern | - | - | - | - | 2 | - |
| Red-throated Loon | 1 | - | - | - | - | - |
| Barn Owl | - | 1 | - | - | - | - |
| Rough-winged Swallow | 6 | - | - | 2 | - | - |
| Cliff Swallow | - | - | - | 60 | 40 | 30 |
| Song Sparrow | - | 16 | 6 | - | - | - |
| Savannah Sparrow | - | 6* | - | - | - | - |
| Red-winged Blackbird | - | 22 | 22 | 26 | 25 | 60 |
| Yellow-headed Blackbird | - | 1 | 2 | - | - | - |
| TOTALS; individuals: | 33 | 85 | 45 | 97 | 70 | 97 |
| species: | 15 | 17 | 12 | 10 | 5 | 6 |

* not beldingi

Table 6-14. Summer bird observations for the Greenville - Banning Channel

| species | dates 7-10 | 7-20 | 8-9 | 8-24 |
|---|---|---|---|---|
| Pied-billed Grebe | 1 | 2 | - | 3 |
| Great Blue Heron | - | 4 | - | 2 |
| Great Egret | - | 6 | - | - |
| Snowy Egret | - | 1 | - | - |
| Green-backed Heron | 1 | 2 | 3 | 2 |
| Black-necked Stilt | - | 3 | - | - |
| Killdeer | - | - | - | 1 |
| Spotted Sandpiper | - | - | - | 1 |
| Willet | - | 1 | 2 | 4 |
| Long-billed Curlew | 1 | - | - | - |
| Rock Dove | 4 | 6 | 8 | 4 |
| Burrowing Owl* | 1 | - | - | - |
| Belted Kingfisher | 1 | 2 | 2 | 1 |
| Barn Swallow | 4 | 2 | - | 1 |
| Cliff Swallow | 20 | 15 | 12 | - |
| Common Yellowthroat | - | - | - | 2 |
| Song Sparrow* | 5 | 3 | 4 | 5 |
| Red-winged Blackbird | - | 1 | - | 35 |
| TOTALS individuals: | 38 | 48 | 31 | 61 |
| species: | 9 | 13 | 6 | 12 |

* on bank between channels

The bulrushes in the channel also provided nesting sites for song sparrow, red-winged blackbird, and common yellowthroat. Cliff swallows, rock dove and a barn owl roosted -- and the former two species and possibly the barn owl nested -- under the Victoria Street Bridge where it passes over this channel. A burrowing owl was once observed in the rocks on the west bank of this channel and may be resident there.

## Coastal Salt Marsh and Tidal Channels

Seasonal census data for this study area are presented in Tables 6-15, 16, and 17. The open water remnant tidal channel attracted small numbers of fish-eating birds and ducks. A flock of mallards was present through much of the winter and became quite tame from feeding by channel-side residents. Most waterbirds were winter visitors to the area and had left by late spring. Only pied-billed grebe remained in the area throughout the year.

A few herons and shorebirds fed on the small portions of the channel bottom that were exposed at low tide. A flock of gulls and killdeer often roosted in the higher areas of the marsh and great blue heron also regularly spent the night in the marsh.

The only "marsh" birds observed were marsh wren and the ubiquitous song sparrow. Both species wintered in the marsh and established territories in the spring. Although searched for, no evidence could be found for the presence of clapper rails in the marsh. Several savannah sparrows were present in the marsh in winter but all were members of the common inland subspecies (Passerculus sandwichensis sandwichensis) rather than of the coastal subspecies, P. s. beldingi. No savannah sparrows were present in the marsh during the summer. Four pairs of Black-necked stilts nested in the marsh in May and at least two pair successfully fledged young.

Fill for oilfield operations and sand dune development along the remnant tidal channel have resulted in several areas of higher ground in the marsh that support ruderal vegetation and a few exotic shrubs. The latter were visited by a few migratory land birds and provided habitat for such unlikely marsh species as Anna's hummingbird and Cooper's hawk. The ruderal fields attracted several species of seed eating sparrow, meadowlark and starling. Two ground squirrel burrows in the northwest corner of the marsh area near a compost pile operated by the City of Newport Beach were occupied by burrowing owls and at least 2 young were successfully fledged. On examination, owl pellets from the entrance of these borrows were found to consist mostly of insect remains, with beetle and jersulem cricket constituting much of the pellet content. A small number of other raptors and shrike also regularly hunted in the marsh area.

A previous survey of the coastal salt marsh area (Massey 1980, see Appendix B) observed several species not seen during this census. Most of these (brant, white-fronted goose, several ducks and shorebirds) are to be expected in the area irregularly in small numbers. Massey also reports the presence of a clapper rail in 1979 and the former presence of ring-necked pheasant. Her study, like this one, found the area generally unsuited for clapper rails and Belding's savannah sparrow and noted that shorebird numbers were very low at Santa Ana, compared with those found in other regional coastal salt marshes.

Table 6-15. Winter Bird Observations for the Coastal Marsh and open water.

| species | dates. 12-16 | 1-22 | 1-27 | | 2-24 | 2-25 | 2-26 | 3-18 |
|---|---|---|---|---|---|---|---|---|
| Pied-billed Grebe | 3 | 6 | 4 | - | 6 | 10 | 8 | 5 |
| Western Grebe | 8 | 4 | 3 | - | 1 | - | - | - |
| Brown Pelican | 5 | - | - | - | 1 | - | - | - |
| Double cr. Cormorant | 2 | 3 | 1 | - | 3 | 4 | 3 | 10 |
| Great Blue Heron | 9 | 6 | 3 | - | 4 | 7 | 7 | 11 |
| Great Egret | 1 | 1 | 3 | - | - | 1 | 2 | 1 |
| Snowy Egret | 2 | 1 | - | - | 4 | 4 | 3 | 5 |
| Green Heron | 1 | - | - | - | - | - | - | - |
| Bl.-cr. Night Heron | - | - | - | - | - | - | - | 1 |
| Canada Goose | - | - | 4 | - | - | - | - | - |
| American Wigeon | - | - | 2 | - | - | - | - | - |
| Mallard | - | 43 | 10 | - | 35 | 52 | 31 | 39 |
| Cinnamon Teal | - | - | 1 | - | 1 | 2 | - | - |
| Bufflehead | 1 | - | 2 | - | 1 | 3 | 2 | - |
| Red-br. Merganser | - | - | - | - | - | 1 | 1 | 2 |
| Ruddy Duck | - | 2 | 1 | - | - | 1 | - | 2 |
| American Coot | 4 | 2 | 13 | - | 12 | 13 | 9 | 4 |
| Black-necked Stilt | - | - | - | - | - | 1 | - | - |
| American Avocet | - | 1 | - | - | - | - | - | - |
| Killdeer | 5 | 30 | 4 | - | - | 8 | - | - |
| Greater Yellowlegs | - | - | - | - | - | 1 | 1 | - |
| Willet | 6 | 12 | 1 | - | 2 | 2 | 3 | 13 |
| Marbled Godwit | - | 34 | - | - | 3 | - | - | 7 |
| Western Sandpiper | - | 40 | - | - | - | - | - | - |
| Short-billed Dowitcher | - | 50 | 2 | - | 4 | - | - | 35 |
| Common Snipe | - | - | - | - | 8 | 6 | 10 | 1 |
| Bonaparte's Gull | - | 1 | - | - | - | - | - | - |
| Ring-billed Gull | 49 | 46 | 55 | - | 4 | 17 | 52 | 9 |
| Western Gull | - | 1 | - | - | - | - | - | - |
| Forster's Tern | - | - | - | - | - | - | - | 1 |
| Common Loon | 1 | - | - | - | - | - | - | - |
| Red-throated Loon | 1 | 2 | 2 | - | 2 | 2 | 2 | 1 |
| Black-shouldered Kite | 1 | - | - | - | - | - | - | - |
| Cooper's Hawk | - | 1 | 1 | - | 2 | 1 | 1 | 1 |
| Red-tailed Hawk | - | 1 | - | - | 2 | 1 | 1 | - |
| American Kestrel | 2 | - | - | - | 1 | - | 1 | - |
| Mourning Dove | 1 | - | 2 | - | 4 | 2 | 7 | - |
| Spotted Dove | - | - | - | - | - | - | 2 | - |
| Anna's Hummingbird | - | 1 | 1 | - | 1 | - | 1 | 2 |
| Belted Kingfisher | 2 | 2 | 1 | - | 3 | 2 | 1 | 2 |
| Northern Flicker | - | 1 | - | - | 1 | - | - | - |
| Black Phoebe | 3 | 2 | 1 | - | 1 | 1 | - | - |
| Say's Phoebe | - | 1 | 2 | - | 2 | 1 | - | - |
| Rough-winged Swallow | - | - | - | - | - | - | 1 | - |
| Common Crow | - | - | 3 | - | 5 | 1 | 6 | - |
| Marsh Wren | - | 1 | - | - | 1 | 5 | 4 | 2 |
| Water Pipit | - | 1 | - | - | - | - | - | - |

Table 6-15 (cont.). Bird Observations for the Coastal Marsh and open water.

| | dates. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| species | 12-16 | 1-22 | 1-27 | | 2-24 | 2-25 | 2-26 | 3-18 |
| Loggerhead Shrike | 1 | - | 1 | - | 3 | 2 | 2 | 2 |
| European Starling | - | 2 | 5 | - | 6 | 2 | 4 | - |
| Yellow-rumped Warbler | 1 | 2 | 2 | - | 2 | 1 | 6 | - |
| Song Sparrow | - | 1 | 8 | - | 10 | 12 | 9 | 4 |
| Lincoln's Sparrow | - | 7 | - | - | - | 2 | 1 | - |
| Golden-crowned Sparrow | - | - | 10 | - | - | - | - | - |
| White-crowned Sparrow | - | 45 | 30 | - | 23 | 30 | 52 | - |
| Savannah Sparrow | - | 1 | 1 | - | 12 | 24 | 14 | 13 |
| Red-winged Blackbird | - | 5 | - | - | - | 2 | - | - |
| Western Meadowlark | - | 23 | 2 | - | 13 | 16 | 10 | 18 |
| House Finch | - | 10 | — | — | 15 | 11 | 54 | 10 |
| Totals, individuals | 109 | 392 | 181 | | 198 | 251 | 291 | 201 |
| species | 22 | 37 | 32 | | 35 | 36 | 33 | 26 |

Table 6-16. Spring Bird Observations for the Coastal Marsh and Open Water

| species | dates 3-23 | 4-14 | 5-2 | 5-22 | 6-5 | 6-21 |
|---|---|---|---|---|---|---|
| Pied-billed Grebe | - | - | - | - | - | 1 |
| Eared Grebe | 6 | - | - | - | - | - |
| Great Blue Heron | - | 1 | - | 6 | 1 | 4 |
| Great Egret | 8 | 1 | - | 1 | - | - |
| Snowy Egret | 1 | 2 | 2 | 6 | - | - |
| Green-backed Heron | - | 1 | - | - | - | - |
| Black-crowned Night Heron | - | - | - | - | - | 1 |
| Cinnamon Teal | 3 | 4 | 4 | 2 | - | - |
| Mallard | 5 | 26 | 6 | 16 | 6 | 10 |
| American Coot | 2 | - | - | - | - | - |
| Black-necked Stilt | 4 | 10 | 4 | 9(4n)* | 6 | 2(2) |
| Spotted Sandpiper | - | 1 | - | - | - | - |
| Willet | 6 | 10 | 7 | - | - | - |
| Marbled Godwit | 22 | 5 | - | - | - | - |
| Short-billed Dowitcher | 2 | 10 | - | - | - | - |
| Long-billed Dowitcher | 4 | - | - | - | - | - |
| Ring-billed Gull | 1 | 4 | - | - | - | - |
| California Least Tern | - | - | - | 6 | - | - |
| Red-throated Loon | 1 | - | - | - | - | - |
| Turkey Vulture | 1 | - | - | - | - | - |
| Black-shouldered Kite | - | - | - | - | - | (1) |
| Northern Harrier | - | - | 2 | - | - | - |
| Cooper's Hawk | 1 | - | - | - | - | - |
| Red-tailed Hawk | - | - | 1 | - | - | - |
| American Kestrel | 1 | - | - | 1 | 1 | 2 |
| Mourning Dove | 3 | 2 | 4 | - | 3 | 2 |
| Anna's Hummingbird | 2 | 2 | 1 | - | - | - |
| Belted Kingfisher | 2 | - | - | 1 | - | - |
| Western Wood Pewee | - | - | - | 1 | - | - |
| Rough-winged Swallow | 2 | - | - | - | - | - |
| Cliff Swallow | - | 35 | - | - | - | 20 |
| Barn Swallow | 2 | - | - | - | - | - |
| Common Crow | 2 | - | 1 | - | 1 | 1 |
| Loggerhead Shrike | 1 | 2 | 1 | 1 | 1 | 1 |
| House Sparrow | 12 | 5 | - | - | - | - |
| Song Sparrow | - | 4 | 2 | 2 | - | - |
| Lincoln's Sparrow | 1 | 1 | - | - | - | - |
| White-crowned Sparrow | 6 | 2 | - | - | - | - |
| Savannah Sparrow | 6 | 4 | - | - | - | - |
| Red-winged Blackbird | - | 25 | - | - | - | - |
| Western Meadowlark | 8 | 9 | 5 | 3 | 2 | 1 |
| House Finch | - | 5 | 6 | - | 6 | - |
| Starling | - | 16 | 10 | - | - | 2 |
| TOTALS; individuals: | 115 | 187 | 56 | 54(4n) | 27 | 47(3) |
| species: | 28 | 25 | 15 | 13 | 9 | 13 |

* numbers in parenthesis are nests and young

Table 6-17. Summer bird Observations for the Coastal Marsh and Open Water

| species | dates 7-10 | 7-20 | 8-9 | 8-24 |
|---|---|---|---|---|
| Pied-billed Grebe | - | - | - | 2 |
| Great Blue Heron | 7 | 4 | 2 | 5 |
| Snowy Egret | - | - | - | 6 |
| Green-backed Heron | - | - | - | 1 |
| Mallard | 4 | - | 6 | 4 |
| Black-necked Stilt | 2(2)* | - | - | 1 |
| Killdeer | - | - | - | 2 |
| Greater Yellowlegs | - | - | 1 | 1 |
| Willet | - | 2 | 3 | 2 |
| Common Snipe | - | - | 1 | - |
| Ring-billed Gull | - | - | 1 | - |
| Osprey | - | - | 1 | 1 |
| Red-tailed Hawk | 2 | - | - | - |
| American Kestrel | 1 | 1 | - | 1 |
| Mourning Dove | - | - | 4 | 4 |
| Burrowing Owl | 4 | 2 | 2(2) | 3 |
| Anna's Hummingbird | 1 | - | - | 2 |
| Belted Kingfisher | 2(1) | 1 | 3 | 1 |
| Cliff Swallow | 10 | - | - | - |
| Common Crow | - | 4 | - | - |
| Loggerhead Shrike | - | - | - | 1 |
| Song Sparrow | - | - | - | 4 |
| Red-winged Blackbird | - | - | 22 | - |
| House Finch | - | - | 2 | 6 |
| European Starling | - | 4 | - | - |
| TOTALS individuals: | 33(3) | 18 | 48(2) | 47 |
| species: | 9 | 7 | 12 | 18 |

* numbers in parentheses are young birds

## Canyons and Mesa Bluffs

Seasonal census data for this study area are presented in Tables 6-18, 19, and 20. The coastal sage scrub community that survives in the canyons and on the Newport Beach Mesa bluffs is only a small remnant of a once more widespread vegetational type. Housing and oilfield development have restricted this community to a few small areas and most of the typical coastal sage birds, such as California quail and roadrunner, have not survived. Only species with very restricted habitat and space needs remain. These are the cactus wren, brown towhee and black-tailed gnatcatcher. This latter species deserves special mention. The black-tailed gnatcatcher are currently being reviewed as part of a Doctoral thesis and the reviewer feels that the coastal form of the black-tailed gnatcatcher is sufficiently different from the much more common desert form to warrant elevation to specific status. Whether a species of subspecies, the destruction of nearly all suitable coastal habitat in California has severely restricted this population and make it one deserving careful monitoring and protection. At least three pair of black-tailed gnatcatcher attempted nesting in the canyon and more pair probably nest along the mesa bluffs.

In addition to the resident black-tailed gnatcatcher, brown towhees and cactus wren bred in the coastal sage scrub. The willow stands in the canyon attracted a variety of wintering species and some migrants. Birds of the mesa top (raptors, and seed-eaters such as finches and mourning doves) often foraged in the canyon also.

The bluffs have been extensively impacted by the removal of sand for fill operations and by attempts at bluff stabilization in which asphalt has been poured over the cliff along much of its length. Despite these disruptions, some places along the cliff, especially in the area near the Pacific Coast Highway and in some of the canyons, harbor good stands of remnant coastal sage habitat. Also of special interest are a pair of kingfishers that were observed several times courting along the face of the bluff and apparently nested in a vertical sand face left from sand mining operations.

## The Oilfield

Seasonal census data for this study area are presented in Tables 6-21, 22, and 23. The oilfield contains three separate habitats: freshwater marshes and ponds, riparian areas, and ruderal fields.

At the beginning of the study period there were several ponds and marshy areas in the oilfield that attracted a wide variety of ducks, herons and shorebirds. By spring, several of these species, including mallard, cinnamon teal, coot and black-necked stilt, as well as such marsh species as sora, common yellowthroat and red-winged blackbird, began territorial defense and courtship activities. However, as the season progressed with no rain, the ponds dried up and nearly all of these species left the area. Only two pair of stilts and probably many of the yellowthroat and red-winged blackbird nested successfully. It is felt that many more of these birds would have nested in a year with more normal rainfall and longer lasting pond habitats.

The remnant willow and riparian habitat in the northeast corner of the oilfield and along the 19th Street boundary fence hosted a number of wintering

Table 6-18. Winter Bird Observations on bluffs and in canyons.

| | dates. | | | | | | |
|---|---|---|---|---|---|---|---|
| species | 12-16 | 1-22 | 1-27 | 2-24 | 2-25 | 2-26 | 3-18 |
| Cooper's Hawk | - | - | - | - | - | - | - |
| Red-tailed Hawk | 1 | 2 | 1 | 1 | - | - | 2 |
| American Kestrel | - | - | 1 | - | - | - | - |
| Mourning Dove | 2 | 1 | - | 5 | 6 | - | 5 |
| Spotted Dove | - | - | - | - | 1 | 2 | 1 |
| Anna's Hummingbird | 2 | 3 | 1 | 3 | 9 | 4 | 5 |
| Black-ch. Hummingbird | - | - | - | - | - | - | 2 |
| Northern Flicker | - | - | - | 2 | - | - | 1 |
| Black Phoebe | 1 | - | 2 | - | - | - | - |
| Western Flycatcher | - | - | - | - | - | - | 1 |
| Rough-winged Swallow | - | - | - | - | - | - | 2 |
| Common Crow | - | - | - | - | - | - | 1 |
| Bushtit | - | 25 | - | 18 | 8 | 4 | 5 |
| Cactus Wren | 1 | 1 | 1 | 3 | 4 | 2 | 2 |
| Marsh Wren | - | 1 | - | - | - | - | - |
| Northern Mockingbird | 2 | 1 | 2 | 3 | 4 | 3 | 5 |
| Hermit Thrush | 1 | 1 | 1 | 1 | 3 | 2 | 1 |
| Ruby-crowned Kinglet | 3 | 2 | 2 | 1 | 1 | 2 | - |
| Bl.-tailed Gnatcatcher | 3 | 2 | 2 | 4 | 5 | 2 | 5 |
| Loggerhead Shrike | - | 1 | - | - | 1 | - | - |
| European Starling | - | - | - | - | - | - | 18 |
| Orange-cr. Warbler | 1 | - | - | 2 | 1 | - | 1 |
| Yellow-rmp. Warbler | 10 | 2 | 3 | 18 | 14 | 12 | 12 |
| Northern Yellowthroat | 1 | 1 | 2 | - | - | - | - |
| Wilson's Warbler | - | - | - | 1 | - | - | - |
| House Sparrow | - | - | - | - | - | - | 18 |
| Song Sparrow | 6 | 8 | 4 | 15 | 12 | 6 | 2 |
| Lincoln's Sparrow | - | - | 1 | - | - | - | - |
| Golden-cr. Sparrow | - | 3 | 2 | 10 | - | - | 8 |
| White-cr. Sparrow | 40 | 50 | 5 | 20 | 31 | 4 | 18 |
| Brown Towhee | 1 | 1 | 1 | 1 | 2 | 3 | 6 |
| Red-winged Blackbird | - | - | 1 | - | - | - | - |
| Western Meadowlark | - | 20 | - | - | - | - | - |
| Brown-headed Cowbird | - | - | - | 4 | 5 | - | - |
| Lesser Goldfinch | 4 | - | - | 3 | 3 | - | - |
| House Finch | 10 | - | 4 | 30 | 23 | 22 | 10 |
| totals, indiv. | 89 | 125 | 36 | 145 | 133 | 68 | 131 |
| species | 17 | 18 | 18 | 20 | 18 | 13 | 23 |

Table 6-19. Spring Bird Observations on bluff and in canyons.

| species | dates 3-23 | 4-14 | 5-2 | 5-22 | 6-5 | 6-21 |
|---|---|---|---|---|---|---|
| Turkey Vulture | - | - | - | - | - | 1 |
| American Kestrel | - | - | - | - | - | 1 |
| Mourning Dove | 8 | 8 | 12 | - | 10 | 6 |
| Chinese Spotted Dove | - | 2 | 6 | 2 | - | 8 |
| Anna's Hummingbird | 2 | 2 | 2 | - | - | 1 |
| Western Flycatcher | - | 2 | - | - | - | - |
| Common Crow | - | 1 | 1 | - | - | - |
| Common Bushtit | 5 | 8 | 2 | - | 10 | 3 |
| Cactus Wren | 1 | 1 | 2 | - | 2(3)* | 3 |
| Northern Mockingbird | 3 | 1 | 2 | 4 | - | 2 |
| Swainson's Thrush | - | - | 1 | - | - | - |
| Ruby-crowned Kinglet | - | 2 | - | - | - | - |
| Black-tailed Gnatcatcher | 3 | - | 3 | - | 4 | 3(3) |
| Loggerhead Shrike | 1 | 2 | 1 | - | - | 1 |
| Orange-crowned Warbler | - | - | 1 | - | - | - |
| Common Yellowthroat | - | 1 | 2 | - | 2 | - |
| House Sparrow | 4 | - | - | - | - | 2 |
| Black-headed Grosbeak | - | 1 | - | - | - | - |
| Song Sparrow | 4 | 6 | 4 | - | 3 | 2 |
| White-crowned Sparrow | 3 | - | - | - | - | - |
| Brown Towhee | 3 | 9 | 5 | 1 | 1 | 3 |
| Brown-headed Cowbird | - | 1 | 2 | - | - | 1 |
| American Goldfinch | - | 9 | 4 | - | - | - |
| House Finch | 14 | 9 | 10 | 10 | 5 | 24 |
| Starling | - | - | 5 | - | - | - |
| TOTALS; individuals: | 51 | 65 | 65 | 17 | 37(3) | 61(3) |
| species: | 12 | 17 | 18 | 4 | 8 | 15 |

* Numbers in parentheses are young birds

Table 6-20. Summer Bird Observations on Bluffs and in Canyons

| species | dates 7-10 | 7-20 | 8-9 | 8-24 |
|---|---|---|---|---|
| Turkey Vulture | 1 | - | - | - |
| Mourning Dove | 12 | 4 | - | - |
| Spotted Dove | 5 | - | 4 | 2 |
| Anna's Hummingbird | 1 | - | 1 | 2 |
| Cactus Wren | 3 | - | 2 | 2 |
| Northern Mockingbird | 2 | - | - | - |
| Black-tailed Gnatcatcher | 2 | - | - | 2 |
| Loggerhead Shrike | - | - | - | 1 |
| Song Sparrow | 3 | - | - | 5 |
| Brown Towhee | 2 | - | 1 | 3 |
| House Finch | 50 | 4 | 26 | 6 |
| TOTALS individuals: | 81 | 8 | 34 | 26 |
| species: | 10 | 2 | 5 | 8 |

Table 6-21. Winter Bird Observations in the Oilfield area.

| species | dates. 12-16 | 1-22 | 1-27 | 2-24 | 2-25 | 2-26 | 3-18 |
|---|---|---|---|---|---|---|---|
| Pied-billed Grebe | - | 4 | 2 | 2 | - | 3 | - |
| Eared Grebe | 1 | - | - | - | - | - | - |
| Great Blue Heron | 3 | 9 | 11 | 4 | 4 | 5 | 5 |
| Great Egret | - | - | 2 | - | 2 | 1 | 1 |
| Snowy Egret | - | - | 6 | 2 | 3 | - | 1 |
| Green-backed Heron | - | - | 1 | 3 | 1 | 1 | 1 |
| Bl.-cr. Night Heron | - | - | 2 | - | - | 2 | 2 |
| American Wigeon | - | 2 | 5 | 2 | 16 | 4 | - |
| Gadwall | - | 8 | 19 | 2 | 2 | 2 | - |
| Green-winged Teal | - | - | - | 2 | - | 3 | - |
| Mallard | 11 | 31 | 68 | 8 | 3 | 10 | 8 |
| Northern Pintail | 2 | - | 7 | 2 | 3 | 4 | - |
| Cinnamon Teal | - | - | 41 | 23 | 18 | 40 | 10 |
| Northern Shoveller | - | - | 1 | - | - | - | - |
| Sora Rail | 1 | 5 | 6 | 4 | 8 | - | 4 |
| Common Moorhen | 1 | - | 1 | - | - | - | - |
| American Coot | 10 | 23 | 55 | 12 | 18 | 18 | 4 |
| Black-necked Stilt | 1 | 4 | 4 | - | - | 4 | - |
| American Avocet | 2 | - | - | - | - | - | - |
| Killdeer | 7 | 1 | 4 | 1 | - | 3 | 3 |
| Greater Yellowlegs | 3 | 1 | 5 | - | 3 | - | 2 |
| Spotted Sandpiper | 1 | - | - | - | - | - | - |
| Willet | 2 | 1 | - | - | - | 1 | - |
| Least Sandpiper | - | - | 32 | - | - | - | - |
| Sh.-billed Dowitcher | - | 1 | 13 | - | - | - | - |
| Common Snipe | - | - | - | 6 | - | - | - |
| Ring-billed Gull | - | 2 | 5 | - | - | 2 | - |
| Black-shouldered Kite | 3 | 4 | 2 | 2 | 2 | 2 | 1 |
| Cooper's Hawk | 2 | - | 2 | - | 1 | - | - |
| Red-tailed Hawk | 3 | 2 | 1 | 1 | 1 | 2 | 2 |
| American Kestrel | 2 | 2 | 2 | 2 | 1 | 1 | 1 |
| Mourning Dove | 51 | 36 | 6 | 10 | 27 | 14 | 7 |
| Spotted Dove | - | - | 1 | - | - | - | - |
| Anna's Hummingbird | 6 | 2 | 2 | 2 | 3 | 3 | 5 |
| Bl.-ch. Hummingbird | - | - | - | - | - | - | 1 |
| Belted Kingfisher | - | 1 | - | - | 1 | 3 | - |
| Northern Flicker | - | - | - | - | 1 | - | - |
| Western Kingbird | - | - | - | - | - | - | 4 |
| Black Phoebe | 3 | 6 | 2 | 2 | 2 | 1 | 1 |
| Say's Phoebe | 1 | - | 4 | - | - | 1 | 1 |
| Rough-winged Swallow | - | - | - | - | - | 5 | 3 |
| Common Crow | - | 4 | - | - | 33 | 5 | 2 |
| Bushtit | 44 | 7 | 12 | 7 | 9 | 8 | 10 |
| Marsh Wren | 1 | - | 1 | 1 | 1 | 4 | 2 |
| Hermit Thrush | 1 | 4 | 1 | 2 | 2 | 1 | 2 |
| Ruby-crowned Kinglet | - | - | 3 | 1 | - | - | - |
| Blue-gr. Gnatcatcher | - | - | - | 2 | 1 | 1 | 1 |
| Water Pipit | 1 | 1 | - | - | - | - | - |

Table 6-21 (cont). Winter Bird Observations in the Oilfield area.

| | dates. | | | | | | |
|---|---|---|---|---|---|---|---|
| species | 12-16 | 1-22 | 1-27 | 2-24 | 2-25 | 2-26 | 3-18 |
| Loggerhead Shrike | 4 | 5 | - | 6 | 2 | 7 | 3 |
| Orange-cr. Warbler | 3 | 1 | - | - | - | - | - |
| Yellow-rmp. Warbler | 130 | 10 | 6 | 6 | 4 | 6 | 18 |
| N. Yellowthroat | 2 | 11 | 4 | 14 | 16 | 5 | 11 |
| Song Sparrow | 45 | 47 | 75 | 60 | 43 | 38 | 44 |
| Lincoln's Sparrow | 22 | 19 | 40 | 1 | 2 | - | - |
| Golden-cr. Sparrow | - | 20 | 35 | 10 | - | 5 | 8 |
| White-cr. Sparrow | 261 | 105 | 140 | 90 | 33 | 27 | 7 |
| Savannah Sparrow | - | - | - | - | - | - | 3 |
| Red-winged Blackbird | 400 | 75 | 36 | 41 | 36 | 33 | 50 |
| Western Meadowlark | 43 | 40 | 13 | 15 | 8 | 29 | 61 |
| Brown-headed Cowbird | - | - | - | - | 2 | - | - |
| American Goldfinch | 3 | - | 3 | - | - | 2 | 11 |
| Lesser Goldfinch | - | - | - | - | 3 | - | - |
| House Finch | 1340 | 40 | - | - | - | 8 | 14 |
| Totals, indiv. | 2416 | 534 | 681 | 348 | 315 | 314 | 314 |
| species | 36 | 35 | 43 | 34 | 36 | 40 | 37 |

Table 6-22. Spring Bird Observations in the Oilfield area.

| species | dates | | | | | |
|---|---|---|---|---|---|---|
| | 3-23 | 4-14 | 5-2 | 5-22 | 6-5 | 6-21 |
| Great Blue Heron | 1 | - | 1 | 1 | - | - |
| Great Egret | 1 | - | - | - | - | - |
| Snowy Egret | - | 2 | - | - | - | - |
| Green-backed Heron | - | - | - | - | 1 | - |
| Black-crowned Night Heron | - | 4 | - | - | - | - |
| Cinnamon Teal | 11 | - | 2 | 2 | - | - |
| Mallard | 2 | - | 2 | 2 | 1 | 3 |
| Sora | - | 3 | 1 | - | - | - |
| American Coot | - | 2 | - | 1 | - | - |
| Black-necked Stilt | - | - | - | - | - | 2(3)* |
| Killdeer | 2 | - | - | 2 | - | - |
| Greater Yellowlegs | 4 | - | - | - | - | - |
| Willet | - | 2 | - | - | - | - |
| Common Snipe | 6 | - | - | - | - | - |
| Turkey Vulture | 4 | - | 2 | 2 | - | 4 |
| Black-shouldered Kite | 1 | 2 | 2 | 1 | 3 | - |
| Northern Harrier | - | - | 1 | - | - | 1 |
| Red-shouldered Hawk | - | 2 | - | - | - | - |
| Red-tailed Hawk | 1 | 1 | 1 | - | - | 1 |
| American Kestrel | - | - | 1 | - | - | 2 |
| Mourning Dove | 3 | 21 | 21 | 12 | 15 | 33 |
| Chinese Spotted Dove | - | 2 | 4 | - | - | - |
| Black-chinned Hummingbird | - | 1 | - | - | - | 4 |
| Anna's Hummingbird | 4 | 2 | 5 | 3 | - | 4 |
| Allen's Hummingbird | - | 1 | 1 | - | - | - |
| Belted Kingfisher | - | - | - | - | - | 2 |
| Black Phoebe | 1 | - | - | - | 1 | - |
| Rough-winged Swallow | 4 | - | - | - | 5 | - |
| Cliff Swallow | - | - | - | - | 12 | 23 |
| Barn Swallow | 1 | 3 | - | - | 2 | 15 |
| Common Crow | 7 | - | 1 | 2 | 45 | 28 |
| Plain Titmouse | - | - | 1 | - | - | - |
| Common Bushtit | 6 | 10 | 6 | 4 | - | 8 |
| Cactus Wren | - | - | 1 | - | - | - |
| Northern Mockingbird | - | - | 3 | - | - | - |
| Swainson's Thrush | - | - | 1 | - | 1 | - |
| Hermit Thrush | 1 | - | - | - | - | - |
| Blue-grey Gnatcatcher | - | - | 1 | - | - | - |
| Loggerhead Shrike | 3 | - | 3 | 3(3) | 3(3) | 3(2) |
| Orange-crowned Warbler | - | - | 2 | - | - | - |
| Yellow-rumped Warbler | 3 | - | - | - | - | - |
| Common Yellowthroat | 6 | 1 | 10 | 8 | 10 | 2 |
| Wilson's Warbler | - | - | 3 | - | - | - |
| Black-headed Grosbeak | - | - | 2 | - | - | - |
| Song Sparrow | 26 | 23 | 16 | 10 | 12 | 6 |
| Lincoln's Sparrow | 3 | - | - | - | - | - |

Table 6-22(cont). Spring Bird Observations in the Oilfield area.

| species | dates 3-23 | 4-14 | 5-2 | 5-22 | 6-5 | 6-21 |
|---|---|---|---|---|---|---|
| White-crowned Sparrow | 13 | 12 | - | - | - | - |
| Golden-crowned Sparrow | 6 | - | - | - | - | - |
| Green-tailed Towhee | - | 1 | - | - | - | - |
| Brown Towhee | - | - | 3 | 2 | - | 1 |
| Northern Oriole | - | 3 | 2 | - | - | - |
| Red-winged Blackbird | 8 | 34 | 16 | 15 | 15 | - |
| Western Meadowlark | 4 | - | - | - | - | - |
| Brown-headed Cowbird | - | - | 4 | - | - | - |
| American Goldfinch | 4 | 10 | 10 | 8 | - | 9 |
| House Finch | 25 | 42 | 24 | 32 | 25 | 19 |
| Starling | - | - | 12 | 18 | 13 | - |
| TOTALS; individuals: | 161 | 182 | 165 | 128(3) | 164(3) | 167(3) |
| species: | 29 | 23 | 33 | 19 | 16 | 20 |

* numbers in parenthesis are young birds

Table 6-23. Summer Bird Observations in the Oilfield area.

| species | dates 7-10 | 7-20 | 8-9 | 8-24 |
|---|---|---|---|---|
| Great blue Heron | 1 | 1 | 1 | 1 |
| Mallard | - | 2 | - | - |
| Black-necked Stilt | - | 1(2) | - | - |
| Black-shouldered Kite | - | 1 | 2 | 1 |
| Red-shouldered Hawk | 1 | 2 | 1 | - |
| American Kestrel | 1 | 2 | 2 | 1 |
| Mourning Dove | 10 | 15 | 2 | 6 |
| Spotted Dove | - | 2 | 3 | 2 |
| Anna's Hummingbird | 1 | 2 | 1 | 3 |
| Allen's Hummingbird | - | - | - | 2 |
| Belted Kingfisher | - | - | 1 | - |
| Western Kingbird | 1 | - | - | 1 |
| Barn Swallow | 10 | 5 | 4 | 6 |
| Cliff Swallow | 15 | - | - | 15 |
| Common Raven | 3 | - | - | - |
| Common Crow | 8 | 3 | 1 | - |
| Common Bushtit | - | - | - | 3 |
| Loggerhead Shrike | 3 | 2 | 4 | 3 |
| Northern Yellowthroat | 3 | 3 | - | 2 |
| Song Sparrow | 9 | 6 | 8 | 25 |
| Brown Towhee | - | - | - | 1 |
| Red-winged Blackbird | - | 5 | - | - |
| House Finch | 11 | 12 | 30 | 2 |
| TOTALS individuals: | 77 | 64(2) | 60 | 72 |
| species: | 14 | 16 | 13 | 15 |

land birds and were visited by a few migratory species during the spring. Resident species included song sparrow, house finch, Anna's hummingbird, and mourning dove, all of which nested.

The ruderal fields in the oilfield were visited by a variety of wintering seed-eating species (house finch, sparrows) and regularly hunted by both resident and wintering raptors. A pair of black-shouldered kites nested successfully in an elderberry along the 19th Street fence, and shrike and kestrel also nested either in the area or nearby. Many song sparrows and common yellowthroats established territory in the fields and had mostly finished nesting before the fields were mowed in June. The area was regularly visited by yellow-rumped warbler in winter, and swallows in summer, who aerially hunted for insects over the fields.

## 19th Street to Victoria Street

Seasonal census data for this study area are presented in Tables 6-24, 25, and 26. This area also consists of three distinct habitats: Victoria Pond, the "Willows" -- a riparian area, and ruderal fields.

During the winter, Victoria Pond hosted a wide variety of ducks as well as herons, and occasionally cormorants, pelicans, and grebes. Most of these species fed only sporadically in Victoria Pond, using the pond mainly as a resting area away from human disturbance. Large numbers of gulls also rested and bathed on the pond during the winter.

As there was no rain during the study period, the level of Victoria Pond steadily fell, exposing mudflats and causing the formation of several small ponds that in May and June attracted feeding shorebirds and egrets. California least terns were observed diving into the pond in small numbers, and kingfisher and pied-billed grebe were also seen fishing. By late summer the pond had been reduced by evaporation to about one-third of its former size and only a few resident species remained. Among the species that were seen on the pond, only two pair each of pied-billed grebe, mallard and coot, and single pairs of least bittern and stilt, nested successfully. Adult black-crowned night herons roosted at Victoria Pond during the winter but left in spring, leaving only a few non-breeding immature birds. It is suspected that more water birds might have nested here in a wetter year.

Red-winged blackbirds, marsh wrens, song sparrow, common yellowthroats and sora rail established territories, or were heard calling in the marsh around the edges of Victoria Pond, and probably nested here successfully before the pond began to dry up.

In March a small flock of domestic ducks and geese appeared on Victoria Pond. These gradually disappeared. Examination of their remains, found near the pond, indicates that they were eaten by coyotes or other local carnivores, an indication of the danger of predators to unwary birds in this area.

The willow riparian habitat in the southeast corner of this study plot hosted a variety of insectivorous species during the winter months. As spring arrived and buds formed, seed-eating species such as goldfinch and sparrows moved into the willows. Several species of resident birds began territorial defense and nesting towards the end of February -- song sparrow, mourning

Table 6-24. Winter Bird Observations between 19th Street and Victoria

Part A. Water birds

| species | dates. 12-16 | 1-22 | 1-27 | 2-18 | 2-24 | 2-25 | 2-26 | 3-16 |
|---|---|---|---|---|---|---|---|---|
| Pied-billed Grebe | 2 | - | 3 | 6 | 3 | 8 | 4 | 3 |
| Eared Grebe | 1 | - | - | - | - | - | - | 1 |
| Western Grebe | 2 | 1 | 4 | 2 | 2 | 3 | 2 | 2 |
| Brown Pelican | - | 1 | - | 6 | - | 3 | 1 | - |
| D. cr. Cormorant | 20 | 6 | 10 | 8 | 9 | 8 | 12 | 18 |
| Great Blue Heron | - | - | - | - | - | - | 1 | - |
| Great Egret | - | - | - | 1 | - | - | 1 | - |
| Green-backed Heron | 1 | - | - | - | - | - | - | 2 |
| Bl. cr. Night Heron | 31 | 10 | 15 | 28 | 32 | 31 | 20 | 22 |
| American Bittern | - | - | - | - | - | - | - | 2 |
| dom. ducks and geese | - | - | - | - | - | - | - | 5 |
| American Wigeon | 6 | - | - | - | - | 15 | 8 | 18 |
| Gadwall | 7 | - | 2 | - | 2 | 2 | 2 | 5 |
| Green-wng. Teal | 6 | - | - | - | - | - | - | 2 |
| Mallard | 4 | 4 | 11 | - | - | 2 | - | 5 |
| Northern Pintail | 10 | 10 | - | 16 | 8 | - | 4 | 3 |
| Cinnamon Teal | 1 | 5 | - | 6 | 2 | - | - | 6 |
| Northern Shoveller | 10 | - | - | - | 6 | - | - | 10 |
| Canvasback | 10 | 3 | 4 | - | 3 | 3 | 3 | - |
| Redhead | 2 | - | - | - | - | - | - | - |
| Lesser Scaup | - | - | 6 | - | - | 3 | - | 4 |
| Red br. Merganser | - | 10 | 75 | 25 | 75 | 91 | 121 | 26 |
| Ruddy Duck | 40 | 35 | 27 | 35 | 26 | 35 | 31 | 20 |
| Sora Rail | 3 | 5 | 8 | 3 | 2 | 2 | 2 | 3 |
| American Coot | 10 | 30 | 20 | 5 | 8 | 12 | 18 | 12 |
| Common Snipe | - | - | - | 1 | - | - | - | 1 |
| Bonaparte's Gull | 800 | 700 | 600 | 80 | 360 | 250 | 200 | 50 |
| Mew Gull | - | - | - | - | - | - | - | 1 |
| Ring-billed Gull | 35 | 150 | 60 | 10 | 16 | 40 | 65 | 21 |
| California Gull | - | - | - | - | 3 | - | - | - |
| Caspian Tern | - | - | - | - | - | - | - | 1 |
| totals; indiv. | 1001 | 970 | 845 | 232 | 557 | 508 | 495 | 243 |
| minus gulls | 166 | 120 | 185 | 142 | 178 | 218 | 230 | 171 |
| total species | 20 | 14 | 14 | 15 | 16 | 16 | 17 | 25 |

Table 6-24 (cont.). Winter Bird Observations between 19th Street and Victoria

Part B. Land Birds

| species | dates. 12-16 | 1-22 | 1-27 | 2-18 | 2-24 | 2-25 | 2-26 | 3-16 |
|---|---|---|---|---|---|---|---|---|
| Turkey Vulture | - | - | 1 | 1 | 1 | - | - | - |
| Black-sh. Kite | 1 | - | - | - | 1 | 1 | - | 1 |
| Cooper's Hawk | 1 | 1 | - | - | - | - | - | 1 |
| Red-shouldered Hawk | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Red-tailed Hawk | 1 | 2 | 2 | - | 1 | 1 | - | 1 |
| Northern Harrier | - | - | - | - | - | - | - | 1 |
| American Kestrel | 1 | 1 | 7 | 2 | 3 | 2 | 1 | 2 |
| Mourning Dove | - | - | - | 2 | - | 2 | 2 | 2 |
| Anna's Hummingbird | 6 | 10 | 3 | 4 | 3 | 7 | 2 | 5 |
| Allen's Hummingbird | 2 | 1 | - | 2 | 1 | 3 | 1 | 1 |
| Belted Kingfisher | 1 | 1 | - | - | - | - | - | - |
| Northern Flicker | 1 | - | - | 1 | 3 | 6 | 4 | 4 |
| Black Phoebe | 2 | 5 | 2 | 2 | 2 | - | 1 | 1 |
| Say's Phoebe | 1 | - | 1 | - | 1 | 1 | - | - |
| Cliff Swallow | - | - | - | - | - | - | - | 2 |
| Barn Swallow | - | - | - | - | - | - | - | 1 |
| Rough-winged Swallow | - | - | - | 2 | 11 | 18 | 5 | 2 |
| Tree Swallow | - | - | - | 3 | - | - | - | - |
| Common Crow | - | - | - | 2 | 1 | - | - | 8 |
| Common Bushtit | 2 | 37 | 2 | 23 | 28 | 21 | 14 | 25 |
| Bewick's Wren | 1 | - | - | - | - | - | - | - |
| Marsh Wren | 3 | 2 | - | - | 1 | - | - | 2 |
| Northern Mockingbird | - | - | - | - | - | - | - | 1 |
| Hermit Thrush | 6 | 3 | 1 | 2 | 1 | 1 | 2 | - |
| American Robin | - | - | - | 1 | - | - | - | - |
| Ruby-cr. Kinglet | 7 | 5 | 4 | 9 | 9 | 8 | 6 | - |
| Blue-gr. Gnatcatcher | 5 | 1 | - | 2 | 1 | 2 | - | - |
| Water Pipit | 4 | - | - | - | 1 | - | - | - |
| European Starling | - | - | - | - | - | - | - | 2 |
| Loggerhead Shrike | 5 | 1 | 1 | 2 | 2 | - | - | - |
| Orange-cr. Warbler | 1 | 1 | - | 12 | 2 | 6 | 1 | 1 |
| Bl. th.-green Warbler | - | - | - | 1 | - | - | - | - |
| Townsend's Warbler | - | - | - | 2 | 2 | 1 | - | - |
| Yellow-rmp. Warbler | 17 | 55 | 25 | 52 | 67 | 42 | 27 | 34 |
| N. Yellowthroat | 1 | 3 | - | 6 | 5 | 6 | 6 | 7 |
| Rose-br. Grosbeak | 1 | - | - | 1 | - | - | - | - |
| Song Sparrow | 40 | 101 | 17 | 26 | 31 | 51 | 31 | 38 |
| Lincoln's Sparrow | 1 | - | 5 | 1 | - | - | - | 2 |
| Golden-cr. Sparrow | 1 | 19 | - | - | - | - | - | 7 |
| White-cr. Sparrow | 205 | 103 | 21 | 22 | 18 | 22 | 12 | 7 |
| Rufous-s. Towhee | 1 | - | - | - | - | - | - | - |
| Brown Towhee | 1 | - | - | - | - | - | 1 | - |
| Northern Oriole | 1 | - | - | - | 1 | - | - | 1 |
| Red-w. Blackbird | - | - | 3 | 26 | 21 | 16 | 32 | 6 |
| Western Meadowlark | - | 5 | - | 13 | 35 | 5 | - | 20 |

Table 6-24 (cont.). Winter Bird Observations between 19th Street and Victoria

Part B. Land Birds

| | dates. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| species | 12-16 | 1-22 | 1-27 | 2-18 | 2-24 | 2-25 | 2-26 | 3-16 |
| American Goldfinch | - | 2 | 16 | 6 | 34 | 25 | 28 | 20 |
| Lesser Goldfinch | - | 10 | - | 20 | 10 | 14 | 1 | 2 |
| Purple Finch | - | - | - | 15 | 5 | 1 | - | - |
| House Finch | 100 | 13 | 37 | 30 | 5 | 72 | 21 | 10 |
| Total, indiv. | 421 | 383 | 149 | 294 | 308 | 335 | 199 | 218 |
| species | 31 | 24 | 18 | 32 | 32 | 26 | 21 | 32 |
| Totals; all birds | | | | | | | | |
| individuals | 1422 | 1353 | 994 | 526 | 865 | 843 | 694 | 451 |
| species | 51 | 38 | 32 | 47 | 48 | 42 | 38 | 57 |

Table 6-25. Spring Bird Observations between 19th Street and Victoria

| species | dates 3-23 | 4-14 | 5-2 | 5-22 | 6-5 | 6-21 |
|---|---|---|---|---|---|---|
| Pied-billed Grebe | 3 | 3 | 6 | 7 | 2 | 6 |
| Western Grebe | 2 | 1 | 1 | - | - | 1 |
| Double-crested Cormorant | 17 | 11 | 3 | 2 | - | - |
| American Bittern | 1 | - | - | - | - | - |
| Least Bittern | - | - | - | - | 1 | 2(2)* |
| Great Blue Heron | - | 1 | - | 2 | - | - |
| Great Egret | - | - | - | - | 1 | 1 |
| Snowy Egret | - | - | - | - | 1 | 2 |
| Little Blue Heron | - | - | - | - | - | 1 |
| Green-backed Heron | 1 | 1 | - | 1 | - | 3 |
| Black-crowned Night Heron | 4 | 3 | 6 | 2 | 12 | 8 |
| White-faced Ibis | - | - | 1 | - | - | - |
| Domestic Ducks | 8 | 6 | 1 | - | - | - |
| Cinnamon Teal | 8 | 2 | 12 | - | 4 | - |
| Mallard | 5 | 2 | 2 | 2 | 8 | 8(12) |
| Northern Pintail | - | - | - | 2 | 2 | - |
| Northern Shoveller | 6 | - | - | - | - | - |
| Lesser Scaup | 4 | - | - | - | - | - |
| Red-breasted Merganser | 10 | - | - | - | - | - |
| Ruddy Duck | - | 10 | - | 1 | 3 | 2 |
| Sora | 4 | 4 | 4 | - | - | - |
| Common Gallinule | - | 1 | - | - | - | - |
| American Coot | 8 | 11 | 11 | 12 | 12 | 15 |
| Black-necked Stilt | - | - | 7 | 10 | 21 | 18 |
| American Avocet | - | - | - | 2 | - | 5 |
| Killdeer | - | 1 | - | 1 | 1 | 5 |
| Marbled Godwit | - | - | - | 1 | - | - |
| Bonaparte's Gull | 250 | 10 | - | 3 | - | - |
| Ring-billed Gull | 35 | 40 | - | 7 | 10 | 31 |
| California Gull | - | - | - | - | 18 | - |
| Western Gull | - | - | - | - | - | 8 |
| Caspian Tern | - | - | - | - | - | 2 |
| California Least Tern | - | - | - | 5 | 8 | 4 |
| Turkey Vulture | - | - | - | - | 1 | - |
| Black-shouldered Kite | - | - | 2 | 2 | 2(1) | 2 |
| Cooper's Hawk | 1 | - | - | - | - | - |
| Red-shouldered Hawk | 1 | 2 | - | 1 | 1 | 1 |
| American Kestrel | 1 | 1 | 1 | - | 1 | 1 |
| Mourning Dove | 4 | 6 | 8 | 9 | 8 | 17 |
| Chinese Spotted Dove | 1 | 2 | 3 | - | - | - |
| Barn Owl | - | - | 1 | 1 | - | 1 |
| Vaux's Swift | - | - | 14 | - | - | - |
| Black-chinned Hummingbird | - | 2 | - | - | 1 | 5 |
| Anna's Hummingbird | 7 | 4 | 8 | 8 | 5 | 4 |
| Allen's Hummingbird | 2 | 4 | 6 | 5 | 3 | 5 |
| Belted Kingfisher | - | 1 | - | - | 1 | - |

Table 6-25(cont.). Spring Bird Observations between 19th Street and Victoria

| species | dates 3-23 | 4-14 | 5-2 | 5-22 | 6-5 | 6-21 |
|---|---|---|---|---|---|---|
| Northern Flicker | 2 | - | - | - | - | - |
| Black Phoebe | - | - | - | 1 | - | 2 |
| Western Wood Pewee | - | - | - | 1 | - | - |
| Hammond's Flycatcher | - | 1 | 1 | 1 | - | - |
| Western Flycatcher | - | - | - | 3 | - | - |
| Ash-throated Flycatcher | - | 1 | - | - | - | - |
| Rough-winged Swallow | 1 | 7 | 4 | - | - | - |
| Cliff Swallow | - | 2 | 11 | 23 | 30 | 16 |
| Barn Swallow | 2 | - | - | 2 | - | 2 |
| Northern Raven | - | 1 | 1 | - | - | - |
| Common Crow | - | - | 1 | 30 | - | 4 |
| Common Bushtit | 20 | 23 | 8 | 12 | 16 | 29 |
| Marsh Wren | - | 1 | - | - | - | 1 |
| Northern Mockingbird | - | - | 3 | - | - | 2 |
| Hermit Thrush | 4 | 2 | - | - | - | - |
| Ruby-crowned Kinglet | 2 | 1 | - | - | - | - |
| Blue-grey Gnatcatcher | - | 1 | - | - | - | 1 |
| Water Pipit | 1 | - | - | - | - | - |
| Cedar Waxwing | - | 2 | - | - | - | - |
| Loggerhead Shrike | - | - | 1 | 1 | 1 | 2 |
| Warbling Vireo | - | 1 | 1 | 3 | - | - |
| Orange-crowned Warbler | 9 | 11 | 2 | 2 | - | - |
| Nashville Warbler | - | 1 | - | - | - | - |
| Yellow Warbler | - | 1 | - | - | - | 1 |
| Yellow-rumped Warbler | 34 | 7 | - | - | - | - |
| Black-throated Grey Warbler | - | 1 | - | - | - | - |
| Townsend's Warbler | - | 1 | 1 | - | - | - |
| Common Yellowthroat | 2 | 6 | 8 | 12 | 12 | 14 |
| Wilson's Warbler | 1 | 1 | 4 | - | - | - |
| Western Tanager | - | - | 2 | - | - | - |
| Black-headed Grosbeak | - | 3 | 8 | 17 | 4 | 4 |
| Blue Grosbeak | - | - | - | - | 1 | - |
| Song Sparrow | 52 | 16 | 28 | 22 | 8 | 10 |
| Golden-crowned Sparrow | 1 | 2 | - | - | - | - |
| Black-chinned Sparrow | - | - | - | - | 1 | - |
| Brown Towhee | - | - | 2 | - | - | - |
| Northern Oriole | - | 3 | 1 | 3 | - | 1 |
| Red-winged Blackbird | 2 | 16 | 34 | 20 | 15 | 6 |
| Western Meadowlark | - | - | - | 1 | - | - |
| Brown-headed Cowbird | 16 | 17 | 6 | 2 | - | 2 |
| American Goldfinch | 27 | 29 | 16 | 27 | 31 | 98 |
| House Finch | 11 | 22 | 10 | 65 | 140 | 26 |
| Starling | - | 3 | 2 | 11 | - | - |
| TOTALS; individuals: | 568 | 329 | 252 | 345 | 391(1) | 377(14) |
| species: | 39 | 53 | 42 | 41 | 35 | 42 |

* numbers in parentheses are young birds

Table 6-26. Summer Bird Observations between 19th Street and Victoria St.

| species | dates 7-10 | 7-20 | 8-9 | 8-24 |
|---|---|---|---|---|
| Pied-billed Grebe | 5(3)* | (2) | 1 | 3 |
| Eared Grebe | 1 | - | - | - |
| Great Blue Heron | - | - | 1 | 1 |
| Great Egret | 28 | 4 | 1 | - |
| Snowy Egret | 3 | - | - | - |
| Green-backed Heron | - | - | - | 1 |
| Black-crowned Night Heron | 16 | 11 | 3 | 4 |
| White-faced Ibis | - | - | 1 | - |
| American Wigeon | 1 | 1 | - | - |
| Mallard | - | 6 | 17 | 3 |
| Ruddy Duck | 1 | - | - | - |
| American Coot | 7(2) | 16(3) | 8 | 4 |
| Black-necked Stilt | 16(3) | 42 | 13 | - |
| American Avocet | 5 | 3 | - | 1 |
| Killdeer | - | - | 3 | 2 |
| Spotted Sandpiper | - | - | - | 1 |
| Greater Yellowlegs | 7 | - | - | - |
| Willet | - | - | - | 1 |
| Least Sandpiper | 30 | - | - | - |
| Short-billed Dowitcher | 35 | 45 | - | - |
| Ring-billed Gull | 30 | 25 | 3 | - |
| California Gull | 30 | 35 | - | - |
| Western Gull | 4 | 4 | - | - |
| Caspian Tern | - | 1 | 1 | - |
| California Least Tern | 2 | - | - | - |
| Osprey | - | - | 1 | - |
| Black-shouldered Kite | 1 | 1 | 2 | 1 |
| Red-shouldered Hawk | - | 1 | 2 | 2 |
| American Kestrel | - | - | 1 | - |
| Mourning Dove | - | 8 | 4 | 4 |
| Spotted Dove | 1 | 4 | - | 4 |
| Barn Owl | 1 | - | 1 | 1 |
| Anna's Hummingbird | 13 | 14 | 12 | 15 |
| Allen's Hummingbird | 4 | 1 | - | 1 |
| Rufous Hummingbird | 2 | - | - | - |
| Black Phoebe | 4 | 1 | 1 | 1 |
| Barn Swallow | - | - | - | 8 |
| Cliff Swallow | 3 | 6 | 5 | 2 |
| Common Crow | - | - | 1 | 1 |
| Common Bushtit | 18 | 18 | 5 | 35 |
| Northern Mockingbird | 2 | 2 | - | 2 |
| Loggerhead Shrike | 2 | 1 | 1 | 1 |
| Orange-crowned Warbler | 2 | - | - | - |
| Common Yellowthroat | 8 | 2 | - | 4 |
| Blue Grosbeak | 1 | - | - | - |
| Black-headed Grosbeak | 5 | 1 | - | - |

Table 6-26 (cont.). Summer Bird Observations between 19th and Victoria Sts.

| species | dates 7-10 | 7-20 | 8-9 | 8-24 |
|---|---|---|---|---|
| Song Sparrow | 54 | 26 | 39 | 32 |
| Northern Oriole | 1 | 2 | - | - |
| Red-winged Blackbird | 4 | 5 | 4 | - |
| Brown-headed Cowbird | - | 6 | - | - |
| American Goldfinch | 44 | 22 | 3 | 6 |
| Lesser Goldfinch | - | - | - | 6 |
| House Finch | 123 | 32 | 30 | 53 |
| TOTALS individuals: | 515(8) | 346(2) | 164 | 200 |
| species: | 38 | 32 | 27 | 29 |

* numbers in parentheses are young birds

dove, bushtit, Anna's hummingbird, American goldfinch. Many migrants were observed in the area and returning black-headed grossbeak, northern oriole, and black-chinned hummingbird also showed signs of nesting. Brown-headed cowbirds were present and parasitized nests of other species. An old nest of a red-shouldered hawk was found in the willows, but was not used in 1984. The red-shouldered hawks that were present in the area throughout this study apparently did not nest. A few Allen's hummingbirds nested in isolated bushes near Victoria Pond and along the northeast edge of this area.

The ruderal fields in this sector, like those in the oilfield, supported a variety of seed-eating birds and raptors, and were hawked over by swallows. Song sparrow and yellowthroat nested widely in this section.

It is well known that vagrant eastern species of birds often winter in dense stands of riparian vegetation along the California coast and such areas are, therefore, often visited by birders. The "willows" of this section are such an area and, for this reason, have been regularly visited by the local birding community. The threat posed to these willows by the proposed extension of 19th Street across the Santa Ana River Channel led to regular censusing of this section and both breeding and wintering bird censuses for this area have been published (Allan, 1982; Hays, 1983a,b). Also, a seven-year bird list for sightings in this area has been compiled. These lists are presented in Appendix C. The only birds on these lists not seen during this study were a few rare winter visitors and migrants.

Of interest in the censuses for the willow area is the complete lack of resident woodpeckers. This absence and the resultant lack of nest holes for other species probably accounts for the near absence of such species as Bewick's wren, house wren, and plain titmouse from the area.

## North of Victoria Street

Seasonal census data for this study area are presented in Tables 6-27, 28, and 29. The area north of Victoria Street, except for a few willows along the ditch at the base of the bluff on the east side of the section, is all ruderal field. The birds listed for this area are therefore, much like those from the ruderal fields in the oilfield and the area south of Victoria Street. Wintering birds included large flocks of seed-eating species: house finch, sparrows and mourning dove; several insect feeders such as phoebes and yellow-rumped warbler; and raptors. A few migrants visited the area in spring and many hummingbirds came into the area, attracted by blooming tobacco plant (Nicotiana glauca). Raptors were regular users of the area. Barn owls were seen flying over the area in early morning and, when perched in the field, would often be surrounded by black-shouldered kites and kestrels. Breeding birds included song sparrow, shrike and several species of hummingbirds. Several species, including northern oriole, mockingbird, spotted dove, and house finch regularly used the area, but nested in suburban vegetation at the top of the nearby bluffs. The black-shouldered kite and kestrel that are resident in the area also nested off the site.

Table 6-27. Winter Bird Observations north of Victoria

| species | 12-16 | 1-27 | 2-26 | 3-16 dates. |
|---|---|---|---|---|
| Turkey Vulture | - | - | 5 | - |
| Black-sh. Kite | 1 | 1 | - | - |
| Red-tailed Hawk | 1 | 1 | 1 | 2 |
| American Kestrel | 2 | 2 | - | 1 |
| Mourning Dove | 2 | - | - | - |
| Northern Flicker | 1 | - | - | 1 |
| Black Phoebe | 3 | - | 1 | - |
| Say's Phoebe | 1 | - | - | - |
| Common Bushtit | - | - | - | 8 |
| Ruby-cr. Kinglet | 1 | - | - | - |
| Loggerhead Shrike | 1 | 2 | 3 | 1 |
| Orange-cr. Warbler | 1 | - | - | - |
| Yellow-rump. Warbler | 11 | 8 | 6 | 2 |
| Song Sparrow | 15 | 20 | 22 | 14 |
| Lincoln's Sparrow | - | - | - | 6 |
| Golden-cr. Sparrow | 1 | - | - | 3 |
| White-cr. Sparrow | 120 | 40 | 50 | 15 |
| American Goldfinch | 1 | - | - | - |
| Lesser Goldfinch | - | - | - | 2 |
| House Finch | 830 | 30 | 16 | 8 |
| Total, indiv. | 992 | 104 | 104 | 63 |
| species | 16 | 8 | 8 | 12 |

Table 6-28. Spring Bird Observations north of Victoria

| species | dates 3-23 | 4-14 | 5-2 | 5-22 | 6-5 | 6-21 |
|---|---|---|---|---|---|---|
| Black-shouldered Kite | - | - | 1 | 5 | 1 | 2 |
| Northern Harrier | - | - | - | 1 | - | 1 |
| Cooper's Hawk | - | - | - | 1 | - | - |
| Sharp-shinned Hawk | 1 | - | - | - | - | - |
| Red-tailed Hawk | 1 | 1 | - | - | 1 | 1 |
| American Kestrel | - | 1 | 1 | 2 | 3 | 3(3) |
| Mourning Dove | 1 | 8 | 10 | 8 | 8 | 11 |
| Chinese Spotted Dove | - | 1 | 2 | - | 2 | 3 |
| Barn Owl | - | - | - | - | - | 1 |
| Anna's Hummingbird | 6 | 3 | 2 | 9 | 2 | 4 |
| Allen's Hummingbird | - | - | - | - | - | 1 |
| Black Phoebe | 1 | - | - | - | - | - |
| Western Wood Pewee | - | - | - | 1 | - | - |
| Hammond's Flycatcher | - | - | - | 1 | - | - |
| Ash-throated Flycatcher | - | 2 | 2 | - | - | - |
| Western Kingbird | - | 1 | 5 | 1 | - | 1 |
| Northern Raven | - | 1 | - | 1 | - | 2 |
| Common Crow | - | 1 | - | 3 | - | 2 |
| Common Bushtit | 4 | - | - | - | - | - |
| Northern Mockingbird | 2 | 5 | 5 | 4 | 3 | 6 |
| Water Pipit | - | 4 | - | - | - | - |
| Loggerhead Shrike | 1 | 2 | 1 | 2(1) | 3(4) | 2 |
| Warbling Vireo | - | - | 1 | - | - | - |
| Orange-crowned Warbler | 2 | - | - | - | - | - |
| Yellow-rumped Warbler | 1 | - | 2 | - | - | - |
| MacGillivray's Warbler | - | 1 | - | - | - | - |
| Common Yellowthroat | 5 | 2 | 6 | - | 2 | - |
| Black-headed Grosbeak | - | 2 | 1 | - | - | - |
| Western Tanager | - | - | 1 | - | - | - |
| Song Sparrow | 39 | 69 | 28 | 32 | 3 | 8 |
| Lincoln's Sparrow | 4 | - | - | - | - | - |
| White-crowned Sparrow | 6 | 2 | - | - | - | - |
| White-throated Sparrow | 1 | - | - | - | - | - |
| Chipping Sparrow | - | 6 | 1 | - | - | - |
| Savannah Sparrow | - | 3 | - | - | - | - |
| Brown Towhee | - | 3 | 2 | 1 | - | - |
| Northern Oriole | - | 4 | - | 5 | 1 | 1 |
| Red-winged Blackbird | - | 1 | - | - | - | 32 |
| Western Meadowlark | 45 | 4 | 6 | 1 | - | - |
| Brown-headed Cowbird | - | 5 | 5 | 2 | - | - |
| American Goldfinch | 6 | 2 | - | 10 | - | 4 |
| House Finch | 16 | 3 | 11 | 71 | 40 | 95 |
| Starling | - | 24 | 32 | 80 | 11 | 3 |
| TOTALS; individuals: | 142 | 178 | 125 | 242(1) | 79(1) | 183(3) |
| species: | 18 | 27 | 21 | 21 | 13 | 20 |

* numbers in parenthesis are young birds

Table 6-29. Summer Bird Observations north of Victoria St.

| species | dates 7-10 | 7-20 | 8-9 | 8-24 |
|---|---|---|---|---|
| Black-shouldered Kite | 6(7)* | 3(3) | 7 | 3 |
| Cooper's Hawk | - | - | 1 | 1 |
| American Kestrel | 6 | 3 | 4 | 3 |
| Mourning Dove | 17 | 50 | 130 | 110 |
| Spotted Dove | 2 | - | - | 6 |
| Barn Owl | 1 | 2 | 2 | - |
| Anna's Hummingbird | 2 | 12 | 4 | 12 |
| Allen's Hummingbird | 3 | 3 | - | - |
| Rufous Hummingbird | 3 | - | - | - |
| Costa's Hummingbird | 2 | 2 | 1 | - |
| Black-chinned Hummingbird | - | - | 1 | - |
| Western Kingbird | 1 | - | - | - |
| Black Phoebe | - | 1 | 1 | - |
| Ash-throated Flycatcher | - | - | 1 | 2 |
| Common Raven | 1 | - | - | - |
| Common Crow | - | 3 | - | 1 |
| Common Bushtit | 8 | 15 | - | - |
| Northern Mockingbird | 9 | 8 | 4 | 7 |
| Loggerhead Shrike | 5 | 2 | 4 | 5 |
| Common Yellowthroat | - | - | 1 | 2 |
| Blue Grosbeak | - | 1 | - | - |
| Song Sparrow | 15 | 23 | 43 | 36 |
| Northern Oriole | 3 | - | - | - |
| Western Meadowlark | - | - | - | 1 |
| Red-winged Blackbird | 30 | - | - | 150 |
| Brewer's Blackbird | - | - | - | 200 |
| Lesser Goldfinch | - | 1 | - | - |
| House Finch | 40 | 43 | 55 | 92 |
| European Starling | 3 | 3 | - | - |
| TOTAL individuals: | 157(7) | 175(3) | 259 | 631 |
| species: | 19 | 17 | 15 | 16 |

* numbers in parentheses are young birds

## The Ocean Beach

Seasonal census data for this study area are presented in Tables 6-30, 31, and 32. Because of heavy use of the ocean beach by surfers and bathers, few birds were seen in this area. Those that were present usually were either in areas that afforded some protection from disturbance, such as the concrete wall between the Santa Ana River and Greenville-Banning Channels, the fenced area set aside for the California least tern breeding colony, or were present in the early morning before people arrived. Least terns were present from May through the beginning of August. Crows, kestrel and western gull were observed on several occasions in the least tern nesting area and probably prey on young terns and eggs. Only the least tern and rock dove nested in this area, the latter under the Pacific Coast Highway Bridge.

## Avian Diversity

Several species reported from the Santa Ana River study site in earlier studies (Massey, 1980; Hays, 1984) were not found during this study. For the most part these are rare migrants or vagrant species and their absence during this study is not surprising. The absence of several "expected" species from the study area is of greater significance. As in the case of both reptiles and mammals, several coastal sage species were absent from the site. These include quail, thrasher, wrentit, and roadrunner. Their absence can be attributed to the small extent of the coastal sage habitat, its isolation from other such areas, and the high level of site disturbance.

Woodpeckers are notably absent from the riparian habitat. Their absence in turn is responsible for the absence of wrens and titmouse -- species which nest in old woodpecker holes.

The coastal salt marsh habitat, as noted elsewhere, presently lacks previously recorded marsh species -- including clapper rails and Belding's savannah sparrow.

## Avian Population Densities

It is extremely hard to compare an area such as the Santa Ana River Marsh and lowlands study site with other coastal sites in terms of the "expected" density of birds. No two coastal areas are exactly alike in terms of vegetation and the Santa Ana River site is unique in its small size but relatively rich habitat diversity. Acknowledging these problems, a few comments can still be made however.

It was surprising to find so many birds in the Santa Ana River Flood Control Channel. This is rather poor habitat for feeding and nesting. The numbers of species and individuals observed suggests that undisturbed places to rest along the shore are at a premium and that this area may serve an important role of providing a safe resting area for aquatic birds.

The coastal salt marsh area had a very low population of birds compared with other coastal marshes in southern California. This is attributed to reduced tidal flow, and the steep banks of the tidal channels. Both factors result in

Table 6-30. Winter Bird Observations along the beach.

| species | 12-16 | 1-22 | 2-24 | 3-16 |
|---|---|---|---|---|
| | | | | dates. |
| Black-bel. Plover | - | 1 | - | - |
| Willet | 3 | 16 | 11 | 15 |
| Marbled Godwit | - | 3 | - | 20 |
| Sanderling | 8 | 10 | 21 | 6 |
| Bonaparte's Gull | 1 | - | - | - |
| Heerman's Gull | 1 | - | - | - |
| Ring-billed Gull | 70 | 120 | 30 | 67 |
| Herring Gull | - | 2 | - | - |
| Western Gull | 40 | 23 | 31 | 15 |
| total, indiv. | 123 | 175 | 93 | 123 |
| species | 6 | 7 | 4 | 5 |

Table 6-31. Spring Bird Observations along the Beach.

| species | dates 3-23 | 4-14 | 5-2 | 5-22 | 6-5 | 6-21 |
|---|---|---|---|---|---|---|
| Willet | 6 | - | - | - | - | - |
| Whimbrel | - | 2 | 1 | - | - | - |
| Marbled Godwit | 4 | - | - | - | - | - |
| Ruddy Turnstone | - | - | 4 | - | - | - |
| Black Turnstone | - | 6 | - | - | - | - |
| Surfbird | - | 5 | - | - | - | - |
| Sanderling | 10 | - | 1 | 3 | - | - |
| Heerman's Gull | - | 1 | - | 1 | 1 | - |
| Ring-billed Gull | 6 | 6 | 30 | 25 | 19 | - |
| California Gull | - | 10 | 25 | 2 | - | - |
| Western Gull | 15 | 36 | 10 | 42 | 60 | 17 |
| Caspian Tern | - | - | 1 | 3 | 8 | - |
| Forster's Tern | - | - | 3 | 2 | - | - |
| California Least Tern | - | - | 30 | 42 | 45 | 45 |
| TOTALS; individuals: | 41 | 66 | 105 | 120 | 133 | 62 |
| species: | 5 | 7 | 9 | 8 | 5 | 2 |

Table 6-32. Summer Bird Observations along the Beach.

| species | dates 7-10 | 7-20 | 8-9 | 8-24 |
|---|---|---|---|---|
| Snowy Egret | - | - | 1 | - |
| Black-bellied Plover | 3 | - | - | - |
| Semipalmated Plover | 2 | - | - | - |
| Willet | 1 | 35 | 25 | 10 |
| Marbled Godwit | - | 28 | 40 | 8 |
| Whimbrel | - | 3 | 1 | 2 |
| Sanderling | - | - | 35 | 35 |
| Heerman's Gull | 16 | 22 | 55 | 4 |
| Ring-billed Gull | - | 21 | 5 | 25 |
| California Gull | - | - | 55 | 4 |
| Western Gull | 30 | 53 | 280 | 30 |
| California Least Tern | 8 | 18 | - | - |
| American Kestrel | - | 1 | - | - |
| Rock Dove | - | - | 16 | 32 |
| Common Crow | 3 | 4 | - | 2 |
| House Finch | - | 2 | 25 | - |
| TOTALS individuals: | 63 | 187 | 538 | 152 |
| species: | 7 | 10 | 11 | 10 |

minimal exposure of intertidal mudflats, allowing little feeding opportunity for shorebirds. Both factors also result in a "drier" marsh than is usual, resulting in few marsh birds.

Bird densities in other study site habitat types were about as expected, or higher than expected, despite their low species diversity (see below). This was due to a few species -- particularly those that do well in suburban habitats, such as finch, mourning dove, and crow -- being very abundant.

## Breeding Birds

Information on breeding birds in the Santa Ana River Marsh and adjacent lowlands has been presented in the habitat descriptions. A summary of this information appears in Table 6-33. Some additional general comments are presented below:

### Aquatic Birds

The numbers of water birds that nested successfully in 1984 is considered low in both freshwater and salt water areas. Pairing of several freshwater species, including cinnamon teal, ruddy duck, and gadwall occurred on oilfield ponds in early spring, but by mid-April the ponds had dried up and these species left the area. In a wetter year these ponds would provide nesting sites for additional individuals and species. The continued presence of non-breeding populations of mallards and stilts throughout the period may represent individuals that normally nest in the area during wetter years, but were unable to do so during 1984.

In salt marsh areas such as Bolsa Chica lowlands, coot and rails are frequently seen nesting along the banks of salt water channels. Their failure to do this at the Santa Ana River Marsh is attributable not to lack of nesting sites, but rather to lack of adequate food resources. The steep sides of the channels and restricted tidal fluctuation left little food available for these species.

### Terrestrial Birds

In the land areas of the Santa Ana River study site the number of breeding species seems low, compared with the use of the area as feeding grounds. Many species that regularly use the area -- including house finch, mockingbird, oriole, kestrel, and mourning dove -- nest in trees in adjacent suburban areas rather than in the study area. This is due not only to the small number of trees on the study site, but also to their frequent disturbance by humans. Species that favor wet or marshy areas such as yellowthroat, redwing blackbird, and marsh wren, were heard defending territory during early spring but disappeared in late April. It is felt that breeding by these species was lower than might be expected during 1984, probably due to the very dry winter.

Past breeding bird information for the Santa Ana study area is limited to a breeding bird survey for the area between 19th Street and Victoria Street (Hays, 1983b and Appendix C). Hays' study commenced April 17 and therefore missed two birds observed during the present study that nest early in the

Table 6-33. Breeding Birds in the Santa Ana Marsh and Adjacent Lowlands.

| Species | Census Areas* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| **Water Birds** | | | | | | | | |
| Pied-billed Grebe | - | - | - | - | - | 2 | - | - |
| Least Bittern | - | - | - | - | - | 1 | - | - |
| Mallard | - | - | - | - | - | 2 | - | - |
| American Coot | - | - | - | - | - | 2 | - | - |
| Sora | - | - | - | - | 2 | 2 | - | - |
| Killdeer | 20 | - | - | - | - | - | - | - |
| Black-necked Stilt | 1 | - | 3 | - | 1 | 1 | - | - |
| California Least Tern | - | - | - | - | - | - | - | 30 |
| **Land Birds** | | | | | | | | |
| Black-shouldered Kite | - | - | - | - | 1 | - | - | - |
| Rock Dove | - | 3 | - | - | - | - | - | 3 |
| Mourning Dove | - | - | - | 2 | - | 6 | 2 | - |
| Barn Owl | - | 1? | - | - | - | - | - | - |
| Burrowing Owl | - | - | - | 2 | - | - | - | - |
| Black-chinned Hummingbird | - | - | - | - | 1 | 2 | 1 | - |
| Anna's Hummingbird | - | - | 1 | 2 | 4 | 8 | 4 | - |
| Allen's Hummingbird | - | - | - | - | - | 3 | 1 | - |
| Belted Kingfisher | - | - | - | 1 | - | - | - | - |
| Cliff Swallow | - | 15 | - | - | - | - | - | - |
| Common Bushtit | - | - | - | - | 5 | 12 | - | - |
| Cactus Wren | - | - | - | 2 | - | - | - | - |
| Marsh Wren | - | - | 2 | - | - | 1 | - | - |
| Black-tailed Gnatcatcher | - | - | - | 3 | - | - | - | - |
| Loggerhead Shrike | - | - | - | - | 2 | - | 1 | - |
| Common Yellowthroat | - | 2 | - | - | 10 | 12 | 4 | - |
| Black-headed Grosbeak | - | - | - | - | - | 3 | - | - |
| Song Sparrow | - | 3 | 2 | 3 | 25 | 30 | 15 | - |
| Brown Towhee | - | - | - | 2 | - | - | - | - |
| Northern Oriole | - | - | - | - | - | 1 | - | - |
| Red-winged Blackbird | - | 15 | - | - | 15 | 10 | - | - |
| Brown-headed Cowbird | - | - | - | - | - | 2 | - | - |
| American Goldfinch | - | - | - | 3 | 6 | 20 | - | - |
| House Finch | - | - | - | - | 4 | 5 | - | - |
| Totals | 2 | 6 | 4 | 9 | 12 | 20 | 7 | 2 |

* 1. Santa Ana River Channel
2. Greenville - Banning Channel
3. Coastal Marsh
4. Bluffs and Canyons
5. Oilfield
6. 19th to Victoria Streets
7. North of Victoria
8. Beach

year: Anna's hummingbird and bushtit. The Hays study also found a nesting meadowlark and two pair of lesser goldfinch -- two species not observed breeding during our study.

## Feeding Relationships

To facilitate analysis of resource utilization, the Santa Ana avifauna was broadly divided into categories by feeding types (Table 6-34). The numbers presented in Table 6-34 must be interpreted with care, for they indicate only the presence of an individual or species and not whether it was feeding or resting. Furthermore, because of the duration of both the nesting season (December - July) and of migration (February - June, July - October) in southern California, the seasonal division cannot be used to indicate whether a bird was wintering, migrating, or summering in the study area. These points will be brought out in the following discussion.

### Aquatic Birds

Aquatic herbivores in the Santa Ana River Study area were observed mostly at Victoria Pond and in the seasonal freshwater ponds which occurred on the oilfield. Few herbivores were observed feeding in the coastal salt marsh and its remnant tidal channels, or in the two flood control channels. The latter channels lack aquatic vegetation due to scouring by floods; the former supports only limited aquatic vegetation, due to restricted tidal fluctuation and steepness of the channel banks. Absence of marine herbivores such as scooters and brant is due to this lack of suitable food sources. The only herbivores regularly seen in the marsh and remnant tidal channel area were mallards and coot. Both of these species are fed by residents bordering the south side of the tidal channel. Herbivorous species were most numerous during the winter; they left the area in the summer months when the fresh water ponds in which they fed dried up. During a wetter year, more species would probably be present later into the summer.

Most of the species feeding on small aquatic invertebrates are shorebirds. These birds appeared in the study area primarily as wintering or migratory species, but were present during all three census periods as "spring" and "fall" migrations occurred in part during the summer months. Most shorebirds, as indicated in the habitat descriptions, were seen in the Santa Ana River Channel where they spent most of their time resting rather than feeding. Species that probe in the mud for food were observed feeding least often. Some feeding was observed in the remnant tidal channels near the salt marsh area, but very little mudflat was exposed at any time and relatively few species were able to feed. The only shorebird species that were resident in the area feed either by "picking" (Stilts), or take terrestrial foods (killdeer).

Rails also feed on invertebrates, mostly picked from vegetation. The rails observed were all in freshwater pond areas and were most numerous in winter and early spring. They decreased in number in the late spring and summer when freshwater habitats dried up.

Gulls are primarily aquatic scavengers. Large numbers of gulls were present during all three census periods, but used the study area almost entirely for

Table 6-34. Avifaunal feeding in the Santa Ana Marsh and Adjacent areas.

| Feeding types | Numbers of Species and Maximum Number of Individuals by Season | | | | | |
|---|---|---|---|---|---|---|
| | Winter | | Spring | | Summer | |
| | sp. | ind. | sp. | ind. | sp. | ind. |
| **Aquatic Feeding Types** | | | | | | |
| Herbivores; ducks, geese, coot, moorhen | 16 | 293 | 8 | 93 | 4 | 45 |
| Carnivores - invertebrates; shorebirds, rails, ibis | 17 | 553 | 22 | 515 | 17 | 392 |
| Carnivores - vertebrates: loons, grebes, cormorant, pelican, merganser, osprey, kingfisher, terns, bitterns | 17 | 346 | 18 | 153 | 12 | 117 |
| Carnivores - pelagic inverts; Bonaparte's gull | 1 | 2801 | 1 | 950 | - | - |
| Omnivores - scavengers; gulls | 7 | 305 | 4 | 133 | 5 | 473 |
| **Terrestrial Feeding Types** | | | | | | |
| Carnivores - vertebrates; hawks, owls, shrike | 7 | 43 | 10 | 45 | 9 | 44 |
| Insectivorous - aerial feeders; swifts, swallows, yellowrump, warbler, flycatchers | 9 | 131 | 11 | 178 | 5 | 49 |
| Insectivorous - gleaners; wrens, warblers, vireos gnatcatcher, titmouse, kinglet, bushtit, grosbeak, oriole, tanagers | 12 | 133 | 18 | 117 | 8 | 64 |
| Omnivores; crow, mockingbird, flicker, thrushes, pipit | 8 | 98 | 8 | 178 | 4 | 27 |
| Herbivores - nectar; hummingbirds | 3 | 21 | 3 | 34 | 5 | 49 |
| Herbivores - primarily seeds; finches, sparrows, doves blackbirds, waxwing | 17 | 3792 | 22 | 746 | 14 | 872 |

resting rather than feeding. Note that this does not mean that the area was not valuable to the gulls -- or other resting species. Shorebirds and gulls need places to rest during migration and during non-feeding periods of the day. Places free of disturbance are rare along the ocean beach and it may be that the presence of secure places to rest or sleep is as important in the maintenance of some species' populations as are feeding areas and nesting sites.

Bonaparte's gull differs from other species of gulls in that it feeds on pelagic plankton. The presence of this species was due entirely to the existence of nearby settling ponds of the Orange County Sewage Treatment Facility where they fed. As with other gulls, Bonaparte's gull used the study area only for resting.

The aquatic birds listed here as feeding on vertebrates feed primarily on fish but occasionally, as in the case of herons, on mice and frogs. All members of this group actively fed in the area, although pelicans fed rather rarely. This can be attributed to the lack of larger fish on which pelicans normally feed. Most of the fishing species were non-breeding individuals. Only the California least tern and kingfisher nested in the area. Fishing species were more numerous in the winter censuses than during other seasons, but this primarily reflected the presence of a large flock of red-breasted mergansers that rested on Victoria Pond and were not feeding. The numbers of fish-eating birds actually feeding in the area remained rather constant during the year, with some decrease in numbers in June when herons and cormorants left the study area to nest elsewhere.

Terrestrial Birds

Carnivorous species, the owls, hawks and shrike, maintained a constant population size throughout the study period. All actively fed in the study area.

Aerial insectivores were represented by the yellow-rumped warbler during the winter and by a variety of migratory birds in the spring. Swallows hunted widely over the newly mowed ruderal fields in late spring, but most aerial insect feeders left the area during the warm summer months. Insect gleaners -- species that pick insects off vegetation -- were almost entirely represented by migratory species, except for the resident gnatcatcher and bushtit. Ground omnivores were present both as wintering species and as migrants. Most left the study area in summer when the ground was dry and surface food was unavailable. The few species that remained throughout the period (crow, mockingbird, starling) spent much time in summer months feeding outside the area in the nearby suburbs.

Hummingbird numbers, as would be expected, were lowest in the winter but increased in the summer with the blooming of tree tobacco and the arrival of summering species.

Seed eating species were extremely numerous in winter but remained common throughout the year. Although relatively few nested in the study area, several species such as house finch and morning dove nested in trees in nearby suburbs and continued to use the area for feeding during the summer months.

## Rare & Endangered Species

This Section summarizes information on rare and endangered species observed in the Santa Ana River Marsh and lowlands study area. No rare or endangered species of amphibians, reptiles or mammals were observed. The five endangered species of birds observed are as follows:

### Brown Pelican

The brown pelican is an occasional visitor to the area, mostly during winter months. Feeding was observed in Victoria Pond and in the Santa Ana River Channel. The numbers of pelicans observed were low. We believe that few fish in the study area are large enough to constitute an adequate food supply for this species.

### Clapper Rail

The coast subspecies of clapper rail was reported heard in the salt marsh in 1979 (Massey, 1980) but has not been reported from the area since. The restriction of tidal flow, very limited mudflat habitat, and lack of Spartina, all make the marsh a poor habitat for this species and its absence is to be expected.

### California Least Tern

An artificial enclosure for the protection of a nesting colony of California least terns is located on the ocean beach just west of the mouth of the Santa Ana River (Figure 2-3). Terns appeared in this enclosure in early May and were present until early August 1984. During this period a few individuals were observed diving in Victoria Pond and, rarely, in the remnant tidal channels of the coastal salt marsh area. Although about 60 birds were present in the nesting area, only four to six individuals were observed at any one time in other areas of the study site. Most terns apparently went out to sea to fish rather than into the study area.

### Peregrine Falcon

The peregrine falcon migrates along the southern California coast and feeds on shorebirds and ducks. Although listed as a winter visitor to Victoria Pond (Hays, 1984), the species can be considered only an occasional migrant through the study area.

### Belding's Savannah Sparrow

Belding's race of the savannah sparrow was observed in the marsh area by Massey (1980) during the winter but was not observed during the nesting season. In the present study no savannah sparrows of Belding's race were observed. Belding's savannah sparrows are abundant at the Bolsa Chica lowlands in habitat very similar to that found in the Santa Ana River Marsh. The reason for their absence from the Santa Ana marsh during 1984 is not known, but it may be due, not to a lack of food or nesting sites, but rather to high predation on nests from the abundant small rodent population.

### 6.2.3 MAMMALS

Prior to this study mammal data from Santa Ana River Marsh and lowlands was limited to a species list and some descriptive distributional notes included in Environmental Impacts Reports, Inc. (1974). Positively confirmed species -- based on sightings of either tracks or animals -- were listed separately from "possibly present" forms.

Friesen et al, in Schreiber (1981) provide an excellent literature review for each of the mammal species found at nearby Ballona Creek, which includes all species confirmed at the Santa Ana River site also. Several key points from their review are bulleted below:

- Moister coastal habitats at Ballona generally yield higher numbers of rodents than drier habitats (see data from Soholt and Jollie (1969), in Schreiber 1981; Table 6-35).

- The introduction of the house mouse (Mus musculus) generally results in a decline of native species such as the deer mouse (Peromyscus maniculatus), as has happened at Ballona Creek.

- Several mammls endemic to the Ballona region (Reithrodontomys megalotis limicola, Microtus californicus stephensi and Sorex ornatus salicornicus) are metabolically adapted to drinking seawater. All three species utilize halophytic plants as food (see Coulombe, 1970).

#### 6.2.3.1 Field Methods

The determination of local population sizes and densities for mammals remains a very difficult issue. Larger predatory species usually forage over broad areas, are nocturnal, are suspicious of traps, and can usually be censused only in terms of frequency of tracks or scat, or visits to scent posts. Intermediate size mammals, such as gophers and rabbits, can be trapped but are more frequently "sight censused" rather like birds. Only small mammal populations -- rats and mice -- are routinely subject to careful quantitative analysis through capture-recapture trapping studies. (See Thompson, [1977] for examples of approaches.)

A variety of techniques were used to survey the mammal fauna of the Santa Ana River Marsh and adjacent lowlands for this study. Direct visual daytime observations were make during regular monthly site visits from December, 1983, through August, 1984. Particular attention was also paid to indirect evidence of mammal use such as tracks, trackways, scats, incidental road kills, and other signs. Tracks were especially well preserved in the soft dirt along the Greenville-Banning Channel. Pit traps were established at several localities (Figure 6-2 and Section 6.2.1.1) but were infrequently used, for they often resulted in the death of the specimens captured.

The occurrence and population density of small mammal species were recorded from both trapping grids and traplines, using Sherman live traps (3" x 3" x 9") baited with peanut butter and bird seed. Trapping grips were set out June 5-8, 1984, in the coastal salt marsh (Figure 6-4, Site 1), ruderal fields just north of 19th Street (Site 2), and in remnant coastal sage of the canyon area

Table 6-35. Ballona Creek mammal trapping results: differences between wet and dry habitats (Soholt and Jullie, in Schreiber, 1981).

| AREA | FROM BALLONA CREEK TO SAND DUNES AT WEST END OF MARSH | BETWEEN BALLONA CREEK AND CULVER BOULEVARD | |
|---|---|---|---|
| | sandy and dry areas not subject to flooding | dry, high areas not subject to flooding | wet areas subject to flooding |
| Number of trap-nights | 176 | 168 | 188 |
| Number of Specimens Captured | 3 | 15 | 22 |
| | 3 *Mus musculus* | 5 *Mus musculus*<br>10 *Reithrodontomys megalotis* | 1 *Sorex ornatus*<br>11 *Mus musculus*<br>8 *Reithrodontomys megalotis*<br>2 *Microtis californicus* |

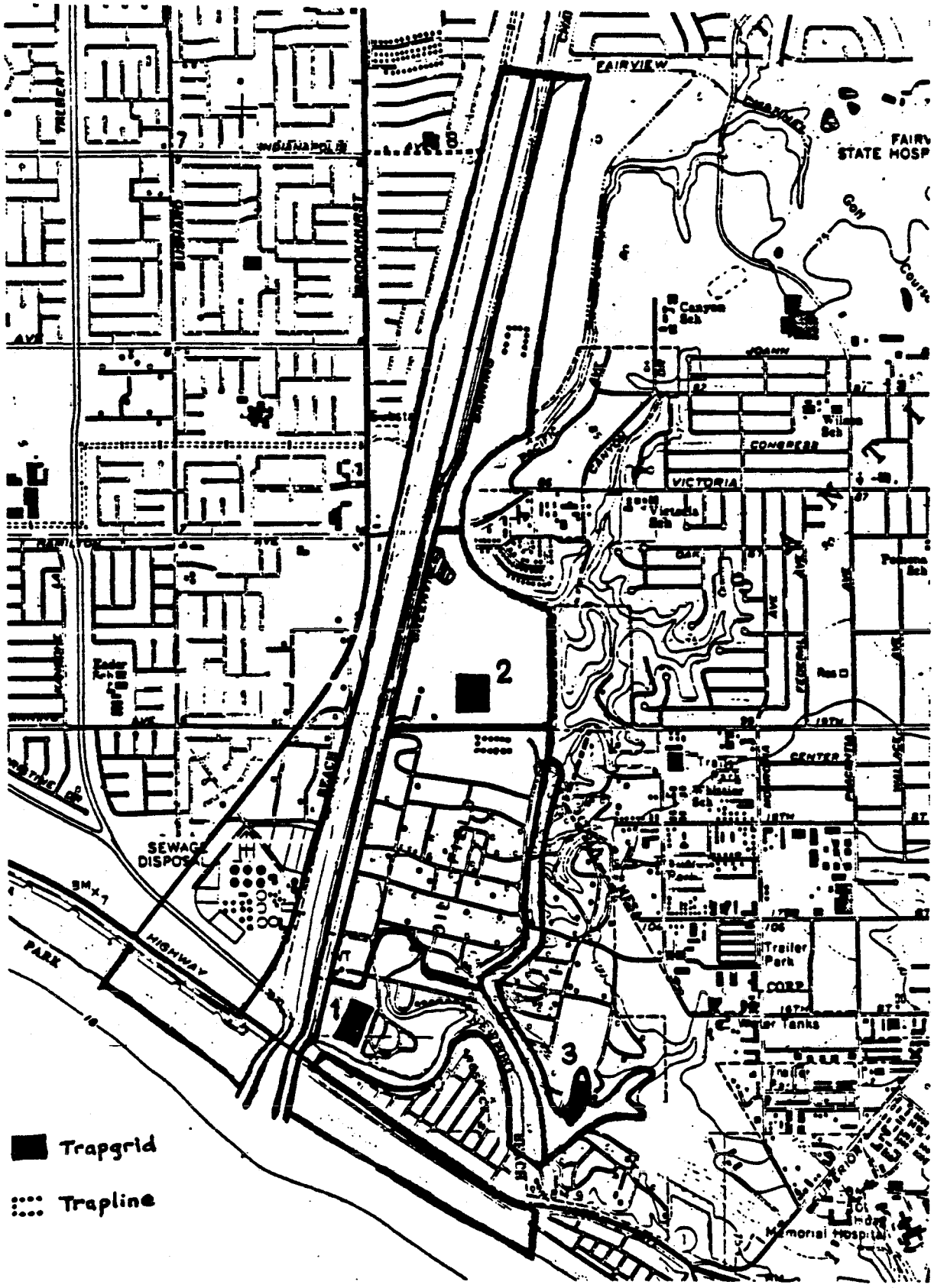



Figure 6-4. Location of small mammal trapping grids (June 5-8, 1984) and traplines (August 9-12, 1984).

at the southeast corner (Site 3) of the study site. Linear traplines were set out August 9-12, 1984 (Figure 6-4). These were located in the salt marsh, adjacent to the more northerly branch of the tidal channel; in riparian habitat just south of 19th Street; and in ruderal field habitat north of Victoria Street.

Finally, owl pellets of the American barn owl were collected from several locations on the study site and their contents examined. (One barn owl roosted regularly under Victoria Street Bridge.) Barn owls were regularly seen hunting over the ruderal grassy areas both north and south of Victoria Street and it is believed that all the faunal remains in the owl pellets came from these areas.

6.2.3.2 Results & Discussion

A list of all mammal species positively confirmed from the study area is presented in Table 6-36. For comparative purposes Table 6-36 also includes lists of mammals confirmed from generally similar habitats (admittedly in widely differing acreages) at Upper Newport Bay (Thompson, 1977), Bolsa Chica (Dillingham Corp., 1971), and Ballona Creek (Friesen et al., in Schreiber, 1981).

It is sufficient here to note that all four locations share broadly similar mammal faunas. Counting recent, positively confirmed species only (and excluding bats and domestic cats and dogs), the species richness at each site is as follows: Upper Newport Pay, 16 species; Bolsa Chica, 13 species; and both Ballona Creek and the Santa Ana River study site, 15 species each.

Results obtained from the June, 1984 small mammal trapping grids, along with data describing the grids, are presented in Table 6-37. Table 6-38 includes a summary of the linear trapline characteristics and their trapping results. Comparative data from substantially larger scale, longer term, small mammal trapping programs conducted at Upper Newport Bay, Bolsa Chica, and Ballona Creek are summarized in Table 6-39. Finally, Table 6-40 provides a listing of faunal remains identified from the barn owl pellets collected on the study site.

Brief comments on each of the mammal species confirmed from the Santa Ana River and lowlands study site are presented below. These are followed by discussions of mammalian faunal diversity, population densities, and food requirements/predator-prey relationships.

Species Commentaries

Common opossum

Opossum tracks were regularly found along the Greenville-Banning Channel, both north and south of Victoria Street. Dead opossums were observed on the Pacific Coast Highway near the oilfield entrance and at the end of 19th Street just east of the study area.

Ornate shrew

The only shrews recovered were two skulls from a barn owl pellet found beneath a pole north of Victoria Street. Shrews probably occur in low density throughout the study area.

Table 6-36. Confirmed species of Mammals from the Santa River Study Site and Similar Regional Habitats.

| Species | Locality | | | |
|---|---|---|---|---|
| | Upper Newport Bay[1] | Santa Ana | Bolsa Chica[2] | Ballona Creek[3] |
| Common opossum (Didelphis marsupialis) | X | X | X | X |
| Ornate shrew (Sorex ornatus) | | X | | X |
| Broad-handed mole (Scapanus latimanus) | | X | X | |
| Black-tailed hare (Lepus californicus) | X | X | X | X |
| Audubon cottontail (Sylvilagus audubonii) | X | X | X | X |
| Brush rabbit (Sylvilagus bachmani) | | | X | |
| California ground squirrel (Spermophilus beecheyi) | X | X | X | X |
| Botta's pocket gopher (Thomomys bottae) | X | X | X | X |
| Western harvest mouse (Reithrodontomys megalotis) | X | X | X | X |
| Deer mouse (Peromyscus maniculatus) | X | X | X | |
| California meadow vole (Microtus californicus) | X | X | X | X |
| Muskrat (Ondatra zibethica) | | | | X |
| Rat (Rattus sp.) | X | X | | X |
| House mouse (Mus musculus) | X | X | X | X |
| Coyote (Canis latrans) | X | X | | |
| Gray fox (Urocyon cinereoargenteus) | | | | X |
| Raccoon (Procyon lotor) | X | | | X |
| Long-tailed weasel (Mustela frenata) | | X | X | X |
| Spotted skunk (Spilogale putorius) | X | | | |
| Striped skunk (Mephitis mephitis) | X | X | X | X |
| Mule deer (Odocoileus hemionus) | X | | | |

[1]Thompson (1977); [2]Dillingham Corp (1971);
[3]Hayes and Guyer, in Schreiber (1981)

Table 6-37. Santa Ana Study Site, Small Mammal Trapping Grid Results (June 5-8, 1984).

| Trapping Grid Characteristics | Habitat | | |
|---|---|---|---|
| | Canyon Sage | Salt Marsh | Ruderal Fields |
| Number of traps: | 44 | 60 | 54 |
| Grid size: | 4 x 11 | 6 x 10 | 6 x 9 |
| Trap spacing: | 50' | 50' | 50' |
| Effective trapping area (acres): | 2.52 | 3.44 | 3.10 |
| Trap nights: | 132 | 180 | 162 |
| **Number of Individuals Trapped** | | | |
| California ground squirrel | - | 3 | - |
| Western harvest mouse | 3 | 7 | 13 |
| Deer mouse | 11 | - | 1 |
| California meadow vole | 1 | - | - |
| House mouse | - | - | 2 |
| Total individuals: | 15 | 10 | 16 |
| Overall capture rate: | 11.4% | 5.5% | 9.9% |

Table 6-38. Santa Ana Study Site, Small Mammal Linear Trapline Results (August 9-12, 1984).

| Location: | North of Victoria St. | Salt Marsh | South of 19th Street |
|---|---|---|---|
| Vegetation: | Ruderal Fields | Salt Marsh | Riparian |
| **Trapline Characteristics** | | | |
| Number of traps: | 40 | 28 | 40 |
| Trap spacing: | 50' | 40' | 50' |
| Trap nights: | 120 | 84 | 120 |
| **Number of Individuals Trapped** | | | |
| California ground squirrel | - | 2 | - |
| Western harvest mouse | 9 | 10 | 2 |
| Deer mouse | - | 4 | 5 |
| California meadow vole | - | 1 | - |
| Total Individuals | 9 | 17 | 7 |
| Overall Capture Rate | 7.5% | 20.2% | 5.8% |

Table 6-39. Small Mammal Trapping Results from Regional Coastal Wetlands Habitats (see Table 6-36 for reference sources).

| | Location | | |
|---|---|---|---|
| | Upper Newport Bay[1] | Bolsa Chica[3] | Ballona Creek[4] |
| Trapping period (month/year): | 8/77-11/77 | 7/70-10/70 | 7/80-5/81 |
| Total trap nights: | 1236 | 1239 | 2005 |
| Western harvest mouse | 4 | 23 | 66 |
| Deer mouse | 8 | 12 | - |
| Norway rat | - | - | 4 |
| House Mouse | 27 | 8 | 71 |
| Total Captures: | 56 | 45 | 144 |
| Overall Capture Rate: | 4.5% | 3.6% | 7.2% |

Table 6-40.Santa Ana Study Site, Faunal Remains from Barn Owl Pellets (April-August, 1984).

| Locality: | Victoria Street Bridge | | | | | | North of Victoria | |
|---|---|---|---|---|---|---|---|---|
| Date: | 4-14 | 5-2 | 5-22 | 7-10 | 7-20 | 8-8 | 7-10 | 8-8 |
| Number of pellets: | 24 | 5 | 12 | 4 | 6 | 2 | 8 | 15 |
| Number of Individuals Represented | | | | | | | | |
| Ornate shrew | - | - | - | - | - | - | - | 2 |
| Broad-handed mole | - | - | - | - | - | - | - | 1 |
| Audubon cottontail | 1 | - | 1 | 1 | - | - | - | 1 |
| Botta's pocket gopher | 2 | 1 | - | - | 1 | - | - | 2 |
| Western harvest mouse | 10 | 1 | 2 | 2 | 1 | - | 2 | 14 |
| Deer mouse | - | - | - | - | 1 | 1 | - | - |
| Calif. meadow vole | 25 | 6 | 7 | 4 | 7 | 2 | 7 | 6 |
| Song sparrow | - | - | - | - | - | - | 1 | - |
| Total Individuals: | 38 | 8 | 10 | 7 | 10 | 3 | 10 | 26 |

Broad-handed mole

Mole tunnels were observed in the oilfield area and near Victoria Pond. The skeleton of one individual was recovered from a barn own pellet collected north of Victoria Street.

California black-tailed hare

Jack rabbit were observed twice in the early morning north of Victoria Street. They are probably more common on the upland mesas near this area, seldom venturing down to the lower elevation ruderal habitat of the study site.

Audubon cottontail

Rabbits were observed in every area and on every trip to the study site. They are extremely numerous over the whole area.

California ground squirrel

Ground squirrels were observed throughout the study area and are especially numerous in the grassy areas of the oilfield and salt marsh.

Botta's pocket gopher

Gophers were neither directly observed nor trapped during the study, but signs of gophers were common and the remains of several were found in barn owl pellets collected in the area. They are considered common throughout the drier portions of the study area.

Western harvest mouse

The western harvest mouse was the most common species of rodent trapped in the study area and was also commonly represented in barn owl pellets. All individuals trapped were referable to the common inland subspecies of harvest mouse, Reithrodontomys megalotis longicaudus and not to the southern California salt marsh subspecies, R. megalotis limicola.

Deer mouse

Deer mice were common in the remnant coastal sage habitat of the canyons and bluffs, and were found less commonly in nearby areas, including the higher elevation salt marsh habitat.

California meadow vole

Voles are notoriously trap shy and it is not surprising that few were caught in live traps. The great number of skulls found in barn owl pellets, plus the frequent occurrence of runs in the grass throughout the area, indicates that this species is common on the study site.

European rat

On one visit to the study site a rat was observed in the rocks under the Victoria Street bridge. Whether it was a black or Norway rat could not be determined.

House mouse

Two house mice were trapped near Victoria Pond. The species may be considered a rare invader of the lowland area from neighboring housing tracts.

Coyote

Twice during the study a coyote with a broken front leg was observed in the oilfield area. Scats of coyote were found throughout the study area.

Long-tailed weasel

Weasels were observed in the canyon and oilfield area and a red-tailed hawk was seen eating a weasel north of Victoria Street.

Striped Skunk

Trackways of skunk were regularly observed in the study area, two dead skunks were found near the west end of 19th Street and a skunk skull was found in the canyon area.

Additional Species

While not confirmed, it is highly probable that the brush rabbit (Sylvilagus bachmani) also occurs at the Santa Ana Study site. This species cannot be identified by sight in the field. Its presence in similar habitats at nearby Bolsa Chica (Table 6-36) however, makes its occurrence at Santa Ana River quite likely.

Other species confirmed from nearby coastal sites (Table 6-36) but not found at the Santa Ana River include fox, raccoon, Muskrat and mule deer. Sign and tracks of thes species are all readily identifiable but were not found, suggesting these species do not occur at the Santa Ana River site.

Mammalian Diversity

Several mammal species characteristic of coastal sage and grassland habitats in southern California were not found in the Santa Ana River study area. These include several rodents in the genera Neotoma (woodrats), Perognathus (pocket mice), and Dipodomys (kangaroo rats), as well as the species Peromyscus californicus (California mouse) and Peromyscus eremicus (cactus mouse). Also missing are racoons, bobcat and fox. The relatively small aerial extent of suitable habitats and their generally disturbed quality are responsible for this. Those species that were found at Santa Ana are the ones most likely to survive near suburban development or in disturbed vegetational zones. The absence of the southern California salt marsh subspecies of Reithrodontomys, R. megalotis limicola, is an indication of the relatively poor quality of the salt marsh habitat.

Mammalian Population Densities

Trapping for small mammals was conducted during the summer months when rodent densities should have been at or near their highest levels. Coastal sage habitat in southern California often yields trapping success rates of 20% or more (Vaughan, 1954). Trapping success in the coastal sage habitat of the Santa Ana River study area was lower however (11.4%), probably because of the small area of habitat and the amount of disturbance it receives from periodic mowing and flooding.

Trapping success in the marsh area was somewhat higher than has been found in other southern California marshes (see Table 6-39). This can be attributed to the restricted tidal regime in the marsh and the presence of upland dune and

road areas well above tide level. These factors have resulted in both the invasion of the marsh by weedy species that provide additional food resources for rodents and also the existence of dry burrow localities for ground squirrels and rabbits, both of which are abundant in the marsh area.

The riparian area just south of 19th Street that was trapped during this study has little water flow. Channels are filled by winter rains and much of the habitat is flooded through the winter and spring. This probably explains the poor trapping success here as compared to other southern California riparian habitats (see Vaughan, 1954).

Population densities in the ruderal field areas north and south of Victoria Street are what one might expect for such habitats. Trapping success was low, but much of the small rodent population consists of gophers and voles, both of which are seldom captured in small mammal traps. The numerous remains of these two species in barn owl pellets (Table 6-40) indicates that both species are numerous in the ruderal field areas. In all areas, the densities of rabbits and ground squirrels seemed higher than usual. This probably reflects the lack of large, wide-ranging predators at the study site.

Food Requirements

Herbivorous species are by far the most numerous feeding type in the Santa Ana River study area. These include the rabbits, vole and gopher, which feed primarily on foliage and roots; the ground squirrel and harvest mouse, which in addition to eating foliage, feed on seeds; and the deer mouse, which feeds on insects as well as plants. Totally carnivorous species are represented by the coyote and weasel. Coyotes feed on rabbits, gophers, and ground squirrels, while weasels feed on the smaller rodents, lizards, birds and amphibians. Omnivorous species which feed on a variety of vertebrates, invertebrates and plants are represented by the opossum and skunk. The only totally insectivorous species observed were the shrew and mole.

Somewhat more detailed information on species predator-prey relationships is presented in the Ballona Creek study (Friesen et al, in Schreiber, 1981), with additions from Hall and Kelson (1959) and Burt and Grossenheider (1964):

Ornate shrews are insectivores taking insects, larvae and pupae. Related species take spiders, snails and earthworms; they can swim well both at and below the water surface.

Broad-handed moles are nocturnal and active year round. They probably prey on earthworms and insects; likely predators include owls, snakes, skunks and weasels.

Audubon (or desert) cottontail and black-tailed hare (or jack rabbit) both eat grasses, shoots and many other kinds of vegetation. Predators include hawks, owls and gopher snakes. At Ballona the cottontail remains in dense pickleweed stands even when flooded with shallow water.

California ground squirrel feeds principally on vegetation -- leaves, non-woody stems and seeds, but is also known to take insects and animal material.

# 7.0 TROPHIC RELATIONSHIPS

The feeding habits of most of the terrestrial vertebrates observed in the Santa Ana River Marsh and adjacent lowlands are well known (see, for instance, Martin, Zim and Nelson, 1951). What is important to know is not so much what these species eat, but rather which resources are limiting to their populations. In addition to adequate food supplies — nesting sites and the existence of resting areas may affect avian population levels within an area. Seasonal variation is also important. Not only do bird populations vary with the season but limiting factors and needs may also change, both throughout the year and from year to year. Some birds feed exclusively on vegetation during the winter but switch to insects during summer months. A habitat can be perfectly satisfactory as a feeding ground but lack nest sites, requiring certain species to leave the area for the breeding season.

These seasonal and annual changes make the construction of food webs for natural communities a difficult task. For habitat areas at the Santa Ana River study site the task is further complicated since individual habitat areas are small and do not contain complete ecosystems. Furthermore, no attempt was made in this study to quantify components of aquatic habitats. Despite these difficulties, food web diagrams for each of the habitat types delineated during the study have been constructed and serve to illustrate the relationships outlined in this report (Figures 7-1 through 7-6). The relative sizes of individual boxes within each diagram reflect our best estimates (often subjective) of the relative abundance of each resource, animal species, or group. Arrow thickness between boxes indicate the relative importance of energy transfer between the components in the diagrams. For simplification, only the major pathways of energy flow have been diagrammed.

## 7.1 SANTA ANA RIVER CHANNEL

The food web for the Santa Ana River Channel (Figure 7-1) consists of parallel terrestrial and aquatic systems; the aquatic developed in the lower channel reaches and the terrestrial in the upper reaches. There is little interaction between them. Annual souring of the channel bottom by spring runoff eliminates both terrestrial and aquatic vegetation from the channels and also eliminates much of the bottom invertebrate fauna. This flora and fauna is re-established each year after winter rains, but never reaches the richness found in other sections of coastal wetlands. The result is that the channel is little used for feeding or nesting by land birds, there being little or no vegetation to their liking. Water birds use the area mostly for resting rather than as a feeding or nesting area. Those that do feed are mostly shorebirds, feeding on sand flies and other insects along the waters edge. Black-necked stilts feed predominantly in this manner and are numerous. Due to the scouring of the channel, food supply for fish is meager and fish populations are low. This in turn is reflected by the small number of fish-eating birds using the channel. No reptiles or mammals regularly occur in this habitat.

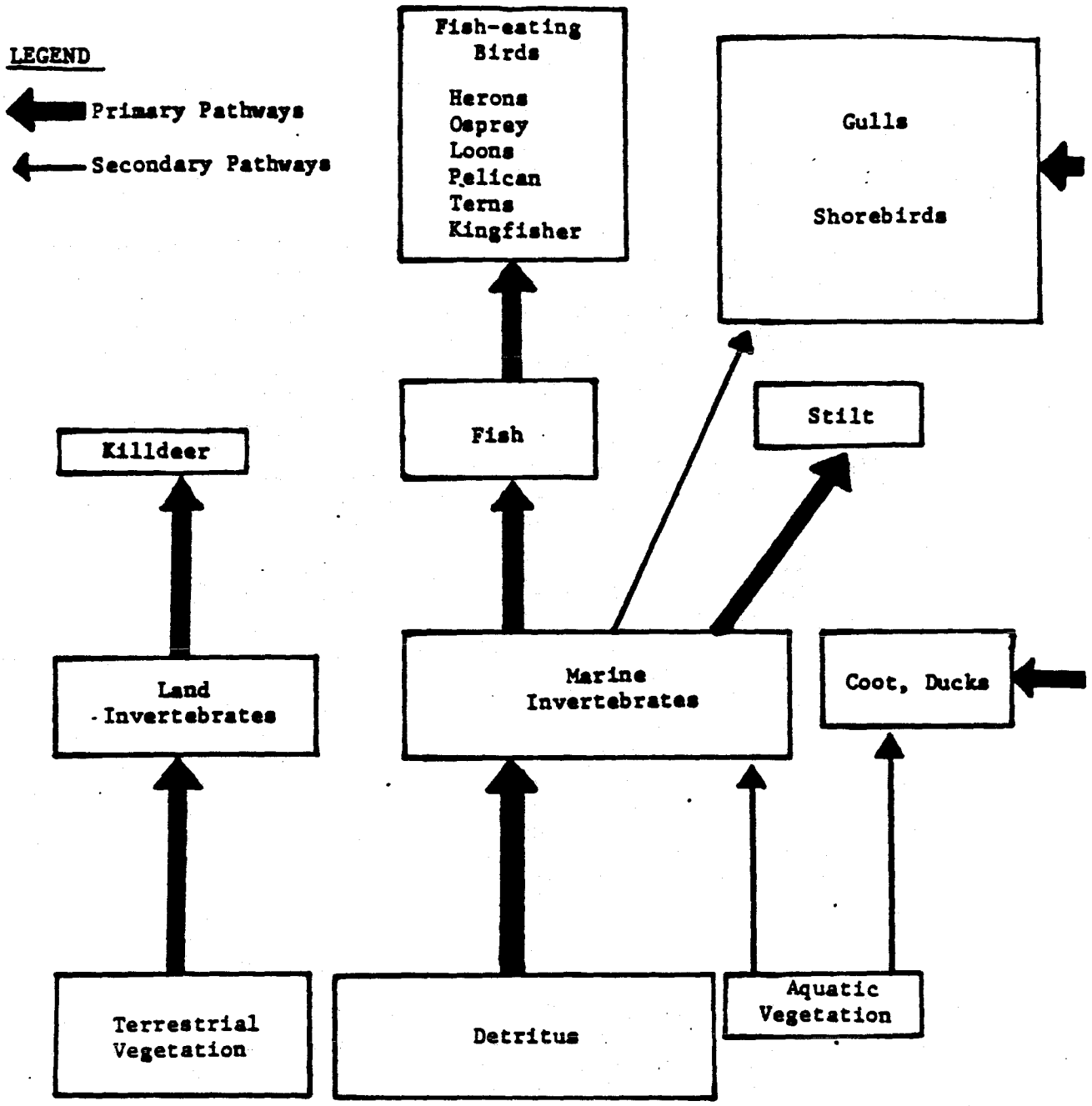



Figure 7-1. Food web relationships for the Santa Ana River Channel.

## 7.2 GREENVILLE-BANNING CHANNEL

Unlike the Santa Ana River Channel the Greenville-Banning Channel (Figure 7-2) shows no evidence of annual flooding and scour. Tidal fluctuation is minimal due to sandbar development at the ocean entrance of the channel. This, together with the influx of freshwater in the upper reaches of Greenville-Banning have prevented the development of much marine life. The muddiness of the channel makes it difficult for aerial diving birds such as terns and pelican to fish. For these reasons, the number of avian species dependent upon marine life, either fish or invertebrates, is small. The small size of the channel and lack of cover along its banks also minimizes use of the area by wildlife. In the upper reaches of the channel, bullrushes are numerous and form the base of a terrestrial food web. A few insectivorous birds occur here. Seed-eating birds, such as red-winged blackbird and song sparrow also nest here but obtain most of their food from adjacent areas. Reptile and mammal use of the area is confined to occasional visits by carnivores, notably opossum.

In summary, a depauperate food supply due to water conditions, the small size of the channel, and lack of adequate cover, all contribute to keeping vertebrate use minimal.

## 7.3 COASTAL SALT MARSH AND TIDAL CHANNELS

The remnant tidal channels of the coastal salt marsh (Figure 7-3) do not support as many birds as one would expect for an area of this size. As with the Greenville-Banning Channel, the reason seems to be poor development of aquatic food resources, both algae and invertebrates. Inadequate tidal flushing and poor access to food resources (due to minimal tidal mudflat areas and steep channel banks) are also responsible. The marsh itself also seems depauperate in certain ways. Although rodent populations and associated raptor populations are normal or above normal for what one might expect in such a limited area (possibly reflecting drier, more upland-like conditions), many marsh birds are absent.

The salt marsh is quite large (78 acres), yet has only a few widely separated, steep-banked, tidal channels. This, together with the tidegate-dependant muted tidal regime, results in much of the marsh surface being quite dry. It apparently depends on unusually high tides and annual rainfall for its moisture (especially apparent during the dry winter of 1983-84). As a result of these conditions the marsh vegetation tends to be rather dry and scrubby. Dense, lush green pickleweed (Salicornia virginica) stands typical of regularly tidally flushed coastal marshes are absent. "Low marsh" vegetation, especially Pacific cordgrass (Spartina foliosa) -- again typical of fully tidal marshes -- is also absent at Santa Ana. This habitat typically harbors a much richer assemblage of benthic invertebrates than the drier "high marsh;" it also provides more suitable habitat for clapper rails.

As in the case of other ruderal field areas on the study site, regular use by large flocks of seed-eating birds, especially in winter, indicates that there is plenty of food available for such species in the marsh. Species that feed primarily on invertebrates, such as meadowlarks, wrens and flycatchers are found in low numbers. The open nature of the marsh affords little shelter and

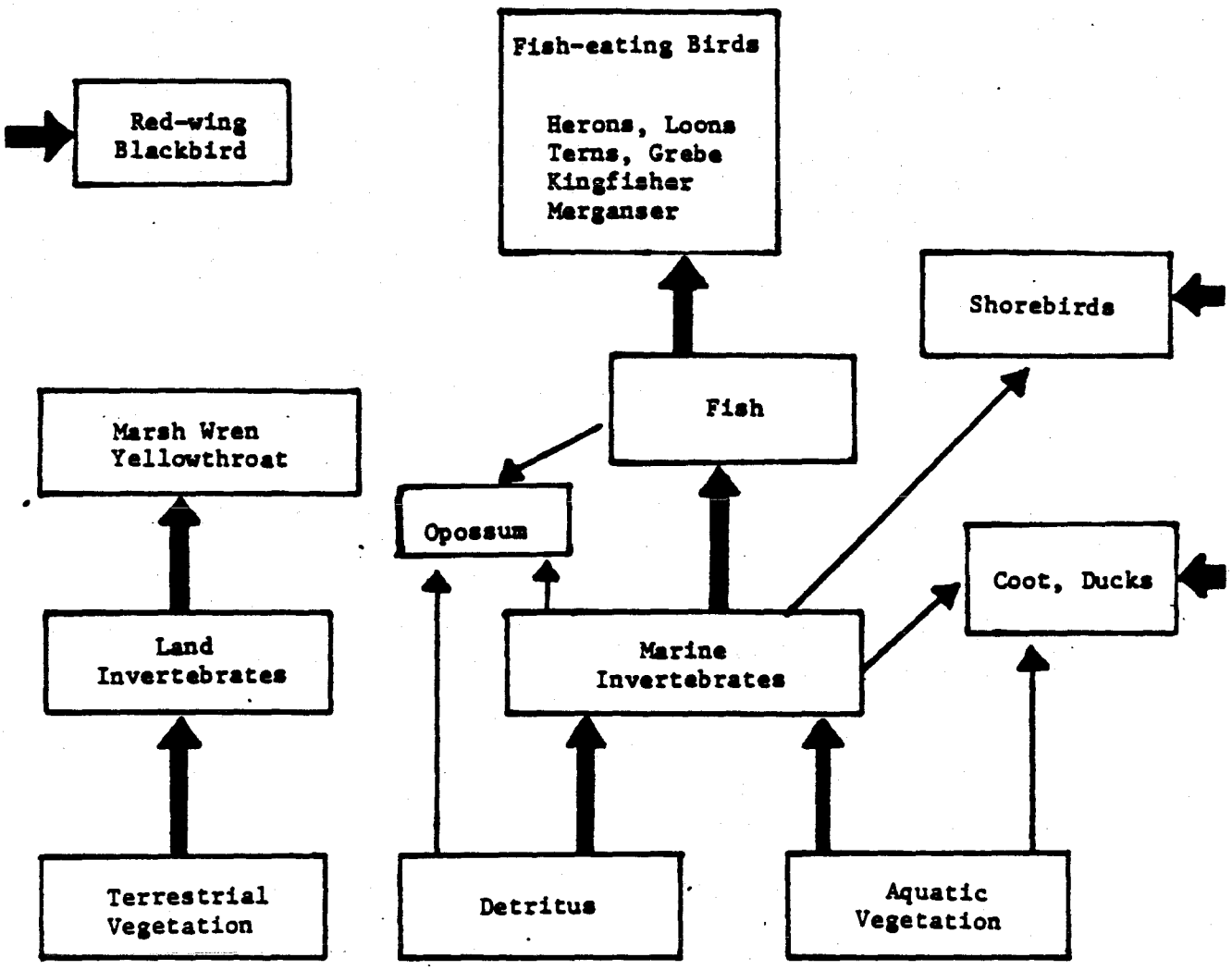



Figure 7-2. Food web relationships for the Greenville-Banning Channel.

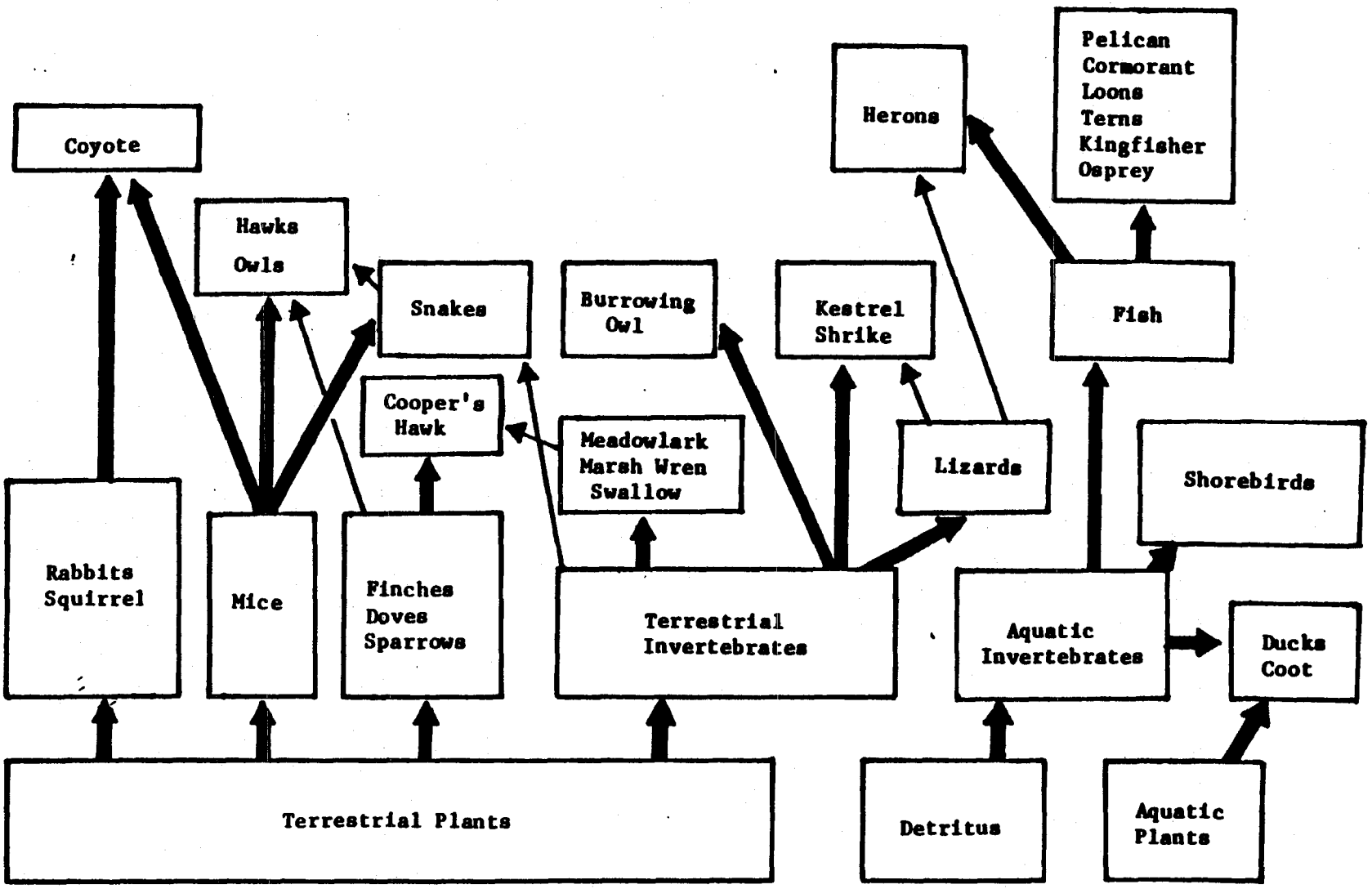



Figure 7-3. Food web relationships for the coastal salt marsh and tidal channels.

as a result mammalian predators such as coyotes are uncommon. Another result is that most avian species also leave the area in summer due to the lack of suitable nesting sites in the marsh.

## 7.4 MESA BLUFFS AND CANYONS

Coastal sage scrub, where present, appears healthy but supports what seem to be below normal numbers of birds, reptiles and mammals (Figure 7-4). The limiting factor for this habitat is its small extent and the fact that it forms a narrow strip of habitat between areas where heavy disruption has occurred — oilfield operations on both the mesa above, and lowlands below. Species with extensive ranges have disappeared and only those species that can survive in a limited area remain. Of these smaller animals, only the birds are present in nearly normal numbers for a habitat area of this size. Numbers of reptiles and small mammals are low. This is probably due in part to predation pressure from neighboring ruderal fields of the mesa tops, which support a large population of wintering raptors. Suppression of weeds and oilfield clearing by mowing have disrupted the native vegetation and allowed invasion by faster growing weeds. Since these weedy species provide less suitable cover and food supplies, this has also reduced sage scrub vertebrate populations.

## 7.5 THE OILFIELD

The freshwater habitat in the oilfield is ephemeral in nature, dependent upon local rainfall and runoff for a water supply. The use of the area by wildlife (Figure 7-5) therefore varies from year to year as water supply varies. The winter of 1983-84 was a dry one and freshwater habitat was limited both in acreage and duration. The number of birds that showed signs of nesting in early spring seemed normal for the size of freshwater habitat available, but most abandoned the area as it dried up. Because of the seasonal nature of the fresh water ponds, fish are not present in this area. The herons present feed primarily on frogs and tadpoles. The area of riparian habit in the oilfield is small but seems to support a normal fauna for its size. The ruderal fields in the oilfield have low populations of mammals and reptiles. This is due to the presence of a limited variety of plants and to regular disruption by mowing operations which eliminate cover and allow severe predation to occur. Bird populations of the ruderal fields seem normal in size, but many species appear to leave the study area in summer due to the lack of appropriate nesting sites.

## 7.6 19TH STREET TO VICTORIA STREET

Victoria Pond is heavily used in winter by waterbirds. However, most seem to rest on the pond rather than feed there. The pond is dependent upon local runoff and is greatly reduced in size by evaporation in summer. This takes the water away from marsh areas surrounding the pond and prevents the development of a stable marsh community. The use of Victoria Pond by large numbers of resting gulls in winter may effect both its water quality and the development of aquatic vegetation. Resident waterbirds were few in number during the 1983-84 study period, probably in part due to the unusually dry winter. A few mosquito fish are present in Victoria Pond and are fed upon by herons, little (least) tern, grebes, and kingfisher.

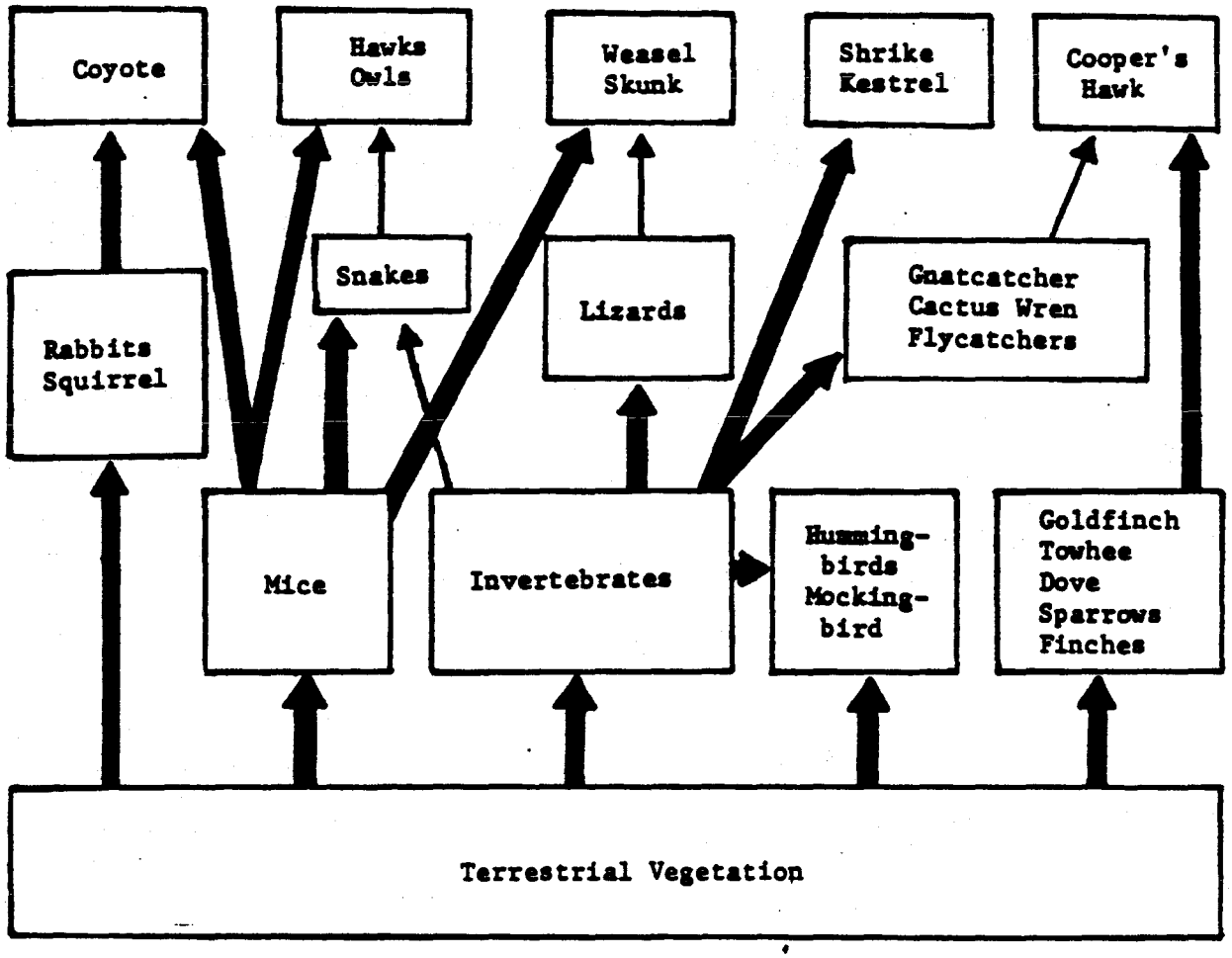



Figure 7-4. Food web relationships for the mesa bluffs and canyons.

The riparian community in the Victoria Pond study unit, consisting primarily of a large stand of willows in the southeast corner of the area, is heavily used by human residents of the area. During the study period many willows were cut down and undergrowth in the willows was heavily impacted by human use. Birds that nest in trees and dense shrubs in the riparian community were little effected by this disruption, but ground species such as rodents and lizards seemed few in number. Flooding of the area in winter may also contribute to these low numbers.

The ruderal fields of this section were not plowed during the year, nor were they much disturbed by human use. Nevertheless, the vegetation, although lush, is limited in diversity. For an area of such limited diversity, it supported a fairly large number of mammals and reptiles. Bird numbers in this habitat were also high. Raptors regularly used the area but did not nest on site. Many seed-eating species also appeared to move off the property to find nest sites. Food web relationships for this study unit differ from those of the Oilfield only in the additional presence of fish, and the birds associated with them (Figure 7-5).

## 7.7 NORTH OF VICTORIA STREET

Due to agricultural use in the past, ruderal fields north of Victoria Street exhibit a limited vegetational diversity. Fire breaks are also regularly plowed across the area. The populations of small mammals, reptiles, and seed-eating birds are high however, and there appears to be plenty of plant food available. A large number of raptors also hunted over the area. However, both the raptors and seed-eating birds leave the area during nesting season because it lacks suitable nesting sites. Food web relationships for this area are identical to those for the Oilfield (Figure 7-5), except for the absence of any aquatic vegetation and associated species.

## 7.8 OCEAN BEACH

The ocean beach area surveyed during this study does not constitute a complete ecosystem (Figure 7-6). It is used only as a resting site by a few species and as a nesting site by little terns (California least terns), which nest within a fenced area set aside by the California Department of Fish and Game.

## 7.9 SUMMARY

To summarize, vertebrate populations are usually limited by food resources, spatial requirements, or the availability of suitable nest sites. In the Santa Ana River Marsh and lowlands the small size of individual habitat types and their generally disrupted nature, whether due to historical or current events, have an effect on wildlife numbers. It appears that marine habitat food resources are below normal, due either to periodic flooding and channel scour, or inadequate tidal flushing. As a result there is little food for shorebirds, or fish -- upon which many fish-eating birds depend. The remnant coastal salt marsh is too small to provide nesting sites for most water-related species and the area is used primarily by migratory and wintering birds. Freshwater habitats lack a stable water supply and fluctuate in quality from year to year. Periodic drying and the small size of the freshwater areas involved keeps their associated vertebrate fauna low.

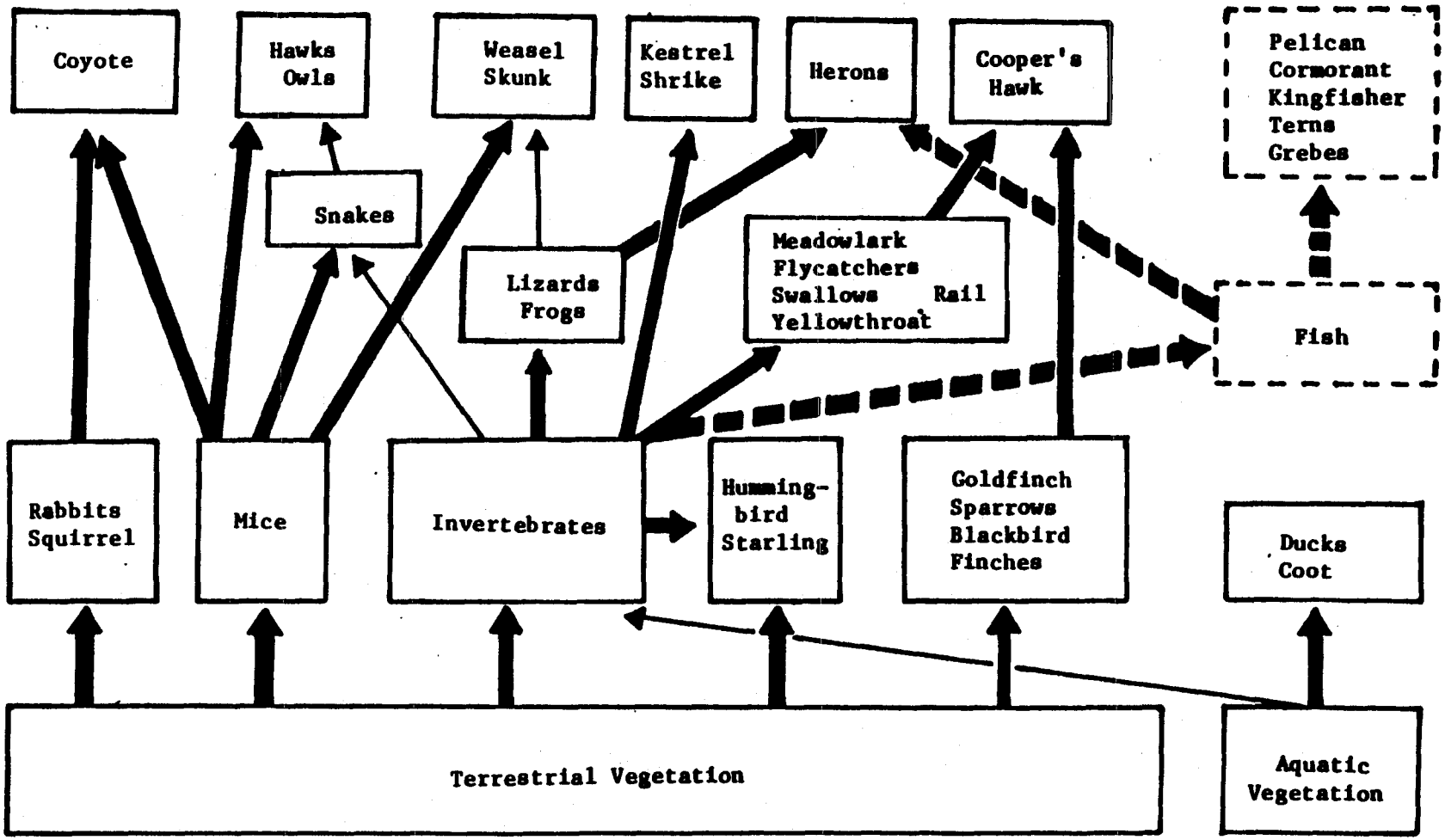



Figure 7-5. Food web relationships for the oilfield. Dashed lines and boxes indicate additional components between 19th and Victoria Streets.

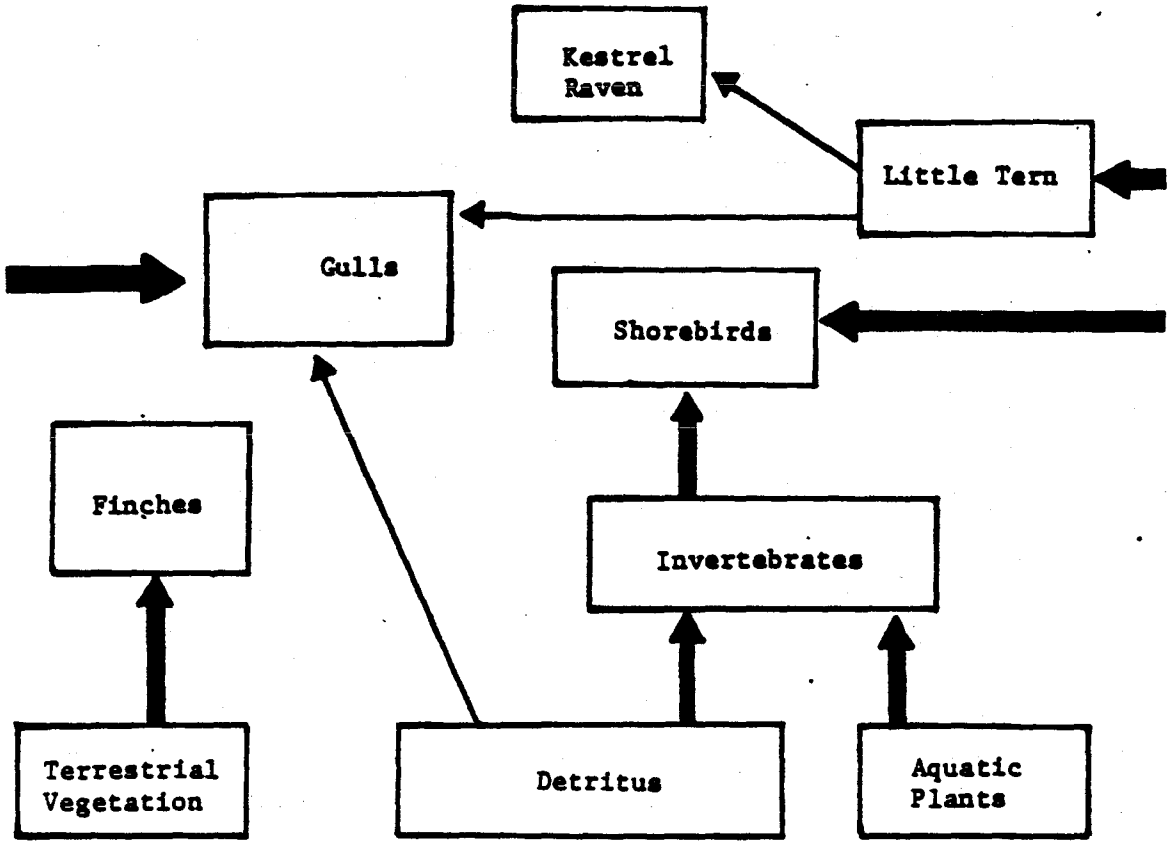



Figure 7-6. Food web relationships for the ocean beach.

Terrestrial habitats at Santa Ana River also suffer from limited size and frequent disturbance. The poor quality of the salt marsh habitat reflects inadequate tidal flushing and its small size. Coastal sage and riparian habitats are also of limited extent and suffer disruption from plowing and tree cutting, respectively. The ruderal fields are depauperate in species due to past agricultural activities and mowing for weed and fire control. Seed-eating species seem least affected by these disruptions, but often leave the area during the breeding season because of a lack of adequate nesting sites. Rabbits, ground squirrels, and voles, are numerous over much of the terrestrial habitat, as are raptoral birds. The raptors however, like the seed-eating species, usually leave the area to nest elsewhere. Larger mammals and reptiles seem scarce in all habitats. This is due to lack of cover and frequent disturbance of the study areas.

# 8.0 ANTICIPATED PROJECT IMPACTS, MITIGATION & MARSH RESTORATION

The purpose of this final section of the report is to draw together data and conclusions presented in earlier sections and outline the more significant biological impacts likely to result if the SANTA ANA RIVER FLOOD CONTROL PROGRAM, ALL-RIVER PLAN (Phase 1, Alternative 6; U.S. Army Corps of Engineers, 1980) is fully implemented as presently proposed.

Potential adverse physical impacts and their biological consequences are considered first; positive impacts second. A third section covers potential mitigating measures that have either already been put forward (U.S. Army Corps of Engineers, 1980), or in light of this study, should now be considered. The section concludes with a brief review of some options for marsh conceptual restoration design and planning.

Our criterion for defining a potential ecological impact as either "POSITIVE" or "NEGATIVE," is whether or not it results in an overall net increase or decline on one or more of the following:

- area of a presently available habitat,
- size of local species populations,
- primary and secondary production levels,
- overall community diversity (i.e., species richness), and
- overall "vigor" of the community,its ability to sustain itself through natural year-to-year variations in local ecological conditions.

## 8.1 POTENTIAL NEGATIVE IMPACTS

### 8.1.1 NEGATIVE PHYSICAL IMPACTS

The principal project-related PHYSICAL IMPACTS that would accompany completion of the "All River Plan" flood control program have already been outlined in Section 2.0 of this report. The more significant long-term, unavoidable negative physical impacts would be as follows:

- Elimination of the Greenville-Banning Flood Control Channel below Victoria Street.
- Replacement of the present soft-bottom Greenville-Banning Channel above Victoria Street, with a concrete rectangular channel.
- Loss of about 5 acres of Victoria Pond.
- Loss of about 8 acres of historic east-riverbank wetlands, between Victoria Street and Pacific Coast Highway (PCH).

- Loss of degraded salt marsh acreage (possibly about 5 acres) near PCH, due to realignment of Talbert Channel outlet.

A number of additional short-term negative impacts are likely to temporarily reduce biological utilization and production, on-site. These include:

- Direct disruption of birds, fish, and benthic biota during channel dredging and construction.

- Indirect disruption of adjacent aquatic habitats due to tidal and land-runoff drainage controls, imposed to accommodate construction.

- If poorly timed, on-site construction could disrupt regular species breeding and/or nesting cycles.

- Increases in human disturbance, construction traffic and related noise, dust, and air pollution. Possible disruption of present "secured access."

- Light pollution and disruption if construction or security requires night lighting.

### 8.1.2 NEGATIVE BIOLOGICAL IMPACTS

Based on the literature review and field investigations conducted for this study, the more significant biological consequences of the adverse physical impacts listed above can be outlined as follows:

Greenville-Banning Channel

Modifications to and/or elimination of, portions of the Greenville-Banning Channel will replace present non-tidal, soft-bottom, brackish aquatic habitats (including a limited area of bulrushes, Scirpus sp.) with a concrete rectangular channel. Although fully open to tidal flushing, the upstream portions of the channel will probably be dry much of the time.

The bulrushes, which presently provide nesting habitat for song sparrow, red-winged blackbird, and common yellowthroat, will be gone. Crayfish and amphibian larvae (tadpoles) will also disappear and the channel will no longer host flocks of up to 40 egrets that occasionally feed among the bulrushes. Use by fish-eating birds: grebes, loons, herons, pelican, and cormorant will also be eliminated. Opossum that presently regularly use the channel may also be displaced.

Removal of the dike that presently separates the Santa Ana River and Greenville-Banning Channels will force the locally resident flock of some 30 to 50 killdeer to find nest space elsewhere -- possibly in the channel bottom further upstream.

On the positive side, the somewhat larger size and more protected nature of the concrete replacement channel could provide a new resting-loafing area for gulls or shorebirds temporarily displaced from other local areas by high tides or human disturbance.

## Victoria Pond

The U.S. Army Corps of Engineers (1980) estimates present freshwater habitats at Victoria Pond at approximately 13 acres. Winter use of the pond appears to be mostly as a resting/roosting area away from human disturbance, by a wide variety of ducks as well as herons, and occasionally cormorant, pelicans and grebes. Large numbers of gulls also rest and bathe in the pond in winter. Feeding use by any of these species is only sporadic.

Pond water level may decline during the spring and summer if evaporation exceeds winter rainfall and runoff, as it did in 1983-84. The smaller ponds and mudflats exposed as the water level recedes attract feeding shorebirds and egrets. Small numbers of California least terns, kingfisher and pied-billed grebe fish in the pond and several species successfully nest there (grebe, mallard, coot, least bittern, stilt in 1983-84 -- possibly black-crowned night herons and others also, in wetter years).

Loss of 5 acres of this site -- possibly including open water, freshwater marsh, willow scrub, and vernal ponds -- as proposed, would obviously severely disrupt and significantly reduce (40% acreage reduction) use by birds and other wildlife.

## East Riverbank Wetlands

Proposed widening of the Santa Ana River Channel, and incorporation of the parallel Greenville-Banning Channel, will result in the loss of some 8 acres of historic wetlands adjacent to the present eastern channel bank between Victoria Street and the Pacific Coast Highway.

Although once occupied by high-quality coastal salt marsh, this area is presently dominated by ruderal field habitats, heavily disturbed by on-going oilfield operations. A variety of wintering seed-eating birds (house finch, sparrows) visit these ruderal fields. The fields are also regularly hunted by both wintering and resident raptors.

In the summer several birds successfully nest here, or nearby -- black-shouldered kite, shrike, kestrel, song sparrows, and common yellowthroat. Swallows hunt for insects here also. Rabbits and ground squirrel are common.

Disturbed ruderal areas remain common within the study region and most species characteristic of such habitats are relatively opportunistic. While loss of this acreage may reduce the total wildlife support capacity of the study site by a small amount (loss of 8 acres from the fenced oilfield area of 157 acres -- a 5.1 percent loss), no unusual or uncommon species of plants and animals are represented here.

## Talbert Channel Salt Marsh

Despite its degraded condition the scarcity of, and regulatory protection afforded, salt marsh habitats makes the probable loss of about 5 acres of marsh due to realignment of Talbert Channel, a significant negative impact. While wildlife uses in the area are presently low, its specific location and potential capacity for restoration make this site of particular importance.

Public Beach and Least Tern Nesting Preserve

The negative impacts of disruption of public beach acreage are self evident. Since the ocean beach is heavily used by swimmers and surfers, wildlife use is generally low. The exception, of course, is the fenced preserve set aside adjacent to Talbert Channel for endangered California least tern nesting.[3] As noted by Massey (1980), this area is one of the few remaining natural, historical sites where least terns continue to breed successfully. Loss of 1.5 acres -- one third -- of the preserve would undoubtedly have a serious negative impact on both the colony size and its breeding success.

Short-Term Adverse Impacts

The potential biological significance of the short-term impacts noted in Section 8.1.1 are clear and straight-forward and need not be discussed further here.

## 8.2 POTENTIAL POSITIVE IMPACTS

### 8.2.1 POSITIVE PHYSICAL IMPACTS

Construction of the presently proposed flood control project -- irrespective of potential mitigating measures -- will also result in at least two POSITIVE PHYSICAL IMPACTS as follows:

- The broader, deeper, Santa Ana River Channel entrance will promote more effective tidal flushing within the channel -- possibly year-round.
- Some 3-million cubic yards of sediment suitable for beach replenishment will become available for local shoreline discharge.

### 8.2.2 POSITIVE BIOLOGICAL IMPACTS

The positive physical impacts noted above (again, irrespective of potential mitigating measures) are likely to have the following biological consequences:

The broader, deeper, channel-mouth and enhanced tidal flushing will result in easier movement and exchange of ocean fish and invertebrates between shallow-water offshore habitats and the lower Santa Ana River Channel. While winter scour from rainfall runoff will probably continue to preclude the development of a "mature" benthic biota, overall variety and availability of food organisms, particularly to fish-eating birds using the channel, should increase. This will likely increase the numbers of such species (grebes, pelican, cormorant, herons, terns, red-breasted merganser and belted kingfisher) feeding in the Channel.

The shorebirds (including both migrant species and resident black-necked stilt and killdeer) and gulls that presently rest and roost within the Santa Ana River Channel will continue to do so. Increased tidal action may force them to relocate further upstream, however. Feeding may increase if changes in channel configuration enhance conditions for the development of benthic invertebrates.

The availability of sediments suitable for beach replenishment will have a positive impact upon the local beachsand littoral drift budget, a continuing problem throughout southern California. Any disruption of sandy beach infaunal invertebrates from release of these dredged sediments would be temporary, lasting only until the sediments reach a dynamic equilibrium under present shore conditions.

## 8.3 MITIGATION MEASURES

During the Santa Ana River flood control alternatives review process, the U.S. Army Corps of Engineers (1980) proposed a number of mitigating measures that were eventually incorporated into selected Alternative 6, the All-River Plan (see Section 2.0). These mitigation measures, proposed to balance the negative impacts discussed under Section 8.1 above, include the following:

- Restoration of 92 acres of historic salt marsh, channel, and adjacent upland habitats between the Santa Ana River and Newport Beach Mesa (Figure 2-5).

- Installation of a fully functional tide gate between Santa Ana River Flood Control Channel and the restored salt marsh preserve.

- Enlargement of Victoria Pond to the south and east, to maintain 13 acres of freshwater habitat.

- Expansion of the California least tern nesting preserve westward, to replace lost acreage (1.5 acres).

- Development of a Construction Sequence Plan to ensure that marsh restoration and movement of the least terns and Victoria Pond are successfully accomplished before flood control improvements begin.

If thoughtfully planned and successfully implemented in an appropriate sequence, each of these mitigation measures proposed will have a profound and highly significant positive impact upon the habitats and wildlife values presently represented in the Santa Ana River Marsh and adjacent lowlands.

Many issues remain to be resolved however, before these mitigation measures can be implemented with a high degree of assured success. What habitat characteristics and plant and animal species are most deserving of restoration? How should the seemingly mutually exclusive requirements of different species be accommodated -- Spartina low marsh for the endangered clapper rail, verses upland hummocks for salt marsh bird's beak; intertidal mud-flats for shorebirds, verses lush Salicornia stands for Belding's savannah sparrows? Should the present marsh be returned to completely natural tidal flushing, with extensive submergence and potential die-off of lowlying vegetation? Or would a "muted" tidal regime be both more appropriate and less disruptive?

Ongoing U.S. Fish & Wildlife studies (sponsored by the Army Corps) are examining the potential for relocating the California least tern nesting preserve eastward along the beach to allow for the realignment of Talbert Channel, but are we assured the scheme will be successful? How far in advance of flood control construction must habitat restoration proceed, to minimize negative

impacts once construction begins?. And how is the restoration to be judged as "successful," or "progressing satisfactorily?"

How can tidal flux and freshwater runoff be handled to maximize wetland habitat diversity, if that is a desired restoration goal? How can the freshwater habitats such as willow riparian, of such concern to local birders, be best enhanced?

And finally, since the habitat restoration site must inevitably become an increasingly "managed system," what priorities and public benefits (education, research, passive recreation, strict wildlife protection, etc.) should be stressed, and what funding mechanisms will be utilized to handle future operations and maintenance casts?

Some additional but less substantial mitigating measures that should be considered during site restoration planning include:

- Possible integration of the Santa Ana River salt marsh restoration program with other regional wildlife enhancement goals -- restoration of additional salt marsh habitat adjacent to Pacific Coast Highway and Talbert Channel, for example, or dedication of a wildlife corridor along the lower reaches of the Santa Ana River.

- Provisions for experimental manipulation of wetland site-characteristics to test and maximize their enhancement/restoration potential.

- Design of effective buffer zones around wetlands, and other sensitive habitats, to enhance overall ecological values and strictly control access by both the public and nuisance predators. (The California Coastal Commission calls for 100-foot buffer zones around wetlands, or at least equivalent protection.)

- Provisions for passive recreational uses -- lookouts, carefully structured trails, and/or an interpretive area for public marsh viewing and education.

- Development of both a specific Water Management Plan and an overall Operations and Maintenance Plan to ensure future successful operation of the restored habitat complex.

- Identification and implementation of an effective mechanism to guarantee present and future funding for both operational and maintenance tasks that will enevitably be required by the marsh restoration program.

## 8.4 MARSH RESTORATION

Comparison of present conditions, vegetation, and wildlife at the Santa Ana River Marsh site with historical accounts (Talbert 1952, for example) and other southern California Coastal Wetlands (Zedler, 1982), leaves little doubt that habitat quality and wildlife values at Santa Ana have been substantially reduced by a long history of environmental modifications and site disturbance. Review of our field study results -- particularly the vegetation discussion (Section 3.8) and trophic relationships summary (Section 7.0) -- indicates

that a few inter-related factors play key controlling roles in the site's present ecosystem. These factors are briefly outlined below, and lead into a concluding summary listing of key considerations for the conceptual design and planning of the proposed salt marsh restoration.

### 8.4.1 VEGETATION FACTORS

Wetlands vegetation at Santa Ana generally suffers from inadequate water supplies. This is reflected both in the absence of several key plant species and reduced primary production values.

The salt marsh vegetation suffers from both poor tidal flushing, which provides soil moisture for regular growth; and from inadequate freshwater supplies, which are needed for germination and initial establishment of several marsh plant species (Zedler 1982, 1984). Increased freshwater would reduce marsh soil salinities somewhat and thus enhance primary production levels.

Presently developed "high marsh" vegetation occupies a lower than normal elevation range (86-150 cm above MLLW) relative to open ocean tides, and "low marsh" Spartina assemblages are absent. If the site were to be exposed to the normal range of ocean tides, some areas of high marsh would be killed off by too frequent and prolonged periods of tidal submergence. Some of these flooded areas could however take on "low marsh" characteristics and possibly Spartina could be introduced.

Freshwater wetland habitats of Santa Ana similarly suffer from poor water availability. Collection and utilization on-site of freshwater runoff from Newport Beach Mesa (or possibly even pumped shallow-well water) could enhance freshwater plant growth and extend the seasonal availability of ponds for bird and wildlife feeding, breeding and nesting, etc.

Protection of willow stands from tree cutting and trampling, as well as careful review and possible elimination of certain fire-prevention mowing practices, would also enhance vegetation growth and development.

### 8.4.2 WILDLIFE FACTORS

Many of the factors influencing the presence and relative success of wildlife populations at the Santa Ana site have already been summarized in Section 7.0. The following list notes several of these key factors and their most obvious contributions:

- Degree of tidal flushing -- introduction or exchange of dissolved nutrients, organic/particulate carbon and larval, juvenile and adult populations; sediment flux; vigor of plant growth.

- Seasonal river scour -- sediment flux (coarser channel sediments also contain fewer organisms and less organic matter); removal of vegetation; communities always at early stage of succession; reduced food resources and protective cover.

- Marine verses freshwater influences -- which species can tolerate salinity extremes or broadly fluctuating conditions.

- Relative size, diversity and productivity of various terrestrial habitat types.

- Permanence of habitat -- ephemeral ponds; disruption from seasonal mowing; year-to-year variation in rainfall and flooding as it affects plant growth.

- Abundance and diversity of food resources, especially for terrestrial birds and animals.

- Availability of suitable breeding sites and nesting areas.

- Levels of human disturbance (nesting areas for the birds, destruction of the willows) and predation pressures.

### 8.4.3 RESTORATION PLANNING CONCEPTS

Conceptual planning and design of a marsh restoration program for the Santa Ana River that will satisfy diverse regulatory agency interests (wildlife values, public health and safety, recreation, etc.) is clearly a complex problem. Some of the key planning concepts to incorporate into such a design are listed below:

1. Increase tidal flushing -- to improve water quality, enhance the marine-estuarine biota, and increase the availability of fish as a food supply for birds (including California least tern).

2. Create additional tidal channels to increase soil moisture, enhance plant production, and increase "edge habitats." (More succulent Salicornia stands will enhance Belding's savannah sparrow habitat. Moister habitat may also reduce small mammal predation pressures.)

3. Emphasize channel designs with gently sloping banks for easier wildlife access, and to promote intertidal mudflat areas and benthic biota to encourage shorebird use.

4. Introduction and propagation of cordgrass (Spartina foliosa) in new "low marsh" settings to provide light-footed clapper rail habitat, if this a preferred agency goal.

5. Utilization of thoughtfully placed dredge spoil piles (if available from dredging) to provide upland cover, shrubs, trees, etc. (deliberately selected and planted compatible species) as potential nesting sites for birds; habitat for amphibians, reptiles, and small mammals; secure habitat "islands" in the event of unusually high tides or flooding.

6. Enhancement and maximum utilization of freshwater sources to improve freshwater/riparian areas, create seasonal ponds, etc.

7. Adequate buffer areas to keep people out (or strictly control their access and movement) and reduce disturbance of nesting birds, vegetation trampling, vandalism, etc. Dogs and cats should also be kept out as much as possible.

# 9.0 ACKNOWLEDGEMENTS

Successful completion of this program reflects a stimulating and interactive team effort. Field program and report authorship contributions from the Principal Investigators are as follows: C. Robert Feldmeth, Ph.D., groundwater, plant biomass, and insect studies (Report Sections 4.0, 5.0 and 6.1); Daniel A. Guthrie, Ph.D., vertebrate ecology studies (Report Sections 6.0 and 7.0); and Barry A. Prigge, Ph.D., vegetation studies (Report Sections 3.0 and 5.0). As Program Leader, Keith B. Macdonald, Ph.D., scoped out and helped organize the field program, and assembled and edited a background Literature Review, Quarterly Status Reports, and this project Final Report.

The Principal investigators were assisted in their field and laboratory studies by a number of students from the Claremont Colleges Joint Sciences Department, including Brad Bierbaum, Denise Hawkins, Anna Lane, Darren Mierau, Christine Schmitz, Ingrid Urich-Sass, and Elaina Wortham. Dan Guthrie also especially acknowledges Loren R. Hays, Sea and Sage Chapter, Audubon Society, who introduced us to birds of the Talbert Park extension.

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# APPENDIX A

California Native Plant Society
Rare and Endangered Species
Plant Status Reports

Astragalus pycnostachyus lanosissimus

Chorizanthe paryi fernandina

Cordylanthus maritimus maritimus

Dichondra occidentalis

Dudleya stolonifera

Dudleya multicaulis

Helianthus nuttallii parishii

CALIFORNIA NATIVE PLANT SOCIETY — Rare Plant Status Report

Compiler: W. B. Critchfield — Date: Jan 1978

Name: ASTRAGALUS PYCNOSTACHYUS Gray var. LANOSISSIMUS (Rydb.) Munz & McBurney
Ventura Marsh Milkvetch

Family: Fabaceae (Leguminosae): Pea Family

CNPS Taxon Code: ASPYL

Status: CNPS (1974):P.E.--3 Federal Register (1976): Endangered

Synonymy and History: Phaca lanosissima Rydberg (1929); Astragalus pycnostachyus var. lanosissimus Munz & McBurney (Munz, 1932). Type: Oct 1882, S. B. & W. F. Parish 1117 (Morong Herbarium): US. Barneby (1964) discussed the confused labeling of the 1881 and 1882 ASPYL collections of the Parishes. ASPYL was collected a few times in the next 30 years and not collected again for more than 50 years. The only recent collection is in 1967. The species and variety names mean "with fat flower-spikes" and "very woolly".

Distribution: Type locality: "La Bolsa, Los Angeles Co., Calif." Historically known from the coast from S Ventura Co. to N Orange Co. at elevations of less than 30 ft (see attached map). Barneby (1964) considered populations in and S of Los Angeles Co. definitely extinct. He thought ASPYL might possibly persist on U.S. military reservations near Point Hueneme, Ventura Co. In 1967 it was collected ca. 5 mi N of Point Hueneme by R. M. Chase (Ventura Co. Dept. Agric.). According to the label, the collection was made from a single plant adjacent to Harbor Blvd., directly across the road from the entrance to McGrath State Beach, on the S side of the mouth of the Santa Clara River. "Apparently more plants were in a mowed area of lawn at the entrance." Maps: USGS Venice, Oxnard, Point Mugu, Seal Beach (all 7.5')

Description: Herbaceous perennial with a thick taproot and several stout, hollow, erect, reddish stems; foliage silvery-white, densely covered with long hairs; compound leaves nearly sessile, 27-39 leaflets 5-20 mm long; nearly sessile flowers numerous, in dense racemes with peduncles 2-4 cm long; flower with the butterfly-like corolla of the pea, petals greenish-white or cream-colored, banner (conspicuous upper petal) 7-10 mm long; calyx-tube 3-3.5 mm long, with teeth 1.2-1.5 mm long; nearly sessile fruit a single-celled pod 8-11 mm long; 8-12 ovules and seeds. Flowering time: Aug-Oct.

Astragalus pycnostachyus var. pycnostachyus grows in salt marshes and other wet places along the Pacific coast of San Mateo, Marin, and Humboldt Cos. It differs from ASPYL in its greener herbage, longer peduncles (4-10 cm), longer calyx-tube (3.7-5.2 mm) and teeth (1.7-3 mm), shorter pods (6-10 mm), and fewer ovules and seeds (2-5, commonly 4).

Other species of Astragalus in the region are: (1) A. brauntonii, (2) A. curtipes, (3) A. didymocarpus, (4) A. gambelianus, (5) A. pomonensis, (6) A. tener var. titi, (7) A. traskiae, (8) A. trichopodus. They differ from ASPYL as follows: pod strongly inflated: 2, 5, 8; pod more or less completely 2-celled: 1, 6, 7; pod with stalk (stipe or gynophore): 3, 7, 8; pod smaller (3-4 mm long): 3, 4, or larger (1.5-7.0 cm long): 2, 5, 8; fewer leaflets

(7-17): 3, 4, 6; peduncle of inflorescence longer (4-25 cm): 5, 7, 8; petals purple: 6, or dull lilac: 1; banner shorter (2.5-4 mm): 4, or longer (11-17 mm): 2, 5, 7, 8; teeth of calyx-tube longer (2.5-5 mm): 1, 7; fewer flowers (3-12) in inflorescence: 6; flowers in globose head: 3.

Habitat: Coastal salt marshes.

Endangerment Factors: Any populations of ASPYL in the Santa Monica or Ballona Marshes are certainly extinct; the latter area is now Marina del Rey and the S part of Venice. Barneby (1964) tried for several years without success to relocate ASPYL in the Los Angeles area. He believed the type locality, "La Bolsa", to be the Ballona Marshes, but this is questionable. There was (and still is) an extensive area of salt marsh on the Las Bolsas and Bolsa Chica land grants between Sunset Beach and Huntington Beach in N Orange Co. Moreover there is a railroad siding named "La Bolsa" on the 1902 edition of the Corona USGS quadrangle within easy walking distanc of the marshes at the mouth of the Santa Ana River. Orange Co., where these localities are located now, was not split off from Los Angeles Co. until 1889. The Parishes may have been quite accurate in their locality information, and marshes in this vicinity should be checked for ASPYL. Barneby's distribution map shows a collection at or near the Las Bolsas marshes (which are a little N of the old "La Bolsa"), but the basis for this mapped locality is unknown. The Bolsas marshes are partly an active oil field (California Coastal Plan: California Coastal Zone Conservation Commission, 1975), but a portion may b relatively undisturbed. The 1967 collection locality in Ventura Co. has b re-checked for ASPYL and none has been found.

Management Suggestions: The military reservations in the vicinity of Point Hueneme should be screened for ASPYL. Las Bolsas marsh (called Bolsa Chica marsh in the Coastal Plan), and the Anaheim Bay marshes just to the N, which are on and near the Los Alamitos Naval Reservation, should also be carefully screened for surviving ASPYL.

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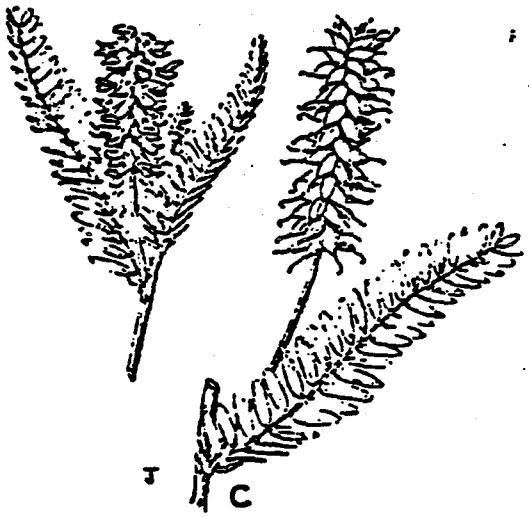
Illustrations:

Below, from P. A. Munz, A FLORA OF SOUTHERN CALIFORNIA, copyright © 1974 by The Regents of the University of California; reprinted by permission of the University of California Press:




Below, from Barneby, 1964, copyright © 1964 by the New York Botanical Garden and used by permission:

Distributional map showing a portion of the Southern California coast:

# CALIFORNIA NATIVE PLANT SOCIETY RARE PLANT STATUS REPORT

Contributor: James L. Reveal Date: Jun 1979

Name: CHORIZANTHE PARRYI var. FERNANDINA (S. Watson) Jepson
San Fernando Valley Chorizanthe

Family: Polygonaceae: Knotweed Family



CNPS Taxon Code: CHPAF

Designation: CNPS(1974):3-2-2-3 Federal: Threatened (under review)

Synonymy and History: *Chorizanthe fernandina* S. Watson (1880); *Chorizanthe parryi* S. Watson var. *fernandina* (S. Watson) Jepson (1923). Type, Jun 1879, Mrs. E. A. Bush s.n.: GH; isotypes: CAS, US.

Distribution: Type from San Fernando Canyon (Goodman, 1934), "near the San Fernando railroad station" (Brown, 1884), Los Angeles Co., Calif. Apparently always rare (Abrams, Davidson & Moxley), and this site may account alone for five of the known collections, none of which is more recent than 1940. Most date from 1920 or before. They represent scattered sites in Los Angeles, Orange, and San Diego Cos. in regions now almost entirely heavily urbanized. Some localities may still exist in at least modified form, as Mt. Lowe, San Fernando (Pacoima?) and Little Tujunga Washes (both flood control areas and the former possibly the type locality), Elizabeth Lake, and Chatsworth Park, all Los Angeles Co.; "hills near Santa Ana", Orange Co.; and near Del Mar, San Diego Co., this the only San Diego collection. Elev.: mostly below 2500 (4000) ft. USGS maps: Calabasas, Del Mar, Mount Wilson, San Fernando, Sunland, Newhall/Val Verde, Lake Hughes, Orange/Black Star Canyon/El Toro, all 7.5'.

Description: *Chorizanthe* is a genus of low annuals with alternate, entire leaves that lack stipules, the upper leaves commonly reduced to opposite or whorled bracts; flowers enclosed in a spine- or bristle-tipped involucre; perianth (5) 6-parted or -cleft; achenes glabrous. CHPAF is a decumbent annual up to 3 dm high; leaves basal, oblanceolate to oblong-lanceolate, 2-7 cm long, strigose, more so below than above, narrowing to the short petiole; lower bracts similar to leaves, entire, becoming reduced and acerose above; inforescences cymose, open; involucres aggregated at the ends of the branches into small clusters, the tube 6-ribbed, urceolate, 2.5-3 mm long, appressed-canescent, the teeth straight or merely curved, divergent, sometimes widely so, the outer 3 commonly longer than the tube, the inner 3 short, never hooked; flowers white, 2.5-3 mm long, glabrous, the tepals unequal, the outer ones oblong-obovate to oblong, the inner ones linear-lanceolate; stamens 9; achenes grayish, 2-2.3 mm long. Flowering time: Apr-Jun.

There are many other *Chorizanthe* that may occur in the area; CHPAF may be told by the combination of decumbent habit, entire bracts, involucre with 6 straight teeth, and unequal tepals.

Habitat: Gravelly to sandy soils, often in washes, mostly in coastal sage scrub.

Endangerment Factors: Development and urban sprawl have reduced the available habitat of CHPAF significantly. Many historical sites have been lost. The Mt. Lowe locality is in Angeles Natl. Forest.

Management Suggestions: Field work is necessary to discover if CHPAF is still extant. If so, the populations should be protected from habitat destruction.

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Supported by California Department of Fish and Game Endangered Plant Program Study 2.0 Job 1.0 (June 1978).

CALIFORNIA NATIVE PLANT SOCIETY — Rare Plant Status Report

Compiler: L. R. Heckard — Date: 1977 ✓

Name: CORDYLANTHUS MARITIMUS Nutt. ex Benth. ssp. MARITIMUS
Salt Marsh Bird's Beak

Family: Scrophulariaceae: Figwort Family

CNPS Taxon Code: COMAM3

Status: CNPS (1974): 3-2-2-2 Federal Register (1976): Endangered

Synonymy and History: Cordylanthus maritimus Nutt. ex Benth. ssp. maritimus (1846); Adenostegia maritima (Nutt. ex Benth.) Greene (1891); Chloropyron maritimum (Nutt. ex Benth.) Heller (1907). Type, T. Nuttall s.n.: K. Chuang and Heckard have redefined the taxonomic concept of COMAM3 from that in CNPS (1974). [See references.]

Distribution: Type collection from "San Diego". Historically has occurred at sea level in coastal salt-marshes from Carpinteria, Santa Barbara Co., to San Diego Co. and northern Baja California (to San Quintín). Present distirbution may be only San Diego Co. in the Tijuana River estuary. COMAM3 was also reported up until 1969 (Myrick) from the Sandyland marsh (Carpenteria) in Santa Barbara Co. At about the time of this compilation it also was reported from a marsh at Point Mugu.

Description: COMAM3 is an annual herb, 15-30 cm tall, with several ascending branches, grayish green (sometimes purplish tinged, hairy). Leaves narrow, 5-20 mm long. Inflorescence of spikes with lance-shaped floral bracts with usually a pair of short teeth near apex. Flowers without stalk. Calyx similar to bract in being lance-shaped, but narrower, lacking teeth, and usually minutely 2-cleft at the apex. Corolla tubular, pale below, 2-lipped with an upper beak-like yellowish tip and a purplish-tinged lower lip and pouch. Seed dark brown, with a reticulate surface, 2 mm long.
Flowering time: May-Jul; in fruit to Oct.

COMAM3 is a very distinct plant in the salt-marshes; no other Scrophulariaceae member occupies this habitat. The 2-lipped corolla (bird's beak) and the lance-shaped calyx distinguish it from its associates and from other members of the Scrophulariaceae.

Habitat: Coastal salt-marsh, growing with pickle weed (Salicornia) and salt grass (Distichlis). Middle littoral zone according to the ecological studies of Purer on the San Diego Bay salt-marshes.

Endangerment Factors: Not only filling in of coastal salt-marshes, but also unknown factors have highly reduced or eliminated COMAM3 from nearly all its known habitats. Research is needed to pin-point what these factors are.

Management Suggestions: Protect habitat from disturbance. Research needed to identify unknown factors adversely influencing plant even when habitat persists. Why is COMAM3 now apparently gone from San Diego Bay marshes but still persists (as of 1971) in the Tijuana River estuary?

Associated species (Salicornia, etc.) seem to be persisting. Related plants (ssp. palustris) have apparently disappeared from San Francisco Bay, again for unknown reasons.

References:

Chuang, T. I., and L. R. Heckard. 1973. Taxonomy of Cordylanthus subgenus Hemistegia. Brit onia 25:135-158. (map and discussion of distribution, past and present)

DeCandolle, A. 1846. Prodromus 10:598. (orig. descrip.)

Gray, A. 1867. New plants of California, etc., collected by H. N. Bolander, etc. Proc. Amer. Acad. Arts 7:327-401. (See p. 383.)

Greene, E. L. 1891. Some neglected priorities in generic nomenclature. Pittonia 2:181.

Heller, A. A. 1907. The genus Chloropyron. Muhlenbergia 3:133.

*Mason, H. L. 1957. (See p. 711.)

*Munz, P. A. 1959. (See p. 674.)

*Munz, P. A. 1974. (See p. 801.)

*Pennell, F. W. 1951. In Abrams, 1951, p. 848.

Purer, E. A. 1942. Plant ecology of the coastal salt marshlands of San Diego County, California. Ecol. Monogr. 12:81-111.

*C. maritimus ssp. palustris of N California and Oregon is included in the taxonomic concept of Mason, Munz, and Pennell.

Illustrations:

Colored slide by L. R. Heckard.

Drawings below from Chuang & Heckard, 1973, reprinted by permission of the New York Botanical Garden, publishers of Brittonia:

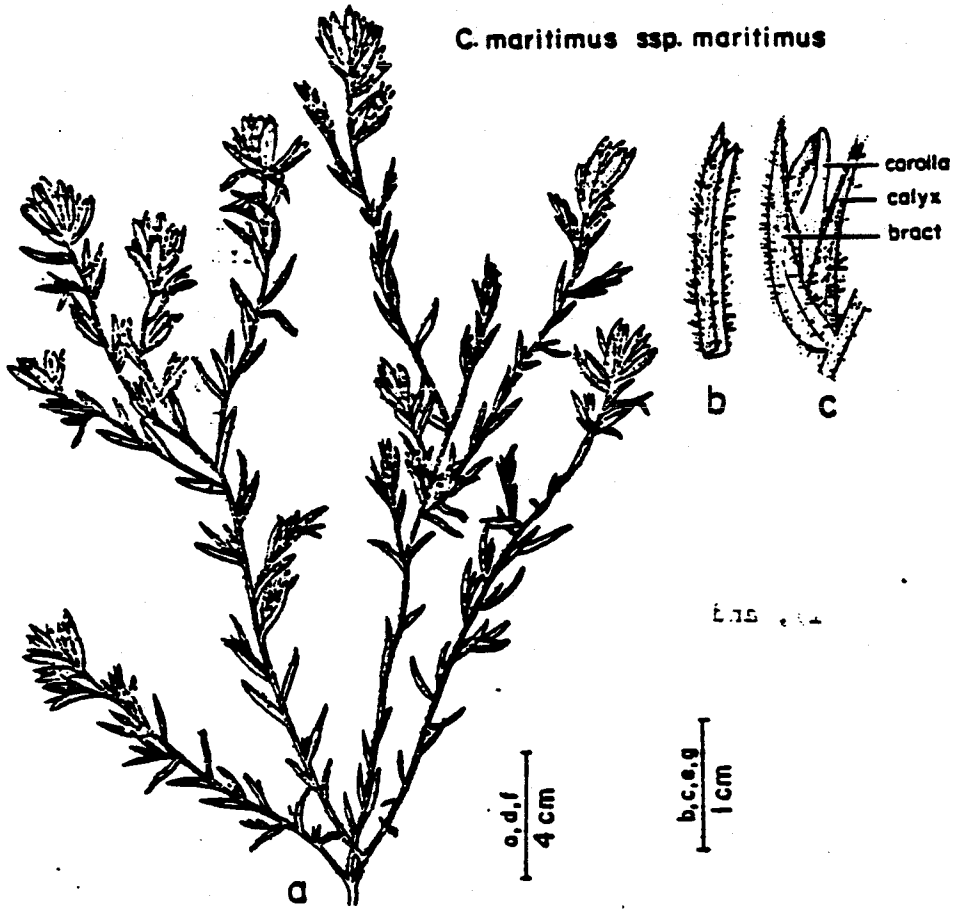



FIG. 5. *Cordylanthus maritimus*. a–c, ssp. *maritimus*. a, habit; b, lobed floral bract; c, flower and entire floral bract (a & c, *Heckard 2465*; b, *Chandler 4003*).

CALIFORNIA NATIVE PLANT SOCIETY — Rare Plant Status Report

Compiler: William B. Critchfield — Date: 1977

**Name:** DICHONDRA OCCIDENTALIS House
Western Dichondra

**Family:** Convolvulaceae: Morning-Glory Family

**CNPS Taxon Code:** DIOC-2

**Status:** CNPS (1974):3-3-2-2 Federal Register (1976): Endangered

**Synonymy and History:** Dichondra occidentalis House (1906); D. repens Forst. var. occidentalis (House) Jepson (1939). Type, 7 Jan 1884, C. R. Orcutt s.n.: US. The two species of Dichondra native to Calif. are still poorly understood. As recently as 1939 Jepson considered the northern D. donelliana Tharp & Johnst. to be naturalized and the southern DIOC-2 as "possibly native".

**Distribution:** Type locality: San Diego, Calif. On the mainland of Calif., DIOC-2 occurs near the coast in Santa Barbara Co. near Surf and Point Sal, in Orange Co. on Niguel Hill, and in San Diego Co. from Agua Hedionda S to Otay Mt. Also on San Miguel, Santa Rosa, Santa Cruz, and Santa Catalina Islands. In N Baja Calif. it has been collected on the mainland as far S as 9 mi NW of San Antonio del Mar, and on the Todos Santos and Coronado Islands (see attached distribution map). Elevational range: 50-1500 ft. A collection from Santa Cruz Is. was identified as D. donelliana by Tharp and Johnston (1961), and all collections from Santa Barbara Co. were identified as that species by Smith (1976), but according to R. Philbrick and S. Junak (pers. comm. Nov 1977) the collections from Santa Barbara Co., including the islands, are all DIOC-2. Maps: (U.S. distribution only) USGS Del Mar, Encinitas, Escondido, La Jolla, Point Loma, Point Sal, Poway Valley, San Juan Capistrano, San Luis Rey, San Miguel (E or W?), Santa Catalina S and E, Santa Cruz B, Santa Rosa S and E, Surf (all 7.5'); Jamul (15').

**Description:** Dichondra is a genus of creeping perennial herbs rooting at the nodes; leaves kidney-shaped with long petioles; small, inconspicuous flowers borne singly in leaf axils; 5-lobed corolla and calyx; ovary of 2 carpels, each chamber (locule) containing 2 ovules. DIOC-2 has perennial rhizomes; herbage sparsely pubescent with short soft hairs; leaf-blade nearly glabrous, decurrent on petiole at base of blade; pedicel 5-20 mm long, recurved just below flower; calyx 1.5-2 mm long (to 2-2.3 mm at fruiting stage), pubescent outside, divided nearly to base, lobes squarish or rounded at apex; corolla 3-3.5 mm long (exceeding calyx), funnel-shaped, glabrous, purplish to reddish, lobed about half its length; ovary developing as a unit into a slightly bilobed, dehiscent capsule 2.8-3.8 mm high, 4.5-5 mm long, and 2.1-2.6 mm wide, each locule containing 1-2 brown or black seeds; 2 styles promptly deciduous. Flowering time: (Jan) Mar-May. Fruiting: Mar-Jun.

The other species of Dichondra with capsular fruits occur in the mountains of SW U.S. (Ariz., N.M., Texas), Mexico, and South America, and all have whitish corollas. The other species native to Calif., D. donelliana Tharp & Johnston (1961), occurs near the coast from SW Ore. to Monterey and in a few localities

in the Sierra Nevada. This species and the cultivated Dichondras differ from DIOC-2 in having corollas about the same length as the calyx and in their fruit: each carpel develops independently into an indehiscent, bladder-like structure (utricle) containing a single seed and attached only at the base; each utricle is shed as a unit. Dichondra donelliana also differs in its white or greenish-white corolla, lobed more than half its length; longer calyx (2-3 mm in flower, 2.5-3.7 mm in fruit); usually dense, appressed, tawny pubescence on the underside of the leaf; and non-decurrent leaf blade.

Habitat: Locally abundant on open, dry ridges, slopes, and coastal headlands in partial shade of trees and shrubs or in open places, often growing in thin, sandy or rocky soil. In Baja Calif. it was noted as having survived a recent fire (R. Moran, pers. comm., Nov 1977). On Catalina it is an element of a depauperate community on "very rocky ridges and slopes with little soil or on heavily eroded clayey slopes with sparse or no grassy cover" (Thorne, 1967). In the Torrey Pines State Reserve N of San Diego it is fairly common on the drier uplands, both in the shade of the pines on N-facing slopes and in the open. In addition to Torrey Pines, associates noted include prickly pear, Rosa, Agave, and Adenostoma.

Endangerment Factors: DIOC-2 is more widely distributed than it was thought to be a few years ago, and its rarity and endangerment were over-rated by both CNPS and the Office of Endangered Species. It has probably been under-collected because of its small size, inconspicuous flowers, and (for many years) questionable status as a native plant. For instance, it was not known to occur on the mainland of Baja Calif. until 1975, when R. Moran collected it in 3 widely separated localities. Some populations in and near San Diego have probably been eliminated (Point Loma, La Jolla). However, the occurrence of DIOC-2 on difficult sites and its ability to propagate itself vegetatively and to withstand fire make it likely that its known distribution is largely intact. The populations in both sections of the Torrey Pines State Reserve are in good condition and protected from major disturbance. DIOC-2 may warrant further consideration as a rare plant, but its classification as Endangered or even Threatened does not appear to be justified.

Management Suggestions: Although DIOC-2 does not seem to be particularly rare, a field survey of its known distribution in S Calif. would provide a more reliable basis for changing the status of this species.

References:

House, H. D. 1906. A new species of Dichondra. Muhlenbergia 1:130-131. (orig. descrip.)

Smith, C. F. 1976. A flora of the Santa Barbara region, California. Santa Barbara Mus. Nat. Hist.

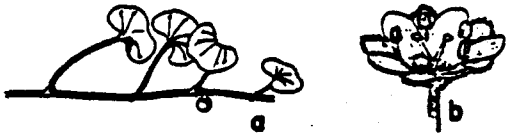
Tharp, B. C., and M. C. Johnston. 1961. Recharacterization of Dichondra (Convolvulaceae) and a revision of the North American species. Brittonia 13:346-360.

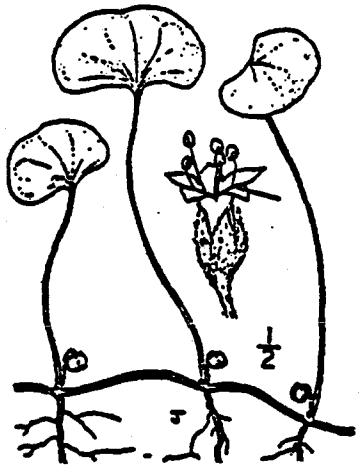
Thorne, R. F. 1967. A flora of Santa Catalina Island, California. Aliso 6:1-77.

Illustrations:



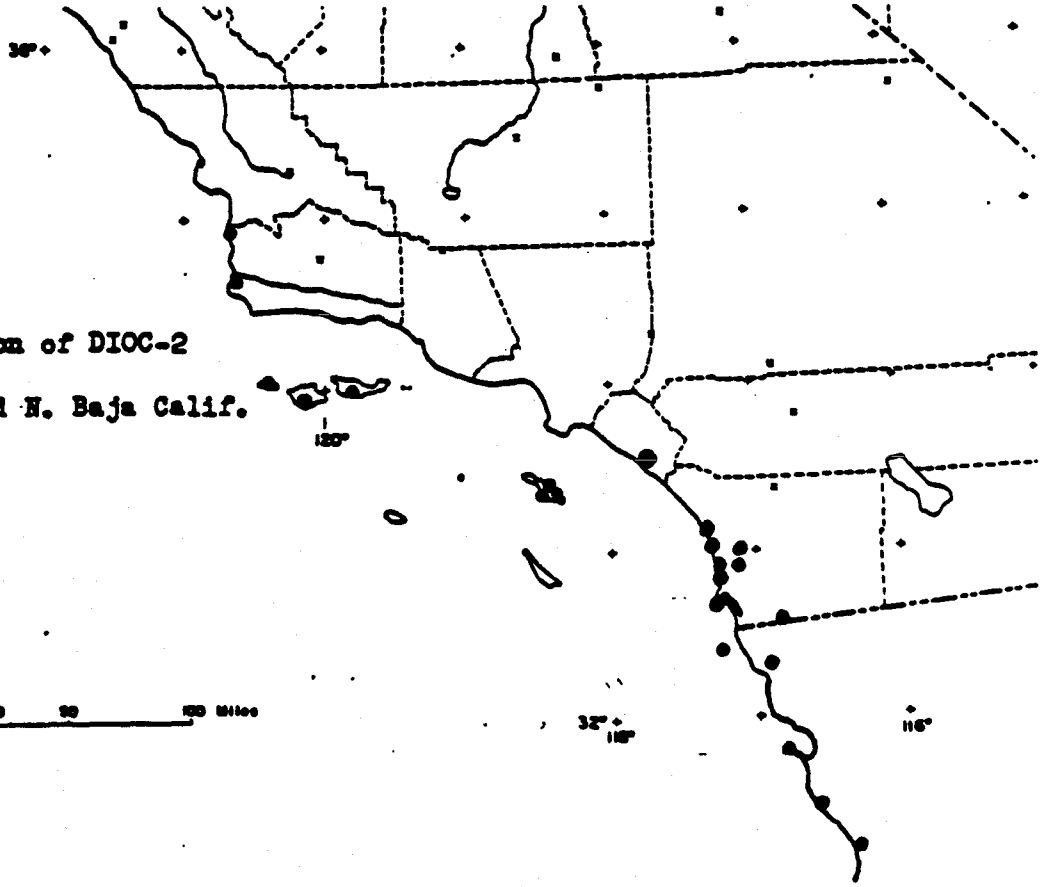
1




2

Note: Neither drawing accurately portrays the flower. (1) shows it as saucer-shaped rather than funnel-shaped, and in (2) the corolla lobes extend much less than half the length of the corolla.



Distribution of DIOC-2

S. Calif. and N. Baja Calif.

CALIFORNIA NATIVE PLANT SOCIETY — Rare Plant Status Report

Compiler: Reid Moran — Date: 1977

Name: DUDLEYA STOLONIFERA Moran
Laguna Beach Dudleya

Family: Crassulaceae: Stonecrop Family

CNPS Taxon Code: DUST

Status: CNPS (1974): 3-2-2-3 Federal Register (1976): Endangered

Synonymy and History: Dudleya stolonifera Moran (1950). Type, 23 Jun 1948, R. Moran 3095: UC.

Distribution: Type collection from near mouth of Aliso Canyon, San Joaquin Hills, Orange Co., Calif. Also known from 2 other localities: Big Bend area of Laguna Canyon and Willow Canyon near its confluence with upper Laguna Canyon. All known localities are below 1000 ft in the San Joaquin Hills of Orange Co. DUST is apparently very localized in its distribution and may occur in other areas of favorable habitat within the general region. Maps: USGS San Juan Capistrano, Laguna Beach, both 7.5'.

Description: Succulent perennial with leaves in basal rosettes from a woody, above ground base (caudex) 1.5-3 cm thick and 10 cm long or longer. Horizontal branches (stolons), up to 5 cm long and 3-8 mm thick, arise from axils of lower rosette leaves and terminate in smaller rosettes. Rosette: with 12-25 bright green leaves, 1.5-3 cm wide, 3-7 cm long, and 3-4 mm thick. Cymose inflorescences arise from axils of rosette leaves. Flowers with 5 bright yellow-green petals fused near their base, 10 stamens with partially fused filaments, and 5 ascending carpels (pistils) that separate before dehiscence (splitting to release seeds). Flowering time: May-Jul.

DUST is the only species of Dudleya normally producing lateral vegetative branches from the axils of rosette leaves. In all other species, either the caudex is unbranched and the rosette solitary, or the caudex divides dichotomously to produce two rosettes. Also, it is readily distinguished from other species of the area by its specialized habitat and by its flat leaves, which are bright green or marked with maroon, but not at all glaucous.

Habitat: Apparently DUST always grows on very steep N-facing rock surfaces that are commonly nearly vertical and sometimes even overhanging. The substrate rocks are middle Miocene sedimentaries. DUST occurs abundantly with mosses and lichens in a very thin layer of soil — often less than 1 cm deep. It is commonly the only vascular plant in this habitat though in some places it is accompanied by Polypodium californicum Kaulf., and in less steep situations by various other plants.

Endangerment Factors: Due to the inaccessibility of its habitat, DUST does not seem to be immediately threatened. As population pressure increases, intrepid plant collectors may pose some threat.

Management Suggestions: At Aliso Canyon, there have been houses at the top of the cliff and a golf course at the bottom for several years, but the DUST population seems to remain undisturbed.

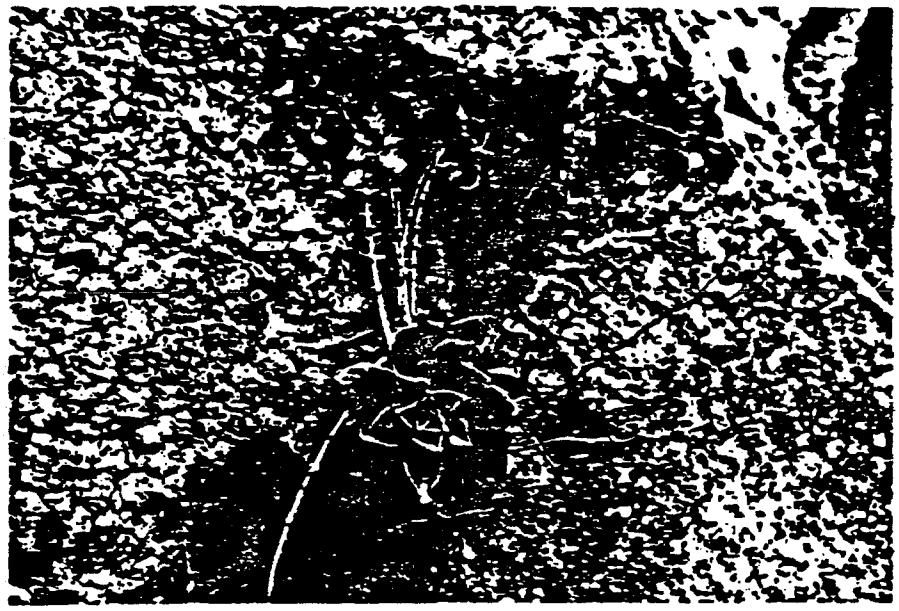
Development has also occurred at the Big Bend site and, similarly, DUST is abundant on the S canyon wall sandstone cliffs. The Willow Canyon population is located on the undeveloped Irvine Ranch. DUST appears stable at its known locations and not too likely to be threatened in the foreseeable future.

References:

Moran, R. 1950. Dudleya stolonifera, a new species from Orange County, California. Bull. S. Calif. Acad. Sci. 48:105-114. (orig. descrip., photos )
Munz, P. A. 1974. (p. 387).

Illustrations:

Colored slides by Reid Moran.



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DUMU

CALIFORNIA NATIVE PLANT SOCIETY — Rare Plant Status Report

Compiler: Reid Moran — Date: 1977

Name: DUDLEYA MULTICAULIS (Rose) Moran
Many-stemmed Dudleya

Family: Crassulaceae: Stonecrop Family

CNPS Taxon Code: DUMU

Status: CNPS (1974): 1-2-2-3 Federal Register (1976): Endangered

Synonymy and History: Hasseanthus elongatus Rose in Britton & Rose (1903), not equivalent to Dudleya elongata Rose in the same publication; Sedum elongatum (Rose) Fedde (1904), not equivalent to S. elongatum Ledebour (1830); H. variegatus (Wats.) Rose var. elongatus (Rose) Johnston (1918); S. oblongorhizum Berger (1930). Type, Jun 1901, L. R. Abrams 1785: US. H. multicaulis Rose in Britton & Rose (1903); S. multicaule (Rose) Fedde (1904), not equivalent to S. multicaule Lindley (1840); S. sanctae-monicae Berger (1930); D. multicaulis (Rose) Moran (1953). Type, Apr 1891, H. E. Hasse s.n.: US.

Distribution: Type collection from bluffs near Santa Monica, Los Angeles Co., Calif. DUMU formerly occurred at scattered localities below 2000 ft in the Los Angeles Basin, from Santa Monica to W San Bernardino and Riverside Cos., and S to N San Diego Co. It probably is gone from the western part of this range, but still persists in the southern and probably eastern parts. One specimen is labeled as being from Tehachapi, Kern Co., but the locality seems doubtful. Maps: USGS San Onofre Bluff, Laguna Beach, Prado Dam, La Habra, San Dimas, all 7.5'.

Description: Succulent perennial with leafy basal rosettes in winter and spring, flowers in the spring, but dead above ground in summer and fall. Rosettes from a thickened, upright, underground stem (corm-like caudex) 1.5-5 cm long and 3-18 mm thick. Rosette leaves 4-15 cm long, linear, 2-6 mm wide and not narrowed into petioles at the base. Cymose inflorescence arises from leaf axils and has 2 or more branches. Five bright yellow (aging paler), spreading petals are fused near base and often flecked with red. Stamens 10, 5 partially fused pistils. Flowering time: May-Jul.

DUMU is not readily confused with plants belonging to other genera, and other Dudleya species of the same area have evergreen leaf rosettes and mostly erect petals. Other members of subgenus Hasseanthus do not occur in the same area and have rosettes with leaf bases narrowed to thread-like petioles.

Habitat: DUMU grows mostly in heavy, often clayey, soils on open or grassy slopes, less commonly on cliffs.

Endangerment Factors: The habitat is obviously vulnerable to urban expansion and possibly to grazing pressure in some areas. DUMU suffers some predation by plant collectors.

Management Suggestions: DUMU is still rather widespread and under no immediate threat. It occurs in the San Onofre Hills, at Camp Pendleton in N. San Diego Co., where it is given some accidental but apparently effective protection by the U.S. Marines. It apparently is common on the Irvine Ranch in the San Joaquin Hills of Orange Co. where for the moment it is protected from development. DUMU is also locally common throughout the ecological reserve on the campus of the Univ. of Calif. at Irvine, but the future of this reserve is questionable.

References:

Berger, A. 1930. Crassulaceae. In A. Engler & K. Prantl, Nat. Pflanzen. Ed. 2. 18a:445.

Britton, M. and J. M. Rose. 1903. New or noteworthy North American Crassulaceae. Bull. New York Bot. Gdn. 3:1-45 (see pp. 37-38). (orig. descrip.)

Clausen, J., et al. 1945. The taxonomy and cytology of Hasseanthus. Desert Pl. Life 17:69-83 (see pp. 73-77).

Fedde, F. K. G. 1904. Die neuen Arten der Phanerogamen. Bot. Jahresber. 31:760-892 (see p. 828).

Johnston, I. M. 1918. A few notes on the botany of southern California. Bull. S. Calif. Acad. Sci. 17:4-66.

Moran, R. 1953. Hasseanthus, a subgenus of Dudleya. Leafl. W. Bot. 7:110.

Munz, P. A. 1974. (See pp. 386-387.)

Illustrations:

Colored slide by R. Mitchel Beauchamp.

Below reprinted from Abrams and Ferris, ILLUSTRATED FLORA OF THE PACIFIC STATES, 4 Vols., with the permission of the publishers, Stanford University Press. 

Right, from Clausen et al., 1945, where DUMU appeared as Hasseanthus elongatus.

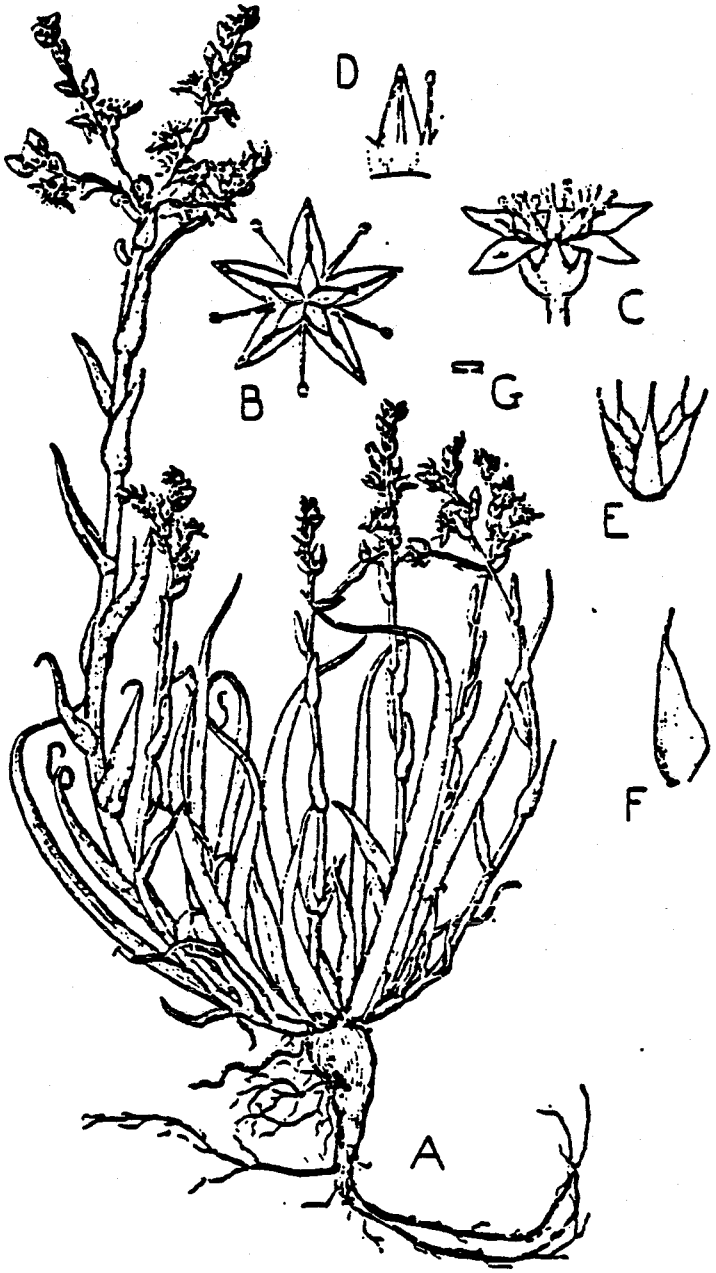
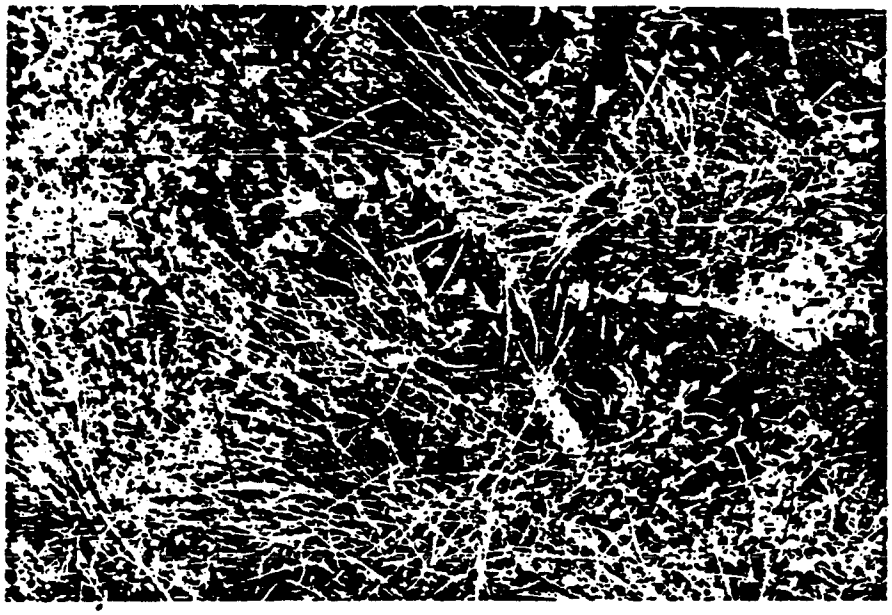



FIGURE 4. *Hasseanthus elongatus*. A, habit sketch (X3/5). B, flower from a. (X2). C, flower from side (X2). D, petal and two stamens (X2.4). E. pistil (X2.4). F, single pistil (X3.2). G, nectar scale (X8). Drawings by Miss Florence Mekeel from plant cultivated in greenhouse, Ithaca, N.Y., originally from Johnson's pasture north of Claremont, Calif.

From a colored slide by R. Mitchel Beauchamp.



CALIFORNIA NATIVE PLANT SOCIETY — Rare Plant Status Report

Compiler: Theodore Niehaus — Date: 1977

Name: HELIANTHUS NUTTALLII T. & G. ssp. PARISHII (Gray) Heiser
Los Angeles Sunflower

Family: Asteraceae (Compositae): Sunflower Family

CNPS Taxon Code: HENUP

Status: CNPS (1974): P.E.-3 Federal Register (1976): Endangered

Synonymy and History: Helianthus parishii Gray (1883); H. californicus DC. var. parishii (Gray) Jeps. (1925); H. nuttallii T. & G. ssp. parishii (Gray) Heiser (1955). Type, no date, S. B. & W. F. Parish 1025: GH. H. oliveri Gray (1885); H. parishii Gray f. oliveri (Gray) Cockerell (1918); H. californicus DC. var. oliveri (Gray) Blake in Munz (1935). Type, no date (1884?), J. C. Oliver s.n.: GH.

Distribution: Parish's type collection came from "near San Bernardino," San Bernardino Co., and Oliver's type collection from "Cienega" a railroad stop deriving its name from a Spanish Land Grant with much marshy area, between Los Angeles and Santa Monica, Los Angeles Co., Calif. Seldom collected but known from San Bernardino, Los Angeles, and Orange Cos. with the last known collection made in 1933. Elev. from near sea level to about 5000 ft. Maps: USGS Newport Beach, Big Bear Lake, Hollywood, Pasadena, Los Angele Fontana, San Bernardino South, all 7.5', the known site destroyed on most.

Description: Tribe Heliantheae. Herbaceous perennial from rhizomes with tuberous roots. Above ground stems renewed annually. Stems very tall, 2-4 m, with alternate leaves. Leaves linear-lanceolate, about 15 cm long and 30 mm wide, with soft whitish hairs and margins shallowly serrate to entire. Flower head bracts (phyllaries) linear-lanceolate, 2-3 mm wide at base, densely white-haired, and barely longer than the disk width of the flower head. Flower heads numerous, 2-5 cm wide, and with bright yellow ray flowers and yellow disk flowers. Flowering time: Aug-Oct.

H. californicus occurs within the range of HENUP, has the same habitat requirements, and is up to 5 m tall. It differs from HENUP in having greenish flower head bracts (phyllaries), with reflexed tips, bract basal width of 3-4 mm, and length much longer than disk width. All parts of H. californicus are green. Helianthus annuus is found in a different habitat and differs from HENUP in having all parts green, broadly egg-shaped leaves, and reddish disk flowers.

Habitat: Swampy or other continuously wet places.

Endangerment Factors: HENUP occurs within an area of intense urbanization and is therefore subject to the habitat-altering factors typical to such areas. Summer moist meadows, summer streams, and swampy areas are now a very rare type of habitat in its area of distribution. Oliver's "Cienega" is remembered now as the name of a major street and a municipal park.

Management Suggestions: Search area of distribution of HENUP for remaining suitable habitat sites (check all "Cienega" place names?) and check for its presence. One possible historical site still in existence is Seven Oaks, now near the Converse R.S. in San Bernardino National Forest. If HENUP is located, the site(s) should be given complete protection from any habitat-altering factors. An ecological study should be made to determine HENUP's requirements for optimum survival and these requirements should be provided.

References:

Blake, . 1935. In P. A. Munz (1935) (p. 549)

Cockerell, T. D. A. 1918. Notes on the flora of Boulder County, Colorado. Torreya 8:181.

Davidson, A. 1903. New records for Los Angeles County. Bull. So. Calif. Acad. Sci. 2:28-30 (See p. 30)

Gray, A. 1883. Characters of new Compositae, with revisions of certain genera, and critical notes. Proc. Amer. Acad. Arts 19:1-73. (orig. descrip. of H. parishii, p. 7)

-------. 1885. Gampoetalae miscellaneae. Proc. Amer. Acad. Arts 20:297-310. (orig. descrip. of H. oliveri, p. 299)

Hall, H. M. 1907. Compositae of Southern California. Univ. Calif. Publ. Bot. 3:1-302. (See p. 131-132)

Heiser, C. B. 1955. Notes on western American sunflowers (Helianthus spp.) Contr. Dudley Herb. 4:316.

----------. 1969. The North American sunflowers (Helianthus). Mem. Torrey Bot. Club 22:1-218.

Illustrations:

Colored slide of isotype specimen on deposit at UC, by Paul G. Young.

# APPENDIX B

## Annotated Check List of Birds from the Santa Ana River Marsh

by

Barbara W. Massey

Reproduced from

Environmental Report (Avifauna),
Lower Santa Ana River
Orange County, California.
U.S. Army Corps of Engineers,
Los Angeles District

1980

## Annotated Check List of Birds From the Santa Ana River Marsh

(R = Resident WR = Winter Resident WV = Winter Visitor SV = Summer Visitor M = Migrant)

| Common Name | Scientific Name | Comments |
|---|---|---|
| Eared grebe | *Podiceps caspicus* | One seen, Nov. 1972 |
| Pied-billed grebe | *Podilymous podiceps* | Regular WR, small number in saltmarsh channels |
| Double-crested cormorant | *Phalacrocorax auritus* | Regular WR, small number in saltmarsh channels |
| Great blue heron | *Ardea herodias* | Regular WR, 1-2 individuals |
| Green heron | *Butorides virescens* | Uncommon WV |
| Snowy egret | *Leucophoyx thula* | Regular WR, 1-3 individuals |
| Common egret | *Casmerodius albus* | |
| Black brant | *Branta bernicia* | One seen Nov. 1972 |
| White-fronted goose | *Answer albifrons* | One seen Nov. 1972 |
| Mallard | *Anas platyrhynchos* | R, up to 50 mingle w/domestic ducks in main channel |
| Pintail | *Anas acuta acuta* | |
| Gadwall | *Anas strepera* | Pair seen during Feb. 1980 |
| Green-winged teal | *Anas carolinensis* | WR, a few individuals |
| Cinnamon teal | *Anas cyanoptera* | WR, a few individuals |
| American widgeon | *Mareca americana* | Irregular WV, one flock of 35 in Mar. 1980 |
| Northern shoveler | *Spatula clypaeta* | One seen Mar. 1980 |
| Canvasback | *Aythya valisineria* | WR, 2-8 individuals usually seen |
| Lesser scaup | *Aythya affinis* | Irregular WV, small number |
| Bufflehead | *Bucephala albeola* | Regular WR, 3-7 individuals |
| Ruddy duck | *Oxyura jamaicensis* | Regular WR, small number |
| California brown pelican | *Pelicanus occidentalis californicus* | |

| Common Name | Scientific Name | Comments |
|---|---|---|
| Red-breasted merganser | *Mergus serrator* | WR, small flock of 5-9 |
| Turkey vulture | *Cathartes aura* | WR, occasional individual soaring over uplands |
| White-tailed kite | *Elanus leucurus* | WR, occasional individual hunting over uplands |
| Red-tailed hawk | *Buteo jamaicensis* | WR, occasional individual hunting over uplands |
| American kestrel | *Falco tinnunculus* | WR, 1-2 individuals |
| Sparrow hawk | *Falco sparverius* | |
| Ring-necked pheasant | *Phasianus colchicus* | Former R, not seen or heard in past few years |
| Light-footed clapper rail | *Rallus longirostris levipes* | Rare WV, one individual heard 2 times, spring 1979 |
| American coot | *Fulica americana* | R, up to 20 in channels and Salicornia marsh |
| Semi-palmated plover | *Charadrius semipalmatus* | Seen once, Nov. 1972, on mudflat |
| Snowy plover | *Charadrius alexandrinus* | Seen once, Jan. 1973, on mudflat |
| Killdeer | *Charadrius vociferous* | R, up to 50, probably breeds in uplands |
| Black-bellied plover | *Squatarola squatarola* | Seen once, Mar. 1980, vernal ponds, uplands |
| Common snipe | *Capella gallinago* | One flock of 9, Mar. 1980,vernal ponds, uplands |
| Long-billed curlew | *Numenius americanus* | WR, 2-6, on mudflat |
| Whimbrel | *Numenius phaeopus* | WV, seen occasionally on mudflat |
| Spotted sandpiper | *Actinis macularia* | One on mudflat, Jan. 1980 |
| Greater yellowlegs | *Totanus melanoleucus* | WR, 1-3, on mudflat, marshedges |
| Lesser yellowlegs | *Totanus flavipes* | WV, uncommon |
| Willet | *Catoptrophorus semipalmatus* | Non-breeding R, 2-40 regularly on mudflat |
| Least sandpiper | *Erolia minutilla* | WV, a few in vernal ponds, uplands |
| Dunlin | *Erolia alpina* | Former WV, no seen in past fewyears |
| Western sandpiper | *Ereunetes mauri* | Former WV, not seen in past few years |
| Sanderling | *Crocethia alba* | Former WV, not seen in past few years |

| Common Name | Scientific Name | Comments |
|---|---|---|
| Long-billed dowitcher | *Limnodromus scolopaceus* | WR, 8-50 regularly feeding on mudflat |
| Marbled godwit | *Limosa fedoa* | WR, 1-10 regularly feeding on mudflat |
| American avocet | *Recurvirostra americana* | WV, 2-4 in vernal ponds, uplands |
| Black-necked stilt | *Himantopus himantopus* | Occasional WV, to vernal ponds, uplands |
| Ring-billed gull | *Larus delawarensis* | WR, 10-100 regularly loaf on dredge spoil in marsh |
| California gull | *Larus californicus* | WV, occasionally with flock of gulls on dredge spoil |
| Bonaparte's gull | *Larus philadelphia* | WV, occasionally with other gulls on dredge spoil |
| Heerman's gull | *Larus heermanni* | Occasional early WV |
| Forster's tern | *Sterna forsteri* | WV, several terns occasionally fish in channels |
| California least tern | *Sterna albifrons browni* | Regular SV, fish in saltmarsh channels |
| Caspian tern | *Hydroprogne caspia* | WV, a few with flock of gulls on dredge spoil |
| Rock dove | *Columba livia* | Local R under highway bridge, occasional visitor to marsh |
| Mourning dove | *Zenaidura macroura* | Local R (breeds in area); flocks up to 30 in winter, uplands |
| Spotted dove | *Streptopelia chinensis* | Local R (breeds in area); small number in winter, uplands |
| Anna's hummingbird | *Calypte anna* | Local R (breeds in area), regular V to uplands |
| Belted kingfisher | *Megaceryle alcyon* | WR, 1-2 frequently fishing in marsh channels |
| Common flicker | *Colaptes auratus* | WV, an occasional user of uplands |
| Tree swallow | *Iridoprocne bicolor* | M, small flocks hawk over uplands in early spring |
| Rough-winged swallow | *Stelgidopteryx ruficollis* | M, small flocks hawk over uplands in early spring |
| Cliff swallow | *Petrochelidon pyrrhonota* | SV, often seen in spring and summer, breeds locally |
| Long-billed marsh wren | *Telmatodytes palustris* | WR, 3-8 in Salicornia marsh regularly |
| Blue gray gnatcatcher | *Polioptila caerulea* | |

| Common Name | Scientific Name | Comments |
|---|---|---|
| Mockingbird | *Mimus polyglottos* | Local R, occasional visitor to saltmarsh (breeds in area) |
| Hermit thrush | *Hylocichla guttata* | |
| Water pipit | *Anthus spinoletta* | Occasional WV, uplands |
| Ruby crowned kinglet | *Regulus calendula* | |
| Loggerhead shrike | *Lanius lodovicianus* | Local R, hunts in uplands (breeds in area) |
| Starling | *Sturnus vulgaris* | Local R, regular V to marsh uplands (breeds in area) |
| Audubon's warbler | *Dendroica auduboni* | |
| Yellowthroat | *Geothlypis trichas* | Occasional WV to Salicornia |
| House sparrow | *Passer domesticus* | Local R, Occasional visitor to uplands (breeds in area) |
| Western meadowlark | *Sturnella neglecta* | R, small number in saltmarsh and uplands, probably breeds |
| Red-winged blackbird | *Agelaius phoeniceus* | WV, occasional large flocks (100+) in uplands |
| House finch | *Carpodacus mexicanus* | Local R, feeds regularly in uplands (breeds in area) |
| American goldfinch | *Spinus tristis* | |
| Savannah sparrow (Beldings) | *Passerculus sandwichensis beldingi* | WR, small number (up to 15) regularly in Salicornia |
| White-crowned sparrow | *Zonotrichia leucophrys* | WR, flocks up to 40 regularly in Salicornia and uplands |
| Lincoln's sparrow | *Melospiza lincolnii* | WR, 2-20 seen regularly in Salicornia |
| Song sparrow | *Melospiza melodia* | R, 2-4 in high parts of marsh, probably breeds in non-native shrubs along channel |

# APPENDIX C

## Birds of the Talbert Park Extension
## Orange County, California

by


L.R. Hays. 1984. Unpublished Species List.

M.K. Allan. 1982. American Birds. 36(1):43-44

L.R. Hays. 1983a. American Birds. 37(1):38-39.

L.R. Hays. 1983b. American Birds. 37(1):93-94.

# THE BIRDS OF THE TALBERT PARK EXTENSION

AREA BOUNDARIES: Bounded on the north by Victoria Street and adjoining residential development; on the east by W. Balboa Blvd. and adjacent housing lying to the north; on the south by the northern boundary of the Banning oil fields; on the west by the Banning Flood Control Channel.

HABITAT ENCOMPASSED: Coastal floodplain with permanent and seasonal ponds and willow forest.

PUBLISHED REFERENCES : American Birds 37:1, January-February, 1983; p. 38 (Winter Bird Count # 37), p. 93 (Breeding Bird Census # 151). American Birds 36:1, January, 1982; p. 43 (Winter Bird Count # 61).

RESEARCHERS/VERIFICATION: Sea and Sage Audubon Society and Departments of Biology; California State University, Long Beach, and California State University, Fullerton.

PREPARED BY: Loren R. Hays, Graduate Student in Ornithology, California State University, Long Beach, and Director, Sea and Sage Audubon Society. My special thanks to Dr. Charles Collins And Dr. Greayer Mansfield-Jones (California State University, Long Beach); Karla Kramer (California State University, Fullerton) and Betty Powers, Ned Harris, Richard Hallowell, Steve Ganley, Phil Swan, Doug Willick, Arleta Patterson, Sylvia Ranney, Sam and Jane Berry, Jonathan Schiesel, Debra Hays, Brian Daniels, and Bev McIntosh for their valuable field work and/or expertise.

LEGEND: S- Spring; Su-Summer; F- Fall; W-Winter; M- a species which migrates in spring and/or fall and is not generally found in the plot in summer or winter; X- a species which has been seen only once or during one period in the plot and is not expecte to be a regular visitor; underlined species are listed as endangered by the appropriate state and/or federal wildlife agency species may be found-at least occasionally- throughout plot unless a habitat preference is stated. Breeds- strong evidence exists (nests, nestlings, fledglings etc.) that species breeds within boundaries of plot.

NOTE: Several species which have been observed flying over the pl have not been included in this list; it was assumed that these species were not actively foraging while passing through. The endangered California Brown Pelican (state and federal listed) is included in this category. This species is, however a regular, year-round visitor to the adjacent Santa Ana River Channel from the Victoria Street Bridge south to the river mouth.

L.R. Hays. 1984. Unpublished Species List.

TALBERT PARK EXTENSION- BIRD SPECIES LIST (ANNOTATED) 3/7/84

Red-throated Loon. W visitor. Ponds.
Horned Grebe. W visitor. Ponds.
Eared Grebe. S visitor. Ponds
Western Grebe. F, W visitor. Ponds.
Pied-billed Grebe. Breeds, year-round resident. Ponds.
California Brown Pelican. W visitor. Ponds. Federal and state l
Double-Crested Cormorant. Year-round visitor. Ponds and vicinity.
Green-backed Heron. Year-round visitor. Ponds, wet areas.
Great Egret. S, F, W visitor. Ponds and vicinity.
Snowy Egret. S, F, W visitor. Ponds and vicinity.
Great Blue Heron. S, F, W visitor. Ponds and vicinity.
Black-crowned Night Heron. S, F, W visitor. Ponds and vicinity.
White-faced Ibis. M (S). Ponds and vicinity.
Brant. Su visitor. Ponds and vicinity.
Mallard. Year-round visitor. May breed. Ponds and vicinity.
American Wigeon. S, F, W visitor. Ponds and vicinity.
Northern Pintail. S, F, W visitor. Ponds and vicinity.
Northern Shoveler. S, F, W visitor. Ponds and vicinity.
Cinnamon Teal. S, F, W visitor. Ponds and vicinity.
Canvasback. W visitor. Ponds and vicinity.
Green-winged Teal. W visitor. Ponds and vicinity.
Lesser Scaup. S, F, W visitor. Ponds and visitor.
Ruddy Duck. Year-round visitor. Ponds and vicinity.
Turkey Vulture. Year-round visitor.
Osprey. Year-round visitor. May breed nearby.
Northern Harrier. S, F, W visitor.
Sharp-Shinned Hawk. S, F, W visitor. Willow forest.
Cooper's Hawk. S, F, W visitor.
Red-shouldered Hawk. Breeds in willow forest, year-round reside
Red-tailed Hawk. Breeds nearby, year-round resident.
Rough-legged Hawk. X, winter of 80-81.
Black-shouldered Kite. Breeds in willow forest, year-round resident
American Kestrel. Year-round visitor, may breed nearby.
Peregrine Falcon. W visitor. Federal and state listed.
Prairie Falcon. W visitor.
Virginia Rail. S, F, W visitor. May not occur now (marsh destroy
Sora. S, F, W visitor. Ponds and vicinity, wet areas.
American Coot. Year-round visitor, may breed. Ponds and vicinity.
Common Moorhen. W visitor. Ponds.
Black-necked Stilt. Breeds near ponds, year-round resident.
American Avocet. Breeds near ponds, year-round resident.
Black-bellied Plover. S, F, W visitor. Ponds and vicinity.
Semipalmated Plover. S, F, W visitor. Ponds and vicinity.
Killdeer. Year-round visitor, may breed.
Greater Yellowlegs. S, F, W visitor. Ponds and vicinity.
Lesser Yellowlegs. M (S). Ponds and vicinity.
Willet. S, F, W visitor. Ponds and vicinity.
Marbled Godwit. S, F, W visitor. Ponds and vicinity.
Whimbrel. M (S). Ponds and vicinity.
Western Sandpiper. S, F, W visitor. Ponds and vicinity.
Least Sandpiper. S, F, W visitor. Ponds and vicinity.
Spotted Sandpiper. S,F, W visitor. Ponds and vicinity.
Common Snipe. W visitor. Wet areas.
Long-billed Dowitcher. S, F, W visitor. Ponds and vicinity.
Short-billed Dowitcher. S, F, W visitor. Ponds and vicinity.

SPECIES LIST (ANNOTATED)
(CONTINUED)

Red-necked Phalarope. M (S). Ponds.
Black-headed Gull. W visitor. Ponds and vicinity.
Little Gull. X, Winter of 1980-1981. Ponds and vicinity.
Mew Gull. W visitor. Ponds and vicinity.
Ring-billed Gull. Year-round visitor. Ponds and vicinity.
California Gull. S, F, W Visitor. Ponds and vicinity.
Western Gull. Year-round visitor. Ponds and vicinity.
Caspian Tern. Year-round visitor. Ponds and vicinity.
Forster's Tern. Year-round visitor. Ponds and vicinity.
California Least Tern. Breeds nearby. Ponds and vicinity.
State and federal listed. Present S-Su.
Burrowing Owl. May breed, year-round resident. Declining.
Great Horned Owl. F,W visitor. Willow forest.
Mourning Dove. Breeds in willow forest, year-round resident.
Spotted Dove. May breed, year-round visitor.
Black-chinned Hummingbird. Breeds in willows, present S-Su.
Rufous Hummingbird. M (S).
Allen's Hummingbird. Breeds in willow forest, present year-round.
Anna's Hummingbird. Breeds in willow forest, present year-round.
Belted Kingfisher. Year-round visitor.
Nuttall's Woodpecker. S, F, W visitor. Willow forest.
Downy Woodpecker. F, W visitor. Willow forest.
Common Flicker. Year-round visitor.
Western Wood Pewee. M (S, F). Willow forest.
Olive-sided Flycatcher. M (S, F). Willow forest.
Willow Flycatcher. M (S).
Hammond's/Dusky Flycatcher. M (S, F). Willow forest.
Western Flycatcher. M (S, F). Willow forest.
Cassin's Kingbird. S visitor.
Black Phoebe. May breed, year-round resident.
Say's Phoebe. S, F, W visitor.
Ash-throated Flycatcher. S, F, W visitor.
Rough-winged Swallow. Breeds nearby, present S-Su-F.
Cliff Swallow. Breeds nearby, present S-Su-F.
Barn Swallow. S, Su, F visitor.
Tree Swallow. M (S, F).
American Crow. Year-round visitor.
Common Raven. Year-round visitor.
Plain Titmouse. S visitor. Willow forest.
Bushtit. Breeds in willow forest, present year-round.
Bewick's Wren. S, F, W visitor.
House Wren. F, W visitor. Willow forest.
Marsh Wren. S, F, W visitor. Formerly in marsh; ponds.
Northern Mockingbird. Year-round resident, may breed.
Swainson's Thrush. M (S, F). Willow forest.
Hermit Thrush. S, F, W visitor. Willow forest.
Varied Thrush. W visitor. Willow forest.
Golden-crowned Kinglet. W visitor. Willow forest.
Ruby-crowned Kinglet. S, F, W visitor. Willow forest.
Blue-Gray Gnatcatcher. S, F, W visitor.
Water Pipit. W visitor.
Cedar Waxwing. W visitor. Willow forest.
Loggerhead Shrike. Year-round visitor.
Solitary Vireo. M (S, F). Willow forest.
Hutton's Vireo. F, W visitor. Willow forest.
Warbling Vireo. M (S, F). Willow forest.

SPECIES LIST (ANNOTATED)
(CONTINUED)

Orange-crowned Warbler. S, F, W visitor. Willow forest.
Nashville Warbler. M (S). Willow forest.
Yellow Warbler. M (S). Willow forest.
Yellow-rumped Warbler. (Two races). S, F, W visitor.
Black-throated Gray Warbler. M (S, F)
Black-throated Green Warbler. W visitor. Willows. 1st date: 12/2[illegible]3
Townsend's Warbler. S, F, W visitor. Willow forest.
Common Yellowthroat. Breeds throughout, year-round resident.
Hermit Warbler. M (S, F). Willow forest.
Black and White Warbler. S, F, W visitor. Willow forest.
MacGillivray's Warbler. M (S, F).
Wilson's Warbler. S, F, W visitor. Willows.
Canada Warbler. X, 9/24/81. Willow forest.
American Redstart. S, F, W visitor. Willow forest. → AND WINTER OF 1983-198[illegible]
Yellow-breasted Chat. M (S). Willow forest.
Western Tanager. S, F, W visitor. Willow forest.
Rose-breasted Grosbeak. X, fall of 1981. Willow forest.
Black-headed Grosbeak. Breeds in willow forest. Present S-Su.
Lazuli Bunting. M (F). Willow forest.
Song Sparrow. Breeds throughout, year-round resident.
Fox Sparrow. F, W visitor. Willow forest.
Lincoln's Sparrow. F, W visitor.
Savannah Sparrow. F, W visitor. May include Belding's race (state-listed endangered subspecies).
White-crowned Sparrow. (Two races). S, F, W visitor.
Golden-crowned Sparrow. F, W visitor.
Green-tailed Towhee. W visitor.
Rufous-sided Towhee. F, W visitor.
Brown Towhee. May breed (or breeds nearby), year-round resident.
Northern Oriole. Breeds in willow forest, year-round resident.
Red-winged Blackbird. May have bred, year-round visitor.
Western Meadowlark. Breeds, year-round resident.
Brewer's Blackbird. Year-round visitor.
Brown-headed Cowbird. Breeds, year-round visitor.
American Goldfinch. Breeds, year-round resident.
Lesser Goldfinch. Breeds, year-round resident.
House Finch. Breeds, year-round resident.
Rock Dove. Year-round visitor.
European Starling. Year-round visitor.
Ring-necked Pheasant. Year-round resident; may now be extirpated.
House Sparrow. Year-round visitor.

SUMMARY

TOTAL SPECIES: 153
TOTAL BREEDING SPECIES: 18. 8 additional species may breed on the plot, 7 species breed (or may breed) nearby or may have bred on the plot in the past.
HABITAT UTILIZATION: 51 species prefer ponds and environs, 37 species prefer willow forest, 65 species are associated with more than one habitat.
ENDANGERED SPECIES ACT: Three species found in described area qualify for treatment under the Endangered Species Act; an additional state and federal listed species is found nearby; one additional state-listed endangered subspecies may be present.
ADDITIONAL SPECIES: Red-breasted Merganser (ponds), American Robin, and Swamp Sparrow, all winter visitors, 1983-1984./

M.K. Allan. 1982

American Birds. 36(1):43-44

61. YOUNG RIPARIAN WOODLAND AND POND. — Location: California: Orange Co., Costa Mesa, Victoria Pond. SE corner of Brookhurst and Hamilton (= Victoria St.), 33°39'N 117°57'W, Newport Beach Quadrangle. Continuity: New. Size: 6.3 ha = 13 acres. Description of Plot: A temporary county fence marks the perimeter of the plot, somewhat rectangular. Following the perimeter is a single row of Mulefat *(Baccharis glutinosa)* and a denser scattering of Mulefat in the SE corner; 40% coverage. Interspersed with the Mulefat are less than 20 young wilows *(Salix spp.* including *S. laevigata)*. Two clusters are up to 20 ft tall in the SE corner. The remainder, 8-15 ft, are evenly distributed around the perimeter. There is no canopy. To the N a brackish pond occupies 6 acres with one dense and three small patches of California Bulrush *(Scirpus californicus)* at its edge. The S bank of the pond is free of vegetation and opens into an unsheltered S area within the *Baccharis* border. This area was dry wetland during most of the count but a shallow pond was formed by the rain of Jan. 28 to make the total area of water about 8 acres (not continuous). Partly covering the wetland area is Pickleweed *(Salicornia virginica)* comprising 25% of the total plot. Among the Mulefat near the fence there is a 7% covering of Australian Saltbush *(Atriplex semibaccata)* with other mixed vegetation, including Tamarisk *sp.*. Tree Tobacco *(Nicotiana glauca)*, Cocklebur *(Xanthium strumarium)* and Pampas Grass *(Cortaderia atacamensis)*. Inside the S border of Mulefat along the edge of wetland are dense patches of California Bulrush interspersed with cattail *(Typha sp.)* and Sedge *(Scirpus robustus)*. Topography: Flat; mean elevation 3.5 ft. Edge: Greenville-Banning Channel parallels the W edge of the plot, which is directly bordered by the Santa Ana River. N is 4-lane Victoria St; E is a dirt road bordered by upland cliff of ruderal and coastal sage scrub vegetation. S is an extensive meadow; 1200 ft. SE is a mature riparian habitat bordered on the E by new urban development. Food: *Baccharis* flowers, Pacific Treefrog *(Hyla regilla)*, Beechey Ground Squirrel *(Citellus beecheyi)*, small mice, cottontail rabbits, turtles fish, flying insects. Weather: Unusually warm and dry Dec. to mid-Jan.; up to 90°F. Average high during count was 64°, average low 53°, range 45°-68°. Total rainfall for the count was 0.59 in. Coverage: Jan. 18-21, 23-24, 26-27, 29, 31. Total: 10 trips; 0800-1645; average 88 min. Count: Bonaparte's Gull, 425 (8078, 3269); Bushtit, 27 (513, 208); Am. Coot, 15 (285, 115); Pintail, 9 (171, 69); Ruddy Duck, 9; unidentified imm. gulls, 9; White-crowned Sparrow, 9; Am. Wigeon, 8 (152, 62); Canvasback, 8; Song Sparrow, 8; Ring-billed Gull, 4 (76, 31); Anna's Hummingbird, 4; Cinnamon Teal, 3 (57, 23); N. Shoveler, 3; Lesser Scaup, 3; Blue-gray Gnatcatcher, 3; Yellow-rumped Warbler, 3; Com. Yellowthroat, 3; House Finch, 3; Com. Crow, 2 (38, 15); Pied-billed Grebe, 1 (19, 8); Double-crested Cormorant, 1; Great Egret, 1; Black-crowned Night Heron, 1; Gadwall, 1; Green-winged Teal, 1; Red-breasted Merganser, 1; Turkey Vulture, 1; Killdeer, 1; Marbled Godwit, 1; Black-necked Stilt, 1; Mew Gull, 1; Mourning Dove, 1; Black Phoebe, 1; Say's Phoebe, 1; Ruby-crowned Kinglet, 1; Great Blue Heron, +; Green Heron, +; Snowy Egret, +; White-tailed Kite, +; Sharp-shinned Hawk, +; Cooper's Hawk, +; Rough-legged Hawk, +; Marsh Hawk, +; Am. Kestrel, +; Willet, +; dowitcher sp., +; W. Gull, +; Forster's Tern, +; Caspian Tern, +; Belted Kingfisher, +; House Wren, +; Hermit Thrush, +; Loggerhead Shrike, +; Red-winged Blackbird, +; Green-tailed Towhee, +. Average Total: 574 birds (10,910/km², 4415/100 acres). Remarks: Total species, 54. The gull counts are a modest approximation as the Bonaparte's Gulls constantly flew in and out between the large pond and the adjacent Santa Ana River, with a few other gulls mixed within the large flocks. Ruddy Ducks and Canvasbacks remained consistent; other ducks varied in number each day. A few Pintails were present most counts but a single count of 42 weighted the average. A small flock of Great Egret, Black-crowned Night Heron, Red-breasted Merganser, Gadwall, and Black-necked Stilt were observed on single counts only. Egrets often flew outside the boundaries but only once flew directly over the plot. Black-crowned Night Herons flew over and circled the pond but did not land. The shallow new S pond attracted Black-necked Stilts, a Willet, and Killdeer.—*MARY K. ALLAN, Dept. of Biology, California State Univ., Long Beach, and 501 1/2 Walnut Ave., Huntington Beach, CA 92648.*

**37. DISTURBED COASTAL FLOODPLAIN.** — **Location:** California; Orange Co., 1 mi NE of Santa Ana River mouth; 33°38'45"N, 117°56'50"W, Newport Beach Quadrangle, USGS. **Continuity:** New. **Size:** 9.7 ha = 24 acres (trapezoidal in shape, N base 430 ft, S base 860 ft, measured by calibrated pace), elev. 1620 ft. **Description of Plot:** A disturbed, heterogeneous, low-lying plot with mixed habitats. Surface runoff from outlying areas and storm sewers provides variable fresh water source. A small (1 acre) marsh is located along the N border of the plot and consists of cattail (*Typha* sp.) and sedge (*Cyperus oderatus*). The balance of the plot is, to varying extents, flooded subsequent to winter rains. Approximately 6 acres (25%) is dominated by immature willows (*Salix* sp.); most of the trees are concentrated in the SW quadrant and form a relatively continuous vegetation. The trees range from 10 to 30 ft in height; most are 15-25 ft. DBH ranges less than 1 in. to 12 in.; average of 4.5 in. Understory almost entirely Pampasgrass (*Cortaderia* sp.); cover ranges from sparse to dense. SE and S central 6 acres dominated by dense association of Cocklebur (*Xanthium strumarium*), *C. oderatus*, various grasses and Asteraceae herbs; Mulefat (*Baccharis glutinosa*), Castor Bean (*Ricinus communis*), and *Cortaderia* scattered throughout. E. central (5 ± acres) is highly disturbed and partially barren; otherwise covered by low forbs and grasses and widely scattered *Haplopappus venetus* shrubs. N sector (exclusive of marsh) consists of dense (impassable) to scattered tussocks of *Cortaderia*, extensive *Cyperus*, isolated stands of bamboo, and representatives of most of the other species previously mentioned. Edge: The S edge is defined by a fence and telephone poles (more disturbed floodplain-oil field beyond); E edge is W. Balboa Blvd. (residential area and small park beyond); N edge is a dirt road (bluffs and residential area beyond); W edge is similar to, but drier than, non-willow associations described previously. Topography: Elevation range 5-20 ft, 5-10 ft. and imperceptible slope if extreme E edge is excluded. Water: Maximum depth of standing water 16 in.; average depth 3 in. Food: Insect, other invertebrate, frog, lizard and small mammal populations large and diverse; good plant food crop. Weather: Temperature range: 44-67°F; avg low, 49°; avg high, 63°. Heavy rain prior to start of count; trace amounts during actual count period. Winter rainfall well below seasonal average. Six count days with little or no wind; two days with moderate to high (10-30 mph) winds. Skies ranged from clear (3 days) to overcast (1 day). Coverage: Jan. 7, 10-12, 14-15, 19, 25; first 6 counts 0825-1235; last 2 1330-1605. Eight counts averaging 2.6 hrs each. Count: Song Sparrow, 19 (196, 79); Bushtit 16 (165, 67); Anna's Hummingbird, 10 (103, 42); Ruby-crowned Kinglet, 10; Yellow-rumped Warbler, 8 (82, 33); Com. Yellowthroat, 7 (72, 29); Blue-gray Gnatcatcher, 6 (62, 25); House Finch, 4 (41, 17); Lesser Goldfinch, 4; Hermit Thrush, 3 (31, 13); Townsend's Warbler, 3; Red-tailed Hawk, 2 (21, 8); Orange-crowned Warbler, 2; Red-winged Blackbird, 2; White-crowned Sparrow, 2; Turkey Vulture, 1 (10, 4); White-tailed Kite, 1; Red-shouldered Hawk, 1; Sora, 1; Com. Snipe, 1; Com. Flicker, 1; Black Phoebe, 1; Com. Crow, 1; Long-billed Marsh Wren, 1; Black-and-white Warbler, 1; Am. Redstart, 1; W. Meadowlark, 1; Am. Goldfinch, 1; Lincoln's Sparrow, 1; Sharp-shinned Hawk, +; Cooper's Hawk, +; Marsh Hawk, +; Virginia Rail, +; Mourning Dove, +; Belted Kingfisher, +; Say's Phoebe, +; Bewick's Wren, +; Loggerhead Shrike, +; Hutton's Vireo, +; N. (Bullock's) Oriole, +; Brown Towhee, +. **Average Total:** 112 birds (1153/km², 467/100 acres). **Remarks:** Total species, 41. Numerous flyovers noted but not included: ducks, gulls, Rock Doves and Starlings (several times each); Com. Ravens and Greater Yellowlegs (once each). Burrowing Owls (maximum of 2) were observed on 3 occasions just to N of plot boundary. A disproportionately high number of species were found in the willows; density projections of some species may thus be affected. The Townsend's Warblers, Black-and-white Warbler, and Am. Redstart were found exclusively in the SW willow forest; the latter two species are of casual occurrence in coastal California. Bushtits may have been induced to cross plot boundaries by "pishing" and squeaking techniques. Singing So Sparrows were quite conspicuous d morning count periods but were much h to locate in afternoon counts. The coun represents increasingly rare open space in coastal Orange County. Although disturb a large part of the plot provides excell escape and feeding cover for a tremendous variety of animal species. While generally destructive, human activity in the ar nevertheless minimal.—*LOREN R. HA Dept. of Biology, Calif. St. Univ., L Beach, and 21661 Brookhurst # 109, Huntington Beach, CA 92646.*

L.R. Hays. 1983a. American Birds. 37(1):38-39.

**151. DISTURBED COASTAL FLOODPLAIN.** — **Location:** California; Orange Co., 1 mi NE of Santa Ana River mouth; 33°38'45"N, 117°56'50"W, Newport Beach Quadrangle, USGS. **Continuity:** New. **Size:** 9.7 ha = 24 acres. **Description of Plot:** See 1982 Winter Bird-Population Study, this issue p. 38. Important plant cover species not previously identified: Curly Dock *(Rumex crispus)*, Ox-Tongue *(Picris echioides)*, Wild Radish *(Raphanus sativus)*, and Rush (*Juncus* sp.). **Weather:** Temperature range 52-72°F; early mornings typically overcast; winds light to moderately high; 2 light rains. **Coverage:** Apr. 17, 20, 24-25; May 5, 8-9, 11; 0545-0905. **Total man-hours:** 17. **Census:** Song Sparrow, 24 (247, 100); Com. Yellowthroat, 14 (144, 58); Anna's Hummingbird, 6 (62, 25); Mourning Dove, 5 (51, 21); Am. Goldfinch, 5; Black-chinned Hummingbird, 4 (41, 17); Allen's Hummingbird, 3 (31, 13); Red-winged Blackbird, 3; Brown-headed Cowbird, 3; N. Oriole, 2; Black-headed Grosbeak, 2; Lesser Goldfinch, 2; White-tailed Kite, 1; W. Meadowlark, 1; Brown Towhee, +. **Total:** 15 species; 75 territorial males or females (772/km², 313/100 acres). **Visitors:** Green Heron, Red-tailed Hawk, Red-shouldered Hawk, Cooper's Hawk, Spotted Dove, Black Phoebe, Rough-winged Swallow, Com. Crow, Bushtit, European Starling, House Finch. **Remarks:** Nests found: Black-chinned Hummingbird (2); Mourning Dove, Allen's Hummingbird. Song Sparrow count may not be representative; territorial, singing males first observed in January. Majority (all?) of Anna's Hummingbirds may have finished breeding before census began. Nesting of Allen's Hummingbirds has only recently (1979) been documented for Orange County; a southward expansion of breeding range may be indicated. The vast majority of 30 + Bushtits remained in large flocks throughout census; no nesting activity was observed. This species has bred on the plot in past years. Goldfinch activity may have peaked after census was concluded. Western migrants well represented; food crop excellent. Vandalistic destruction of willows seems to be increasing.—*LOREN R. HAYS, 21661 Brookhurst #109, Huntington Beach CA 92646.*

L.R. Hays. 1983b. American Birds. 37(1):93-94

APPENDIX D

# Birds of Upper Newport Bay

by

H.W. Frey, R.F. Hein & J.L. Spruill

Reproduced From

National Resources of Upper Newport Bay
Coastal Wetland Series No. 1
California State Dept. Fish & Game.

1970

# BIRDS OF UPPER NEWPORT BAY

These species are known to occur in or adjacent to Upper Newport Bay.

KEY

A = Abundant
C = Common
U = Uncommon
O = Occasional
R = Rare
V = Vagrant

* = Breeding birds (known or presumed)
† = Expected loss with dredging and bulkheading.
Ø = Breed in adjacent freshwater marsh.
‡ = Marsh breeders (salt or fresh/ brackish)

## Shorebirds

| | | |
|---|---|---|
| Semipalmated plover † | *Charadrius semipalmatus* | C |
| Snowy plover * † | *Charadrius alexandrinus* | U |
| Killdeer * † | *Charadrius vociferus* | C |
| American golden plover † | *Pluvialis dominica* | V |
| Black-bellied plover † | *Squatarola squatarola* | C |
| Ruddy turnstone † | *Arenaria interpres* | U |
| Black turnstone † | *Arenoria melanocephala* | R |
| Common snipe † | *Capella gallinago* | O |
| Long-billed curlew † | *Numenius americanus* | C |
| Whimbrel † | *Numenius phaeopus* | U |
| Spotted sandpiper † | *Actitis macularia* | O |
| Solitary sandpiper † | *Tringa solitaria* | O |
| Willet † | *Catoptrophorus semipalmatus* | A |
| Greater yellowlegs † | *Totanus melanoleucus* | C |
| Lesser yellowlegs † | *Totanus flavipes* | O |
| Knot † | *Calidris canutus* | U |
| Pectoral sandpiper † | *Erolia melanotos* | R |
| Baird's sandpiper † | *Erolia bairdii* | R |
| Least sandpiper † | *Erolia minutilla* | C |
| Dunlin † | *Erolia alpina* | C |
| Short-billed dowitcher † | *Limnodromus griseus* | A |
| Long-billed dowitcher † | *Limnodromus scolopaceus* | U |
| Western sandpiper † | *Ereunetes mauri* | A |
| Marbled godwit † | *Limosa fedoa* | A |

| | | |
|---|---|---|
| Louisiana heron † | *Hydranassa tricolor* | R |
| Little blue heron † | *Florida caerulea* | V |
| Black-crowned night heron † | *Nycticorax nycticorax* | C |
| American bittern † | *Botaurus lentiginosus* | U |
| White-faced ibis † | *Plegadis chihi* | V |
| American flamingo † | *Phoenicopterus ruber* | V |

Gulls and terns

| | | |
|---|---|---|
| Glaucous-winged gull | *Larus glaucescens* | U |
| Western gull | *Larus occidentalis* | C |
| Herring gull | *Larus argentatus* | C |
| California gull | *Larus californicus* | A |
| Ring-billed gull | *Larus delawarensis* | A |
| Mew gull | *Larus canus* | U |
| Bonaparte's gull | *Larus philadelphia* | C |
| Heermann's gull | *Larus heermanni* | C |
| Gull-billed tern | *Gelochelidon nilotica* | |
| Forster's tern | *Sterna forsteri* | A |
| Common tern | *Sterna hirundo* | U |
| Arctic tern | *Sterna paradisaea* | |
| Least tern * † | *Sterna albifrons* | |
| Royal tern | *Thalasseus maximus* | |
| Elegant tern | *Thalasseus elegans* | |
| Caspian tern | *Hydroprogne caspia* | |
| Black tern | *Chlidonias niger* | |

Swans

| | |
|---|---|
| Whistling swan † | *Olor columbianus* |

Geese

| | |
|---|---|
| Canada goose † | *Branta canadensis* |
| Black brant † | *Branta nigricans* |
| White-fronted goose † | *Anser albifrons* |
| Snow goose † | *Chen hyperborea* |

| | | |
|---|---|---|
| **Surface ducks** | | |
| Mallard * † | *Anas platyrhynchos* | C |
| Gadwall † | *Anas strepera* | U |
| Pintail * † | *Anas acuta* | A |
| Common teal † | *Anas crecca* | V |
| Green-winged teal † | *Anas carolinensis* | C |
| Blue-winged teal † | *Anas discors* | O |
| Cinnamon teal † | *Anas cyanoptera* | C |
| European widgeon † | *Mareca penelope* | U |
| American widgeon † | *Mareca americana* | A |
| Shoveller † | *Spatula clypeata* | C |
| **Diving ducks** | | |
| Redhead | *Aythya americana* | O |
| Ring-necked duck | *Aythya collaris* | O |
| Canvasback | *Aythya valisineria* | O |
| Greater scaup | *Aythya marila* | V |
| Lesser scaup | *Aythya affinis* | C |
| Common goldeneye | *Busephala clangula* | O |
| Bufflehead | *Bucephala albeola* | V |
| White-winged scoter | *Melanitta deglandi* | U |
| Common scoter | *Oidemia nigra* | U |
| Surf scoter | *Melanitta perspicillata* | A |
| **Stiff-tailed ducks** | | |
| Ruddy duck * † | *Oxyura jamaicensis* | C |
| **Mergansers** | | |
| Hodded merganser | *Lophodytes cucullatus* | R |
| Common merganser | *Mergus merganser* | O |
| Red-breasted merganser | *Mergus serrator* | C |
| **Vultures** | | |
| Turkey vulture | *Cathartes aura* | C |

Hawks, falcons, and eagles

| | | |
|---|---|---|
| White-tailed kite * | *Elanus leucurus* | U |
| Sharp-shinned hawk | *Accipiter striatus* | U |
| Cooper's hawk * | *Accipiter cooperii* | U |
| Red-tailed hawk * | *Buteo jamaicensis* | C |
| Swainson's hawk | *Buteo swainsoni* | R |
| Rough-legged hawk | *Buteo lagopus* | R |
| Golden eagle | *Aquila chrysaetos* | R |
| Marsh hawk | *Circus cyaneus* | U |
| Osprey | *Pandion haliaetus* | R |
| Peregrine falcon | *Falco peregrinus* | R |
| Sparrow hawk * | *Falco sparverius* | C |

Birds occurring in the immediate areas adjacent to Upper Newport Bay.

| | | |
|---|---|---|
| Ring-necked pheasant * | *Phasianus colchicus* | U |
| California quail * | *Lophortyx californicus* | C |
| Mourning dove * | *Zenaidura macroura* | A |
| Spotted dove * | *Streptopelia chinensis* | O |
| Roadrunner * | *Geococcyx californianus* | R |
| Barn owl * | *Tyto alba* | C |
| Burrowing owl * | *Steotyto cunicularia* | C |
| Short-eared owl * | *Asio flammeus* | U |
| Anna's hummingbird * | *Calypte anna* | A |
| White-throated swift * | *Aeronautes saxatalis* | U |
| Belted kingfisher * † | *Megaceryle alcyon* | U |
| Red-shafted flicker * | *Colaptes cafer* | C |
| Western kingbird * | *Tyrannus verticalis* | U |
| Black phoebe * † | *Sayornis nigricans* | U |
| Horned lark * | *Eremophila alpestris* | C |
| Cliff swallow * | *Petrochelidon pyrrhonota* | C |
| Common crow * | *Corvus brachyrhynchos* | C |
| Common bushtit * | *Psaltriparus minimus* | C |
| Cactus wren * | *Campylorhynchus brunneicapillum* | R |
| Long-billed marsh wren * † ‡ | *Telmatodytes palustris* | U |

# APPENDIX E

## Birds of Bolsa Chica Lowlands

by

Gerald Collier

Reproduced From

An Environmental Evaluation of
the Bolsa Chica Area
Dillingham Environmental Co.

1971

# BIRDS OF BOLSA CHICA

| Scientific Name | Common Name |
|---|---|
| Anas acuta | Pintail |
| Anas cyanoptera | Cinnamon teal |
| Anas platyrhynchos | Mallard (duck) |
| Ardea herodias | Great blue heron |
| Arenaria interpres | Ruddy turnstone |
| Buteo jamaicensis | Red-tailed hawk |
| Butorides virescens | Green heron |
| Calidris canutus | Knot |
| Calypte anna | Anna's hummingbird |
| Carpodacus mexicanus | House finch |
| Casmerodius albus | Common egret |
| Cathartes aura | Turkey vulture |
| Catoptrophorus semipalmatus | Willet |
| Charadrius alexandrinus | Snowy plover |
| Charadrius semipalmatus | Semipalmated plover |
| Charadrius vociferus | Killdeer |
| Childonias niger | Black tern |
| Circus cyaneus | Marsh hawk |
| Colaptes cafer | Red-shafted flicker |
| Columba livia | Rock dove |
| Corvus brachyrhynchos | Common crow |
| Corvus corax | Common raven |
| Crocethia alba | Sanderling |
| Empidonax difficilis | Western flycatcher |
| Ereunetes mauri | Western sandpiper |
| Erolia alpina | Dunlin |
| Erolia minutilla | Least sandpiper |
| Euphagus cyanocephalus | Brewer's blackbird |
| Falco spaverius | Sparrow hawk |
| Fulica americana | American coot |

## BIRDS OF BOLSA CHICA (Continued)

| Scientific Name | Common Name |
|---|---|
| Himantopus maxicanus | Black-necked stilt |
| Hirundo rustica | Barn swallow |
| Hydroprogne caspia | Caspian tern |
| Lanius ludovicianus | Loggerhead shrike |
| Larus delawarensis | Ring-billed gull |
| Larus heermanni | Heermann's gull |
| Larus occidentalis | Western gull |
| Larus philadelphia | Bonaparte's gull |
| Leucophoyx thula | Snowy egret |
| Limnodromus griseus | Short-billed dowitcher |
| Limosa fedoa | Marbled godwit |
| Lobipes lobatus | Northern phalarope |
| Lophortyx californicus | California quail |
| Mareca americana | American widgeon |
| Megaceryle alcyon | Belted kingfisher |
| Melospiza melodia | Song sparrow |
| Micropalama himantopus | Stilt sandpiper |
| Numenius americanus | Long-billed curlew |
| Numenius phaeopus | Whimbrel |
| Oxyura jamaicensis | Ruddy duck |
| Passerculus sandwichensis | Savannah sparrow |
| Pelecanus occidentalis | Brown pelican |
| Petrochelidon pyrrhonota | Cliff swallow |
| Pipilo fascus' | Brown towhee |
| Podicaps caspicus | Eared grebe |
| Podilymbus podiceps | Pied-billed grebe |
| Recurvirostra americana | American avocet |
| Sayornis nigricans | Black phoebe |
| Spatula clypeata | Shoveller |
| Speotyto cunicularia | Burrowing owl |
| Spinus psaltria | Lesser goldfinch |

## BIRDS OF BOLSA CHICA (Continued)

| Scientific Name | Common Name |
|---|---|
| Squatarola squatarola | Black-bellied plover |
| Steganopus tricolor | Wilson's phalarope |
| Sterna forsteri | Forster's tern |
| Sterna hirundo | Common tern |
| Sturnella neglecta | Western meadowlark |
| Sturnus vulgaris | Starling |
| Telmatodytes palustris | Long-billed marsh wren |
| Thalasseus elegans | Elegant tern |
| Totanus flavipes | Lesser yellowlegs |
| Totanus melanoleucus | Greater yellowlegs |
| Tringa solitaria | Solitary sandpiper |
| Tyrannus verticalis | Western kingbird |
| Zenaidura macroura | Mourning dove |
| Zonotrichia atricapilla | Golden-crowned sparrow |
| Zonotrichia leucophrys | White-crowned sparrow |

# BOLSA CHICA

## SCIENTIFIC AND COMMON NAMES FOR NEW SPECIES OBSERVED 17 OCTOBER, 1970 THROUGH 29 MARCH, 1971

| Scientific Name | Common Name | Species Name Abbreviation |
|---|---|---|
| Podiceps auritus | Horned grebe | HGR |
| Aechmophorus occidentalis | Western grebe | WGR |
| Nycticorax nycticorax | Black-crowned night heron | BCN |
| Botaurus lentiginosus | American bittern | AMB |
| Branta canadensis | Canada goose | CNG |
| Anas strepera | Gadwall | GAD |
| Anas carolinensis | Green-winged teal | GWT |
| Anas discors | Blue-winged teal | BWT |
| Aythya americana | Redhead | RED |
| Aythya marila | Greater scaup | GSC |
| Aythya affinis | Lesser scaup | SCA |
| Bucephala albeola | Bufflehead | BUF |
| Clangula hyemalis | Oldsquaw | OSQ |
| Melanitta perspicillata | Surf scoter | SCO |
| Mergus merganser | Common merganser | COM |
| Mergus serrator | Red-breasted merganser | RBM |
| Limnodromus scolopaceus | Long-billed dowitcher | LBD |
| Elanus leucurus | White-tailed kite | WTK |
| Capella gallinago | Common snipe | SNI |
| Actitus macularia | Spotted sandpiper | SSP |
| Larus argentatus | Herring gull | HEG |
| Larus californicus | California gull | CAG |
| Larus canus | Mew gull | MEW |
| Streptopelia chinensis | Spotted dove | SPD |
| Asio flammeus | Short-eared owl | SEO |
| Tyrannus vociferans | Cassin's kingbird | CAK |

# BOLSA CHICA

## SCIENTIFIC AND COMMON NAMES FOR NEW SPECIES OBSERVED SINCE 29 MARCH, 1971

| Scientific Name | Common Name | Species Name Abbreviation |
|---|---|---|
| Buteo lineatus | Red-shouldered hawk | RSH |
| Falco peregrinus | Peregrine falcon | PER |
| Phasianus colchicus | Ring-necked pheasant | RNP |
| Phalaropus fulicarius | Red phalarope | RP |
| Stercorarius pomarinus | Pomarine jaeger | PJ |
| Larus glaucescens | Glaucous-winged gull | GWG |
| Sterna albifrons | Least tern | LT |
| Archilochus alexandri | Black-chinned hummingbird | BCH |
| Myiarchus cinerascens | Ash-throated flycatcher | ASH |
| Conotopus sordidulus | Western wood pewee | WWP |
| Bombycilla cedrorum | Cedar waxwing | CWX |
| Hylocichla ustulata | Swainson's thrush | STH |
| Vermivora celata | Orange-crowned warbler | OCW |
| Oporornis tolmiei | Macgillivray's warbler | MCG |
| Wilsonia pulsilla | Wilson's warbler | WIW |
| Agelaius tricolor | Tricolored blackbird | TCB |
| Icterus bullockii | Bullock's oriole | BUL |
| Piranga ludiviciana | Western tanager | TAN |
| Phalacrocorax auritus | Double-crested cormorant | DCC |
| Pandion haliaetus | Osprey | OS |