ROOM 505 CITY HALL
DO NOT REMOVE

Draft
Environmental Impact Report

First Phase Project for Playa Vista
Master Plan Project for Playa Vista

TECHNICAL APPENDICES

VOLUME X

APPENDIX J:
Biotic Resources

EIR No. 90-0200-SUB(C)(CUZ)(CUB)

State Clearinghouse No. 90010510

September 1992

City of Los Angeles

This Document is Printed on Recycled Paper

010508

DRAFT

ENVIRONMENTAL IMPACT REPORT

First Phase Project for Playa Vista
Master Plan Project for Playa Vista

EIR No. 90-0200-SUB(C)(CUZ)(CUB)

State Clearinghouse No. 90010510

TECHNICAL APPENDICES

VOLUME X

APPENDIX J:

Biotic Resources

September 1992

City of Los Angeles

TABLE OF CONTENTS

Appendix J-1: Ballona Wetland -- Tidal Flushing Before Tidal Restoration

John M. Boland, Ph.D and Joy B. Zedler, Ph.D

THE FUNCTIONING OF BALLONA WETLAND IN RELATION TO TIDAL FLUSHING PART I -- BEFORE TIDAL RESTORATION

John M. Boland, Postdoctoral Research Associate

Joy B. Zedler, Principal Investigator, Professor of Biology

Pacific Estuarine Research Laboratory (PERL)

Biology Department

San Diego State University

San Diego, CA 92182

JANUARY 1991

Project sponsored by the National Aubudon Society

ABSTRACT

To test hypotheses about the functioning of estuaries, we collected detailed information about the soils, plants and animals at six channel sites and fifteen "marsh" sites in Ballona Wetland, from March to November 1990. Our results were:

THE CHANNEL SITES

1. Tidal range inside Ballona Wetland was greatly reduced. It was at most lm relative to a potential 2.7m , i.e, a 63% reduction in tidal amplitude.
2. Water salinity declined progressively upstream. A major freshwater inflow event dropped average water salinities from 35ppt in July to 5ppt in October.
3. Macroalgae were abundant and appeared to smother the benthos. Channel bottoms were anaerobic within 2mm of the sediment surface.
4. Benthic invertebrates were rare and declined upstream in relation to the salinity gradient and a 62% decline in abundance occurred following the freshwater intrusion in late summer.
5. The fish community was similar to the communities found in channels of tidal salt marshes but was lower in species richness and abundance . The abundance of mosquito fish throughout the system in October reflected the brackish water salinities.
6. Few birds used the channels.

THE "MARSH" SITES

7. The moisture content of the soil was highest in the western-most sites and declined towards the east. Soils in the salt marshes were low in moisture content and brackish, rather than waterlogged and hypersaline as in fully tidal salt marshes. The salt panne substrate was hypersaline all year. The old agricultural field soils were relatively dry and mildly saline.
8. Edaphic algal mats were lacking in all but the wettest marsh site.
9. Nitrogen content was relatively high in the marsh soils and probably did not limit vascular plant growth.
10. The salt marsh sites were dominated by *Salicornia virginica*, pickleweed. Pickleweed standing crops were much higher than in fully tidal systems, such as Mugu Lagoon and Tijuana Estuary. We believe that the pickleweed at Ballona Wetland had a somewhat higher productivity and a somewhat longer turnover time than at Mugu Lagoon.
11. Canopy heights of pickleweed appeared to reach a threshold at 55cm and were generally taller than in tidal estuaries. Although the plants growing in the old fields tended to grow taller, they had less biomass per m^2.

12. Pickleweed foliar nitrogen was high, 2-3 times higher than that at Tijuana Estuary.

13. Detritus production and decomposition rates were low relative to fully tidal marshes, with moisture being a likely limiting factor.

14. The marsh invertebrate community was dominated by amphipods, spiders and insects. Their numbers were higher in the wetter pickleweed sites than in the drier pickleweed sites.

15. Bird use of the "marsh" sites was minimal. Although Savannah Sparrows occurred in all habitats, males set up breeding territories in one area only. We hypothesize that they chose this area because it was isolated from human disturbance.

16. Red foxes bred in the wetland. As many as eight were seen in one day.

We conclude that Ballona Wetland is a remnant salt marsh that receives little tidal flow. In its channels, macroalgae can be abundant but animals are relatively rare. In its salt marshes, only pickleweed is abundant, soils are relatively dry, and animals are relatively rare. Although several exotic species (e.g., several plants, a snail, a fish, a mammal) have invaded the wetland, it does support many native species, and a small number of rare and sensitive species (e.g., the Savannah Sparrow). We expect that the restoration of tidal flow to Ballona Wetland will greatly improve conditions for the native species, reduce the populations of the exotic species, and improve the general functioning of the wetland.

INTRODUCTION

Restoration projects provide unique opportunities to ecologists -- they allow one to test one's understanding of a system in a large scale experiment (Diamond 1987). In fact Bradshaw (1987) argues that there is no more direct test of our understanding of the functioning of an ecosystem than to attempt to restore it to a fully functional ecosystem.

Ballona Wetland is a relatively small, remnant salt marsh that is the last major coastal marsh in Los Angeles County. Maguire Thomas Partners, the principal owners of Ballona Wetland, wish to restore the wetland by improving the opening to the ocean and reintroducing tidal flushing. PERL is conducting studies of the Ballona Wetland ecosystem in order to improve the restoration project, to allow assessment of the success of restoration project, and to test ideas about the functioning of southern California's coastal wetlands.

We have focused our research on the Ballona Wetland food web. The food webs of the southern California coastal wetlands have been relatively poorly studied. This is in contrast to the food webs of coastal systems elsewhere, e.g. Darnell (1961), Teal (1962), Day *et al.* (1973), Odum and Heald (1975), Wiegert et al. (1981). Studies of California coastal marshes have emphasized plant community composition (Hinde 1954, Vogl 1966, Zedler 1977) and changes in community structure following disturbances (e.g., Resh and Balling 1983, Zedler and Nordby 1986, Onuf 1987). Likewise, the research on California mudflats and channels has focused on community structure (e.g., Peterson 1977, Hosmer 1977, Homziak 1977, Allen 1980, Schreiber 1981, Seapy 1981, Nordby 1982, Onuf and Quammen 1983, Boland 1988, Nordby and Zedler in press).

Little is known about the factors that control the nature of the food web in an estuary as a whole. We hypothesize that physical factors play important roles. In particular, we hypothesize that water salinity and current speeds are important in channels, and soil moisture and soil salinity are important in marshes. It is these physical factors that will be altered by restoration of tidal flow to Ballona Wetland, thus providing a unique opportunity to test our hypotheses.

Our pilot study of Ballona Wetland (PERL 1989) included initial surveys of the dune, channel and salt marsh communities. However, we documented limited tidal flow in the salt marsh and noted various ecosystem attributes that appeared to relate to the reductions in tidal amplitude, tidal circulation, and water and soil salinities. For example, we noted the presence of extensive floating macroalgal mats in the channels. These algae appear to smother the benthos, create anoxic conditions in the channel sediments, and reduce the abundances of infaunal invertebrates (e.g., clams, polychaetes, ghost shrimps). Also, in the salt marsh we found the soils to be relatively dry, and epibenthos (both algae and animals) to be lacking. The vascular plants appeared to be relatively low in plant food quality and plant decomposition rates seemed low. Finally, the conditions of reduced tidal flow and reduced water and soil salinity appeared responsible for the invasion of several exotic species to both the channels and marshes.

Because of a greatly dampened tidal range within Ballona Wetland, we hypothesized that the marsh and channel habitats are relatively segregated. The small tidal flow can not provide the normal linkage between the two habitats. Aquatic organisms are largely restricted to the channels, and terrestrial organisms are restricted to the salt marsh and old fields. The current food web at Ballona Wetlands is no doubt complicated, but our pilot study (PERL 1989), suggested two major chains within the web: (a) the mainly terrestrial or salt marsh food chain that involves living vascular plants, insects and birds;

and (b) the mainly aquatic or channel food chain that involves algae, marine invertebrates and fish (Figure 1A). Birds from the marsh feed along the channel edges, providing at least one link between these two chains. However, links in the reverse direction appear limited. Marsh plant productivity has few opportunities to move into the channels, and channel consumers can not move into the marsh.

We predict that the restoration of tidal action to Ballona Wetland will have many impacts on environmental conditions and on the food chains (Figure 2). These impacts will be brought about by the increases in the current speeds in the channels, increases in the marsh soil moisture content, and increases in the salinity of the marsh soils and channel water. For instance, we predict that more birds will visit the restored wetland. This is because the increased current speeds in the channels will cause the macroalgal abundance to decline and the microalgae to increase, and these in turn will allow the number of benthic invertebrates to increase; these invertebrates are eaten by many species of sandpipers, plovers and gulls, but the invertebrates are also eaten by fish, which in turn are eaten by terns, herons, egrets, etc. We therefore expect more sandpipers, plovers, gulls, terns, herons, and egrets to be present in the restored Ballona Wetland.

A graphic representation of the hypothesized food web after tidal restoration (Figure 1B) incorporates these changes. In general, we hypothesize that these shifts will increase the linkages between the marsh and channel food chains and increase the variety and population sizes of most compartment. It is the predictions in Figure 2 that we proposed to test by this before-and-after study. When completed, i.e., when both the before-restoration and after-restoration data have been collected, our study will advance the knowledge of how southern California wetlands function, show how the food web changes in the areas that currently support wetland species, and identify the habitats that become functional wetlands.

In order to test the predictions we have set up 21 permanent study sites in the wetland and collected detailed information about the water, soils, plants and animals at each site. We plan to revisit these sites after restoration to measure the same factors and test our hypotheses. All sites have been clearly staked and labelled, all methods are fully described below so that they can be easily duplicated, and all the before-restoration results are presented in detail. We have not intended to inventory all the plants and animals that use the wetland. Instead we have focused on the lowland areas of the wetland, i.e., the areas most likely to be affected by the restoration of tidal flow, and have described the current conditions at these sites to allow quantitative assessment of the changes that are due to the restoration.

The research reported here is the first half of the complete study - i.e., the before-restoration condition at Ballona Wetland. We proposed to conduct research on the current functioning of Ballona Wetland for a full year, i.e., from February 1990 through February 1991, but we were funded for only three seasons of field work. Therefore in this report we present the results from our Spring, Summer and Fall 1990 field work.

Finally, of vital concern to the restoration of Ballona Wetland is the presence of a small population of Belding's Savannah Sparrows. The Belding's Savannah Sparrow (*Passerculus sandwichensis beldingi*) is the only endangered bird species that currently breeds and winters in the Ballona Wetland. It has been the focus of another research project by Barbara Massey and Ken Corey. Last year they found between nine and 31 breeding territories in the wetland (PERL 1989). They have continued to monitor the distributions, abundances and breeding activities of the Belding's Savannah Sparrow in Ballona Wetland (Corey and Massey 1990) and we draw on some of their 1990 results in our discussion.

METHODS

Seven habitats were identified in the Ballona Wetland: proximal and distal channels; eastern, central and western *Salicornia virginica* marshes; salt pannes; and old agricultural fields. Three sampling sites were chosen for intensive study in each of the habitats, making a total of 21 sites: 6 channel sites and 15 "marsh" sites (Figure 3).

We have defined the seasons as Spring (March, April and May), Summer (June, July and August), and Fall (September, October and November). Some data were collected every month (e.g., bird numbers), but most were collected once per season during the middle month, i.e., April, July and October.

CHANNEL SITES

At each of the six channel sites the following information was collected:

Salinity of the water. At each site three surface samples were taken from points 10m apart along the channel. The salinity of the water was determined in parts per thousand using a refractometer.

Fish and nektonic invertebrates. At each site a blocking net (3mm mesh) was thrown across the channel at two points a measured distance apart (appoximately 8m). The nektonic organisms trapped between the nets were caught by dragging a hand net (1mm mesh) through the water several times (usually 5 to 10 times) until no more were caught. [This was a laborious task at most sites because of the abundant macroalgae.] The fish and other organisms were then identified, counted and released. Specimens that were difficult to identify in the field were preserved in 70% alcohol for later examination in the lab.

Birds. At each site a 200-m portion of the channel was censused by walking along the bank and counting all the birds that occurred in the channel. These censuses were conducted each month.

The channel bottoms consist of three microhabitats: the high intertidal mud, the mid-to-low intertidal mud and the mid-channel mud. When collecting the following benthic information we made three measurements, one in each of the microhabitats, and between 1m and 2m apart.

Depth of anaerobic layer. At each site one hole was dug in the sediment in each microhabitat and the depth of the aerobic-anaerobic boundary was measured.

Macroalgae abundances. At each site one circular quadrat (56cm diameter = $0.25m^2$) was placed in each microhabitat. The drifting macroalgae in each quadrat were collected, most of the water squeezed out of it and weighed.

Benthic invertebrates. At each site one coffee can corer (10cm diameter x 14cm tall) was pushed 12cm into the sediment in each microhabitat. The core was removed and the sediment was washed over a 1-mm screen. The residues were then preserved in 70% alcohol. All macrofauna in the residues were identified and counted under a dissecting microscope.

"MARSH" SITES

Each marsh site is a permanently marked square plot, 15m x 15m. The northeast and northwest corners of the square are marked by a black stake and a blue stake, respectively. Each stake has an aluminum label attached to it with PERL and SITE # written on it. At each of the marsh sites the following information was collected:

Soil moisture, soil salinity and soil nitrogen. At each site three randomly placed soil cores were obtained using a 2-cm diameter corer. The soil (approximately 100g) from the 5 - 15-cm depth was bagged, put in a cooler and returned to the lab where it was frozen for later analysis. Each soil sample was divided into three portions. The first portion was weighed, dried for 24 hours at 80°C, reweighed, and the percent moisture content (C) was computed as: $C = 100[(W - D) / D]$, where W is the sample weight wet and D is the sample weight dry. The second portion was thoroughly mixed with de-ionized water until the paste was runny (soil paste, cf. Richards 1954); the salinity of the interstial water was then measured in parts per thousand using a refractometer. This technique estimates the salinity of the soil after a heavy rainfall (PERL 1990). Finally, the extractable nitrogen of the third portion of the soil sample was measured by extracting the soil in 50ml of 2M KCl for an hour and analysing the extract for NH_4 using the automated phenate method and for (NO_3 + NO_2) using the cadmium copper reduction method. In this report we give the results as total extractable nitrogen in the soil, i.e. $NH_4 + NO_3 + NO_2$.

Algae. At each site the abundance of algae was estimated by randomly placing three circular quadrats (56cm diameter) in the site and estimating the percent cover in each quadrat.

Standing crop of the vascular plants. At each site the maximum canopy height was measured at three places selected haphazardly. In addition, we collected plants during August to estimate the end of year biomass at each site. Three 35-cm diameter quadrats were randomly placed in each site. The plants within each quadrat were clipped at ground level, bagged and returned to the lab where they were separated into species, dried at 75°C for two days and weighed.

Nitrogen content of *Salicornia virginica* foliage. At each site where *Salicornia* occurred (Sites 7 to 15) one sample of green *Salicornia* foliage (approximately 20grams) was collected from more than five plants. The sample was bagged, put in a cooler and returned to the lab where it was frozen for later analysis. Each sample was dried at 80°C to a constant weight, ground in a Wiley mill, and digested by the Kjeldahl method. The digest was analysed for total nitrogen.

Detritus production. Detritus production was estimated by placing three plastic trays in each of the sites. (Plant pots 18cm in diameter and 3.5cm deep were used.) The trays were placed flush with the surface of the soil, and left for 28 days, after which the accumulated debris was weighed.

Decomposition rates. Decomposition rates were measured using *Scirpus californicus*. Although *Scirpus* is not abundant in Ballona Wetland, it is a useful plant to use in decomposition comparisons because similar green plants can be collected during each season and the type of plant material can be relatively constant from season to season, and from year to year. *Scirpus* was collected from PERL at Tijuana Estuary; stems were cut into 25-cm lengths and dried for 2 days at 75°C. Approximately 40g of the plant material was placed in a 5-mm mesh bag and weighed. Three of the bags were randomly staked on the soil surface in each of the sites and left for 28 days. The litterbags were then bagged and returned to the lab where they were redried at 75°C for 2 days and reweighed. The difference in the before and after weights is a measure of the decomposition rates at Ballona Wetland.

Invertebrates. The marsh invertebrates were sampled in two ways. First, small mobile invertebrates, principally spiders and insects, were sampled using pan traps. (Plant pots 18cm in diameter and 3.5cm deep were used.) Three traps were randomly placed in each site. They were placed flush with the surface of the soil, filled with propylene glycol (anti-freeze) and left for 48 hours; the propylene glycol was then strained through a 0.5-mm mesh screen and the organisms caught were preserved in 70% alcohol and later identified (mostly to family) and counted under a dissecting microscope. Second, large organisms were sampled using a circular quadrat (56cm in diameter, $0.25m^2$ area). Three quadrats were randomly placed in each site and the large animals (primarily snails) in the quadrat were counted.

Birds. At each site a 200 x 25m strip (1/2 hectare) was censused by walking a path near the site and counting all the birds that occurred on the ground or in the vegetation in the strip; species that flew over the habitat or were observed in the habitat but out of the strip were noted as "also present." All censuses were conducted between sunrise and three hours after sunrise. Censuses were conducted each month.

Red Foxes. All foxes seen during visits to the wetland were counted and their locations noted.

RESULTS AND DISCUSSION

The period of study coincided with a below-average rainfall year. As in the previous three years, there was little wetting of the site by rainfall and no naturally-occurring flood event.

CHANNEL SITES

Tidal range and current speeds. There was little tidal flow in the channels. On most days the difference between the depth of the water at high and low tides was only a few centimeters. On 11 January 1990 the predicted high and low tides for the open shore were 7.3ft and -1.7ft (2.2m and -0.5m) MLLW respectively, for a tidal amplitude of 9ft (2.7m) -- one of the highest tidal ranges of the year. The tidal range was measured at the six channel sites on that day to estimate the maximum tidal range in the channels. The tidal range was less than 1m inside the Ballona Wetland (Figure 4A); it was greatest in the channels close to Ballona Creek (at Site 1) and dropped off rapidly away from Ballona Creek. On a similar day current speeds were measured during the ebbing tide. Maximum flow rates were generally low; they ranged from 0 (Site 6) to 17m/minute (Site 4), and averaged 4.6m/minute in the other sites.

Water salinities. The salinity of the water varied from seawater (35ppt) at Site 1 to fresh water (0ppt) at Site 6. The average salinities were higher at Sites 1 through 4 indicating that these sites were most influenced by Ballona Creek, where the salinity is usually near that of seawater. The average salinities were lower at Sites 5 and 6, the sites farthest from Ballona Creek, indicating that these sites were more influenced by the freshwater runoff into Ballona Wetland (Figure 4B).

In late summer 1990, there was an unusual discharge of freshwater into Ballona Wetland. This water came from a dewatering project upstream that discharged 500gal of water/min for 24hours/day for three months, i.e., from August through October (Victor Leipzig, personal communication). One effect of this freshwater discharge was to lower the salinity greatly at all sites; whereas the average salinity in the channels had been 35ppt in July it was only 5ppt in October (Figure 4C). Without this unusual inflow, it is likely that the average salinity would have remained at approximately 35ppt from July until the first big rain storm, which came during November this year. We believe that this unusual discharge of freshwater into the system during summer and fall had a detrimental effect on the organisms living in the channels (see below).

Macroalgae. Macroalgae, primarily *Enteromorpha*, were abundant at all channel sites except Site 6 (Figure 5A). At Sites 3, 4 and 5, the macroalgae were so abundant that they covered more than 85% of the channel bottom and the average wet weight was more than 300g per quadrat or 1200g per m^2. The average wet weight of algae in the channels increased from spring (174g per quadrat) to summer (297g per quadrat) to fall (341g per quadrat). We hypothesize that macroalgae were so very abundant at Ballona Wetland because (a) the slow current speeds allowed them to accumulate, and (b) inflows from urban areas and from the old agricultural fields stimulated growth. These hypotheses are not mutually exclusive and both may describe the current conditions at Ballona Wetland. The restoration of tidal flow should decrease the abundance of macroalgae by increasing current speeds and by reducing the influence of urban and agricultural inflows.

Depth of anaerobic layer. The depth of anaerobic/aerobic boundary averaged for all microhabitats and sites was 0.2cm below the surface of the sediment, i.e. very shallow.

Benthic invertebrates. Benthic invertebrates were common at Sites 1 to 3 only (Figure 5B). Particularly abundant at these sites were crabs (during summer), Spionid worms, Capitellid worms and the snail, *Cerithidea californica*. [Detailed results are given in Appendix 1.] The generally low abundances of benthic invertebrates at Sites 4 and 5 may be due to smothering by the abundant macroalgae at these sites.

The benthic invertebrates were less than half as abundant during October as they had been during April and July. For instance, at Site 1 there was an average of 35 individuals per core during July but only 13 individuals per core during October (Appendix 1). We hypothesize that the unusual freshwater discharge into Ballona Wetland, described above, caused this decline, either indirectly through the growth of smothering macroalgae or directly. Experimental work on the impact of low-salinity shocks has shown that several estuarine invertebrates are quickly killed by freshwater treatments (Stacey Baczkowski, PERL, pers. comm.).

Fish and nektonic invertebrates. Nektonic insects, mostly water boatmen, were abundant only at Site 1 (Figure 5C). Fish occurred at all sites; but were most common at Sites 5 and 6 where many mosquitofish were caught (Figure 6A; Appendix 2). Crayfish were abundant only at Site 6. The distributions of these nektonic organisms appears to be due to their searching out areas of preferred salinity. Support for this comes from a seasonal comparison of their distributions. The species most common at Sites 1 and 2 during April and July (e.g., topsmelt, water boatmen) when the salinities there were relatively high, were rare there during October when the salinities were very low. On the other hand, the mosquito fish appears to search out waters of low salinity; it was common at Site 5 and absent from Sites 1 and 2 during April and July, but it appeared in all habitats during October when the salinities everywhere were low (Appendix 2).

The fish community at Ballona Wetland is similar to the communities found in channels of salt marshes elsewhere - i.e., dominated by topsmelt, longjaw mudsucker, arrow goby, California killifish, and mosquito fish (Nordby and Zedler, in press). However, there are generally fewer fish species and fewer fish individuals at Ballona Wetland. We suggest four reasons for this. First, greatly lowered salinities can kill estuarine fish (Chris Nordby, pers. comm.). Second, there was sometimes little water in the channels for the fish; Site 6 tended to dry out during summer, and during very low tides Sites 1 through 4 were almost dry -- the fish were forced to retreat with the tide into Ballona Creek or seek out the few pools that were available to them. The only channel that always had water in it, Site 5, also had the most fish in it (Figure 6A). Third, macroalgae appear to smother the benthos and reduce the prey available to carnivorous fish. And finally, the anoxic sediments may give off enough sulfides to be toxic to fishes (Russ Vetter, NMFS Southwest Fisheries Lab, pers. comm.).

Birds. Birds were rare in the channels; none of the sites averaged more than 2 birds per 200m of channel (Figure 6B). The birds that did occur included herons (e.g., Great Egret, Black-crowned Night Heron), shorebirds (e.g., Killdeer, Willet), ducks (e.g., Mallard, Blue-winged Teal) and passerines (e.g., Red-winged Blackbird; Appendix 3). We hypothesize that birds were rare because their foods, particularly fish and benthic invertebrates, were rare.

"MARSH" SITES

Soil salinity. The soil salinities were low in the old agricultural fields (Sites 19 - 21), moderate in the *Salicornia* dominated marshes (Sites 7 - 15), and high in the salt pannes (Sites 16 - 18; Figure 7A).

Soil moisture. The moisture content of the soil was highest in the western-most sites (Sites 7 - 10) and declined toward the east; moisture content was very low in the old agricultural field sites (e.g., Site 19; Figure 7B). The marsh sites were generally drier than marsh sites in other southern California estuaries. One consequence of this dryness is that algae were very rare in the Ballona Wetland marshes. An algal mat, dominated by *Enteromorpha*, occurred only in Site 8, the wettest site.

Nitrogen content of the soil. The soils at Ballona Wetland were high in inorganic nitrogen. Total nitrogen values for other salt marshes are generally less than 10 micrograms of total extractable nitrogen per gram of dry soil (Zedler et al. 1990), but at Ballona Wetland four sites had values higher than 15 micrograms of total extractable nitrogen per gram of dry soil (Figure 7C). We hypothesize that fertilizers used in the old agricultural fields have leached into the salt marsh and salt panne soils. Further, it appears that differences in the drainage of the agricultural fields can account for the spatial patterning of very high and moderately high soil nitrogen. We suggest that the relatively good drainage south of Culver and Jefferson has flushed the nitrogen out of that system and today the nitrogen content of the soils at Sites 21, 15 and 14 is relatively low. On the other hand, the relatively poor drainage north of Culver and Jefferson has not allowed the nitrogen to be flushed out of that system and today the nitrogen content of the soils at Sites 13, 16, 17, 18, 19 and 20 is remarkably high.

Vascular plant community. *Salicornia virginica*, pickleweed, dominated at Sites 7 to 15 whereas "other species," e.g., grasses, *Bassia hyssopifolia*, *Salsola iberica*, *Rumex sp.*, *Cressa truxillensis*, dominated at Sites 19 - 21. Soil salinity can explain why the species composition varies from site to site; "other species" occur where the salinity is less than 6ppt, *Salicornia* occurs where the salinity is between 7ppt and 30ppt, and no plants occur in areas where the salinity is over 40ppt, i.e., in the salt pannes (Figure 8A).

Standing crop of the vascular plants. The end-of-year biomass ranged from zero in the salt pannes (Sites 16 to 18) to 300g dry weight per quadrat (1/10m^2) at Site 10 (Figure 8B). Relative to other southern California wetlands that have abundant *Salicornia*, Ballona Wetland had very high aboveground biomass of *Salicornia virginica* (Table 1). Comparing all the sites for which we have data on pickleweed biomass, there is a general pattern of higher standing crop in areas that are not continuously tidal. Peñasquitos Lagoon, a semi-tidal wetland in San Diego County, had the highest value on record in 1978, a flood year with major freshwater inflow. During drier years (e.g., 1977) the standing crop at Peñasquitos Lagoon was similar to that at Ballona Wetland. At two tidal estuaries, Mugu Lagoon and Tijuana Estuary, pickleweed standing crops were generally lower than at Ballona Wetland (Table 1).

Canopy height. The maximum canopy heights ranged from 26cm to 73cm in the *Salicornia* marshes at Sites 7 to 15 which is generally taller than *Salicornia* marshes in tidal, Tijuana Estuary (PERL, unpubl. data). The *Salicornia* canopy heights changed little from season to season (i.e., small std errors; Figure 8C). On the other hand, the canopy heights varied considerably in the old agricultural fields (Sites 19 - 21). Here the vegetation was a mixture of various annuals (e.g., grasses, *Bassia hyssopifolia*, *Salsola iberica*, *Rumex sp.*, *Cressa truxillensis*) that were relatively short in April, but by October were more than 1m tall in most places. There was no vegetation in the salt panne sites (Sites 16 - 18).

Maximum canopy heights were also measured when the end-of-year biomass data were collected. A comparison of maximum canopy height and total biomass shows that the *Salicornia* at Sites 7 to 15 followed a different pattern to the "other species" at Sites 19 to 21 (Figure 9A). *Salicornia* appeared to reach a threshold height at approximately 55cm; sites with relatively high biomass were no taller than sites with relatively low biomass. Therefore for *Salicornia* one cannot predict biomass from maximum canopy heights. On the other hand, the line for the "other species" is quite a good fit -- the "other species" did not reach a threshold and one can predict biomass from maximum canopy heights. Notice that even though the *Salicornia* was generally shorter than the "other species" its biomass was generally greater (Figure 9A).

Foliage condition. Most of the biomass of pickleweed exists as brown, rather than green branches (Table 1). Although values were spatially variable at Ballona Wetland, most sites had less than 20% green material. Site 15 had the highest proportion of green biomass, but total biomass was very low, apparently in part due to insect damage (Boland, pers. obs.). Low percentages of green branches have also been found at Mugu Lagoon. In August, when green branches were at their peak biomass, they comprised only 29% of the total aboveground material; from October through February, green branches were below 10% of the total (Onuf 1987).

Foliar nitrogen of the vascular plants. The *Salicornia* foliage was high in nitrogen. The range at Ballona Wetland was from 18.6 to 26.8mg nitrogen per gram of plant material (Figure 9B), whereas the range for four recently sampled *Salicornia* sites at Tijuana Estuary was from 6.2 to 10.2mg N/g (Zedler et al. 1990).

High foliar nitrogen concentrations might arise either from a high proportion of nitrogen or a lower salt load in the plant tissue. In other words, plants from the two estuaries could have different C:N ratios, and different protein content; or the plants could have similar C:N ratios but different concentrations of nitrogen per dry weight, if those from one site have a higher salt content.

Evidence that Ballona Wetland has higher nitrogen availability than Tijuana Estuary is provided by the nitrogen content of the soil, which ranged from 2.5 to 23.4 mg/kg at Ballona Wetland (Figure 7C) and from 1.7 to 16.0 mg/kg at Tijuana Estuary. However, Covin and Zedler (1988) show that nitrogen-loading rates, rather than inorganic N concentrations in soils are the critical determinant of plant growth, and such information is very difficult to obtain. The suggestion that plants at Ballona Wetland may have lower salt content than those at Tijuana Estuary follows from the lower soil salinities at Ballona Wetland. However, we lack information on ash-free dry weights or C:N ratios for *Salicornia virginica*. A CHN analyzer will soon be available to PERL to allow such analyses in the future.

Detritus production (litter fall). Material falling from the canopy averaged less than 2g per pan per month in all sites (Figure 9C). Although these monthly rates appear low they are for approximately 1/40 square meter and for 1/13 of a year. Averaging the measurements for Sites 7-15 for all three measurement periods and extrapolating values to a full year indicates $400 g/m^2/yr$ litter fall for Sites 7 to 15.

Vascular plant decomposition. Loss rates of plant material *(Scirpus californicus)* from litterbags were low, especially considering that the data are for the first four weeks of decomposition. The rate of loss during the 28 days averaged 4.4% for Sites 7 to 15 (Figure 10A). The lowest loss rate was 2.1%/month at stations 14 and 15 in July, and the highest loss rate was 10.3%/month at station 8 in October (Figure 10A). Material deployed in July (mean 2.4%/month) was slower to decompose than that deployed in spring (5.1%/month) and fall (5.6%/month).

In April 1988, Rutherford (1989) deployed litterbags of *Spartina foliosa* in low and high marsh sites at tidal marshes along San Diego Bay. Her average first-month decomposition rate was 42%/month, with a range of 39 to 45%/month. The decomposition rates at San Diego Bay are therefore much higher than at Ballona Wetland. Because the San Diego Bay and Ballona Wetland studies used different species and took place in different years, the comparison is only a general one. However, it is the expected difference, since drier sites are known to have slower decomposition rates (Winfield 1980).

Invertebrates. The invertebrates caught in the pans were primarily amphipods, spiders and insects (particularly Collembola, Diptera, Homoptera, and Hymenoptera; Appendix 4). There were a moderate number of invertebrates (approximately 60 per pan) at most sites, but more invertebrates were caught in the wetter *Salicornia* sites (Sites 7 to 9) than in the drier *Salicornia* sites (Sites 13 to 15; Figure 10B). The invertebrate community at Ballona Wetland was similar to the communities in tidal estuaries (PERL 1990). The African land snail, *Otala lactea*, occurs in the wetland; it was common (approximately 1 per m^2) at Site 19 and present (<1 per m^2) at Sites 10 - 15, 20 and 21. It was particularly obvious on wet mornings.

Birds. Birds were rare at most sites except the old agricultural fields and Sites 11 and 17 (Figure 10C). The most common species were the Savannah Sparrow and Western Meadowlark in the *Salicornia* sites (Sites 7 to 15); the Great Blue Heron and Blackbellied Plover resting in the salt panne (Site 17); and the Savannah Sparrow, White-crowned

Sparrow, and House Finch in the old agricultural fields (Sites 19 to 21; Appendix 5). Although Savannah Sparrows occurred in all habitats, males set up breeding territories near Site 11 only. We observed a maximum of nine males displaying in this area (during March). Other species that showed breeding behavior and were likely breeders in the wetlands were the Killdeer, Western Meadowlark and Red-winged Blackbird.

Foxes. Red Foxes breed in the wetland - there was a fox den near Site 11 -- and individuals were seen in the wetland during every visit. The greatest number -- eight -- was seen on 23 April; four of these individuals were adults (seen near Sites 10, 11, 12, and 14) and the other four were cubs (frolicking with an adult at the den). Fox counts made during the monthly bird censuses are given in Appendix 6.

GENERAL DISCUSSION

The aims of our research are to test ideas about the functioning of southern California's coastal wetlands and to provide information that will improve the restoration effort. The research done in 1990 is the first half of the complete study -- i.e, the before-restoration condition at Ballona Wetland. We have presented the detailed results of our 1990 field research; now we discuss four general topics: the significance of the high pickleweed standing crop, the Belding Savannah Sparrow's choice of breeding habitat, restoration problem areas, and the nature of the food webs at Ballona Wetland before tidal restoration.

The significance of the high pickleweed standing crop. The high standing crop of pickleweed at Ballona Wetland does not necessarily mean that there was high pickleweed productivity, nor does it necessarily indicate high functional value. On the contrary, two systems with low pickleweed standing crops, Mugu Lagoon and Tijuana Estuary, were considered to be the region's most natural ecosystems in 1976 when the California Sea Grant College funded basic research at each site.

Pickleweed is a highly variable species; it has a very wide geographic range, has the broadest intertidal range of all the salt marsh natives, can dominate both tidal and non-tidal sites, and has a variety of growth forms. It is also a rather brittle plant, that readily loses branches when disturbed. In non-tidal areas, branches often grow thicker, and biomass accumulates because it is neither transported out of the system nor decomposed in situ. In fully tidal sites, there is less biomass accumulation, because tidal flows cause breakage, facilitate decomposition, and export plant parts.

The functioning of the pickleweed might be characterized by calculating a "turnover time," defined here as the August biomass/annual aboveground productivity. At the tidal Mugu Lagoon, Onuf (1987) estimated the annual aboveground productivity to be 290 g/m^2, for a turnover time of 440/290 = 1.5. This suggests that every 1.5 years, the material in the canopy is completely renewed, or that the average stem lives 1.5 years. Even though the pickleweed productivity rate is not very high, the system would be considered very dynamic, with much material being removed from the canopy, rather than accumulating.

At Ballona Wetland, the turnover time cannot be calculated, because we did not set out to measure plant productivity (the effort required greatly exceeded available funding). However, we can use some of our results to speculate on the dynamics of pickleweed at Ballona Wetland. If we assume that Ballona Wetland had the same productivity rate as at Mugu Lagoon, the turnover rate would be estimated as 1372/290 = 4.7. Our data on detritus production rates suggest that Ballona Wetland productivity was slightly higher than that measured at Mugu Lagoon. For the plant canopy to remain constant in biomass, net aboveground productivity would need to be about equal to the litter fall (detritus production) rate we estimated ($400 g/m^2/yr$). With a productivity rate of $400 g/m^2/yr$, the turnover rate would be estimated as 3.4 years.

We believe that Ballona Wetland had a somewhat higher pickleweed productivity rate and a somewhat longer turnover time than Onuf found at the lower marsh of Mugu Lagoon. High vascular plant productivity rates are certainly possible for semi-tidal systems. The earlier comparisons of Tijuana Estuary and Peñasquitos Lagoon provided strong indications that pickleweed may be more productive with reduced tidal flushing, and Griswold's (1988) data indicated that it grows better when not in continually saturated soils (Table 1). We also suspect that turnover rates differ for semi-tidal and tidal systems. The high standing crops at Ballona Wetland and Peñasquitos Lagoon surely indicate longer turnover times for the plant canopy in semi-tidal estuaries.

The Belding's Savannah Sparrow's choice of breeding habitat. The Belding's Savannah Sparrow is an endangered species that occurs in Ballona Wetland year round. In 1989 and 1990 Massey and Corey found between nine and 31 male breeding territories in the wetland (PERL 1989, Corey and Massey 1990). Although Belding's Savannah Sparrows were seen in other habitats during the breeding season (Appendix 5), in both years they established breeding territories in and around Site 11 only (Boland, pers. obs.; Corey and Massey 1990). Because much of the habitat around Site 11 is at a low elevation, it is likely that much of the current sparrow breeding habitat will be lost after tidal restoration (PERL 1989). Therefore some important questions need to be addressed: Why did the sparrows choose to set up breeding territories at Site 11 only? And can habitats elsewhere be improved so that the sparrows will move there when tidal flow is restored?

Let us tackle the first question, i.e., why did sparrows choose to set up breeding territories at Site 11 only. Corey and Massey (1990) do not address the question directly but imply that the general dryness of the marsh has limited the birds to this habitat. In previous years, e.g., 1987, there were 29 territorial males near Sites 7, 8, 10, 11, 12 and 18. The sharp reduction in the number of territorial males from 1987 to 1989 they say "is thought to be the end result of lack of tidal flow and the long drought that southern California has been experiencing over the past four years." We may call their idea for why the sparrows are now in this site only: The Best Site in Dry Years Hypothesis.

However, our data indicate that Site 11 was not the wettest *Salicornia* site and did not support unusually large plants or many invertebrates. Sites 7 to 10 were wetter than Site 11 (Figure 7B), Sites 7 and 10 had greater plant biomass (Figure 8A), Sites 7 to 10 and 12 to 14 had greater canopy heights (Figure 9A), and all the other sites had more invertebrates (Figure 10B). So why did the territorial males choose Site 11 only? We suggest that they did it because it is the best site that is isolated from human disturbance. Three observations support this Isolation Hypothesis. First, we frequently saw people walking in the wetland near Culver Blvd. and near the west channel (i.e, near Sites 8, 9 and 14), often they were accompanied by dogs, but we never saw people near Site 11 -- it was too difficult to get to. Second, Belding's Savannah Sparrows have not set up breeding territories in other, apparently better, sites, i.e., where there was more vegetation cover and more invertebrates. Third, herons most frequently chose to rest in the salt panne near Site 11.

The important difference between these two hypotheses is that they provide different answers to the second question, i.e., can habitats elsewhere in Ballona Wetland be improved so that the sparrows will move there when tidal flow is restored? The Best Site in Dry Years Hypothesis suggests that when tidal flow is restored the sparrows will establish territories in other parts of the wetland. In contrast, the Isolation Hypothesis suggests that even if conditions do improve in other areas the sparrows will not set up territories there because there is too much disturbance. In fact the Isolation Hypothesis suggests that other areas of the marsh may already be better than Site 11.

We suggest that the managers take both of these hypotheses into consideration when developing the restoration plan. The plan should call for increased tidal flow into the marshes, increased restrictions to public access and creation and/or improvement of salt marshes in the most isolated parts of Ballona Wetland.

Restoration problem areas. We have noticed two areas in which the restoration of Ballona Wetland may have problems. The first concerns the restoration of Belding's Savannah Sparrow habitat -- and this problem has just been discussed.

The second concerns the actions of the Mosquito Abatement workers. First, there is conflict between the goals of the Mosquito Abatement District -- to drain flooded areas -- and the restoration of Ballona Wetland -- to allow the wetland to be wet. During February and March 1990, heavy rains flooded the *Salicornia* marsh near Site 15. Unfortunately Mosquito Abatement workers discovered mosquitoes in the water and so they sprayed the area around Site 15 with oil and dug a drainage ditch to lead the water into one of the channels. They also discovered mosquitoes in other parts of the wetland but because these wetlands are in areas they refer to as "the bird sanctuary" they used only a developmental hormone on these mosquitoes. Their actions appear to have been successful because by 23 March 1990 Site 15 was relatively dry and there were no mosquitoes remaining (Don Birkinshaw, pers. comm.). We believe that the Mosquito Abatement District need to be brought into the restoration program at Ballona Wetland. They should be asked to treat all areas as part of "the bird sanctuary," to drive on tarred roads only, and not to drain pooled areas.

The nature of the food webs at Ballona Wetland before restoration. We conclude that limited tidal flushing at Ballona Wetland has multiple impacts on both the structure and functioning of the wetland ecosystem.

Because of the low tidal amplitude, the linkages between the marsh and channel communities are limited. The two function more independently than in fully tidal wetlands. In a fully tidal system, the channel water flows into the marsh carrying channel organisms with it, and then flows out carrying marsh organisms into the channel. The result is that the distributions of marsh and channel species overlap and that movements between the two habitat types are facilitated. In addition, nutrients brought into the channels move onto the marsh and are taken up by the algae and vascular plants, and organic materials produced by the marsh algae and vascular plants move into the channels (Winfield 1980). In contrast, the limited tidal action at Ballona Wetlands severely restricts such interactions.

In the marsh, nutrient-recycling and food chain support functions are impaired. Detritus production and decomposition rates are both low, and pickleweed biomass accumulates, indicating slow recycling of plant material. Algal mats are rare or absent, limiting the grazer food chains that are thought to be very important in tidal salt marshes (Zedler 1980, 1982). Marsh invertebrate communities are dominated by spiders and insects indicating the terrestrial nature of the marsh food web. In addition, these invertebrates are relatively small and rare and therefore do not attract many birds.

In the channels, reduced salinities and poor water circulation have major impacts on the structure and functioning of the channel system. Macroalgae accumulate smothering the benthos; microalgae cannot grow; marine invertebrates are low in species richness and abundance; and birds and fishes are rare and low in species richness.

An additional consequence of reduced tidal flushing at Ballona Wetland is that exotic species -- both plant and animal -- have invaded the marsh and channel ecosystems. In the drier marsh sites, several weedy plants (e.g., *Carpobrotus* spp., *Atriplex semibaccata*) have become established in areas that would otherwise support native salt marsh vegetation. Such weedy invasions can reduce the growth of, or completely elliminate, native salt marsh plants (Zedler et al. 1990). Red foxes have established a den and reproduced within the salt marsh. In the channels, the exotic fish, the yellowfin goby, is present, and brackish marsh plants (e.g., *Scirpus robustus*) have encroached on the estuarine channels. These invasions are readily explained by two features of reduced tidal flushing -- the lower soil moisture of marsh habitats (which develop when high tides cannot inundate the site), and the lower salinities of marsh soils and channel waters (which develop when freshwater inflows are not "overwhelmed" by saline tidal waters).

RECOMMENDATIONS FOR FUTURE RESEARCH

Research to compare conditions before and after restoration.

The potential for restoration of tidal flows to Ballona Wetland has provided us with a unique opportunity to test several hypotheses about wetland ecosystem functioning. The general hypothesis (H1) and several specific hypotheses (H2-7) are outlined below. We have described the ecosystem in 1990 before restoration and need to conduct a long-term study after restoration to assess changes. The following hypotheses will be tested by repeating field sampling after the restoration is underway. It is not clear that the hypothesized changes will develop in the first few years of increased tidal flow. We recommend a 10-year montoring program of post-restoration ecosystem development, and strongly recommend that the 1990 sampling program be repeated annually for at least 5 years after tidal restoration. Should tidal enhancement occur over a period of years, the sampling should be extended appropriately.

H_1: Physical factors such as water salinity and current speeds in channels and soil moisture and soil salinity in marshes play important roles in controlling the nature of the food web in the estuary as a whole.

H_2: Channel macroalgae will decline following tidal enhancements because:
a) more rapid currents will prevent their accumulation, and
b) reduced influence of urban and agricultural inflows will lower growth.

H_3: The abundance of channel invertebrates and fishes will be higher and more stable with more predictable salinity regimes (i.e., elimination of non-seasonal freshwater intrusions).

H_4: Channel bird densities will increase because they are positively correlated with the densities of their fish and benthic invertebrate prey.

H5: After tidal flushing is enhanced, the salt marsh soils will support good pickleweed growth and high epibenthic algal productivity due to an abundance of soil nitrogen.

H6: After tidal flushing is enhanced, vascular plant standing crops will decrease and turnover time (standing crop/annual productivity) will decrease as breakage, export, and decomposition increase.

H7: Linkages between the marsh and channel ecosystems and food chains will increase in response to increasing tidal amplitude.

Additional research to be conducted before restoration.

Additional observations and experiments described below would advance knowledge of estuarine functioning in general, and of Ballona Wetland in particular. We believe that the more information the managers of Ballona Wetland have at their disposal the greater the chance that the restoration of Ballona Wetland will be successful.

First, continuation of our present study. We have completed three seasons of sampling at the 21 permanent study sites. Continued data collection through February 1991 would allow a full 4-season data set to chracterize the food webs before tidal enhancement. In addition, continued studies through February 1992 would be most useful because 1990 was not a typical before-restoration year. The unusual flow of freshwater into the Ballona Wetland channels from a dewatering project upstream severely lowered salinities in the channels, and we believe that it caused the dramatic changes in the abundances of macroalgae, benthic invertebrates and fishes in the channels. We recommend further studies before tidal enhancement to provide replication (and greater confidence in) the existing baseline data set.

Second, salt marsh primary productivity. We have been asked several questions about the importance of Ballona Wetland to the open water estuarine system of Ballona Creek. For example: How high is the primary productivity of the salt marsh? How will salt marsh primary productivity change with increased tidal flushing? Salt marsh primary productivity is difficult to measure; for vascular plants it involves monthly measurements of the growth of tagged branches (Onuf 1987) and for benthic algae it involves frequent measurements of the amount of oxygen evolved by mats placed in light and dark chambers (Zedler 1980). Both methods are problematical. We decided instead to measure vascular plant and algal standing crop. These results have revealed some interesting patterns, e.g., that the biomass of pickleweed is relatively high at Ballona Wetland, however our knowledge would be improved if we collected data on salt marsh primary productivity during 1991. We recommend these additional measurements to assess plant growth be made before tidal restoration for comparison after tidal restoration.

Third, foliar nitrogen concentrations. We found unusually high foliar nitrogen concentrations in the pickleweed at Ballona Wetland and identified two factors that could contribute to elevated tissue nitrogen: a lower carbon:nitrogen ratio in the plant's organic matter (and associated high protein content and high nutritional value) and/or a lower salt load due to lower-salinity soils. With the acquisition of a CHN analyzer and the opportunity to collect additional plant tissues for ash-free-dry-weight determinations, we can test for the relative importance of each factor in producing pickleweed with high nitrogen content. If the elevated foliar nitrogen levels are due to increased protein and nutritional values, Ballona Wetland may well have very high potential for food chain support, given additional tidal wetting. On the other hand, if the high N/plant weight is due to low salt content in the plant tissues, increased tidal flushing would quickly lower foliar nitrogen concentrations as marsh soils are flooded with seawater. We recommend sampling of pickleweed tissue and appropriate analyses (C:N content and ash-free dry weights).

Fourth, macroalgal experiments. We have hypothesized that macroalgae in the channels are smothering the benthos, promoting anoxic conditions near the sediment surface, decreasing the abundance of benthic invertebrates, and ultimately decreasing the abundances of fish and birds in the channels. We would like to conduct tests of these hypotheses in Ballona Wetland during 1991. The tests would involve removal of macroalgae from some sites in the western channel, the addition of macroalgae, or a suitable mimic (e.g., cloth pegged to the sediment), to some sites in the eastern channel, and the frequent measurement of the depth of the anoxic layer and benthic invertebrates in the study sites. We recommend that the impact of macroalgae on sediments be assessed.

Fifth, fish. Another question we have been asked regarding the importance of Ballona Wetland to Ballona Creek is: What role does the marsh system play in providing food chain support for the fishes in Ballona Creek? We could address this issue through the use of multiple stable isotopes. We could survey the marsh, channel, and ocean primary producers to obtain signatures for each potential source of plant foods. We could then look for a match in the signature of fish tissues to indicate whether various fishes are feeding primarily on marsh vascular plants, macroalgae, or phytoplankton. Unfortunately, the analyses for multiple stable isotope signatures are expensive, and a large number of samples would be needed to establish that linkages between Creek fishes and marsh producers exist. Other research on the fish in Ballona Creek should be done by local fish ecologists. If there is sufficient funding for and interest in establishing linkages between Ballona Creek and Ballona Wetland, we recommend a coordinated program of fish sampling and multiple stable isotope evaluation.

ACKNOWLEDGEMENTS

We thank the National Audubon Society for sponsoring our research. Many researchers at PERL assisted us, they include Max Busnardo, Bob Espinoza, Brian Fink, Ted Griswold, René Langis, Mark Lung, Ricardo Martinez-Lara, Joe Verfaillie and George Vourlitis -- we thank them all.

LITERATURE CITED

Allen, L.G. 1980. Structure and productivity of the littoral fish assemblage of upper Newport Bay, California. Ph. D. dissertation. University of Southern California, Los Angeles.

Boland, J. 1988. The ecology of North American shorebirds: latitudinal distributions, community structure, foraging behaviors, and interspecific competition. Ph.D. dissertation. University of California, Los Angeles.

Bradshaw, A. 1987. Restoration: an acid test for ecology. In: Restoration Ecology. W. Jordan, M. Gilpin and J. Aber (eds.) Cambridge University Press.

Corey, K. and B. Massey. 1990. A population and banding study on the Belding's Savannah Sparrow at Ballona Wetland, 1989 - 1990. Unpublished report.

Darnell, R. 1961. Trophic spectrum of an estuarine community based on studies of Lake Ponchartrain, Louisiana. Ecology 42: 553-568.

Day, J., W. Smith, P. Wagner and W. Stowe. 1973 Community structure and carbon budget of a salt marsh and shallow bay estuarine system in Louisiana. Publ. No. LSU-SG-72-04. Center for Wetland Resources, Louisiana State University, Baton Rouge, Louisiana.

Diamond, J. 1987. Reflections on goals and on the relationship between theory and practice. In: Restoration Ecology. W. Jordan, M. Gilpin and J. Aber (eds.) Cambridge University Press.

Griswold, T. J. 1988. Physical factors and competitive interactions affecting salt marsh vegetation. M.S. Thesis, San Diego State University. 84 p.

Hinde, H.P. 1954. The vertical distribution of salt marsh phanerogams in relation to tide levels. Ecol. Monog. 24: 209-225.

Homziak, J. 1977. Substrate relationships and competition among three species of Callianassid shrimp. M.A. thesis. San Diego State University, San Diego.

Hosmer, S.C. 1977. Pelecypod-sediment relationships at Tijuana Estuary. M.A. thesis. San Diego State University, San Diego.

Nordby, C. S. 1982. The comparitive ecology of ichthyoplankton within Tijuana Estuary and in adjacent nearshore waters. M.S. thesis. San Diego State University, San Diego.

Nordby, C. S., and J. B. Zedler. In press. Responses of fishes and benthos to hydrologic disturbances in Tijuana Estuary and Los Penasquitos Lagoon, California. Estuaries.

Odum, W.E. and E. Heald. 1975. The detritus based food web of an estuarine mangrove community. Pages 265-286 in L. Cronin, ed., Estuarine Research Vol 1. Academic Press, New York

Onuf, C.P. 1987. The ecology of Mugu Lagoon, California: an estuarine profile. U.S. Fish and Wildl. Serv. Biol. Rep. 85 (7.15).

Onuf, C.P. and M. L. Quammen. 1983. Fishes in a California coastal lagoon: effects of major storms on distribution and abundance. Mar. Ecol. Prog. Ser. 12: 1-14.

PERL. 1990. A manual for assessing restored and natural coastal wetlands with examples from southern California. California Sea Grant Report No. T-CSGCP-021. La Jolla, California.

PERL. 1989. Research for adaptive management of Ballona Wetland. Tech. Rep. 89-02. Pacific Estuarine Research Laboratory, San Diego State Univ., San Diego.

Peterson, C.H. 1977. Stability of species and of community for the benthos of two lagoons. Ecology 56: 958-965.

Resh, V. and S. Balling. 1983. Tidal circulation alteration for salt marsh mosquito control. Environ. Manag. 7: 79-84.

Rutherford, S. E. 1989. Detritus production and epibenthic communities of natural versus constructed salt marshes. M.S. Thesis, San Diego State University. 79 p.

Schreiber, R.W., editor. 1981. Biota of the Ballona Region, Los Angeles County. Los Angeles Natural History Museum, Los Angeles.

Seapy, R. 1981. Structure, distribution, and seasonal dynamics of the benthic community in Upper Newport Bay, California. Calif. Dept. of Fish and Game, Sacramento, Calif. Marine Resources Tech. Rep. No. 46.

Teal, J. 1962. Energy flow in the salt marsh ecosystem of Georgia. Ecology 43: 614-624.

Vogl, R. 1966. Salt marsh vegetation of upper Newport Bay, California. Ecology 47: 80-87.

Wiegert, R., R. Christian and R. Wetzel. 1981. A model view of the marsh. Pages 183-218 in L. Pomeroy and R. Wiegert, eds., The ecology of a salt marsh. Springer-Verlag, New York.

Winfield, T. 1980. Dynamics of carbon and nitrogen in a southern California salt marsh. Ph. D. dissertation. University of California Riverside and San Diego State University, San Diego.

Zedler, J. B. 1977. Salt marsh community structure in the Tijuana Estuary, Calif. Estuarine and Coastal Marine Science 5:39-53.

Zedler, J. B. 1980. Algal mat productivity: comparisons in a salt marsh. Estuaries 3:122-131.

Zedler, J. B. 1982. The ecology of southern California coastal salt marshes: a community profile. U.S. Fish and Wildlife Sercie, Biological Services Program, Washington, D. C. FWS/OBS-31/54.

Zedler, J. B., and C. S. Nordby. 1986. The ecology of Tijuana Estuary: an estuarine profile. U.S. Fish Wildl. Serv. Biol. Rep. 85 (7.5). 104pp.

Zedler, Joy B. C. S. Nordby, and Ted Griswold. 1990. Linkages: Among estuarine habitats and with the watershed. NOAA Technical Memorandum, National Ocean Service, Office of Ocean and Coastal Resource Management, Marine and Estuarine Management Div. Washington, D. C. 31 p. plus figures and tables.

Table 1. Comparative standing crop data for pickleweed *(Salicornia virginica)* in semi-tidal and tidal wetlands of southern California and for experimental (non-tidal) mesocosms. Data are for August standing crops (live + dead) in grams per square meter. The total green, total brown, and % green biomass data are also given. Sources are: this study for Ballona Wetland, Onuf (1987) for Mugu Lagoon, and Zedler et al. (1980) for Tijuana Estuary, San Diego River (flood control channel) and Los Peñasquitos Lagoon, and Griswold (1988) for experimental mesocosms.

Location	Site	Total	Green	Brown	% Green
Semi-tidal wetlands					
Ballona Wetland (1990)					
	western (#7-9)	**1928**	379	1549	18-22
	central (#10-12)	**2427**	247	2180	8-14
	eastern (#13-15)	**1372**	322	1050	16-51
Peñasquitos Lagoon	lower marsh				
1977		**2670**			
1978		**4415**			
Tidal wetlands					
Mugu Lagoon (mean for 1978-1981)					
	lower marsh	**440**	129	311	29
San Diego River	lower marsh				
1977		**799**			
1978		**1477**			
Tijuana Estuary	mid-marsh				
1976		**845**			
1977		**1096**			
1978		**956**			
Experimental mesocosms at PERL					
(1986-1987)	low elevation	**562**			
	medium elevation	**914**			
	high elevation	***2792**			

* Extremely variable; range of values among 9 mesocosms = 728-13,103).

Figure 1A. Simplified diagram of the existing food chains at Ballona Wetland. With minimal tidal influence, linkages between the channels and marshes are few. BSS = Belding's Savannah Sparrow. Box size is a crude indication of standing crop; width of arrow indicates relative amount of energy transfer (low vs. high rate). ? = uncertain transfer.

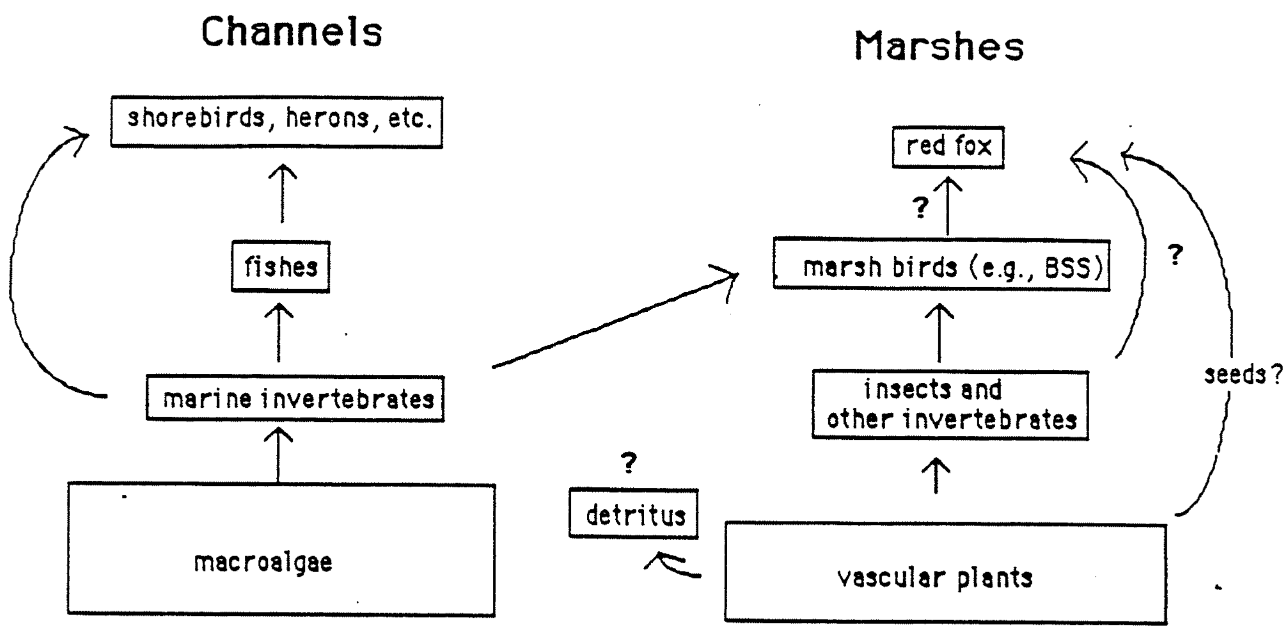


Figure 1B. Hypothesized food web at Ballona Wetland following tidal enhancement. With restored tidal flows, there would be many linkages between channel and marsh food chains.

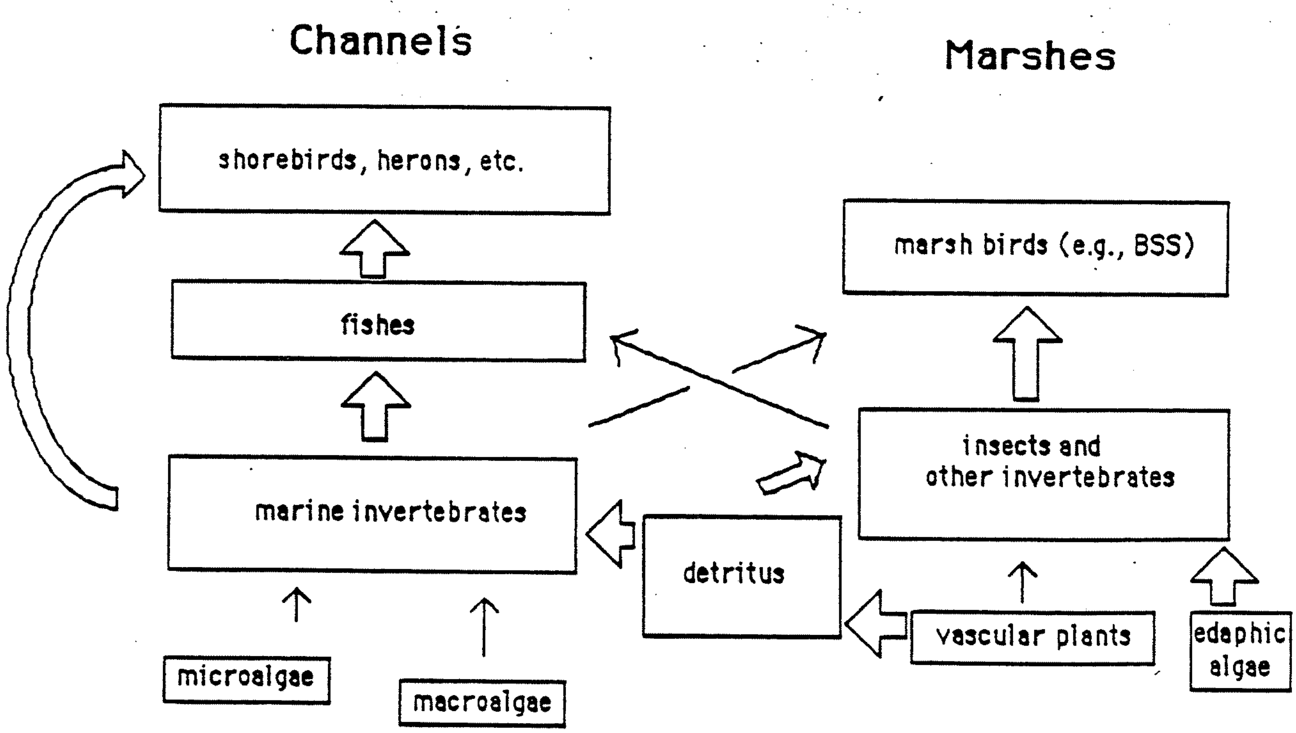
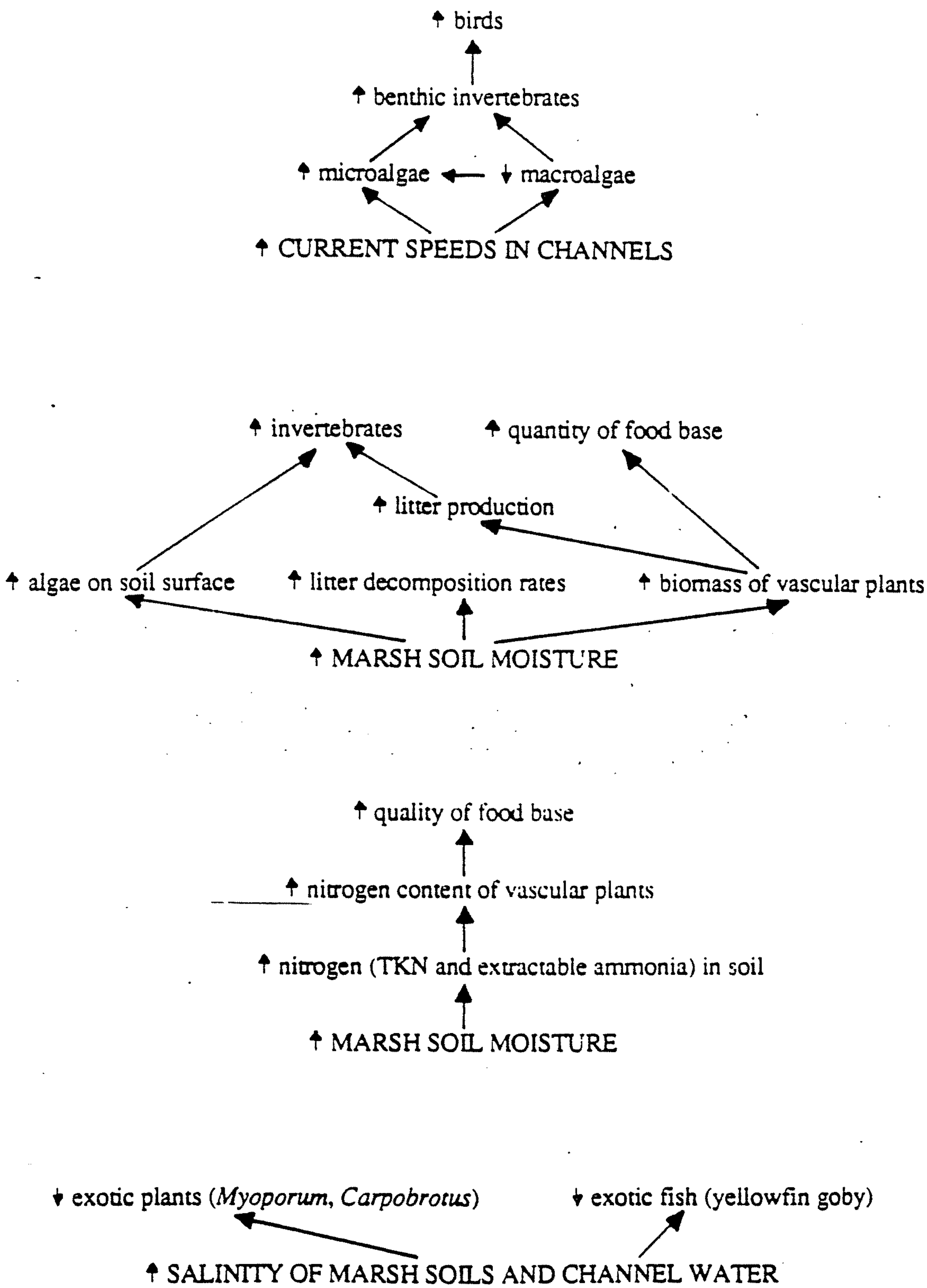


Figure 2. Hypothesized changes to environmental conditions and food chain support.



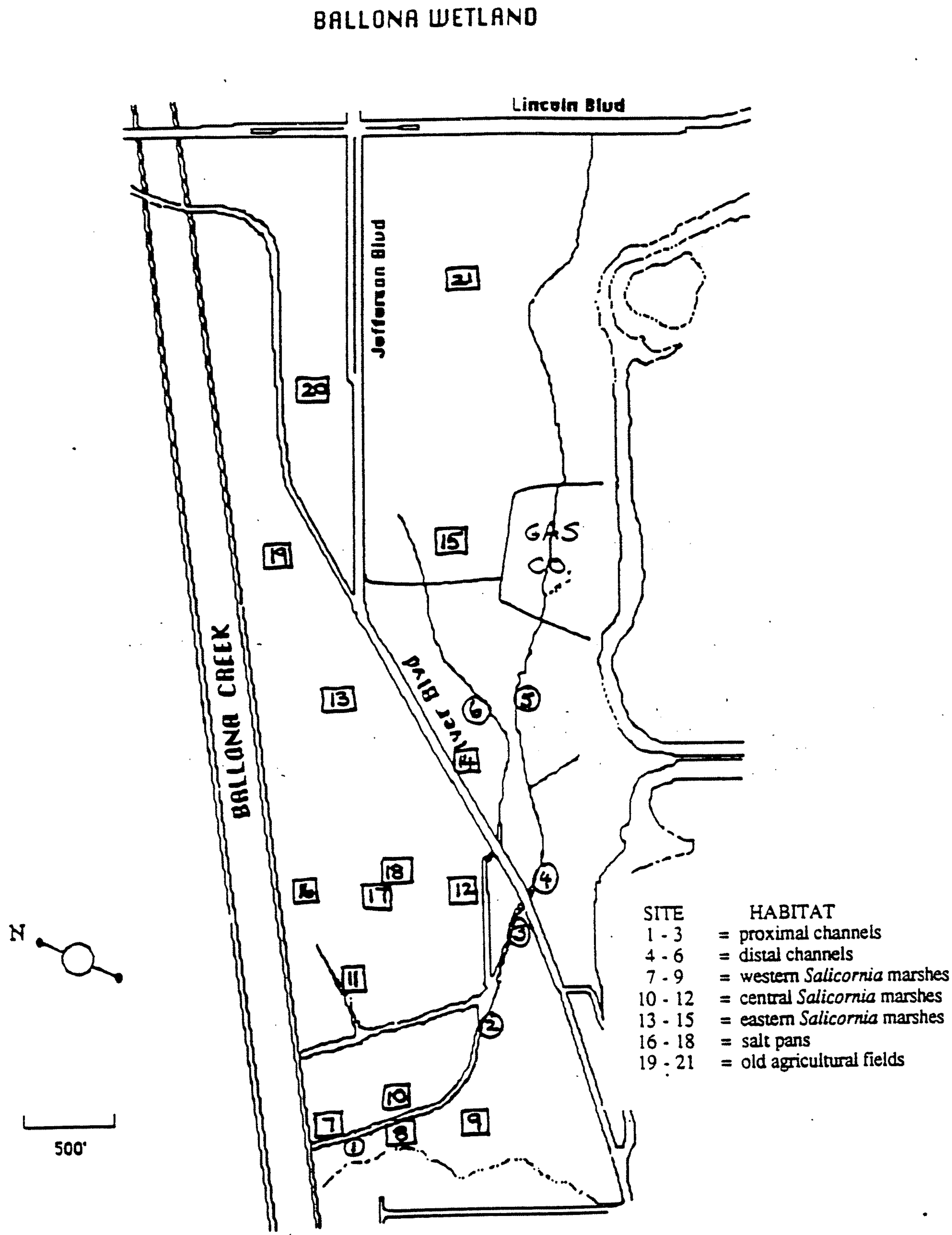


Figure 3. The locations of the 21 sampling sites at Ballona Wetland.

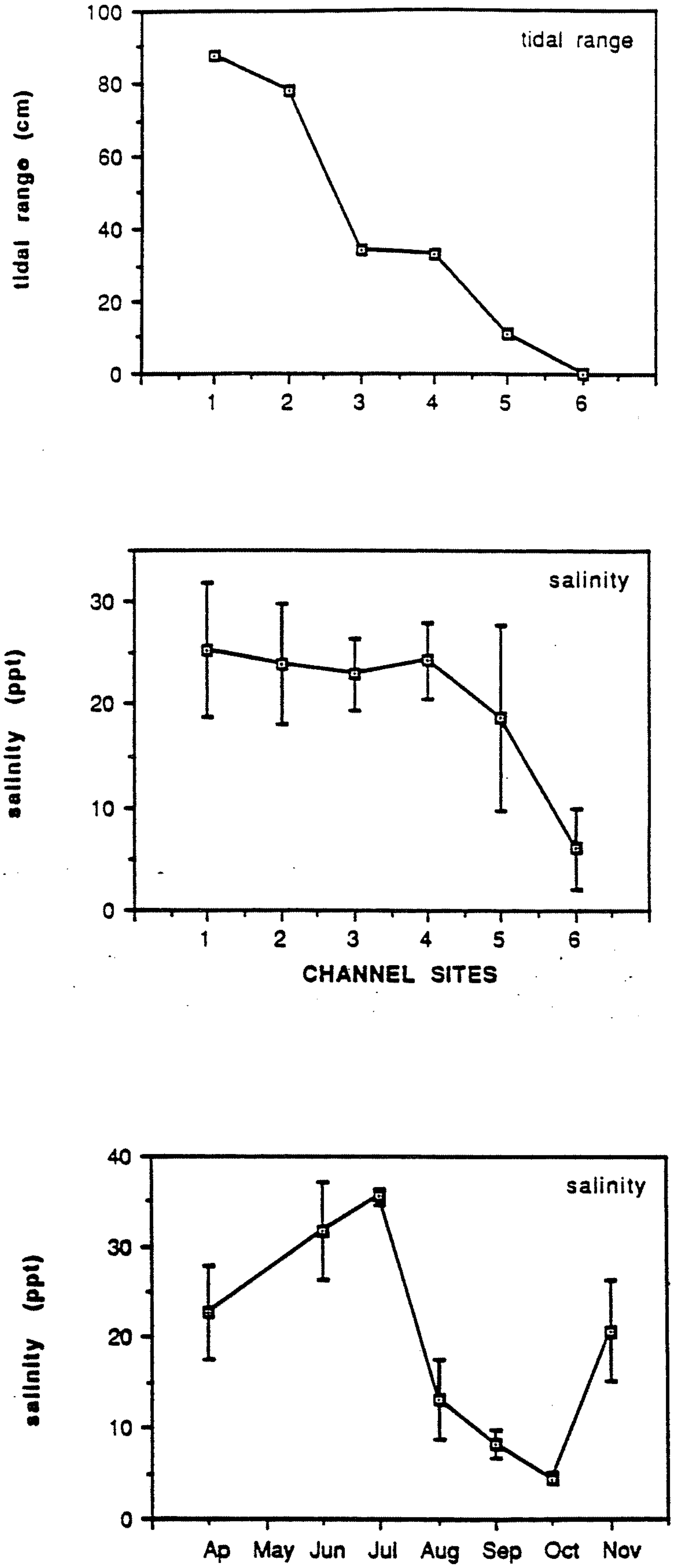
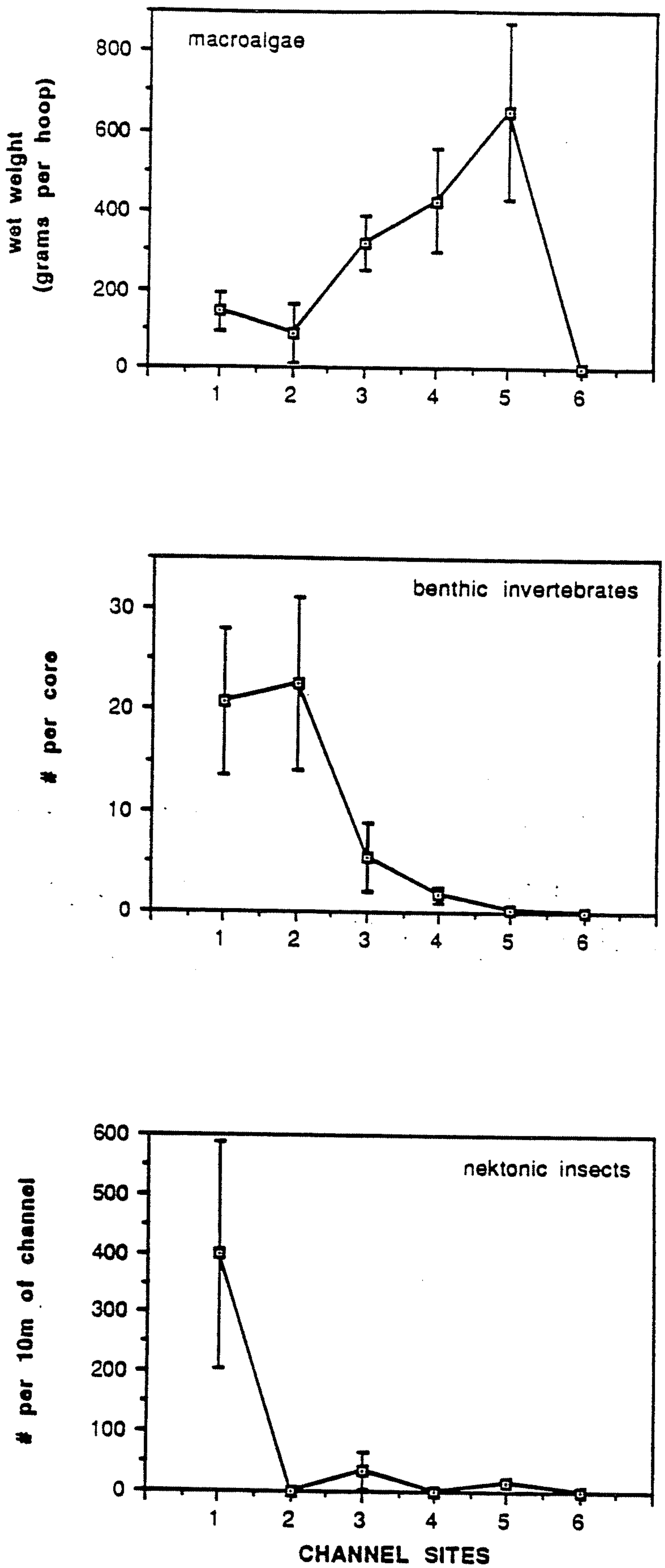
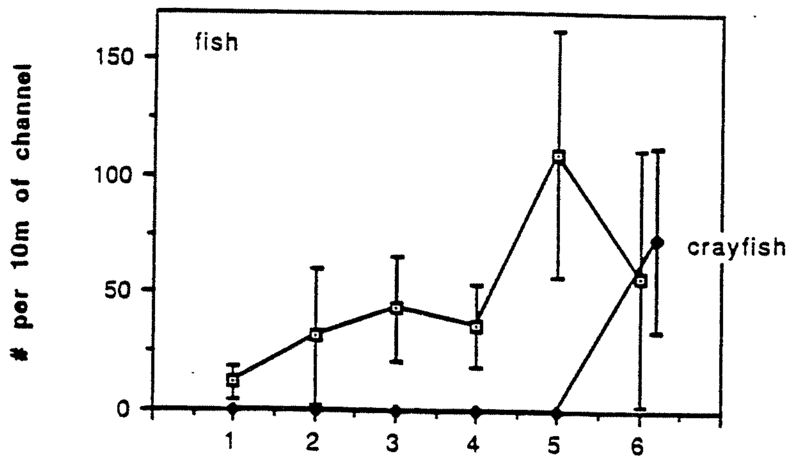


Figure 4. The magnitude of the tidal range (A) and the salinity of the water in the six channel sites (means of the three seasons ± 1 std. error; B). The sites are arranged in order of decreasing tidal amplitude. The changes in the salinity of the water in the six char⁻⁻¹ sites during the study period (means ± 1 std. error; C).



010538

Figure 5. The abundances of macroalgae (A), benthic invertebrates (B), and nektonic insects (C) at the six channel sites (means of the three seasons ± 1 std. error). The sites are arranged in order of decreasing tidal amplitude.



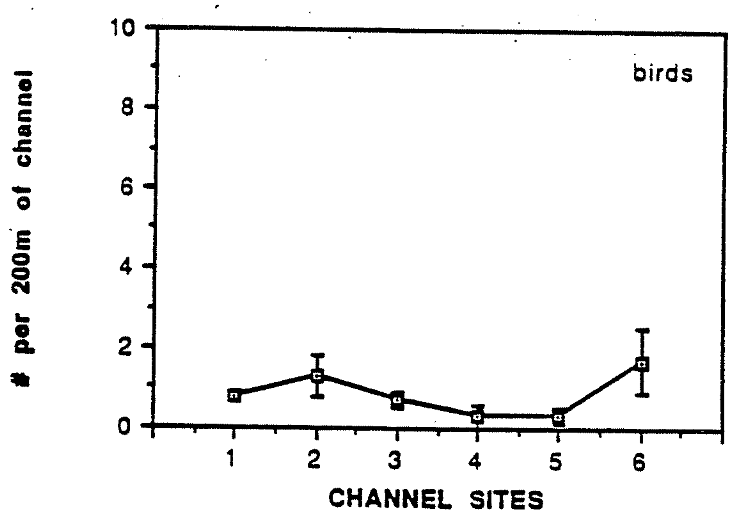
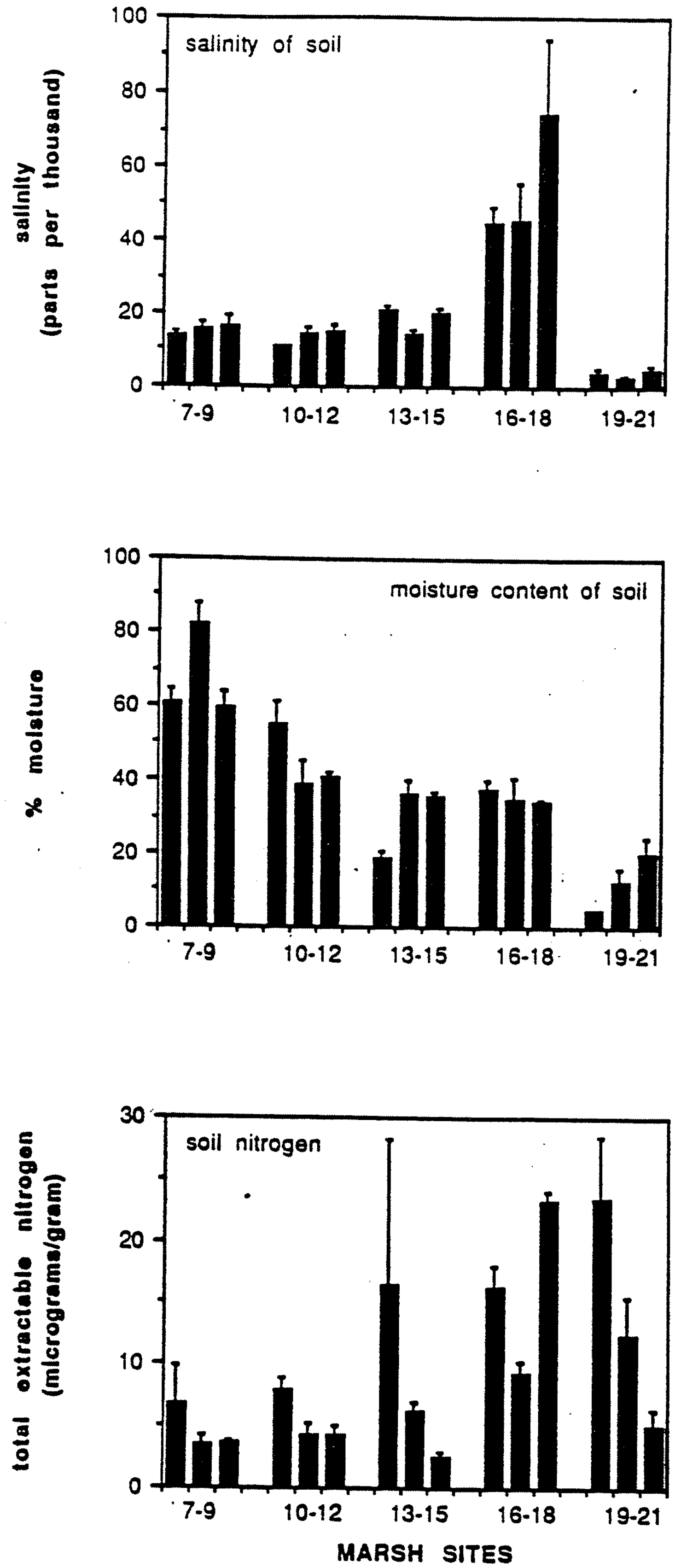


Figure 6. The abundances of fish (A), crayfish (A), and birds (B) at the six channel sites (means of the three seasons ± 1 std. error). The sites are arranged in order of decreasing tidal amplitude.



010540

Figure 7. The salinity (A), the moisture content (B) and nitrogen content (C) of the soils at the marsh sites. The means of the three seasons (± 1 std. error) are given.

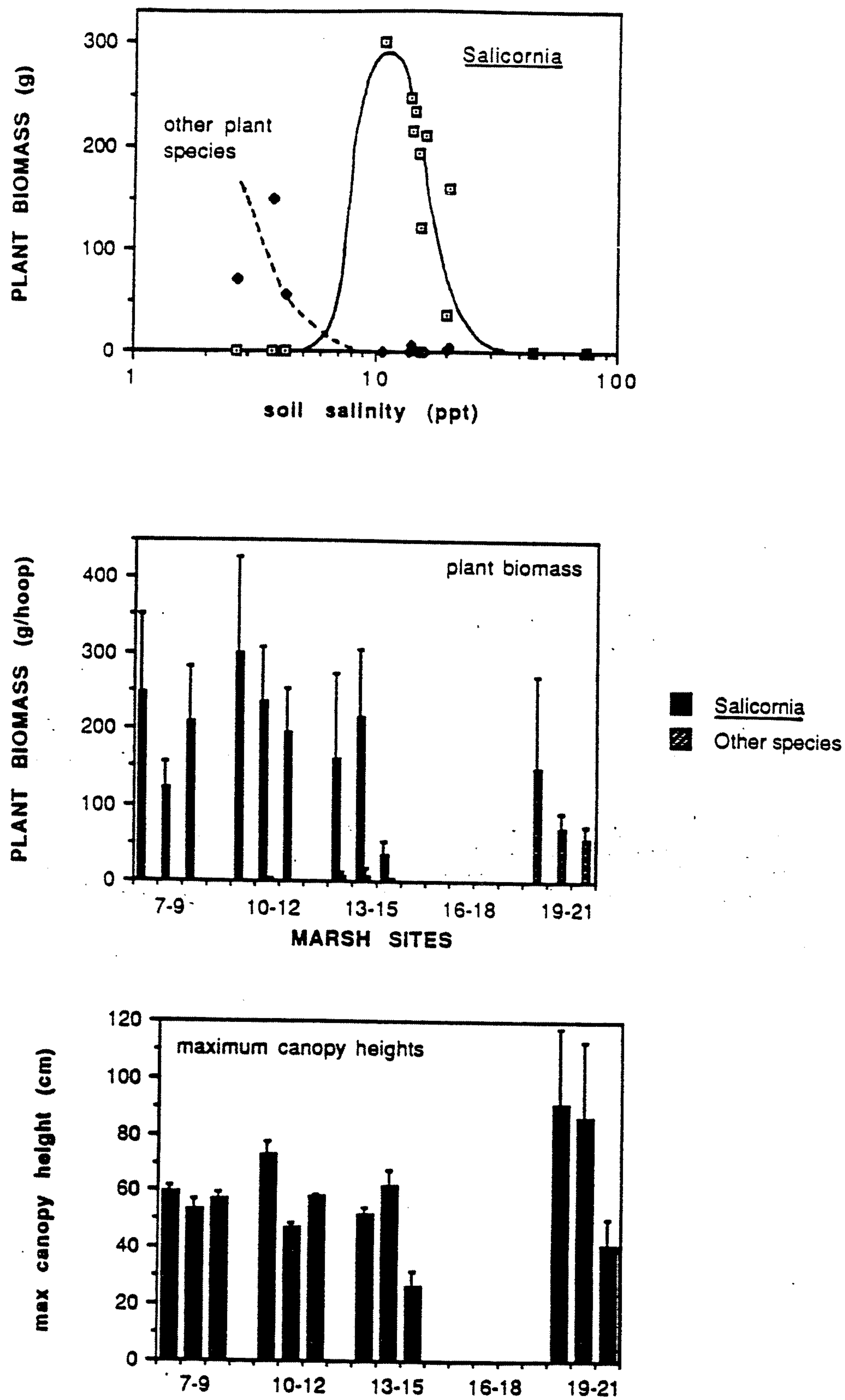


Figure 8. Plant biomass in the marsh sites as a function of soil salinity (A). The mean plant biomass in 1/10m² hoops (B) and the maximum canopy heights of the plants in the marsh sites (C); the means of the three seasons (± 1 std. error) are given .

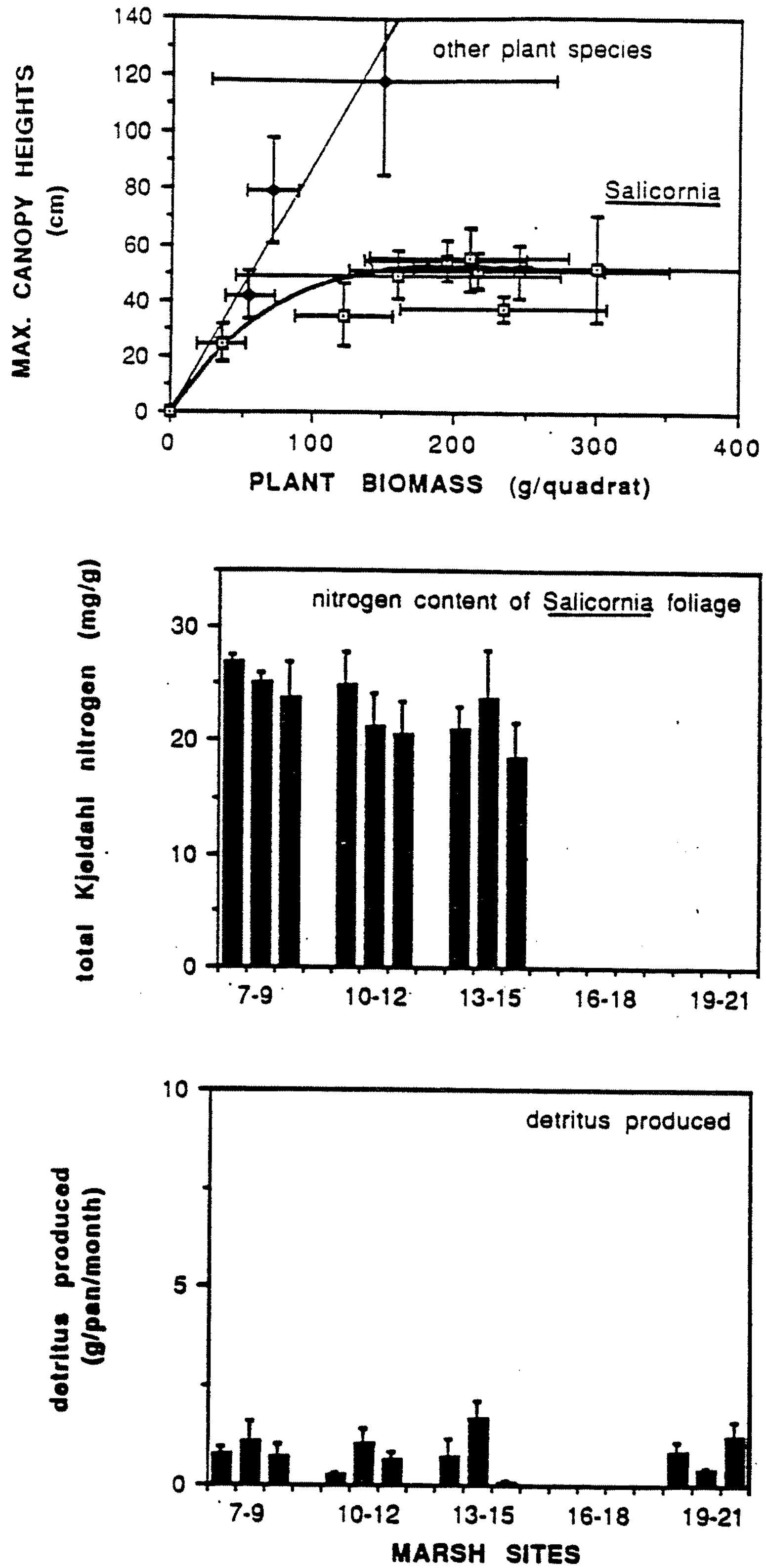


Figure 9. Maximum canopy heights as a function of plant biomass (A); the means of the three samples (± 1 std. deviation) are given for both factors. The nitrogen content of the *Salicornia* foliage (B) and the detritus produced at the marsh sites. The means of the three seasons (± 1 std. error) are given.

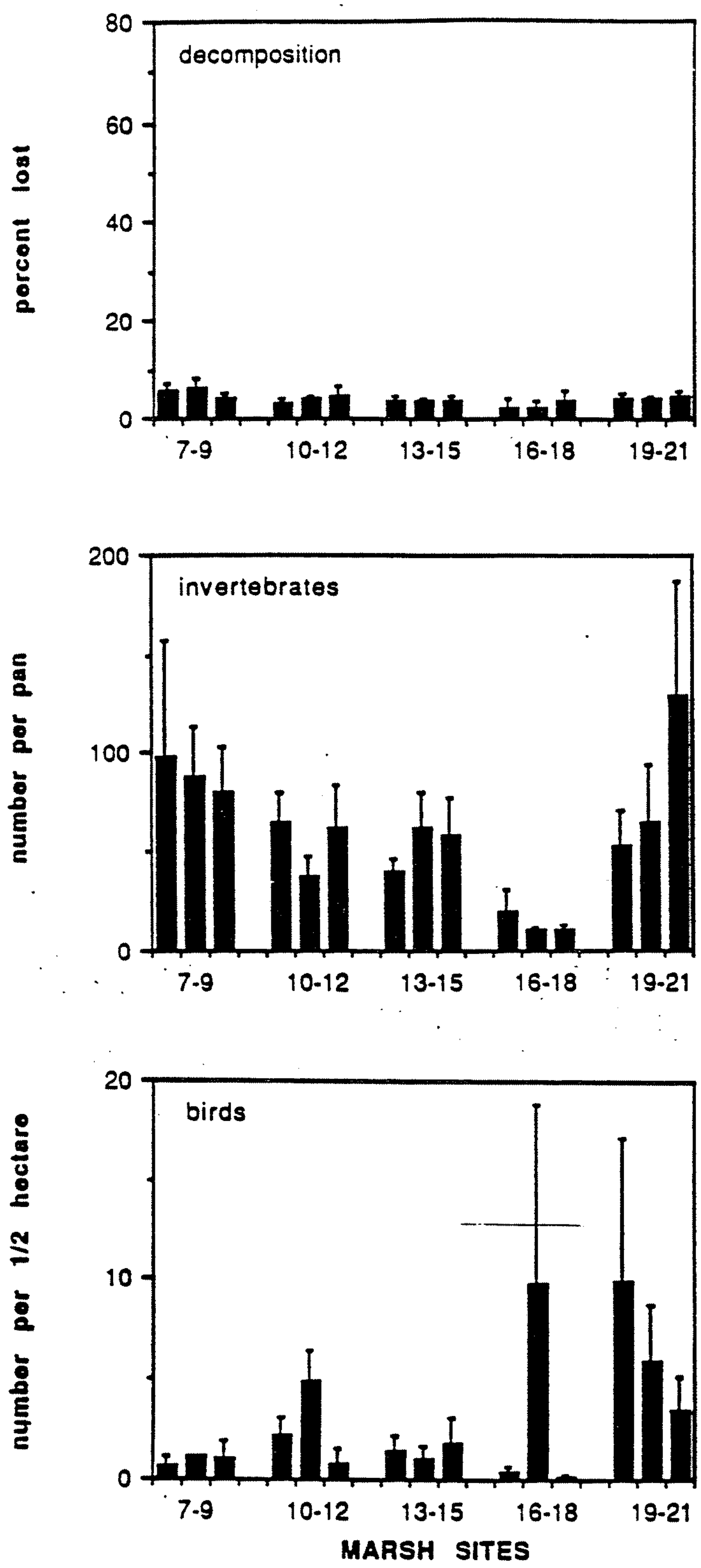


Figure 10. The decomposition rates (A), the abundances of invertebrates (B), and the abundances of birds in the marsh sites. The means of the three seasons (± 1 std. error) are given.

APPENDIX 1. The benthic invertebrates caught at the six Channel sites. The mean number of individuals per core (n = 3; core surface area = 78.54cm^2), is given. The results for the three seasons are presented separately in 1A, 1B and 1C.

APPENDIX 1A. Ballona Wetland benthic cores - April 1990

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
WORMS						
Spionidae - mean	7	1.3	3.7	0.3		
std d	8.2	1.5	6.4	0.6		
Capitellidae - mean	1.7	21.7	0.3	0.3		
std d	2.9	35.8	0.6	0.6		
Oligochaeta - mean	0.3	3.7				
std d	0.6	6.4				
Total worms	**9**	**26.7**	**4**	**0.7**	**0**	**0**
MOLLUSC						
Cerithidea californica - mean	4.7	8.3	0.7			
std d	4	10.4	0.6			
Macoma nasuta - mean		0.3				
std d		0.6				
Haminoea vesicula	X					
Total molluscs	**4.7**	**8.7**	**0.7**	**0**	**0**	**0**
CRUSTACEANS						
amphipods				X	X	
crab holes	X	X				
MISC						
Fish eggs - mean			4.7			
std d			8.1			
Total misc	**0**	**0**	**4.7**	**0**	**0**	**0**
TOTAL INVERTS (no misc) - mean	**13.7**	**38.7**	**4.7**	**0.7**	**0**	**0**
std d	**7.1**	**47.8**	**5.5**	**1.2**	**0**	**0**
std e	**4.1**	**27.6**	**2.7**	**0.4**	**0**	**0**
X = present in habitat but not in samples						

APPENDIX 1B. Ballona Wetland benthic cores - July 1990

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
WORMS						
Spionidae - mean	20.3	1.7	4			
std d	18.2	2.1	3.6			
Capitellidae - mean	9.7	1.7	0.7			
std d	9	2.9	1.2			
Oligochaeta - mean		3.3				
std d		3.3				
Total worms	30	6.7	4.7	0	0	0
MOLLUSC						
Cerithidea californica - mean	5.3	12.7	5.3	1.3		
std d	4	12.7	6.7	2.3		
Macoma nasuta - mean		0.3				
std d		0.6				
Assiminea - mean					0.7	
std d					1.2	
Total molluscs	5.3	13	5.3	1.3	0.7	0
CRUSTACEANS						
amphipods - mean			1.7			
std d			2.1			
crabs:						
Uta crenulata	X	X	X			
Pachygrapsus crassipes	X	X	X			
Total Crustaceans	0	0	1.7	0	0	0
TOTAL INVERTS - mean	35.3	19.7	11.7	1.3	0.7	0
std d	23	11.2	11.2	2.3	1.2	0
std e	0.6	6.4	6.5	1.3	0.7	0
X = present in habitat but not in samples						

APPENDIX 1C. Ballona Wetland benthic cores - October 1990

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
WORMS						
Spionidae - mean	2			2.3		
std d	2.6			3.2		
Capitellidae - mean	6.3	0.3		0.3		
std d	8.5	0.6		0.6		
Nereidae - mean	0.7					
std d	0.6					
Total worms	**9**	**0.3**	**0**	**2.6**	**0**	**0**
MOLLUSC						
Cerithidea californica - mean	3.7	8.7				
std d	3.2	5.7				
Tagelus californianus -mean		0.3				
std d		0.6				
Total molluscs	**4.7**	**9**	**0**	**0**	**0**	**0**
CRUSTACEANS						
amphipods - mean	0.3			0.3		
std d	0.6			0.6		
crabs:						
Uta crenulata		X				
Total crustaceans	**0.3**	**0**	**0**	**0.3**	**0**	**0**
TOTAL INVERTS - mean	**13.3**	**9.3**	**0**	**3**	**0**	**0**
std d	**12.7**	**4.9**	**0**	**3.6**	**0**	**0**
std e	**7.4**	**2.8**	**0**	**2.1**	**0**	**0**
X = present in habitat but not in samples						

APPENDIX 2. The nekton caught at the six Channel sites. The number of individuals per 10m of channel, is given. The results for the three seasons are presented separately in 2A, 2B and 2C.

APPENDIX 2A. Ballona Wetland nekton (number per 10m of channel) - April 1990

NAME				NUMBER	per 10m		
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
FISH							
Atherinops affinis	topsmelt		77				
Gillichthys mirabilis	longjaw mudsucker	2	13				
Acanthogobius flavimanus	yellowfin goby			X			
Clevelandia ios	arrow goby						
Fundulus parvipinnis	California killifish			X			
Gambusia affinis	mosquito fish			X	6	63	4
Leptocottus armatus	staghorn sculpin						
Total fish		**2**	**90**	**0**	**6**	**63**	**4**
INSECTS							
Corixidae	water boatmen	577		87			
Hydrophilidae	water scavenger beetles			11		10	2
Total insects		**577**	**0**	**98**	**0**	**10**	**2**
CRUSTACEANS							
crayfish							85
Total crustaceans		**0**	**0**	**0**	**0**	**0**	**85**
TOTAL NEKTON		**579**	**90**	**98**	**6**	**73**	**91**

X = present in habitat but not in sample

010549

APPENDIX 2B. Ballona Wetland nekton (number per 10m of channel) - July 1990

NAME				NUMBER per 10m			
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
FISH							
Atherinops affinis	topsmelt						
Gillichthys mirabilis	longjaw mudsucker						
Acanthogobius flavimanus	yellowfin goby						
Clevelandia ios	arrow goby	8					
Fundulus parvipinnis	California killifish			X			
Gambusia affinis	mosquito fish			75	67	215	
Leptocottus armatus	staghorn sculpin						
Total fish		**8**	**0**	**75**	**67**	**215**	**0**
INSECTS							
Corixidae	water boatmen	600					
Hydrophilidae	water scavenger beetles					31	
Total insects		**600**	**0**	**0**	**0**	**31**	**0**
CRUSTACEANS							
crayfish							
Total crustaceans		**0**	**0**	**0**	**0**	**0**	**0**
TOTAL NEKTON		**608**	**0**	**75**	**67**	**246**	**0**

X = present in habitat but not in sample

APPENDIX 2C. Ballona Wetland nekton (number per 10m of channel) -October 1990

NAME		NUMBER per 10m					
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
FISH							
Atherinops affinis	topsmelt						
Gillichthys mirabilis	longjaw mudsucker			1			
Acanthogobius flavimanus	yellowfin goby						
Clevelandia ios	arrow goby						
Fundulus parvipinnis	California killifish	3	3				
Gambusia affinis	mosquito fish	22	1	55	34	52	167
Leptocottus armatus	staghorn sculpin						
Total fish		**25**	**4**	**56**	**34**	**52**	**167**
INSECTS							
Corixidae	water boatmen	17		6			
Hydrophilidae	water scavenger beetles					7	
Total insects		**17**	**0**	**6**	**0**	**7**	**0**
CRUSTACEANS							
crayfish							135
Total crustaceans		**0**	**0**	**0**	**0**	**0**	**135**
TOTAL NEKTON		**42**	**4**	**62**	**34**	**59**	**302**

X = present in habitat but not in sample

APPENDIX 3. The birds seen at the six Channel sites. The numbers given are number of individuals per 200m of channel averaged over the three monthly censuses per season. The results for the three seasons are given separately in 3A, 3B and 3C.

APPENDIX 3A. Channel birds - Spring 1990

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Great Egret		0.3	0.3			
Black-crowned Night Heron	0.7	0.3				
Mallard					0.7	
Killdeer			0.7			
Willet	0.3					
Red-winged Blackbird						1.0
Song Sparrow						X
Total individuals (sum of means)	1.0	0.6	1.0	0.0	0.7	1.0
Total species	2	2	2	0	1	1

X = seen in habitat but not in counts

APPENDIX 3B. Channel birds - Summer 1990

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Great Blue Heron		1.3				
Green Heron	0.3			0.7		
Black-crowned Night Heron		1	0.3	0.3		
Spotted Sandpiper			X			
Wilson's Phalarope	0.3					
Belted Kingfisher						X
Mockingbird						X
House Finch						X
Song Sparrow						0.7
Total individuals (sum of means)	0.6	2.3	0.3	1.0	0.0	0.7
Total species	2	2	2	2	0	4

X = seen in habitat but not in counts

APPENDIX 3C. Channel birds - Fall 1990

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Great Egret	X					
Snowy Egret		X				
Great Blue Heron		X				
Green Heron		X		X		0.7
Blue-winged Teal	0.7	0.7				
Coot	X		0.3			
Black-bellied Plover		X				
Least Sandpiper		X				
Willet		0.3	0.3			
Belted Kingfisher	X	X				
Long-billed Marsh Wren						0.3
House Finch						1.3
Song Sparrow						0.7
Savannah Sparrow						0.3
Total individuals (sum of means)	0.7	1.0	0.6	0.0	0.0	3.3
Total species	4	8	2	1	0	5

X = seen in habitat but not in counts

APPENDIX 4. The number of invertebrates, primarily insects, caught in pans at the "Marsh" sites. The numbers given are the mean number of individuals caught per pan averaged over three pans per site and three sites per habitat. The results for the three seasons are given separately in 4A, 4B and 4C.

APPENDIX 4A. Ballona Wetland "insects" - April 1990

Sites:	# 7 - 9	# 10 - 12	# 13 - 15	# 16 - 18	# 19 - 21	
CRUSTACEANS						
AMPHIPODS	11.5	0.1	0.0	0.0	0.0	
ISOPODS	0.0	0.0	0.0	0.0	0.5	
ARACHNIDS						
MITES	0.1	1.4	1.3	0.0	2.6	
SPIDERS	11.8	2.7	2.8	0.4	10.0	
INSECTS						
COLEOPTERA	1.2	1.6	4.1	0.1	2.6	
COLLEMBOLA	19.4	4.6	28.6	0.6	102.4	
DERMAPTERA	0.0	0.0	0.0	0.0	2.8	
DIPTERA	43.9	31.2	12.7	4.0	23.5	
HEMIPTERA	0.0	0.0	0.0	0.0	0.0	
HOMOPTERA	18.9	14.4	11.1	1.6	4.5	
HYMENOPTERA - ants	1.9	4.9	1.7	0.0	0.5	
" - wasps	6.0	6.1	7.9	0.4	1.4	
LEPIDOPTERA - adults	0.6	0.7	8.0	0.3	0.5	
" - larvae	0.4	0.0	0.1	0.0	0.3	
NEUROPTERA	0.0	0.0	0.0	0.2	0.0	
ORTHOPTERA	0.0	0.6	0.0	0.0	0.7	
THYSANOPTERA	1.9	1.5	1.3	0.4	0.8	
unidentified insects	3.9	5.1	3.3	0.1	1.4	
TOTAL	104.9	70.9	78.2	7.3	145.5	

010557

APPENDIX 4B. Ballona Wetland "insects" - July 1990

Sites:	# 7 - 9	# 10 - 12	# 13 - 15	# 16 - 18	# 19 - 21
CRUSTACEANS					
AMPHIPODS	32.2	0.5	0.0	0.0	0.0
ISOPODS	0.2	0.2	1.7	0.0	0.0
ARACHNIDS					
MITES	0.0	0.2	0.2	0.3	0.0
SPIDERS	1.3	3.3	2.0	0.3	4.7
INSECTS					
COLEOPTERA	1.0	1.7	1.7	0.2	2.8
COLLEMBOLA	5.0	2.5	3.3	1.3	0.7
DERMAPTERA	0.0	0.2	1.0	0.0	0.8
DIPTERA	23.7	15.0	21.3	5.0	2.5
HEMIPTERA	0.2	0.3	0.3	0.0	0.0
HOMOPTERA	3.8	6.0	2.5	1.2	3.7
HYMENOPTERA - ants	2.7	1.7	3.2	1.0	1.0
" - wasps	7.8	4.0	10.3	1.0	5.3
LEPIDOPTERA - adults	0.2	0.2	1.2	0.0	14.7
" - larvae	0.4	0.2	0.0	0.0	0.5
NEUROPTERA	0.0	0.0	0.0	0.2	0.0
ORTHOPTERA	0.2	0.5	0.2	0.0	0.2
PSCOPTERA	1.3	0.8	2.7	0.3	0.7
THYSANOPTERA	1.0	1.0	0.5	0.2	1.5
THYSANURA	0.0	2.5	0.8	0.2	3.7
unidentified insects	0.0	0.0	0.0	0.0	0.0
TOTAL	81.0	40.8	52.9	11.2	42.8

APPENDIX 4C. Ballona Wetland "insects" - October 1990

Sites:	# 7 - 9	# 10 - 12	# 13 - 15	# 16 - 18	# 19 - 21
CRUSTACEANS					
AMPHIPODS	8.5	0.0	0.0	0.0	0.0
ISOPODS	0.0	0.1	0.0	0.0	1.0
ARACHNIDS					
MITES	0.0	0.3	0.0	0.0	0.0
SPIDERS	1.0	0.8	1.0	0.7	0.3
INSECTS					
COLEOPTERA	0.0	0.3	0.8	0.0	2.8
COLLEMBOLA	9.7	10.4	5.3	0.4	23.9
DERMAPTERA	0.0	0.0	0.0	0.0	0.1
DIPTERA	6.5	12.3	2.2	2.3	3.8
HEMIPTERA	0.0	0.6	0.0	2.1	1.1
HOMOPTERA	3.8	4.9	6.6	1.4	6.4
HYMENOPTERA - ants	0.7	4.0	1.9	0.4	1.3
" - wasps	0.7	1.7	5.2	0.1	7.0
LEPIDOPTERA - adults	0.0	0.3	0.4	0.1	0.0
" - larvae	0.2	0.1	0.0	0.0	0.0
NEUROPTERA	0.2	0.4	0.0	0.4	0.2
ORTHOPTERA	0.0	0.0	0.0	0.0	0.0
PSCOPTERA	1.8	1.4	2.1	0.2	0.9
THYSANOPTERA	1.3	1.9	1.6	0.1	1.4
THYSANURA	0.0	1.9	1.2	0.1	2.1
unidentified insects	0.0	0.1	0.0	0.0	0.0
TOTAL	34.4	41.5	28.3	8.3	52.3

010559

APPENDIX 5. The birds seen at the fifteen "Marsh" sites. The numbers given are number of individuals per 1/2 hectare averaged over the three monthly censuses per season. The results for the three seasons are given separately in 5A, 5B and 5C.

APPENDIX 5A. Marsh birds - Spring 1990

Sites:	# 7	# 8	# 9	# 10	# 11	# 12	# 13	# 14	# 15	# 16	# 17	# 18	# 19	# 20	# 21
Osprey				X											
Red-tailed Hawk							X								
American Kestrel										X					
Killdeer								X				0.3			
Willet	X														
Common Snipe					0.3										
Mourning Dove				X				X					X		X
Allen's Hummingbird							X								
White-throated Swift								X	X						X
Vaux's Swift	X			X											
Barn Swallow	X			X				X	X						
Violet-green Swallow															X
Cliff Swallow	X			X				X	X						X
Common Raven			X									0.3			
Western Kingbird				X					X						
Mockingbird				X				X							
Loggerhead Shrike			X						X			X			
Red-winged Blackbird									X						
Starling						X									X
Long-billed Marsh Wren							0.3	0.3							
Western Meadowlark	X		X	0.7					X		0.3		1.3	0.7	0.3
Savannah Sparrow	X	1.0	0.3	1.7	4.7		0.7	0.3	1.0	0.7	X				3.3
White-crowned Sparrow													8.3	10.0	1.0
House Finch		X													14.7
Total individuals (sum of means)	0.0	1.0	0.3	2.4	4.7	0.0	1.0	0.6	1.0	0.7	0.3	0.3	9.6	10.7	19.3
Total species	6	2	4	9	2	1	4	8	8	2	2	3	3	2	9
X = seen in habitat but not in count															

APPENDIX 5B. Marsh birds - Summer 1990

Sites:	# 7	# 8	# 9	# 10	# 11	# 12	# 13	# 14	# 15	# 16	# 17	# 18	# 19	# 20	# 21
Great Blue Heron		X													
Red-tailed Hawk								X							
American Kestrel															X
Black-bellied Plover											28.0				
Mourning Dove													X		X
White-throated Swift									X						
Vaux's Swift									X						
Barn Swallow	X	X							X	X			X	X	X
Cliff Swallow		X	X	X					X						X
Mockingbird	X	X	X	X					X						
Loggerhead Shrike	X			X		X		X	X						X
Western Meadowlark				0.7		X									0.3
Savannah Sparrow	0.3	1.3			2.0		0.3								
House Finch													3.3	1.0	
Total individuals (sum of means)	0.3	1.3	0.0	0.7	2.0	0.0	0.3	0.0	0.0	0.0	28.0	0.0	3.3	1.0	0.3
Total species	4	5	2	4	1	2	1	2	6	1	1	0	3	2	6

X = seen in habitat but not in count

010562

APPENDIX 5C. Marsh birds - Fall 1990

Sites:	# 7	# 8	# 9	# 10	# 11	# 12	# 13	# 14	# 15	# 16	# 17	# 18	# 19	# 20	# 21
Great Blue Heron		X			3.3					1.0	0.3				
Great Egret					1.7						0.7				
Red-tailed Hawk														X	
American Kestrel														X	
Killdeer										X					
Willet					0.3										
Great Horned Owl				0.3											
Mourning Dove														X	
Say's Phoebe		0.3			X	X									
Black Phoebe		X													
Yellow Warbler	0.3														
Yellow-rumped Warbler			2.3										0.7		
Wilson's Warbler								X							
Mockingbird			X												
Loggerhead Shrike	X		0.3				X								
Long-billed Marsh Wren	1.0			X											
Western Meadowlark		X	X	X		X		1.7	0.3				X	0.7	X
Savannah Sparrow	0.3	0.7	0.3	3.0	2.3	2.3	3.0	0.7	4.0				3.3	5.3	5.3
White-crowned Sparrow													X	0.3	
House Finch													X	X	X
Total individuals (sum of means)	1.6	1.0	2.9	3.3	2.3	2.3	3.0	2.4	4.3	0.0	0.0	0.0	4.0	6.3	5.3
Total species	4	5	5	4	5	3	2	3	2	2	2	0	5	7	3

X = seen in habitat but not in count

010563

APPENDIX 6. Red Fox abundances. The number and location of Red Foxes seen during our monthly bird censuses.

Month	Number	Location
March	1	Site 5
April	8	Sites 10, 11 (5 individuals), 12, 14
May	4	Sites 11, 13, 14, 20
June	1	Site 13
July	1	Site 16
August	2	Sites 10, 21
September	1	Site 11
October	0	-
November	2	Site 5 (2 individuals)

DRAFT

BOTANICAL RESOURCES OF PLAYA VISTA

By

James Henrickson
Department of Biology
California State University
Los Angeles, California 90032
May 12, 1991

CONTENTS

DRAFT

BOTANICAL RESOURCES OF PLAYA VISTA

By

James Henrickson
Department of Biology
California State University
Los Angeles, California 90032
(213-)343-2057

INTRODUCTION

This report presents data on botanical resources of the Playa Vista lands controlled by Maguire Thomas Partners (Fig. 1). The Playa Vista site lies partially within the City of Los Angeles and partially within unincorporated Los Angeles County and extends into communities of Mariña del Rey north of the Ballona Creek channel and west of Lincoln Boulevard, into Culver City east of Lincoln Boulevard, and into Playa del Rey south of Ballona Creek channel. The property is traversed by several major streets and a major flood-control channel that divides the site into distinct sections: the northeast-southwest running Ballona Creek channel that drains an area of approximately 120 square miles into Santa Monica Bay; the northwest-southeast running Lincoln Boulevard that extends from northern Santa Monica south to the Los Angeles airport; the northeast-southwest-running Culver Boulevard that extends from the Santa Monica Freeway to the beach at Playa del Rey; and the east-west running Jefferson Boulevard that extends from just east of the Coliseum near the Harbor Freeway and feeds into Culver Boulevard on the site (Fig. 1).

The entire Maguire Thomas Partners-Playa Vista site consists of 1004.8 acres. The roads and channel are used to separate the site into four areas that are discussed separately (Fig. 1).

Area A, consisting of 138.6 acres, lies north of Ballona Creek channel and west of Lincoln Boulevard. It occurs within the county of Los Angeles and is separated from developed portions of Marina del Rey by Fiji Way that forms its northern and western border. The area ranges from 9.3 to 17.4+ feet in elevation and consists primarily of areas filled during the excavations of Ballona Creek in the early 1930's and Marina del Rey in the early 1960's. The area drains internally as the marginal portions are higher in elelvation than the central flats.

Area B consists of 337.9 acres and occurs south of Ballona Creek channel, west of Lincoln Boulevard, and extends up to the service road (Cabora Drive) that overlies a major sewer pipeline near the base of the Playa del Rey Bluff, the northerly facing hills that form the southern border of the site. The sewer line leads west and then south of this area and feeds into the Hyperion Sewage Treatment Plant. Area B extends westward into the sandy flats and dunes that border the homes along the street named Vista del Mar. The site ranges from 2.4 to 5 feet in the lower flats and extend up to 50 ft in elevation along the lower slopes of the Playa del Rey bluffs below Cabora Drive. The flats contain the only remaining undisturbed salt marsh and sand dune habitats on the site.

Area C, 66.3 acres in extent, occurs north of Ballona Creek channel and east of Lincoln Boulevard. Its irregular north and eastern border is formed by apartments that border Fiji Way and Villa del Marina and its northeastern border is formed by the Harbor Freeway. It is traversed in an east-west direction by Culver Boulevard, and contains fill from development of the Ballona Creek Flood Control Channel, the marina at Marina del Rey, for berms for the Pacific Electric Railroad, and the Marina Freeway. Spoil was also deposited on area C as a result of the raising of Culver Boulevlard were it crosses over Lincoln Boulevard. At present the site ranges from 4.6 to 25.6 ft in elevation, with the noted low occurring in a depression near the east-bound Culver Boulevard to Lincoln Boulevard exit curve and and high occurring along the elevated Culver Boulevard near Lincoln Boulevard. It is a site that was given to the state in lieu of taxes after the death of Howard Hughes by the Summa Corporation and has been repurchased by the Maguire Thomas Partners-Playa Vista.

Area D, consisting of 462 acres, is the largest section of the site extending nearly 2 miles in an northeast-southwest direction. It lies east of Lincoln Boulevard and south of Jefferson Boulevard. Its southern border is marked by Cabora Drive, which overlies the Hyperion sewage treatment plant pipeline that passes along the lower portion of Del Rey bluffs. The site contains several large manufacturing buildings and parking lots of the Hughes Corporation and in the past contained a large private airstrip. The east-west running Teale Street extends all along the southern portion of the site extending from Centinela Avenue westward to Lincoln Boulevard. The street is bordered to the south by the remnents of Centinela Creek now straightened, confined, and known as Centinela Ditch. The area has been actively filled by soil brought in from outside the area and presently ranges from 12 to 22 feet in elevation in the flats, contains an estimated 30 ft tall ridge of dirt fill, and extends up to 165 ft along the southern bluffs.

The Playa Vista site is an important site botanically as it contains one of the last remnants of coastal wetland habitats in Los Angeles County. It is estimated that at one time Los Angeles County contained about 6800 acres of Coastal wetlands, but this acreage has suffered a 96 percent reduction due to development of wetlands (e.g. the Los Angeles and Long Beach harbors, Anaheim Bay) and channelization of the major rivers that flowed into these wetlands (Henrickson 1976, from Speck 1969). At the present time the Ballona wetlands contains about 120 acres of pickleweed habitat (in areas A, B, and C) and 31 acres of salt flats (in areas A and B), and this represents the largest remnant of this once extensive wetland habitat in Los Angeles County. The only other coastal wetland habitat in Los Angeles County consists of a small wetland (about 10 acres in size) (R. Vogl, pers. comm.) at the mouth of Malibu Creek and a badly degraded La Cerretos wetland near the Los Angeles Harbor of about 30 acres in extent.

History of the Marsh:

Clark (1979) and Strauss in Clark (1979) have reviewed the history of land use of the Ballona wetlands. The Ballona Creek wetland is part of a historically much larger wetland area that extended from the Del Rey bluffs northwestward about two miles into what now is the city of Venice near Venice Boulevard and extended eastward to about 1.5 miles from the ocean to an area just east of Lincoln Boulevard (areas under about 5 feet elevation). The earliest recorded survey of the wetlands are those of George Hansen, who as County Surveyor, was to apportion land from an old Mexican land grant amongst various claimants. In his report of 1868 he stated that Rancho La Ballona contained 2,120 acres of 4th class lands, that constituted tide overflowed lands. This would include both the channels and terrestrial habitats on the site. The 2,120 acre wetland size is accepted by Clark (1979) as an accurate portrayal of the historic extend of the tidelands in the Ballona area.

During the late 1800's the wetland area was used by several hunting lodges and resorts and other resorts provided rowing and sailing in the extensive lagoons within the marsh. In 1880's rail lines were constructed through portions of the marsh as the Atcheson, Topeka and Santa Fe build rail lines to Ballona and south to Redondo and north to Venice. They envisioned a harbor at Ballona, but the initial wharf constructed was destroyed by storm waves and the project was abandoned.

The 1896 U.S.G.S. Redondo quad map (Figs. 2-3) shows the Ballona marsh after construction of the railways and a roadway into Port Ballona. The marsh is shown as a series of lagoons and interconnecting channels with some islands in the lagoons. The lagoons all connect to a 1.7 mile long channel that parallels the coastal dunes and the entire system empties into the ocean at Port Ballona. At that time the marsh appears to have been reduced to about 1550 acres and about 34 percent of the system is portrayed as lagoons and channels. It is not known if the entrance to the sea was open throughout the year or if it closed off during the summer. If it indeed stayed open throughout the year, and there is no report to the contrary, there must have been considerable freshwater inflow into the wetland system to allow the mouth to remain open in the face of strong wave and tidal action along the unprotected coast. It is possible that the wetland habitat at that time consisted of a mixture of freshwater and brackish water lakes, lagoons, and fresh and brackish marsh areas and open salt flats.

The Ballona marsh system received waters from three sources. The main source was through Ballona Creek which drained some 120 miles of the adjacent Los Angeles Basin. Ballona Creek discharged floodwaters directly into the marsh and may have run year around fueled by springs. The Centinela Creek drains a much smaller area around the Baldwin Hills to the east and its passage into the marsh was nearer the Del Rey Bluffs to the south and follows the same course today in the region west of Lincoln Boulelvard. An additional source of waters to the marsh were artesian wells as are discussed below.

In the first decade of the 20th century the Beach Land Company purchased land in Playa del Rey with intensions to develop the town and harbor. Pacific Electric cars brought tourists to the area to swim in the lagoon. The Southern California Auto Club built an 18-mile road that extended through the marsh called the Speedway, that later became Culver Boulevard.

The period between 1910 and 1920 saw development of adjacent lands as the areas known as the Palms and Culver City began to build. Cattle ranching and farming continued through the region.

By 1924 (Fig. 4), the site was crossed by Speedway and the Pacific Electric Railroad line, and contained Recreational Gun clubs. Playa Street, later known as Jefferson Boulevard was present, as was a street corresponding to Fiji Way, and other streets were present nearer the lagoon opening. The 1924 quad map indicates an estimated 1150 acres of marsh habitat. Lincoln Boulevard was extended to Culver Boulevard by the mid 1930's and truck farms were begun in that area.

By 1924 Ballona Creek had been channelized east of Lincoln Boulevard, but the runoff water from the creek still ran into the wetlands in area A. In 1938, the Army Corps of Engineers extended Ballona Creek Channel to the ocean removing most of the water that previously flowed into system dumping the dredge material on the adjacent marsh lands, and within two years the natural inlet of the wetland system was closed by sediments (Clark 1979).

Oil and gas drilling rigs were erected along the coast and in the wetlands in the 1930's and roadways were build to serve the wells. Agriculture increased and the wetlands were drained into Ballona Creek channel. Homes were built on the dunes of Playa del Rey in the 1940's and drilling rigs continued to operate on the site throughout that decade. From 1941 until 1954, the site was gradually acquired by the Summa Corporation and large industrial buildings and an industrial airport were build in the flats east of Lincoln Boulevard. In the 1950's the drilling towers were removed from site though other facilities for the underground storage of gas were retained on the site and housing and agriculture increased in and around the site.

By 1950, the wetland habitats had been greatly reduced. The 1950 Venice quad map (Fig. 5) shows the Ballona Lagoon paralleling the dunes for some 1.5 miles from the Del Rey bluffs to the city of Venice, and only about 550 acres is indicated as wetlands. The interior lakes, except for the confined Los Angeles Lake, were gone. During the early 1960's the wetland habitats were further reduced by construction of Marina Del Rey north of Ballona Creek. Discharge of the dredge materials on adjacent marshland sites north of Ballona Creek further reduced wetland habitats in the area. Agriculture has continued on the site until the early 1980's and that decade has seen further filling of lands of area D.

In 1979 the Summa Corporation announced its plans for development of the Ballona wetlands area. The plan included 6000-7000 housing units and commercial and industrial development and a Marina and several major roadways that would traverse the marsh. A total of 72 acres of prime marshland was to be offered for sale as a preserve.

At the present time only 84 acres of moderately undisturbed Pickleweed saltmarsh and 26 acres of salt flat habitats exists on the site in area B, while some 32 acres of pickleweed and some 5 acres of salt pans have redeveloped on the dredge spoils in area A, north of Ballona Creek. This represents an estimated 93 percent reduction in wetland habitats in the Ballona marsh.

Saltmarsh structure:

There is no known record of the vegetation characteristics of the original wetlands on the Ballona marsh. We can surmise its likely composition from knowledge of the water resources for the marsh in relation to its egress to the ocean and we can gain some insight from the present composition of the remaining marsh vegetation. With regards to salt marshes in general, they develop in interfaces of freshwater drainages into protected ocean estuaries in temperate zones; in the tropics these areas form mangrove swamps. If there is a massive and continual flow of freshwater into a bay, as with a major river, there will be a gradual zonation of freshwater, brackish and saltwater habitats created reflecting the mixing of the fresh and salt waters. If the freshwater is of sufficient quantity, the stream will continually flush out to the ocean through a large channal and any protected marginal areas will develop freshwater and saltmarsh habitats depending on the type of waters that flow into the area.

In Southern California, however, most rivers and streams exhibit a highly seasonal activity, reflecting precipitation in their local drainages, and the streams may flow strongly after winter rainstorms, and subside considerably during the summer and fall. During the time of high water flow, the water will flow directly to the ocean and flush the estuary with fresh water, but during the summer, when freshwater flow is reduced, the waters become progressively more saline and the action of the surf on the sand may close the mouth of the river creating a closed estuary, which may eventually be breached following the next winter storms. Depending on the inflow of freshwater and saltwater in marsh systems, the marshes may vary considerably in salinity during the year and this variation in salinity will greatly effect the composition of the vegetation.

The open ocean shore is an area of high stress for plants and animals. Rocky intertidal areas suffer both from the pounding of waves and the alternate periods of saltwater inundation and exposure. In spite of that, a highly specialized group of plants and animals cling to such habitats. Sandy shorelines are even more repressive habitats as the shifting sands prevent colonization of surface dwellers and the only life present is either burried in the sand or walking on or flying above the sand.

In estuaries, protection is provided from the physical abuse of waves, but the tides continue to flux daily leaving some areas inundated continually, other areas inundated daily, still other higher areas inundated only occasionally while other areas are inundated only by the highest tides pushed by onshore winds. All these areas that at some time interface with brackish or saltwaters develop distinctive flora and faunal assemblages of highly specialized species tolerant of these stressful physiological environments.

The tidal activity creates a continuum that, however, can roughly be broken into a series of overlapping zones. At the lowest level is a subtidal or "Marine" zone that is continually covered by water. Above that is the intertidal or "Littoral" zone that is variably covered by tides. The lowest portion of the Littoral zone consists of unvegetated intertidal flats; the mid and upper parts of the littoral zone consists of vegetated tidal flats (i.e. the true salt marsh).

The true salt marsh, in turn, can be divided into three zones, each with a characteristic assemblage of plants. The "Lower littoral zone" or Spartinetum, borders the intertidal flats and is typically submerged by saltwater twice daily. In Southern California this zone is dominated by Cordgrass (Spartina foliosa), a rhizomatous, perennial species that dies back in the winter and redevelops from its rhizomes each spring and summer becomming 5 to 6 feet in height by the end of summer. Large stands of Cordgrass are present in Anaheim Bay in northern Orange County, but it is lacking in the Ballona marsh.

At its upper margins this zone interfaces with the "Mid-littoral zone", the Salicornetum, an area that is covered by the higher high tides, but not every day. It is an area subject to prolongued periods of exposure usually not exceeding 15 days. In this zone, Pickleweeds (the annual Salicornia bigelovii, or the perennial S. virginica) are commonly dominant and in lower areas occur with Saltwort (Batis maritima) and in the higher areas are mixed with some Frankenia (Frankenia salina) and Arrowgrass (Triglochin maritima). This zone is well represented in the Ballona marsh, but with a reduced species diversity.

The "Upper littoral zone" or Suaedetum extends above the mean higher high water mark to the extreme high water level in the marsh. It represents the upper margin of the marsh, a zone that occasionally is inundated by saltwater and as such excludes many species that are intolerant of saltwater and undergoes long periods of drying when the surface of the soil may become highly saline. The common species present in this portion of the marsh, in Southern california, include the Shoregrass (Monanthochloe littoralis), Saltgrass (Distichlis spicata), Pickleweed (Salicornia virginica) that extends well into this zone, Sea-blite (Suaeda taxifolia) with the uppermost open salt flats or "salinas" developing stands of the spring-flowering Pickleweed (Salicornia subterminalis), Saltgrass, and annual Iceplants (Gasoul crystalinum and G. nodiflorum). This zone is again well represented in the Ballona marsh, but in a confused mixture of species as tidal flushing has been prevented in the most of the marsh.

The Maritime zone lies above the intertidal zone. It lies above areas influenced by tidal action, but receives moist winds from the ocean that mitigate daily fluctuations in temperature. In this region the maritime zone consists of coastal sand dunes and adjacent terraces with a grassland and Coastal sage scrub vegetation

Water Sources for the Ballona Marsh:

The historic Ballona marsh received waters from three sources: Ballona Creek, Centinela Creek, and from artesian upwellings of water. The largest source of water was from Ballona Creek, a small creek draining the western Los Angeles basin northeast of the site. It drains an area of about 120 square miles in size (an area 11 x 11 miles, or 77,440 acres). Prior to the straightening and channelization of Ballona Creek in 1924 (to Lincoln Avenue) and 1938 (to the ocean) it represented a natural river with freshwater plants growing along its margins. At present it is channelized completely for a distance eastward of about 8.5 miles ending up paralleling Venice Boulevard near La Brea Avenue. This is not a major drainage when compared to the Los Angeles and San Gabriel Rivers whose drainages extend from the south slope of the San Gabriel Mountains.

The marsh also received waters from Centinela Creek, which drains an area of approximately 3 square miles (about 2000 acres) from the west slopes of the Baldwin Hills directly east of the site. Prior to being diverted and channelized into the Centinela Ditch in the 1940's, Centinela Creek flowed parallel to, but about 450-650 ft north of, the south bluffs and fed into the marsh near Playa del Rey. The Centinela ditch connects with the historical Centinela Creek drainage west of Lincoln Avenue.

The Ballona marsh area also received artesian waters. A USGS Water Supply Study of 1904 (see Conel, p. 2, in Environmental Management Services, 1990) notes that at that time the water table in the area was 10 ft above mean sea level and areas below 10 ft mean sea level received artesian waters. This included all areas throughout the marsh including areas along Ballona and Centinela Creeks. The amount of water involved in this artesian uplift is not known, but may have played a strong role in the overall development of the marsh. Conel, (pers. communication), noted that the farms in the area at that time grew high-water requiring crops such as celery to take advantage of the high ground-water levels. While the ground water was once high in the area, at present time, it is much lower. Conel (op. cit.) reports that the water table at the junction of Lincoln Ave. and Teale St. was 2.3 and 3.9 ft in October 1989 and February 1990 respectively.

The 1896 U.S.G.S. topographic, quad map (Redondo) showing the Ballona marsh (Figs. 3-4) shows that the marsh contained a large series of lagoons and channels that were a considerable distance from the mouth of the estuary. The lagoons undoubtedly filled with fresh water following winter-spring floods and, depending on the inflow of water during the year, may have varied from fresh to brackish water during the summer. The distance of these lagoons from the source of salt water, may have mitigated the saltwater influence on the marsh system. If the system received a continual supply of freshwater from Ballona Creek and artesian sources the marsh may very well have had a very strong freshwater vegetation component. Also if the mouth of the estuary tended to close off during the summer, the freshwater component may have been strengthened resulting in a freshwater-brackish water system in most of the lagoons, but with salinities increasing during dry summer months due to evaporation.

If indeed there was a lack of tidal interaction during the summer, the Cordgrass dominated Lower littoral zone would not be expected to be developed as Cordgrass needs tidal flushing to allow for aeration of its roots during the summer. Cordgrass is lacking from the marsh today and may have never been a component of the Ballona system.

Most of the marsh probably consisted of freshwater-dependent species in the inland portions of the marsh and around some lagoons with the areas influenced by seasonal saltwater flow containing various saltmarsh plants characteristic of the mid and upper littoral zones, namely the species that occur in the marsh today such as Pickleweed, Saltgrass, Sea-blite, etc. The strong fresh and saltwater interaction would be expected to create a highly diverse vegetation whose freshwater component probably expanded during wet years and whose halophytic component probably increased during years with little rainfall.

Floras of Salt and Freshwater marshes:

Saltmarshes and freshwater marshes have distinctive floras adapted specifically to the highly restrictive environmental parameters of these habitats. Few plants can tolerate high soil salinity or water-saturated soils with limited aeration. Thus saltmarshes and freshwater marshes exclude many species and the species that do occur are often highly adapted and restricted to these specific habitats. Because of this, a viable salt marsh typically has a flora consisting of relatively few, specialized species.

The following lists enumerate species that are common in saltmarshes and freshwater marshes in Southern California with indications of those species that occur in the present Ballona marsh. The attempt here is to determine if the Ballona marsh, as it remains today, has a balanced flora. Of the typical salt marsh species expected, our current flora has only 12 of a total of 24 potential saltmarsh species, a mere 50 percent of the expected flora. This leads one to conclude that the Ballona salt marsh flora is depauperate and unbalanced.

The following species are those found in salt marshes in Southern California. Those that occur in the Ballona marshes are indicated with a plus sign (+), those not occurring in the Ballona marshes are indicated with a minus sign (-). Non-native naturalized species are indicated with an asterisk (*).

+*Atriplex patula ssp. hastata, Saltbush. Common in Area B.
- Batis maritima, Saltwort. Not present in Ballona.
+*Carpobrotus edulis, Iceplant. Common in Area B where it forms extensive stands.
- Cordylanthus maritimus, Bird's beak. Not present in Ballona.
+ Cressa truxillensis var. vallicola, Cressa. Common in dry saline areas, areas A, B, C, both within and outside of the marsh.
- Cuscuta salina, Dodder. Not observed.
+ Distichlis spicata, Saltgrass. Common in area B, in marsh and with Iceplant.
+ Frankenia salina, Frankenia. Infrequent in areas A, B, C, in depressions, sometimes within the marsh.
-*Gasoul crystalinum, Crystal iceplant. Rare in the dunes of area B.
+*Gasoul nodiflorum, Annual iceplant. Frequent in open saline flats along margin of marsh.
+ Jaumea carnosa, Fleshy Jaumea. Infrequent in wet lower salt marsh of Area B.
- Juncus acutus var. spherocarpus, Spike-rush. Not observed in Ballona.
- Limonium californicum, Sea lavender. Not observed in Ballona.
- Monanthochloe littoralis, Shore grass. Not seen in Ballona.
- Ruppia maritima, Ditch grass. Rare if present, reported by Gustafson (1981), not seen during this survey.
- Salicornia bigelovii, Annual Pickleweed. Not found in Ballona.
+ Salicornia subterminalis, Pickleweed. Rare in marginal marsh of Area B.
+ Salicornia virginica, Pickleweed. Common in wet or seasonal wet areas in Area B and in seasonal wet areas of Area A.
- Spartina foliosa, Cordgrass. Not found in Ballona.
+ Spergularia macrotheca var. macrotheca. Sand spurry. Rare in Pickleweed salt marsh of Area B.
+ Spergularia villosa, Sand spurrey. Infrequent in Pickleweed salt marsh of area B.
- Suaeda esteroa, Sea blite. Not observed in Ballona.
+ Suaeda taxifolia, Sea blite. Infrequent in marginal banks of Ballona Creek in Area B.
- Triglochin concinnum, Arrow grass. Not observed in Ballona.

Peripherial salt marsh species: There are a number of species, many introduced, that are associated with salt marshes, occurring in slightly saline weedy areas around and within the marshes. These are well represented in the Ballona Marsh area and include:

+Atriplex californica, California saltbush. Rare prostrate perennial in margin of marsh in area B.
+*Atriplex rosea, Redscale. Frequent summer-developing plant in margins of marsh in area A.
+*Atriplex semibaccata, Australian saltbush. Common to abundant perennial in disturbed areas and subsaline depressions throughout the site.
+Aster exilis, Aster. Common in slightly wet areas of area B.
+*Bassia hyssopifolia, Bassia. Common to abundant summer-developing annual in subsaline flats and disturbed areas throughout the site.
+*Bromus rubens, Foxtail chess. Frequent to abundant in slightly raised, less saline areas within the marsh and in disturbed areas throughout the site.
+*Cynodon dactylon, Bermuda grass. Frequent in disturbed and in subsaline areas throughout the site.
+*Lolium perenne ssp. multiflorum, Italian ryegrass. Common to abundant in the eastern portion of area B in old fields and among dispersed pickleweed.
+*Lycium ferocissimum, Boxthorn. Infrequent, scattered shrub in the salt marsh of area B.
+*Myoporum laetum, Myoporum. Frequent large shrubs in saltmarsh of area B.
+*Picris echioides, Ox-tongue. Very common on slightly saline old fields and marginal marsh areas.
+*Salsola australis, Russian thistle. Common to abundant in subsaline flats and disturbed areas throughout the site.
+Sida leprosa var. hederacea, Alkali mallow. Common in upper dry saline flats. and subsaline disturbed areas.
+Solidago occidentalis, California goldenrod. Forming local patches in marginal marsh areas in area B.
+*Sonchus oleraceus, Sow thistle. Scattered through drier raised portions of the marshes and in roadside weed areas.
+*Tetragonia tetragonioides, New Zealand Spinach. Common in margins saltmarsh and in grassy fields of area B.

Freshwater marsh species: There is a separate group of freshwater-adapted species that occur in seasonal and permanent freshwater areas throughout the site. They include;

+*Apium graveolens, Wild celery. Infrequent in freshwater wet areas of area B.
+*Agrostis semiverticillata, Bentgrass. Infrequent annual grass in moist ditches in areas B and D.
+Chenopodium ambrosioides, Mexican Tea. Infrequent perennial in moist flats.
+*Cyperus alternifolius, Umbrella plant. Infrequent perennial herb in freshwater wet sites in area D and B.
+Cyperus eragrostis, Umbrella sedge. Frequent to locally abundant in drainages in areas B and D.
+Eleocharis macrostachya, Spike-rush. Infrequent perennial herb in moist areas.
+Eleocharis montevidensis, Spike-rush. Infrequent perennial herb in moist areas of area D.
+Epilobium ciliatum, Willow herb. Infrequent annual in freshwater ditches.
+*Leptochloe uninervia, Spangletop. Local summer grass in moist ditches of area D.
+Lythrum hyssopifolia, Lythrum. Infrequent in shallow, freshwater pools in area D.
+Polygonum lapathifolium, Smartweed. Infrequent in wet, freshwater areas of areas B and D.

+*Polypogon monspeliensis, Beardgrass. Frequent to abundant in moist depressions throughout the site.

+Populus fremontii, Cottonwood. Infrequent in freshwater stream-ditch of Centinela ditch along Teale Road.

+Rumex salicifolius, Willow-leaved dock. Infrequent annual in moist freshwater microhabitats throughout disturbed areas and ditches.

+Salix laevigata, Gland willow. Frequent small trees in freshwater wet areas in area D.

+Salix lasiolepis, Arroyo willow. Frequent shrub-tree in freshwater areas along Teale Street and near dunes in area B and D, infrequent elsewhere on the site.

+Scirpus californicus, Tule. Locally abundant in freshwater ditches and ponds throughout area B and occasionally in area D.

+Scirpus olneyi, Threesquare. Infrequent but locally common in freshwater ditches in areas C, B, and D.

+Scirpus robustus, Robust sedge. Infrequent but locally abundant perennial herb in freshwater ditches in area B.

+Typha domingensis, Cattail. Locally abundant in freshwater ditches through areas B and D.

+Typha latifolia, Cattail. Reported as infrequent in freshwater habitats on the site.

+Xanthium strumarium var. canadense, Cocklebur. Infrequent in ditches and seasonally wet areas throughout.

On the opportunistic nature of the flora:

The history of the vegetation of the Ballona area is one involving a continued degradation of natural habitats by man. Areas of natural vegetation have long ago been modified either directly by man or indirectly by man's interference with the water systems feeding into the area. Nearly all of the upland sites have been directly disturbed and/or converted into agricultural fields, roadways, roadsides. At the present time no agriculture is practiced on the site though at one time nearly all of area D was agricultural. Watermellons and pumpkins have been grown in the sand fan outwash from Hastings Canyon that borders area B (R. Vogl, pers. comm.). The eastern portion of Area B has also been cultivated the 1980's and the furrows are still visible in the substrate as well as the borderlines of the fields. The western portion of Area D and nearly all of areas A and C have been filled with hauled-in dirt fill (Area D) or dredgings from the adjacent marshland during construction of the waterways in Marina del Rey.

Even with all this alteration of the environment, the site still contains, in most areas, a vegetative cover. The old fields and disturbed flats and hillsides have developed a very distinctive weed flora dominated by pioneer species capable of establishing in open habitats. The seeds of these species blow in or are carried into the site from plants occurring in adjacent areas. The most common annual species in upland disturbed sites are the Chess grasses (Bromus diandrus, B. rubens, B. mollis), Wild oats (Avena barbata), Fescue grass (Festuca megalura), Storksbill (Erodium cicutarium), Black mustard (Brassica nigra), Star thistle (Centaruea melitensis), Ox-tongue (Picris echioides), Sweet clover (Melilotus indicus), and Garland chrysanthemum (Chrysanthum coronatum). In the summer, other annuals species develop in upland disturbed sites including the Russian thistle, (Salsola australis), Tall stephanomeria (Stephanomeria virgata), Telegraph weed (Heterotheca grandiflora), Horseweed (Conyza canadensis), Sow thistle (Sonchus oleraceus), Wild lettuce (Lactuca serriola or S. virosa) and others. Disturbed areas also develop occasional shrubby species during the summer including Castorbean (Ricinus communis), Australian saltbush (Atriplex semibaccata), Sweet fennel (Foeniculum vulgare), and occasional Coyote brush (Baccharis pilularis ssp. consanguinea), and Tree tobacco (Nicotiana glauca). In areas of slightly saline soils the summer flora includes Bassia (Bassia hyssopifolia), sometimes Cressa (Cressa truxillensis), Italian rye grass (Lolium perenne ssp. multiflorum) and Annual iceplant (Gasoul nodifolrum) and these areas have a tendency to develop more Ox-tongue and Russian thistle. Of all the above listed species, only three annuals, the Tall stephanomeria, Telegraph weed, and Horseweed, and one shrub, the Coyote brush, are native species; all the rest are naturalized species.

Most of the species listed above are opportunistic pioneer species that do very well in exposed, open habitats. Most of them have easily dispersed seeds (dispersed by the wind or birds) that have the opportunity to invade into disturbed areas from adjacent sites. Just what grows in any one upland site is often controlled by chance, that is by which seeds first get to the site and become established. In older sites diversity increases gradually as additional seeds are dispersed onto the site. There are probably many other species that could grow in these habitats but do not as they have not been dispersed to the sites. It is interesting that more mesic habitats on the site show greater species diversity and greater density in overall vegetation. It is also interesting that areas that hold rainwater after rains often contain species specifically adapted to these habitats such as Cattails (Typha domenguensis), Lythrum (Lythrum hyssopifolia), Willow-leaved dock (Rumex salicifolius), and others even if the sites appear to be relatively young. Saline habitats again are much more restrictive to plants and the presence of salinity greatly alters the weed flora on a particular site. Also sandy habitats throughout the site have distinctive floras typically characterized by the presence of the shrubby Croton (Croton californicus) and certain native annuals such as the Primrose (Camissonia spp.).

What is strongly evident is that the site is well supplied by seeds of a highly diverse weed flora that are capable of dispersing to and establishing in suitable habitats. However, some habitats, such as the extensive strongly compacted areas of fill in the southwestern portion of area D, are so restrictive to plant growth, that few plants have become established.

Opportunistic redevelopment of vegetation also occurs in remnants of the true salt marsh where various non-native species have become established. There are several sites in area B where Iceplant (Carpobrotus edulis) has vegetatively spread over large areas. Shrubs of Myoporum (Myporum laetus), and Boxthorn (Lycium ferocissimum), both exotics, also occur in the wet marsh area. But the most remarkable redevelopment of vegetation has occurred in depressions in areas A and C where Pickleweed (Salicornia virginica) has redeveloped in areas of dredge spoils derived from the digging of the adjacent marina of Marina del Rey. This area, characterized by internal drainage, presently sits from 5-7 ft above the original surface of the land and the presence of Pickleweed here is a remarkable example of the ability of native species to redevelop in areas of proper habitat. The fact that the area is quite saline excludes many potentially competitive species.

METHODS:

The site was visited during a series of on-foot reconnaissances extending from April to October 1990. During these visits data were accumulated that lead to production of a check list of the vascular flora of the site. Names of familiar species were recorded directly, those of dubious identity were collected and identified using Munz (1974) or other floras and taxonomic literature and in some instances they were compared with collections from the herbarium of Rancho Santa Ana Botanic Garden in Claremont, California. A series of direct observations on the vegetation were used to construct vegetation maps of the entire site during the spring survey and the vegetation maps were checked and modified during the fall survey.

Aerial photography of all but portions of Area D at a 1"=300' scale flown on October 26, 1989 (with portions of Area D flown August 9, 1987) were used for the vegetation mapping. The vegetation maps were drawn over 1"=200' base maps by Gay Havens. No quantitative data of vegetation densities or diversity were made during the survey. Records of vegetation diversity were made by means of a series of check lists and notes made directly on maps.

Acreages of component vegetations were determined by cutting the maps into the component areas and weighing them on an analytical scale to the nearest thousandth of a gram. Areas of known size, mostly areas repesenting 40 to 60 acres, were also cut out and weighed to determine the average weight per acre. The method presumes the paper is of uniform thickness and weight, and overall proved to be quite accurate, with some determined acreages conforming exactly to that determined by the cartographers at PSOMAS, and others varying by less than 1 percent over a 135 acre tract of land.

The present study was done independently of previous studies of the Marsh though the work of Gustafson (1981) was consulted in making the ckecklist. The main purpose of this study was to determine the remaining resources on the site and to evaluate these resources. To this end the vegetation and flora of areas A, B, C, and D are described, enumerated through a series of flora checklists, and discussed in the section that follows. We have also been asked to comment on the Full-tidal and Muted-tidal restoration plans for area B and the freshwater marsh plans for portions of areas D and B.

RESULTS

VEGETATION AND FLORA OF AREA A:

The 138.6 acre area A is delimited by Ballona Creek to the south, Lincoln Avenue to the east, and Fiji Way to the south and east (Figs. 1 and 7). It presently lies adjacent to Marina del Rey and is an area that has been strongly modified by adjacent developments. The 1896 USGS Redondo quad map of the site shows that this area was situated south and east of the main lagoons of the marsh and that the site consisted a series of wet ponds or marshes that drained to the northwest towards the main lagoons and the marsh areas alternated with presumably higher and drier sites. Ballona Creek flowed directly into this site. The earliest maps showing topography of the site (Venice quad. 1924) show the site as ranging from sea level to 5-7 ft above mean sea level.

Modifications to the site began with the construction the roadway that parallels Fiji Way and lead to the coast prior to 1924. During the 1930's oil was discovered on the site and wells were sunk in the far western portion of area A and various roadways constructed to service the wells. By 1924 Ballona Creek channel was channalized as far west as Lincoln Avenue. At that time Ballona Creek then emptied directly into the area A west of Lincoln Avenue. In 1938, the Army Corps of Engineers dredged and channelized the remaining portion of Ballona Creek all the way to the sea depriving the marsh of this inflow of fresh water. The natural inlet of Ballona Marsh at Playa del Rey filled in within two years after completion of the channel (Clark 1979). Dredgings from the Ballona Creek Channel was dumped in adjacent portions of area A raising the elevation of the areas directly along the levee. In the late 1950's construction began on the marina at Marina del Rey, and dredgings from the marine channels were poured onto the site raising the overall elevation of the site from was less than 5 feet to a low of 9.3 ft in an area about 600 ft south of the junction of Admirialty Way and Fiji Way to a high of about 17.4 ft in the far western end of the site.

The dredge material added to the site came from other areas of Ballona Marsh and thus consisted mostly of marsh or wetland clayish soils. But some of the sandy soils were also brought into the site and persist as surface soils today. The substrate materials were piped in as a sludge and allowed to settle in the center of the site. But in much of the area the substrate was graded after the soils were brought in and the final topography consits of series of distinct ridges in a regular pattern reflecting the ultimate mechanical grading.

The ultimate topography of area A has resulted in internal drainage with the marginal areas having elevations of 15 to 18 feet and the central areas elevations of 11 to 9.3 ft elevation above mean sea level. Because of this, rains have transferred the salts leached from the old marsh soils to the center of the site resulting in a distinct vegetational zonation with weedy, upland plants developing around the periphery and more salt-tolerant plants developing in the central portion of the site, ultimately ending up with distinct salt pans in some areas of low drainage.

Vegetation and Flora:

The vegetation and floristic composition of area A is presented in a series of checklists numbered A-1 through A-12 that refer to areas indicated in Figure 7. Each checklist gives the species encountered in the plant association and indicates the relative frequency of the species, that is whether a particular species is abundant, common, frequent, infrequent, or rare on that particular site. Most of the checklists distinguish between spring and summer annuals and between perennial herbs and shrubs.

In the discussion below, vegetation of area A is described from the areas of lowest elevation containing stands of Pickleweed to the higher areas containing mixtures of native and weedy species or only of weedy species.

The acreages of the various vegetation types and percentages of each as compared to the entire site is presented below. The acreages reflect those determined independently by me and vary from those of PSOMAS (who record 138.6 acres), by 1.5 acres, or less than 1 percent.

Area	Habitat	Acreage	Percent of total
A-1	Pickleweed area with tidal influence	2.1	1.5
A-2	Dense pickleweed without tidal influence	20.2	14.4
A-3	Open pickleweed without tidal influence	12.5	8.9
A-4	Flats with pickleweed and grasses	5.1	3.6
A-5	Open sandy flats	9.4	6.7
A-6	Areas with dense Coyote brush	18.5	13.2
A-7	Areas with sparse Coyote brush	6.8	4.9
A-8	Areas with Pampas grass	1.2	0.1
A-9	Disturbed open areas (west)	11.6	8.3
A-10	Disturbed open areas (east)	32.5	23.2
A-11	Disturbed open areas (southeast)	7.8	5.6
A-12	Sandy dune-like area	0.5	0.0
	Salt flats	4.7	3.4
	Trails	6.7	4.7
	Parking areas	2.3	1.6
		-------	-----
		140.1	100.0 %

Total pickleweed area (A-1-2-3): 34.8 acres
Total Coyote brush area (A-6-7): 19.3 acres
Total strongly disturbed areas (A-9-10-11): 51.9 acres

1. **PICKLEWEED AREA WITH TIDAL INFLUENCE:** (Area A-1; 2.1 acres). Only a small area on the site receives tidal flow. This occurs along a ditch that runs parallel to Fiji Way in the northeastern portion of the site and crosses Lincoln Boulevard extending into area C. The ditch connects to the waters of Marina del Rey to the north. The bottom of the ditch ranges from 0.4 ft above mean sea level at the western end to 2.9 ft at its crossing of Lincoln Boulevard. The bottom and lower margins of the ditch contains a nearly continuous stand of Pickleweed (Salicornia virginica), rare Tule (Scirpus californicus), and the marginal slopes contain very large and conspicuous shrubs of Saltbush (Atriplex lentiformis ssp. breweri), mixed on the uppermost slopes with various annual weeds.

2. DENSE PICKLEWEED WITHOUT TIDAL INFLUENCE: (Area A-2; 20.3 acres). There are two separate areas that contain dense stands of pickleweed, both occur

in saline depressions that receive rainwater from adjacent areas. The western 3.7 acre site varies in elevation from 11.7-12.9 ft above mean sea level, while the larger, eastern area of 16.6 acres has elevations ranging from 9.3-12.6 ft. The eastern area borders barren salt pans of about 4.6 acres in extent that lack vegetation entirely; the salt pans range from 10.5-11.9 ft in elevation--surprisingly the salt pans are not the lowest areas on the site.

In these stands, pickleweed is clearly dominant with (20-)40-95 percent estimated cover and the individual plants range from 1-1.5 ft tall with 1-3 ft diameters. Development of the pickleweed plants appears entirely dependent on rainwater and their spring-summer development will reflect winter-spring rains. In drought periods, such as that presently occurring, they suffer strong summer dieback, but this does not necessarily result in the death of the plants as many resprout in the spring. Associates include only a series of weedy, spring annuals that develop during the time that soils are less saline and, except for the Iceplant (Gasoul nodiflorum), the annuals die off by the end of spring. These include various Chess grasses (Bromus rubens, Bromus diandrus, Bromus mollis), Fescue grass, (Festuca megalura), Star thistle (Centaurea melitenis), Schismus grass (Schismus barbatus), Storksbill (Erodium cicutarium), Wild oats (Avena barbata), Sweet clover (Melilotus indicus), and Wild barley (Hordeum leporinum). Their relative frequencies are indicated in the the following checklist.

3. OPEN PICKLEWEED WITHOUT TIDAL INFLUENCE: (Area A-3; 12.5 acres). At the upper elevational margins of the dense stands of Pickleweed, at (9.8-)10.3-12.7(-13.4) ft above mean sea level, the Pickleweed is less dense, ranging from approximately 5 to 35 percent total cover and occurs scattered to frequent among the spring-developing annual grasses in association with some perennial herbs and shrubs as indicated below. The most common species in this association are the annual grasses, particularly the Chess grasses (Bromus diandrus), along with Bromus rubens, B. mollis, and Festuca megalura. The annual grasses and herbs develop in the spring while the soil is less saline and typically occur in slightly raised areas within the flats. In addition to the grasses mentioned above, spring annual associates include Star thistle (Centaurea melitensis), Storksbill (Erodium cicutarium), Schismus grass (Schismus barbatus), London rocket (Sisymbrium irio), Sow-thistle (Sonchus oleraceus), Sweet clover (Melilotus indicus), Black mustard (Brassica nigra), Redscale (Atriplex rosea, in sandy areas), and Wild oats (Avena barbata). The annual iceplant Gasoul nodiflorum, and Bassia (Bassia hyssopifolia) develops during the summer. In addition to annuals, the open pickleweed areas also develop some perennial herbs such as Australian saltbush (Atriplex semibaccata), Horehound (Marrubium vulgare), and the native Cressa (Cressa truxillensis). Shrubs of Coyote brush (Baccharis pilularis) are rare on the site.

4. FLATS WITH PICKLEWEED AND GRASSES: (Area A-4; 5.1 acres). This sector is more like a disturbed grassland with a scattering of Picklweed. The area ranges from 12 to 12.8 ft above mean sea level and consists primarily of weedy annual grasses with a scattering of Pickleweed, Coyote brush and Australian saltbush and other species as indicated in the checklist A. The annuals found here are the same as those listed above.

5. OPEN SANDY FLATS: (Area A-5, 9.4 acres). Area A-5 is an area of sandy substrate that occurs just above the more open pickleweed flats north of the central portion of the site at an elevation of 11.5 to 14.3 ft above mean

sea level. It appears that when the substrate was pumped onto the site, this area received a sandy overcoating of unknown depth. Here the superficial sand dries quickly after rains as compared to organic-rich or clay substrates and makes establishment of many species difficult. Thus the vegetation in the area is very open and mostly of low stature. The spring flora consists of a dense carpet of Storksbill mixed with some Foxtail chess (Bromus rubens), and Schismus grass. In the summer, small plants of Cressa are very common along with some carpets of Iceplant (Carpobrotus edulis), scattered Redscale (Atriplex rosea), Australian saltbush (Atriplex semibaccata) and a very sparse covering of Pickleweed. Overall vegetation here is very sparse due to the sandy substrate. Adjacent areas of lower elevation contain more Pickleweed, more upland areas contain stands of Coyote brush and Pampas grass.

6. AREAS WITH COYOTE BRUSH (Baccharis pilularis ssp. consanguinea): (Areas A-6, A-7; 18.5 and 6.8 acres respectively). There are two areas that have developed dense to moderately dense stands of Coyote brush, a conspicuous, native, rounded shrub that ranges from 4 to 10 ft in height. Area A-6 occupies about 16.5 acres and ranges from 11.9 to 15.5 ft elevation. It contains often dense stands of Coyote brush, while area A-7 contains a much more open stand and ranges from 13.1 to 14.7 ft elevation. These areas are presumably less saline and all drain into areas containing more Pickleweed.

In area A-6 Coyote brush often forms nearly pure, often dense stands, but can also occur with scattered Seep willows (Baccharis salicifolia), Myoporum (Myoporum laetus), and Pampus grass (Cortaderia atacamensis). Spring annuals include most of the same grasses and herbs that occur in weedy sites throughout the area with the addition of local stands of a Cudweed (Gnaphalium beneolens) on sandy soils and the annual Garland chrysanthemum (Chrysanthemum coronatum) which is often frequent in the spring. Summer annuals include Bassia and Horseweed (Conyza canadensis) along with the Tall stephanomeria (Stephanomeria virgata), Alkali mallow (Sida leprosa), and an introduced thistle (Cirsium vulgare). It is evident that the Coyote brush is declining at the present time due to the drought and in many areas there is very strong dieback of Coyote brush.

Area A-7, in contrast, has a much more open stand of Coyote brush, that also exhibits very strong dieback and occurs mostly with annual Chess grasses, and a scattering of Pampas grass, Pickleweed, and other species.

7. AREA WITH PAMPAS GRASS (Cortaderia atacamensis): (Area A-8; 1.2 acres). This is a small area dominated by Pampas grass near Fiji Way at 13.2-13.7 ft elevation. The Pampas grass is surrounded by and occurs in association with Coyote brush and Seep willow (Baccharis salicifolia) and the typical assortment of naturalized spring annuals including species of Erodium, Sisymbrium, Melilotus, Brassica, Chrysanthemum, and the ubiquitous Chess grasses. A secondary series of annual species develop in the summer including the Tall stephanomeria (Stephanomeria virgata), Redscale (Atriplex rosea), Tarweed (Hermizonia fasciculata), Horseweed (Conyza canadensis), Wild lettuce (Lactuca serriola), Sow thistle (Sonchus oleraceus), Goosefoot (Chenopodium murale), and annual Iceplant (Gasoul nodiflorum). A portion of this area has burned off during the past summer and if rains are sufficient this spring the plants should be able to redevelop. Pampas is an exotic species and is considered a pest in disturbed areas.

8. DISTURBED OPEN AREAS: [Areas A-9, (11.6 acres); A-10, (30.8 acres); and A-11, (7.8 acres)]. Much of the higher portions of the site are dominated by weedy annuals with a scattering of perennial herbs and shrubs.

Area A-9, in the western portion of the site, ranges from 13.1 to 16.5 ft in elevation and contains an annual spring flora dominated by the Chess grasses (Bromus diandrus, B. rubens), Wild oats, Storksbill, Black mustard, Star thistle, Sweet clover, local stands of Chrysanthemum, and occasional stands of Sweet alyssum (Lobularia maritima). In the summer other annuals develop such as Russian thistle (Salsola australis), Tarweed (Hemizonia fasciculata), the Tall stephanomeria, Sow-thistle, and Telegraph weed. Common perennial herbs include Iceplant (Carpobrotus edulis) that form distinct large patches, Bermuda grass (Cynodon dactylon), Cressa, Sweet Fennel (Foeniculum vulgare), and Jimpson weed (Datura meteloides), while shrubs of Australian saltbush and Frankenia (Frankenia salina) occur in local concentrations.

The site also contains scattered shrubs and local stands of Coyote brush, Seep willow, and Pampas grass, and there are a few stands of species more characteristic of Coastal sage scrub such as Coastal sagebrush (Artemisia californica), and large and conspicuous Laurel-leaved sumac (Rhus laurina). Some stands of Gum tree (Eucalyptus camaldulensis) occur along Fiji Way within this area.

We also include in this sector a dense area of Seep willow (Baccharis salicifolia), of 1.2 acres in size, that has formed in a depression surrounded by oil well roads in the southwestern corner of the site.

Area A-10, located in the far eastern portion of the site, while containing most of the annual species occurring in the western (A-9) site, has some distinctive aspects. Overall the area ranges from 12.2 to 15.2 ft elevation. In areas bordering Lincoln Boulevard that are disked each late spring to remove the weeds, a very dense and nearly pure stand of the bright yellow-flowered Chrysanthemum coronatum develops each spring. As they are always allowed to fruit before being disked up, the species has become very common throughout the eastern portion of the site. Other upland areas have a grass-dominated understory dominated by Chess grasses, Wild oats, Storksbill, Black mustard, Star thistle, and an assortment of other weedy species as indicated in the checklist following. Summer annual flora again consists of Bassia, Sweet fennel, Russian thistle, Tall stephanomeria, Telegraph weed,, Tarweed, Sow thistle, while perennials include local stands of the prennial tall Cudweed (Gnaphalium beneolens) on sandy soils and a scattering of Tree tobacco (Nicotiana glauca), Saltbush (Atriplex lentiformis and A. semibaccata), Seep willow, Coyote brush (that forms an extensive stand discussed as A-4), and local carpets of dense Iceplant (Carpobrotus edulis). In the far southeastern corner of the site on rather high areas, there is an influx of Coastal sage scrub species, Coastal sagebrush (Artemisia californica) and a scattering of very large and conspicuous shrubs of Laurel-leaved sumac (Rhus laurina), some to 30 ft in diameter.

Area A-11, is another weed dominated area, 7.8 acres in size, in the southeastern portion of the site that develops a spring flora consisting of annual Chess, Fescue and Wild oat grasses and often dense stands of Chrysanthemum with some Black mustard and Star thistle etc. However, in the summer the site develops a strong overstory of Bassia hyssopifolia and Redscale

(Atriplex rosea). Salicornia virginica is also scattered in the area. Overall, with an elevation from 10.8-12.6 ft, the area appears to be a portion of the low, sparse pickleweed flats. The area also has a rather strong development of Coyote brush (see Map A).

9. SANDY DUNE-LIKE HABITAT: (Area A-12; 0.5 acres). Sandy substrates occur mixed throughout this area (see area A-5) where sand has been brought in to the flats. In contrast, a small slope area that borders Culver Boulevard as it enters the extreme southeastern portion of this site contains a steep sandy slope ranging from 15 to 30.2 ft elevation. The sandy slopes contain some sand-adapted shrubs not otherwise found on area A including Croton (Croton californicum), Bird's foot trefoil (Lotus scoparius), Evening primrose (Camissonia cheiranthifolia ssp. suffruticosa), as well as more widspread species such as Coyote brush, Sweet alyssum (Lobularia maritima), Iceplant, Western ragweed (Ambrosia psilostachya), and Castorbean (Ricinnus communis). Annuals include species of Bromus, Avena, Festuca, Brassica, Heterotheca and Stephanomeria. It is interesting that this pocket of sand has developed or possibly retained a flora containing characteristic sand dune elements.

Comments on the Vegetation and Flora:

Area A has an interesting history. It once was the central portion of the Ballona Marsh and received waters directly from Ballona Creek. It has suffered continual degradation through time, first by the construction of Ballona Creek Channel, which deprived it of its outside source of fresh water, and later by being filled with material excavated both from the Ballona Creek channel and from the marina of Marina del Rey, which was pumped into the site through sleuce pipes. The result was a complete change in its topography. The old marsh had an elevation of about 3-5 feet in this area and now the site ranges from 9.3 to 17 ft above mean sea level with Culver Boulevard extending to 30 ft above mean sea level where it crosses Lincoln Boulevard.

After being filled with dredge material from the marina, the site was abandoned and allowed to revegetate. As the site has internal drainage, rains tended to leach the salts from the higher soils at the peripherial sites and this drained to the middle of the site creating more freshwater habitats along the peripheral raised areas and more saline habitats in the lower depressions. Various weedy species and an assemblage of native herbs and shrubs developed in the upland portions of the site, while the lower saline habitats developed flats of Pickleweed (Salicornia virginica). Today, the site contains about 20 acres of dense pickleweed and 12 acres of less dense to sparse pickleweed. While this is not in itself a rare or endangered species, it is a indicator species of salt marshes which are recognzied as habitats of value and habitats that have greatly diminished in area in Southern California (Henrickson 1976).

However, the redeveloped Pickleweed flats on this site are not comparable to natural Pickleweed flats as the flats here lack the species diversity found in natural Pickleweed flats (only one other salt marsh species occurs in area A, that being Frankenia salina). Also these Pickleweed flats are completely dependent on local rainwater for their development, that is, they receive runoff only from within area A. Thus they tend to grow only during the spring and early summer, but may strongly dieback during the summer if there are no follow up summer rains. As long as the salinity remains high in this area, no other plants will be able to grow in the lowest areas. Interestingly, while this is a newly developed area of Pickleweed, the soils, in many places, are typical of salt marsh soils as they have been dredged from previous marsh areas in the adjacent marina. A total of 9.8 acres of area A qualify as federal jurisdictional wetlands (Federal Interagency Committee for Wetland Delineation, 1989). These areas consist of the tidal Pickleweed (A-1) and portions of the dense Pickleweed (A-2) and some of the salt flats that accumulate water. Interestingly much of the Pickleweed habitat does not meet federal wetland standards due to soils.

FLORA CHECKLISTS OF AREA A.

A-1 Area along ditch paralleling Fiji Way. 0.4-2.9 ft elevation at base of ditch, to 15 ft at top of berm; xxx acres.

Salicornia virginica
Atriplex lentiformis ssp. breweri
Scirpus californicus Rare
Other plants on the slopes are weeds such as Chrysanthemum coronatum etc.

A-2 Area dominated with large Pampas grasses. 13.2-13.7 ft elevation, xxx acres.

Spring annuals	Shrubs, summer annuals and perennial herbs
Bromus diandrus C	Cortaderia atacamensis C
Bromus rubens C	Baccharis pilularis ssp. consanguinea F
Bromus mollis I	Baccharis glutinosa I
Centaurea melitenis F	Stephanomeria virgata F (to 8 ft tall)
Erodium cicutarium C	Solanum nodiflorum R
Chrysanthemum coronatum F	Chenopodium murale R
Sysimbrium altissimum R	Sonchus oleraceus I
Melilotus indicus I	Gasoul nodiflorum F
Brassica nigra F	Atriplex semibaccata I
Sisymbrium altissimum I	Atriplex rosea I
	Hemizonia paniculata I
	Conyza canadensis I
	Lactuca serriola I

A-3 Grassland and disturbed weedy areas. 13.1-16.5 ft elevation, xxx acres.

Spring annuals	Shrubs and Summer annuals
Bromus rubens C	Atriplex californica R
Bromus diandrus F	Atriplex semibaccata F
Festuca megalura I	Frankenia salina I
Erodium cicutarium C	Gasoul nodiflorum F
Brassica nigra C	Salsola pestifera I
Rumex crispus I	Hemizonia paniculata C
Melilotus indicus F	Stephanomeria virgata F
Centaurea melitenis F-C	Sonchus oleraceus I
Rumex crispis I	Heterotheca grandiflora F
Chrysanthemum coronatum O-A	Ricinus communis R
Lobularia maritima I	Artemisia californica F
Perennials	Rhus laurina I
Carpobrotus edulis I	Baccharis salicifolia F
Malephora crocea I	Baccharis pilularis ssp. consanguinia F
Cynodon dactylon I	Eucalyptus camaldulensis I
Cressa truxillensis F-C	Myoporum laetum R
Bassia hyssopifolia F	Cortaderia atacamensis F
Foeniculum fulgare O-F	
Datura meteloides F	

A-4 Dense stand of Baccharis pilularis ssp. consanguinea, 11.9-15.5 ft elevation, xxx acres. Some areas show much dieback of Baccharis

Spring annuals	Shrubs and summer annuals
Bromus rubens C	Baccharis pilularis ssp. consanguinea' A
Bromus diandrus F	Solanum nodiflorum R
Bromus mollis F	Marrubium vulgare I
Centaurea melitensis C	Cortaderia atacamensis I
Erodium cicutarium C	Myoporum laetus I
Schismus barbatus C	Atriplex semibaccata I
Gnaphalium beneolens F (local)	Atriplex rosea I
Melilotus indicus F	Bassia hyssopifolia I
Chrysanthemum coronatum F	Conyza canadensis F
	Stephanomeria virgata F
	Cirsium vulgare O-F
	Sida leprosa O-I

A-5 Dense stands Salicornia virginica, 9.3-12.6 (eastern) 11.7-12.9 (western), xxx acres.

Salicornia virginica A
Bromus rubens I
Bromus diandrus I
Bromus mollis R
Festuca megalura R-I
Centaurea melitenis I
Gasoul nodiflorum F-C
Schismus barbatus F
Erodium cicutarium I
Avena barbata I
Melilotus indicus I
Hordeum leporinum I-O

A-6 Open stands Salicornia virginica, (9.8-)10.3-12.7(-13.4) ft, xxx acres.

Spring annuals	Shrubs and Perennials
Bromus rubens C	Salicornia virginica F-C
Bromus diandrus A	Baccharis pilularis R
Bromus mollis C	Atriplex lentiformis R
Festuca megalura I-C	Bassia hyssopifolia I
Centaurea melitenis I-F	Sisymbrium irio R
Gasoul nodiflorum F-C	Sonchus oleraceus I
Schismus barbatus F	Atriplex semibaccata R
Erodium cicutarium I	Atriplex rosea I (sandy areas)
Avena barbata I-F	Marrubium vulgare R
Melilotus indicus I-F	Cressa truxillensis C (small on sandy soils)
Brassica nigra R-I	

A-7 Weedy area dominated by annual grasses, 12.2-15.2 ft, xxx acres.

Spring flora	Summer flora
Bromus diandrus C	Bassia hyssopifolia I-F
Bromus rubens C-A	Foeniculum vulgare I-F
Bromus mollis I-F	Salsola australis I
Avena barbata C	Stephanomeria virgata F
Erodium cicutarium C	Conyza canadensis R
Brassica nigra F	Heterotheca grandiflora I-F
Centaurea melitenis C	Hemizonia paniculata I

Schismus barbatus I
Rumex crispus I
Raphanus sativus I

Chrysanthemum coronatum I-A
Centaurea repens R-I
Pichris echioides I
Lepidium latifolium R

Amaranthus albus R
Lactuca eucra R
Sonchus oleraceus I
Conyza canadensis R

Perennials and Shrubs
Cressa truxillensis O-C
Gnaphalium beneolens C-sandy soils
Atriplex semibaccata F
Nicotiana glauca I
Artemisia californicum I
Heliotropium currasavicum R-I
Frankenia grandiflora R
Carpobrotis edule F
Cynodon dactylon I
Ricinnus communis I
Baccharis glutinosa R
Baccharis pilularis I
Rhus laurina F
Cortaderia atacamensis F
Atriplex lentiformis ssp. breweri I

A-8 Area with grasses and sparse Baccharis pilularis, 13.1-14.7 ft, xxx acres.

Spring annuals
Bromus diandrus A
Bromus rubens A
Bromus mollis A
Avena barbata F
Melilotus indicus F

Shrubs and summer annuals
Baccharis pilularis C
Cortaderia atacamensis I
Salicornia virginica I
Bassia hyssopifolia I
Atriplex rosea I
Salsola pestifera I

A-9 Area of sandy substrate, 11.5-14.3 ft, xxx acres.

Spring annuals
Erodium cicutarium A
Bromus rubens F
Schismus barbatus C
Centaurea melitenis F
Sisymbrium irio R

Shrubs and Summer annuals
Salicornia virginica I
Bassia hyssopifolia F-C
Cressa truxillensis C
Atriplex rosea I
Carpobrotus edulis F
Atriplex semibaccata I

A-10 Sandy Dune-like habitat, 15-30.2 ft, xxx acres.

Perennials-Shrubs:
Baccharis pilularis I
Croton californicum F
Lotus scoparius F
Camissonia cheiranthifolia I
ssp. suffruticosa
Lobularia maritima F
Carpobrotus edule F
Ricinus communis I
Ambrosia psilostachya F
var. californica

Annuals:
Bromus diandrus C
Bromus rubens C
Festuca megalura C
Avena barbata F
Brassica nigra F
Heterotheca grandiflora F
Stephanomeria virgata I

A-11 Weedy flat in depression with summer Bassia hyssopifolia, 10.8-12.6 ft, xxx acres.

Spring annuals
Bromus rubens C-A
Bromus diandrus C
Bromus mollis I
Chrysanthemum coronatum I-A
Centaurea melitensis I
Festuca megalura
Avena barbata O-C
Brassica nigra O-I

Shrubs and Summer annuals
Bassia hyssopifolia F-A
Atriplex rosea F
Salicornia virginica I, scattered
Baccharis pilularis I
Helitropium currasavicum R
Sida leprosa I
Marrubium vulgare R

A-12 Flat with Salicornia and grasses, 12.0-12.8 ft, xxx acres.

Spring annuals
Bromus rubens C
Bromus diandrus C-A
Bromus mollis F
Hordeum leporinum F
Festuca megalura F
Chrysanthemum coronatum I-A
Centaurea melitensis I
Melilotus indicus I
Gasoul nodiflorum I

Shrubs and Summer annuals
Salicornia virginia O-F
Baccharis pilularis I
Cressa truxillensis I
Atriplex semibaccata I
Marrubium vulgare I
Salsola australis R
Helitropium currasavicum R
Bassia hyssopifolia I
Atriplex rosea R

VEGETATION AND FLORA OF AREA B:

The 337.9 acre area B is delimited by the Ballona Creek Channel to the north, by Lincoln Boulevard to the east, by the Del Rey bluffs on the south with the property line extending up to Cabora Drive that overtops the buried sewage line that continues to the Hypericon Sewage treatment plant, to the remnants of the Playa Vista dunes that border the homes along Vista del Mar to the west (Fig. 8).

The area contains the only salt marsh habitat on the site that has not been previously filled. However, the site does not receive a normal tidal flushing as there are two series of tide gates (the westernmost consisting of one gate about 2.5 ft in diameter, the eastern one having three gates, about 3 ft in diameter) that connect this portion of the marsh with the Ballona Creek channel. The tide gates allow an outflow of water from the site, but they partially restrict the inflow of water from the Ballona channal onto the site. Elevations throughout the site range from 2.4 to 5 ft in the lower flats and extend to 50 ft along the property line on the southern bluffs. The Del Rey bluffs continue upward to about 160 ft elevation. Prior to development of the Ballona Creek channel, the site received waters both from Ballona and Centinela Creeks. At present the site receives waters from the Centinela ditch, a small drainage, but the portion of the Centinela Creek drainage on the site is still intact. The site is traversed by Culver and Jefferson Boulevards and in the past was traversed by the tracks of the Red Trolley line. While the Trollry line is no longer operating, the raised roadbed remains in some areas north of Culver Boulevard (Fig. 8). The eastern portion of the flats, from an area south of where Culver and Jefferson Boulevards join to Lincoln Boulevard has been farmed since the 1930's until the 1980's with Lima beans and Barley being grown. These areas still show the plow furrows and field-margin embankments. The 1896 topographic map of the site (Figs. 2 and 3) show the western portion of the site as within the southern most lake, while the eastern portion of the site was already crossed by roads and outside tidal influence by that time.

Vegetation and Flora:

The vegetation and floristic composition of Area B is presented in a series of checklists numbered B-1 through B-25 that refer to areas indicated in Fig. 8. Each checklist gives the species encountered in the plant association and indicates the relative frequency of the species, that is whether a particular species is abundant, common, frequent, infrequent, or rare on that particular site. Many of the checklists distinguish between the spring and summer annuals and between perennial herbs and shrubs.

In the discussion below, the vegetation of Area B is described from the areas of the best salt marsh, salt pans, and sand dunes in the northeastern corner of the site, eastward towards the adjacent disturbed flats nearer Lincoln Boulevard. As the vegetation is very diverse, it is divided into many smaller vegetation types or facies of vegetation types. PSOMAS records a total of 337.9 acres for the area, my analyses totaled 343.6 acres, a 1.7 % increase as I incorporated more weedy areas near the highways, that are actually outside the property line.

Area	Habitat	Acreage	Percent of total
B-1	Tidal Pickleweed flats	24.4	7.1
B-1a	Cressa flats	3.5	1.0
B-2	Pickleweed bordering salt flats	15.2	4.4
B-3	Disturbed margins of roadways, wellsites	11.8	3.4
B-3a	Disturbed flats near Culver Blvd.	7.5	2.2
B-4	Iceplant dominated flats	24.9	7.2
B-5	Sand dunes and flats	3.1	0.9
B-6-11	Disturbed flats (north of Jefferson Blvd.) (78.0 acres)		
B-6	Roadside weeds along Jefferson Blvd.	3.2	0.9
B-7	Bassia flats	46.3	13.5
B-8	Salsola flats	19.5	5.7
B-9	Cressa flats	2.8	0.8
B-10	Raised roadway embankments	2.7	0.8
B-11	Weedy upland sites	3.5	1.0
B-12	Old fields with Lolium	44.9	13.1
B-13	Old fields with Picris	12.0	3.5
B-14	Seasonal wet Pickleweed flats	44.6	13.0
B-15	Freshwater drainages	7.7	2.2
B-16	Eucalyptus grove and environs	2.8	0.8
B-17	Freshwater areas with Scirpus and Salix	2.0	0.6
B-18	Hastings Canyon sandy fan	4.9	1.4
B-19-24	Southeastern flats (near Lincoln Blvd.) (14.0 acres)		
B-19	Flat with Lolium and Atriplex	1.2	0.4
B-20	Flat with Aster	1.9	0.5
B-21	Mixed mesic habitat	3.5	1.0
B-22	Flats with Sweet clover	1.7	0.5
B-23	Stands of Arroyo willow	1.9	0.5
B-24	Sandy disturbed slopes	3.8	1.1
B-25	Del Rey bluffs	6.0	1.7
	Salt flats	26.3	7.7
	Industrial gas sites	9.8	2.9
		343.4	99.8

Pickleweed areas: B-1-2-14: (84.2 acres; 24.5 %)
Freshwater and willow areas: B-15-17-23: (11.6 acres; 3.4 %)
Sandy habitats B-3-18: (8.0 acres; 2.3 %)
Disturbed habitats: B-3-4-6-7-8-10-11-12-13-24: (191.7 acres; 55.8 %)
Southeastern flats: B-19-20-21-22-23: 10.2 acres; 3.0 %)

B-1 TIDAL PICKLEWEED FLATS: (Area B-1; 24.4 acres). The best salt marsh in area B is that occurring adjacent to the Ballona Creek channel that receives some inflow of tidal waters through improperly functioning tide gates. The tide waters flow in through the gates and fill the local canals and keep portions of this marsh generally wetted. The marsh flats here are recorded at elevations of 0.6-1.6 ft above mean sea level with channels extending well down to -2.2 ft below mean sea level.

Vegetation is clearly dominated by Pickleweed (Salicornia virginica), which has an estimated 70-95 percent total cover and which, unlike the seasonal pickleweed flats in Area A, retains its succulent and greenish stems throughout the year. Common associates include Salt grass (Distichlis spicata) while Frankenia (Frankenia salina) and Fleshy Jaumea (Jaumea carnosa) are less frequent with the latter occurring in the wettest portions of the marsh along the canals. The slightly raised areas contain often local stands of Cressa (Cressa truxillensis), Marsh aster (Aster exilis), and Hastate-leaved saltbush (Atriplex patula ssp. hastata), along with some Iceplant (Carpobrotus edulis) and some Chess grasses (Bromus rubens, B. diandrus). The marsh also contains isolated shrubs of Myoporum (Myoporum laetum), Boxthorn (Lycium ferrocissimum), and on the higher banks, Saltbush (Atriplex lentiformis ssp. breweri). The Slender-stemmed pickleweed (Salicornia subterminalis) is also present here on raised areas, while Sea-blite, (Suaeda taxifolia) another typical Salt marsh species, occurs restricted to the upland margins of Ballona Creek channel well above the marsh proper.

Just east of the main tidal channel on slightly higher ground is a grassy flat designated on the maps as Area B-1a (3.5 acres) that is an area of higher mid-littoral habitat that has all the associates of the pickleweed, but the pickleweed is absent. The site is dominated by Saltgrass and develops moderately dense stands of Cressa, Frankenia with scattered Hastate-leaved saltbush (Atriplex patula), some areas of Chess grasses, scattered Myoporum, Boxthorn, and in some of the higher ridges along the channel, large shrubs of Saltbush (Atriplex lentiformis ssp. breweri). This appears to be an excellent area of marsh having a good concentration of marsh species.

2. PICKLEWEED BORDERING SALT FLATS: (Area B-2; 15.2 acres). To the east, the Pickleweed less frequently receives water from the channels and dries out more during the summers, but still retains high densities with total Pickleweed cover estimated from 70-90 percent. It occurs again with the slender-stemmed Salicornia subterminalis, Frankenia, and Cressa. In slightly raised sites, Foxtail chess (Bromus rubens) is frequent, occurring with the weedy Bassia (Bassia hyssopifolia).

The stands of Pickleweed give way to an extensive series of salt flats (26.3 acres) that develop a white surface during the spring-summer. These flats range from 0.7 to 1.7 ft in elevation and are devoid of vegetation. The Pickleweed flats extend to 2.2 ft in elevation.

3. DISTURBED MARGINS OF ROADWAYS, WELLSITES: (Area B-3, Area B-3a; 19.3 acres, 7.5 acres respectively). The portion of marsh adjacent to the salt flats contains a number of roadways extending to the gas-well heads and other raised areas (including the old trolly line) that have reduced soil salinity and develop a weedy flora. The sites range from 2.5 to 6.9 ft above mean sea level. On these sites the flora is completely different than that on the adjacent flats and this shows the strongly restrictive nature of soil salinity in plant growth as few of these weeds venture out onto the salt marsh proper.

Most of this area has an understory vegetation dominated by the spring-developing Chess grasses (Bromus diandrus, B. rubens with less B. mollis), that occur with Wild oats (Avena barbata), Storksbill (Erodium cicutarium), Star thistle (Centaurea melitensis), some Chrysanthemum, Wild radish (Raphanus sativus), etc. Another series of annuals develop during the summer including Telegraph weed (Heterotheca grandiflora), Tall stephanomeria

(Stephanomeria virgata), Russian thistle (Salsola australis), London rocket (Sisymbrium irio), and Tarweed (Hemizonia paniculata), etc. Perennial herbs are also frequent including Saltgrass (Distichlis spicata on the lower slopes), Bermuda grass (Cynodon dactylon), Australian saltbush (Atriplex semibaccata that is sometimes locally abundant), Cressa, Spurge (Euphorbia serpens), Dwarf caesalpinia (Hoffmanseggia glauca), Iceplant (Carpobrotus edulis) and a number of other species. Shrubs include some local stands of species characteristic of Coastal sage scrub as Coastal sagebrush (Artemisia californica), Wormwood (Artemisia dranunculus), Hastate-leaved saltbush (Atriplex patula ssp. hastata), Tree tobacco (Nicotiana glauca) as well as some exotics as Boxthorn (Lycium ferrocissimum), and St. Johns bread (Ceratonia siliqua). This vegetation represents more of an upland, weedy component that occurs elsewhere in disturbed areas within Area B.

A separate area of disturbed habitat (area B-3a, 7.5 acres) occurs north of the businesses bordering Culver Boulevard. This highly disturbed flat contains mostly weedy grasses and herbs, and at one time contained horse stables. It contains scattered Canary-island date palms, Acacia, Eucalyptus, Tree tobacco, Castorbeans, Myporum, Elderberry, and Arundo and an understory of weedy annual grasses and herbs including Chess grasses, Wild oats, Chrysanthemum, various mallows, Bassia, Australian saltbush and others.

4. ICEPLANT DOMINATED FLATS: (Area B-4; 24.9 acres). The flats between Culver Boulevard and the old Trolly right-of-way, those south of Culver Boulevard, and those east of the dunes at the far west end of the area contain solid stands of Iceplant [Carpobrotus edulis (yellow flowers) with some indication of introgression in some plants with Carpobrotus aequilaterale (rose-purple flowers)]. This leaf succulent has expanded over these flats by means of vegetative growth and forms very dense stands. In area B the flats lie from 2.5 to 50 ft above mean sea level. In each of these stands the associates are different. In the stands north of Culver Boulevard, Saltgrass (Distichlis spicata), occasional Frankenia and and Boxthorn (Lycium ferocissimum) are present. Where the flats border drainages, the wet margins may have local stands of Pickleweed, Hastate-leaved saltbush, Tule (Scirpus robustus), and even St. Augustine grass (Stenotaphrum secundatum). The iceplant stands south of Culver Boulevard, in contrast, also contain Yerba mansa (Anemopsis californica) and shrubs of Castorbean (Ricinus communis), Western Goldenrod (Solidago occidentalis), Frankenia, Saltgrass, and many weedy species and the stand continues well up the adjacent bluffs well above 100 ft in elevation. The stands along the western dunes also show more diversity as they extend onto the sandy flats where they occur with Coyote brush (Baccharis pilulars), Weep willow, Myoporum, Sweet fennel (Foeniculum vulgare), Eucalyptus, Pampas grass, and a weedy assortment of annuals. The acreage of Iceplant given above is the combined acreage for all the many stands on the site.

5. SAND DUNES AND FLATS: (Area B-5, Area B-5a; 3.1 and 1.6 acres respectively). The Playa Vista sand dunes are remnants of what was an extensive system of dunes that bordered Santa Monica Bay. This small remnant, ranging from 3.7 to 20 ft in elevation, still retains some of the unique species characteristic of this dune system. While the area contains many weedy species (see checklist), natives include three Evening primroses (Camissonia cheiranthifolia ssp. suffrutescens, C. lewisii, and C. micrantha), Coastal ragweed (Ambrosia camissonis), Sand verbena (Abronia umbellata), Croton (Croton californicum), an endemic Buckwheat (Eriogonum parvifolium), Coastal wallflower

(Erysimum suffrutescens), and a Bush lupine (Lupinus camissonis). The dune system is slated for restoration, but recently the dunes were disturbed by off-road vehicles. This area also contains many exotic species that have been cultivated near the adjacent homes along Vista del Mar

The adjacent lower areas (Area B-5a, 1.6 acres) contain conspicuous stands of Arroyo willow (Salix lasiolepis), some Cottonwoods (Populus fremontii), Myoporum, Pampas grass and Iceplant. The presence of the typically fresh-water Arroyo willows and cottonwoods is an anomally. They appear to have developed in response to a season of sufficient rains to allow their initial establishment and since that time they have persisted perhaps benefiting from a high water table or from the ability of the sand to hold deeper waters.

6. DISTURBED FLATS: (Areas B-6 through B-11; 78.0 acres). The area east of the salt flats and north of Jefferson Boulevard consists of disturbed flats ranging from 3.5 to about 7 ft above mean high tide. The area is bisected by Culver Boulevard, and the old Trolly line and this area contains a mosiac of vegetation reflecting the time since the last disturbance and soil salinity as it affects the ability of the flora to develop. The area is represented by 5 checklists (B-6 through B-11) which reflect changes in species composition in the area. One of these areas (B-7) also occurs in the flats south of Jefferson Boulevard. All of this area at some time has been disturbed, and much of it has been used for agriculture, some within the past 10 years. The elevations of the flats appear to reflect the original elevations and except for the elevated roadways, the areas appear not to have been artifically filled. As most of these areas have many of the same species, only the dominant species will be listed and the reader will be referred to the appropriate checklists for a complete reporting of the species encountered in the respective areas.

Area B-6 (about 3.2 acres) covers the roadside weeds encountered in disturbed areas along Culver and Jefferson Boulevards. These areas range from 5.5 to about 11 ft elevation and contain a mixture of common weeds and exotic shrubs and trees. The only native species present here are weedy species of wide occurrence. Overall the roadside weedy areas are dominated by annual grasses, such as the Chess grasses, Wild oats, Wild barley (Hordeum leporinum), Schismus grass (Schismus barbatus), along with Black mustard. A distinctive summer flora develops in which Bassia (Bassia hyssopifolia), Russian thistle (Salsola australis) are common along with an assortment of weed including Cheeses (Malva parviflora), Bermuda grass (Cynodon dactylon), Australian saltbush (Atriplex semibaccata), Alkali weed (Sida leprosa), Horseweed (Conyza canadensis), Telegraph weed (Heterotheca grandiflora), Tall stephanomeria (Stephanomeria virgata), and New Zealand spinach (Tetragonia tetragonioides) and some additional native and introduced weedy species. Frequent small trees include the Fan palm (Washingtonia robusta), the Canary Island date palm (Phoenix dactylifera), Castor bean (Ricinus communis), Tree tobacco (Nicotiana glauca) and a rare Albizia distachya.

Area B-7 (46.3 acres) distinguishes old marsh flats that develop a dense stand of Bassia (Bassia hyssopifolia) in the summer. These areas range from 3.6 to 6.2 ft in elevation and occur over a large area mainly north of, but also south of, Jefferson Boulevard. In the spring these flats are dominated by the Chess grasses (Bromus rubens and B. diandrus), Wild oats (Avena barbata) and Italian rye grass (Lolium perenne ssp. multiflorum), but during the summer, large rounded shrubs of Bassia, 2-3 ft tall develop becoming abundant and often forming a continuous canopy over the grassy understory. These Bassia areas intermix with areas dominated with Russian thistle (Salsola australis, area B-8) forming a mosiac of vegetative cover. The Hastate-leaved saltbush (Atriplex patula ssp. hastata), New Zealand spinach (Tetragona tetragonioides) and some Goosefoot (Chenopodium album), Australian saltbush (Atriplex semibaccata), Cressa, and Alkali weed also develop in these areas in the summer.

Area B-8 (19.5 acres) designates areas similar to those found in area B-7 but that develop dense stands of Russian thistle 2 to 3 ft tall during the summer months over an elevation gradient of 3.6 to 4.5 ft elevation. Again these areas also occur south of Jefferson Boulevard near Lincoln Boulevard but the main flats occur north of Jefferson. Again the associated species are the same as those listed above, and many areas exist where populations of Bassia and Russian thistle intermix, and most of the associates are the same except that south of Jefferson, Coyote brush (Baccharis pilularis ssp. consanguinea) occurs scattered in some areas.

Area B-9 (2.8 acres) is a depression (at 3.2 to 3.9 ft elevation) in the area north of Jefferson Boulevard that for some reason lacks both Bassia and Russian thistle and develops a dense stand of Cressa (Cressa truxillensis var. vallicola) during the summer. Interestingly there are several areas along roadsides in which the overstory of weeds is cut back by road crews during the summer that develop dense, local stands of Cressa.

Area B-10 (2.7 acres) emphasizes the distinctive flora that occurs along the old trolly line north of Culver Boulevard near Lincoln Boulevard. The top of the berm ranges from 12 to 19.4 ft above mean sea level and the top and sides of the berm contain a weed-dominated flora with an understory of vernal annual grasses, mustards, and radish, and a summer flora with Bassia, Salsola, Horseweed, Ox-tongue (Picris echioides), Stephanomeria etc. Perennials include Cressa, Sweet fennel, various weedy palms, Castorbean, and a few native species, but nothing of note except for a weedy Canary grass (Phalaris paradoxa).

Area B-11 (3.5 acres) is a weedy area at 4.5-6.2 ft elevation, that contains vegetative remnents of a old homesite along the Ballona Creek channel. The area has a rather typical weed component but also contains some interesting species such as Mexican tea (Chenopodium ambrosioides), and Willow-leaved dock (Rumex salicifolius), species that are supposed to be more restricted to moist soils, but here occur among weeds next to an old road. The site also contains a number of old trees such as Gum trees (Eucalyptus camaldulensis), a single English walnut (Juglans regia), some Spanish dagger (Yucca gloriosa) and Elm (Ulmus parvifolia). This area extends along the south bank of the Ballona Creek Channel.

7. OLD FIELDS WITH LOLIUM and PICRIS: (south of Jefferson Boulevard: (Areas B-12 and B-13; 44.9 acres and 12.0 acres respectively). The area south of Jefferson Boulevard has not been filled but the eastern portion of this area, roughly south of the area where Jefferson Boulevard joins into Culver Boulevard has in the past been farmed (barley and lima beans) and in many areas furrows still remain in the substrate. In the eastern portion of this area at elevations of 3.1 to 3.6 ft and further to the west down to 2.6 ft elevation, the old fields remain in a disturbed condition and vegetation is dominated by grasses or weeds. Some of the areas show dominance of Russian thistle, other areas are dominated by Bassia, but most of the area consists of an extensive

sward of annual grasses that develop from rainwater in the spring.

Area B-12 (44.9 acres), an area dominated by spring-developing grasses, forms the bulk of the eastern most flats in areas not affected by tidal action, similar areas also occur among stands of Pickleweed further to the west. The most abundant grass here is Italian Rye grass (Lolium perenne ssp. multiflorum) that occurs in association with lesser amounts of the Chess grasses, Wild oats, Fescue grass, and Beardgrass (Polypogon monspeliensis). Other annuals include the Hastate-leaved Saltbush (Atriplex patula ssp. hastata), Wild radish (Raphanus sativus), Sweet clovers (Melilotus indicus, M. albus), New Zealand spinach (Tetragonia tetragonioides), Curly Dock (Rumex crispus), local stands of Ox-tongue (Picris echioides), and occasional Marsh aster (Aster exilis). The fields also contain local stands of Pickleweed, some Frankenia, Saltgrass, Alkali mallow, Bermuda grass, and Cressa. Coyote brush and Pampas grass are infrequent. In the far eastern fields this vegetation forms an extensive stand; in the west it interdigitates with areas of dense Pickleweed.

Area B-13 (12.0 acres) occurs south and southeast of the main grassland area in an area where the grasses give way to very dense stands of Ox-tongue (Picris echioides) exhibiting to 90 percent total cover. The Picris flats, ranging from 3.2 to 4.2 ft in elevation, also contain most of the same species that occur in the grasslands including dense stands of Italian rye grass and the chess grasses etc. The change from areas dominated by Italian rye grass and Ox-tongue is, in many areas, sharp and distinct.

8. SEASONAL WET PICKLEWEED FLATS: (Area B-14; 44.6 acres). West of the main grassy fields (Area B-12) and interdigitated with areas dominated by grasses are extensive stands of Pickleweed (Salicornia virginica) that receive local waters in the spring that stand for a period of time but do not receive any tidal inflow of waters from the various channels. The flats ranging from 2.2 to 2.9 ft in elevation form extensive stands of a seasonally wet Pickleweed flats that dry out during the summer. The flats show an interesting mixing with grass-dominated flats towards the west where dominance can change abruptly without any obvious change in elevation.

The dominant plant here is the Pickleweed that forms 70-90 percent cover. Mixed with this and on slightly higher acres are Salt grass (Distichlis spicata), Australian saltbush (Atriplex semibaccata), Cressa, Alkali mallow, and occasionaly stands of the rhizomatous Western goldenrod (Solidago occidentalis). Annuals included Italian Rye grass (Lolium perenne ssp. multiflorum), the Chess grasses, particularly Broumus diandus and B. rubens, some Bassia, and a scattering of Wild oats, Marsh aster, Beard grass (Polypogon monspeliensis), New Zealand spinach, Sand spurrey (Spergularia marina, S. bacconi), Curly dock, Wild lettuce (Lactuca spp.) and others. The Pickleweed flats are usually wet and growing in the spring, but by the end of summer are very dry and show cracks in the soils. The weed component continues off this site and continues onto the adjacent grassy flats.

9. FRESHWATER DRAINAGES IN THE MARSH: (Area B-15; 7.7 acres). The Centinela Creek flows westward north of the bluffs. It has been largely confined to a man-made ditch and its vegetation is cut each summer east of Lincoln Boulevard, but west of Lincoln the stream retains a more natural vegetative association as it flows through a series of straight segments before passing under Culver Boulevard and passing out to Ballona Creek Channel.

Through this route it ranges from about 2.1 ft to a low of -2.1 ft near Ballona Creek channel. The creek contains mostly freshwater during the spring and summer and in dry years can dry out completely during the summer. The vegetation along the creek bed is interesting in its compositional mosaic, in that along its route there will be local areas dominated by Cattails (Typha dominguensis), adjacent to areas dominated by pure stands of Tule (Scirpus californicus), or Threesquare (Scirpus olneyi), or Umbrella sedge (Cyperus eragrostis), occasionally Cyperus robustus. The raised sides of the channels contain Saltgrass (Distichlis spicata), Bermuda grass (Cynodon dactylon), occasionally Pickleweed, Plantain (Plantago lanceolata), and on the higher banks series of weeds that often form local stands. The annuals include Black mustard (Brassica nigra), Wild radish (Raphanus sativus), various Chess grasses (Bromus spp.), Sow thistle (Sonchus oleraceus) and others. Shrubs of Arroyo willow (Salix lasiolepis) are infrequent as are adjacent plants of Pampas grass. Most of the species in the waterways directly are native with weedy species occurring on the higher banks.

10. EUCALYPTUS GROVE AND ENVIRONS: (Area B-16; 2.8 acres). There is a moderate-sized grove of old and large Eucalyptus (Eucalyptus camaldulensis) along the bluff near the west end of the site. This grove forms a shaded understory with very sparse growth. The grove is surrounded by a large stand of Pampas grass and Iceplant on its northerly and westerly margins and has some local stands of Castorbean (Ricinus communis), Myoporum (Myoporum laetum), some Arroyo willow (Salix lasiolepis) and inside some shrubs of Lantana (Lantana camara), Horehound (Marrubium vulgare), and Algerian ivy (Hedera canariensis), St. Augustine grass, Ehrharta grass (Ehrharta erecta), and Wild radish, Black mustard, Horseweed, and the ubiquitous Chess grasses. The trees serve as home for a moderately sized population of Monarch butterflies during the winter.

11. AREA WITH SCIRPUS AND SALIX: (Area B-17; 2.0 acres). This area represents a very complex wet area along the bluff margins east of the gas companies holdings that has a mixture of habitats in close association. The area, ranging from 2.6 to 4.8 ft elevation, contains a dense stand of Arroyo willow, mixed with some Pampas grass (on the east margin), occasional Pepper tree (Schinus terebenthifolus), and adjacent areas have dense stands of Treesquare (Scirpus olneyi) alternating with local stands of Tule (Scirpus californicus) and Cattail (Typha dominguensis). The slightly upland areas contain the usual assortment of weeds including Chess grasses, Ox-tongue, Hastate-leaved saltbush, Marsh aster, Sweet clover (Melilotus albus), etc. Adjacent slopes contain Castorbean and Coastal sagebrush (Artemisia californica) and the usual grasses. The adjacent flats contain mixed herbs and Pickleweed. To the east this area borders the sand fan that extends from Hastings Canyon buffered by a large stand of Pampas grass.

12. HASTINGS CANYON SANDY FAN: (Area B-18; 4.9 acres). The sandy fan that pours from the highly eroded Hastings Canyon through a channel that crosses the sewer-line access road (Cabora Drive) contains an interesting assortment of plants, some just weeds and others characteristics of sandy habitats. The vegetation varies from relatively sparse to dense. The fan, which ranges from 4.5 to 45 ft in elevation, contains much Bird's foot trefoil (Lotus scoparius) and Croton (Croton californicus), Castorbean, Pampas grass (very common along the lower western margins of the fan), some Tree tobacco, occasional Arroyo willow and Coyote brush. There are rather distinct spring and summer annual components as indicated in the checklist for the area. Most are common weeds,

but there are also some interesting species such as Watermelon, that has persisted on the site since 1981 when it was reported by Gustafson.

13. EXTREME SOUTHEASTERN FLATS: (Areas B-19 through B-24; 14 acres). The region south of Centinela Creek, immediately west of Lincoln Boulevard is very complex. It is a region that ranges in elevation from 3.1 ft elevation in the flats to about 15 ft in the base of the bluffs and has a substrate that represents a mixture of the clay wetland soils in the flats that are partially overlain by sands washed down from the surrounding bluffs. In about 1984, the sewer line that passes along the roadway at the 50 ft elevation mark along the bluffs broke through, fertilizing a portion of this site and causing more soil outwashing. After this event the flora showed some changes developing dense stands of some wetland plants such as Cyperus eragrostis that have since nearly died back. The region was mapped out in the fall of 1990 and the region exhibited great vegetative diversity with vegetation shifting dominance over small areas to form a complex vegetative mosaic. Each of these local dominant areas is indicated in the accompanying map (fig. 8) and the components of the floras are listed in the checklists.

Area B-19 (1.2 acres) is a small flat containing a mixture of Italian rye grass (Lolium perenne ssp. multiflorum), Bermuda grass, some Russian thistle and Bassia, and a rather dense scattering of Hastate-leaved saltbush (Atriplex patula ssp. hastata) along with some areas of Pickleweed (Salicornia virginica), Cressa and an assortment of weedy species. The site ranges from 3.7 to 4.3 ft in elevation. To the south this gradually gives way to an area dominated by the Marsh aster (Aster exilis).

Area B-20 (1.9 acres) dominated by a dense stand of the fall-flowering Marsh aster (Aster exilis). This interfaces with local stands of Ox-tongue (Picris echioides), Hastate-leaved saltbush, Pampas grass, some local stands of Cattail, Bermuda grass and other dense stands of Sweet clover (Melilotus albus). This area also contains the remnant stands of Tule (Scirpus robustus) and Umbrella sedge (Cyperus eragrostis) that apparently developed after the sewage outfall onto the site. The site ranges from 3.4 to 3.8 ft in elevation.

Area B-21 (3.5 acres) lies further to the west along the bluff where areas dominated by Marsh aster, Ox-tongue, Cattail, and willows form around what appears to be a slightly more moist area that contains an assortment of interesting grasses. The site ranges from 3.1 to 4.8 ft in elevation. Trees and shrubs here include Pampas grass, Arroyo willow, scattered small Palm trees (Washingtonia robusta), some Pepper tree (Schinus terebentifolia), Castorbean, and Seep willow. The herbaceous component consists of a large number of species with Ox-tongue, Marsh aster, Beard grass (Polypogon monspeliensis), Willow-leaved dock (Rumex salicifolius), Paspalum grass (Paspalum dilatatum), Barnyard grass (Echinochloa crus-galli), Ehrharta grass (Ehrharta erecta), St. Augustine grass, Umbrella sedge (Cyperus eragrostis), and two species of Plantain (Plantago lanceolata and P. major). Additional species are listed in the checklist. The adjacent slopes contains a local and very dense population of Virgin's bower (Clematis ligusticifolia).

B-22 (1.7 acres) consists of weedy upland areas dominated by local stands of the white-flowered Sweet clover (Melilotus indicus) occurring in association with stands of Arroyo willow, Castorbean, Pampas grass and an assortment of upland annual weeds. It occurs it higher elevations ranging from 4.5 to 8.2 ft elevation.

B-23 (1.9 acres) represents the local but dense stands of Arroyo willow (Salix lasiolepis), that occur among Pampas grass, Castorbean, rare Canary Island date palm (Phoenix canariensis), some Seep willow, and an assortment of weedy annual and perennial herbs as indicated in checklist B-23.

B-24 (3.8 acres) is the rather open, sandy-substrate area at the base of the bluffs that contains many weedy species. The shrubs present include Tree tobacco (Nicotiana glauca), Castorbean, Eucalyptus, Seep willow, Croton, Coastal sagebush, and a native Brickellia (Brickellia californica) and the herbaceous species have distinct spring and summer components. The shift from marsh soils in the lower flats to primarily sandy soils in towards the foothills of the adjacent bluffs, show a shift from marsh species to dry-land species. The species present are again presented in checklist B-24.

14. DEL REY BLUFFS: (Area B-25; 6.0 acres). The grassy slopes along the Del Rey bluffs south of the Ballona wetlands contain a diverse flora consisting of an understory of weedy grasses and a scattering of shrubs, some native Coastal sage scrub species and others exotic. The Playa Vista property line goes up to the 50 ft level where a roadway (Cabora Drive) parallels the raw sewage line that passes to the Hyperion treatment plant further to the south along the coast. The property above that road belongs to others but the flora checklists continue to the top of the bluffs. The western portions of the bluffs are dominated by a nearly pure stand of Iceplant (Carpobrotus edulis). This occurs in association with various grasses such as annual Ripgut chess grass (Bromus diandrus). The Iceplant drops out abruptly on a property line near Veragia Road and the bluff west of this line is largely dominated by the Chess grasses, Wild oats and an assortment of annual and perennial herbs. The bluffs also contain Coastal sage scrub species namely Coastal sagebrush (Artemisia californica), which is often quite common, Bush lupine (Lupinus longiflorus), Bush aster (Corethrogyne filaginifolia), Bush bedstraw (Galium angustifolium), the sand-loving Croton californicus, along with Arroyo willow (Salix lasiolepis), and Seep willow (Baccharis glutinosa), the lower slopes also contains stands of Castorbean. Herbaceous associates of interest include some Everlastings (Gnaphalium beneolens, G. bicolor), Perezia (Perezia microcephala), Jimson weed (Datura wrightii), Giant rye grass (Elymus condensatus), and Melic grass (Melica imperfecta), which is often locally common.

There are historical reports of many species occurring on these bluffs that were not seen during this survey including populations of Farewell-to-spring (Clarkia sp.), Ground pink (Linanthus dianthiflorus ssp. dianthiflorus), and Owl's clover (Orthocarpus purpurascens). A few specimens of the annual Buckwheat Eriogonum gracile were found at the top of the bluff. The upper bluffs at one time contained a population of a large-leaved, shrubby Australian saltbush (Atriplex nummularia) that C.B. Wolf described as a new species (Atriplex johnstonii) in 1935. It is still persisting.

Comments on the Vegetation and Flora:

Data shown in the text summary table show that area B, contains only 84.2 acre of land that is dominated by Pickleweed, a mere 24.5 percent of the entire area B. We can add to this some 26.3 acres of salt flats, considered to be a typical salt marsh habitat, but the salt flats of the site are scarsely productive habitats as they remain dry throughout the year except after rains. In contrast, over 190 acres of area B, approximately 55 percent of the site consists of variously disturbed habitats ranging from upland weedy-grass habitats to abandoned fields that have redeveloped in Russian thistle, Bassia, Italian rye grass (the portions of the abandoned fields that have redeveloped Pickleweed are included in the Pickleweed habitat category). The broad fields of solid Iceplant, that form a disturbed habitat could also be added to the disturbed habitats as it represents a strongly modified habitat on the site.

In addition to the pickleweed habitat area B does contain some good freshwater habitats along Centinela Creek and near the Del Rey Bluffs (area B-17) that contain excellent freshwater habitat, the latter also being habitat for the recently discovered endangered Ornate shrew (Ornex ornatus salicornicus), a species confined to marshes.

FLORA CHECKLISTS OF AREA B

B-1 TIDAL PICKLEWEED FLATS: (0.6-1.6 ft; 24.4 acres).

*Annuals

*Bromus diandrus R
*Bromus rubens R
Bassia hyssopifolia I
Aster exilis R
* = mainly in higher microhabitats

Perennials and shrubs

Salicornia virginica A (70-95 % cover)
Distichlis spicata F
Frankenia salina I
Jaumea carnosa I
Atriplex patula ssp. hastata I
Carpobrotus edule R
Lycium ferrocissimum I
Myoporum laetum I
Atriplex lentiformis ssp. breweri
Salicornia subterminalis I
Suaeda taxifolia I (mostly margins)
Cressa truxillensis O-F

B-2 CRESSA FLATS: (1.6-2.2 ft; 3.5 acres).

Annuals

Cressa truxillensis C
Sonchus oleraceus I
Tetragonia tetragonioides I
Bassia hyssopifolia I-F
Bromus rubens F
Gasoul nodiflorum F

Perennials

Cressa truxillensis C
Distichlis spicata C
Carpobrotus edile R

Shrubs

Salicornia virginica I
Atriplex lentiformis I
Myoporum laetum I
Lycium ferrocissimum I
Atriplex semibaccata I

B-2 PICKLEWEED BORDERING SALT FLATS: (0.7-2.2 ft; 15.2 acres).

Annuals

Bromus rubens R-I
Bassia hyssopifolia R-I

Perennials and shrubs

Salicornia virginica A
Salicornia subterminalis I
Frankenia salina I
Monanthochloe littoralis I
Cressa truxillensis I

B-3 DISTURBED MARGINS OF ROADWAYS, WELLSITES: (2.5-6.9 ft; 19.3 acres)

Spring annuals

Bromus diandrus I-A
Bromus rubens F-C
Avena barbata I-C
Horedum leporinum I
Erodium cicutarium I-C
Centaurea melitensis O-I
Melilotus indicus O-I
Chrysanthemum coronatum O-C
Raphanus sativus O-F

Perennial herbs

Foeniculum vulgare I-F
Distichlis spicata O-I
Atriplex semibaccata F-A
Cressa truxillensis O-I
Grindelia robusta R
Lotus purshianus O-I
Centaurea repens O-I
Plantago lanceolata R
Euphorbia serpens O-F

B-3 continued

Summer annuals

Heterotheca grandiflora I
Hemizonia paniculata O-I
Stephanomeria virgata I
Salsola australis I-F
Tetragonia tetragonioides I
Bassia hyssopifolia R-F
Tribulus terrestris O-I
Lactuca virosa R
Malacothrix saxatilis R
Sisymbrium irio O-I
Amaranthus albus O-R
Cynodon dactylon I
Oryzopsis miliacea R
Hoffmanseggia glauca I
Carpobrotus edule F

Shrubs

Artemisia californica I
Artemisia dranunculus I
Solanum nigrum I
Atriplex patula ssp. hastata
Salicornia subterminalis O-I
Lotus scoparius R
Ceratonia siliquia R
Nicotiana glauca I

B-3a DISTURBED AREAS NEAR CULVER BLVD: (2.8-7.5 ft; 11.7 acres).

Annuals

Bromus rubens A
Bromus diandrus C
Avena barbata C
Chrysanthemum coronatum C
Raphanus sativus F
Brassica nigra C
Malva parviflora C
Sisymbrium irio C
Chenopodium murale F
Eschscholzia californica I
Salsola australis F
Bassia hyssopifolia C

Perennials

Carpobrotus edule C
Cynodon dactylon F
Oxalis pes-caprae
Distichlis spicata F

Shrubs-trees

Myoporum laetum C
Phoenix canariensis I
Ricinus cummunis I
Salix lasiolepis I
Arundo donax I
Eucalyptus camaldulensis I
Acacia sp. I
Schinus molle R
Ficus carica R
Ulmus sp. R
Atriplex semibaccata I

B-4 ICEPLANT DOMINATED FLATS AND SLOPES: (2.5-50 ft; 24.9 acres).

Annuals

Avena barbata I
Bromus diandrus I
Bromus rubens I
Hordeum leporinum I
Sonchus oleraceus I
Raphanus sativus I
Rumex salicifolia I

Shrubs

Baccharis salicifolia I
Myoporum laetum I
Lycium ferrocissimum I
Cortaderia atacamensis I-F
Eucalyptus camaldulensis I

Perennials and shrubs

Carpobrotus edulis A
Distichlis spicata I-F
*Salicornia virginica I
*Atriplex patula ssp. hastata I
Lycium ferocissimum I
Anemopsis californica (local C)
Frankenia salina I
*Scirpus robustus
*Stenotaphrum secundatum I
Baccharis salicifolia I
Foeniculum vulgare I-F
Solidago occidentalis I

* along drainages

B-5 SAND DUNES AND FLATS: (3.7-20 ft; 4.5 acres).

Spring annuals
Avena barbata I-F
Avena fatua I
Bromus rubens C
Bromus diandrus F
Avena barbata F
Festuca megalura I
Crassula erecta I
Tetragonia tetragonioides I
Lotus strigosus I
Cuscuta californica F
Camissonia lewisii I
Camissonia micrantha I
Chaenactis glabriscula I
Abronia umbellata F
Schismus barbatus F
Brassica geniculata F-C
Cakile maritima I
Raphanus sativus I
Erodium cicutarium F
Erodium botrys I
Sonchus oleracea I
Gasoul crystallinum I

Summer annuals
Stephanomeria virgata F
Heterotheca grandiflora F
Salsola australis F
Amaranthus albus I

Perennials
Carpobrotus edule C-A
Carpobrotus edulis-aequilaterus C
Camissonia cheiranthifolia F
ssp. suffrutescens
Cynodon dactylon F
Distichlis spicata I
Ambrosia chamissonis F
Phacelia ramosissima F
Ambrosia psilostachya I
Abronia umbellata F
Lobularia maritima F
Digitaria glomerata I
Oxalis pes-caprae F
Erysimium suffrutescens I
Juncus mexicanus I
Plantago lanceolata I

Shrubs
Baccharis salicifolia I
Baccharis pilularis I
Myoporum laeteum C
Populus fremontii R
Salix lasiolepis F
Cortaderia atacamensis F
Agave attenuata I
Crassula argentea F
Bauhinia variagata R
Yucca gloriosa I
Washingtonia robusta F
Ricinus communis F
Euryops pectinatus I
Opuntia cf. ficus-indicus R
Croton californicum I
Agave americana striata R
Morus albus I

Shrubs continued
Acacia sp. R
Lupinus chamissonis I
Eriogonum parvifolium I
Aloe vera I
Haplopappus cf. pinifolius

B-6 DISTURBED FLATS, ROADSIDES: (5.5-11 ft; 3.2 acres).

Spring Annuals
Avena barbata F
Bromus rubens C-A
Bromus diandrus F-A
Raphanus sativus I
Brassica nigra F-C
Schismus barbatus F
Hordeum leporinum F
Sonchus oleraceus F

Perennial herbs
Atriplex semibaccata F
Sida leprosa var. hederacea I
Cynodon dactylon F
Convolvulus arvensis I
Heliotropium curassavicum I
Datura wrightii I

Shrubs and Trees
Nicotiana glauca F

B-6 continued

Summer annuals
Bassia hyssopifolia F
Salsola australis F
Helianthus annuus
ssp. lentiformis R
Tetragonia tetragonioides I
Malva parviflora I
Conyza canadensis I
Conyza bonariensis I
Heterotheca grandiflora I
Stephanomeria virgata I

Ricinus communis C
Albizia distachya R
Washingtonia robusta I
Phoenix dactylifera I

B-7 DISTURBED FLATS WITH BASSIA: (3.6-6.2 ft; 46.3 acres).

Spring annuals
Avena barbata I
Bromus rubens C
Bromus diandrus C
Lolium perenne ssp. multiflorum C
Sonchus oleraceus I

Summer annuals
Bassia hyssopifolia A to 100 percent cover
Salsola australis F-C
Atriplex patula ssp. hastata I
Tetragonia tetragonioides I and Chenopodium album R

Perennials
Cynodon dactylon I
Atriplex semibaccata I-F
Cressa truxillensis I-F
Sida leprosa ssp. hederacea I

B-8 DISTRUBED FLATS WITH SALSOLA: (3.6-4.3 ft; 19.5 acres).

Spring annuals
Avena barbata I
Bromus rubens C
Bromus diandrus C
Lolium perenne ssp. multiflorum C-A
Sonchus oleraceus I
Chrysanthemum coronatum I

Summer annuals
Salsola australis A (to 90 % cover)
Brassica hyssopifolia F-C
Picris echioides I, local A
Stephanomeria virgata I

Perennials
Cressa truxillensis O-F
Atriplex semibaccata I
Sida leprosa ssp. hastata I-F
Foeniculum vulgare I

Shrubs
Baccharis pilularis ssp. consanguinea

B-9 DISTURBED FLATS WITH LOCAL CRESSA: (3.2-3.9 ft: 2.8 acres).

Annuals
Avena barbata I
Bromus diandrus C
Bromus rubens C
Lolium perenne ssp. multiflora C
Picris echioides F

Perennials
Cressa hyssopifolia C-A
Cynodon dactylon I
*Salsola australis F
*Bassica hyssopifolia F
*common along margins of the site

B-10 DISTURBED, RAISED ROADWAY EMBANKMENTS: (12-19.5 ft: 2.7 acres).

Spring annuals
Avena barbata F
Bromus diandrus F-A
Bromus rubens F-C
Festuca megalura F
Brassica nigra F
Raphanus sativus I
Lolium perenne ssp. multiflorum I-F

Summer annuals
Bassia hyssopifolia F
Salsola australis I-A
Amaranthus tamariscanus R
Conyza canadensis I
Picris echioides F
Tetragonia tetragonioides F
Stephanomeria virgata F

Perennials
Cressa truxillensis I (local A)
Foeniculum vulgare I
Silymbum marianum R
Nicotiana glauca R
Solidago californica R
Washingtonia robustus I
Phoenix canariensis R
Ricinus communis F
Cynodon dactylon I

B-11 DISTURBED, WEEDY UPLAND SITES: (4.5-6.2 ft: 3.5 acres).

Spring annuals
Avena barbata F
Bromus rubens C
Bromus diandrus A
Bromus mollis I
Horedum leporinum I
Festuca megalura I
Brassica nigra I-F
Raphanus sativus I
Malva parviflora

Summer annuals
Bassia hyssopifolia I-A
Salsola australis I-C
Stephanomeria virgata I
Conyza canadensis I
Lactuca seriola I
Lactuca virosa R
Picris echioides F

Perennial herbs
Chenopodium ambrosioides R
Foeniculum vulgare I
Heliotropium curassavicum R
Polygonum salicifolia R
Phalaris canariensis I
Cynodon dactylon R
Ambrosia psilostachya I

Trees
Eucalyptus camaldulensis I
Juglans regia R
Ulmus parvifolia I
Nicotiana glauca I
Yucca gloriosa I

B-12 OLD FIELDS WITH LOLIUM: (2.6-3 ft; 44.9 acres).

Spring annuals
Lolium perenne ssp. multicaulis A
Bromus diandrus C
Bromus rubens F
Bromus mollis I
Avena barbata I
Festuca megalura I
Atriplex patula ssp. hastata F
Aster exilis I
Melilotus indicus I
Melilotus albus I
Raphanus sativus
Picris echioides F, Local C
Bassia hyssopifolia F-C
Tetragonia tetragonioides F
Polypogon monspelensis F
Rumex crispus I

Perennials
Salicornia virginica F
Frankenia salina I
Distichlis spicata I-F
Sida leprosa var. hederacea F
Cynodon dactylon F
Cressa truxillensis C

Shrubs
Baccharis pilularis I
Cortaderia atacamensis I

B-13 OLD FIELDS WITH PICRIS: (3.2-4.3 ft; 12.0 acres).

Spring annuals
Avena barbata F
Bromus rubens C
Bromus diandrus C
Lolium perenne ssp. multiflorum A
Sonchus oleraceus F

Summer annuals
Picris echioides A (to 90 % cover)
Bassia hyssopifolia F-C
Salsola australis F-C
Atriplex patula ssp. hastata I-F

Perennials
Cynodon dactylon I
Atriplex semibaccata I-F
Cressa truxillensis I-F
Sida leprosa ssp. hederacea I

Summer annuals (continued)
Tetragonia tetragonioides I
Chenopodium album R

B-14 SEASONALLY WET PICKLEWEED FLATS: (2.2-2.9 ft; 44.6 acres).

Annuals
Lolium perenne ssp. multicaulis C
Bromus diandrus F-C
Bromus rubens F
Bromus mollis I
Avena fatua I
Picris echioides I
Aster exilis I
Lactuca serriola I
Lactuca virosa I
Rumex crispus I
Bassia hyssopifolia F
Juncus sphaerocarpus I
Polypogon monspelieneis I
Atriplex patula ssp. hastata I
Spergularia marina I
Tetragonia tetragonioides I
Melilotus indicus I

Perennials and shrubs
Salicornia virginica A
Cressa truxillensis I-C
Atriplex semibaccata I
Distichlis spicata F
Sida leprosa var. hederosa F
Solidago occidentalis I
Carpobrotus edule R

B-15 FRESHWATER DRAINAGES: (-2.1-2.1 ft: 7.7 acres).

Spring annuals
Brassica nigra F
Raphanus sativus C
Bromus diandrus C
Lactuca serriola I
Lactuca Virosa I
Sonchus oleraceus I
Bromus rubens C
Bromus mollis I
Atriplex patula ssp. hastata

Perennials
*Typha dominguensis C
*Scripus californicus C
*Scripus olneyi C
*Cyperus eragrosits C
Distichlis spicata F
Salicornia virginica F
Cynodon dactylon F
Plantago lanceolata I
Sorghum nutans R
* = in water

B-16 EUCALYPTUS GROVE AND ENVIRONS: (3-10 ft: 2.8 acres).

Annuals
Atriplex rosea
Raphanus sativus
Brassica nigra
Conyza canadensis
Bromus diandrus
Bromus rubens
Polypogon monspeliensis

Perennials
Carpobrotus edule C
Stenotaphrum secundatum A
Ehrharda erecta C
Marrubium vulgare I
Hedera canariensis I
Chenopodium ambrosioides I
Plantago lanceolata

Shrubs and trees
Eucalyptus camaldulensis A
Cortaderia atacamensis A
Ricinuis communis F
Solidago occidentalis F
Salix lasiolepis I
Lantana camara I
Myoporum laetus I

B-17 FRESHWATER AREAS WITH SCIRPUS AND SALIX: (2.6-4.8 ft; 2.0 acres).

Annuals
Bromus diandrus I
Bromus mollis I
Atriplex patula ssp. hastata F
Picris echioides F
Tetragonia tetragonioides I
Melilotus albus I
Xanthium strumarium I
Aster exilis I
Heterotheca grandiflora I

Perennials
Scirpus olneyi A
Scirpus californicus F
Typha dominguensis F (local A)
Sida leprosa var. hederacea I
Oenothera hookeri I

Trees
Salix lasiolepis local A
Cortaderia atacamensis F
Schinus terebenthifolia I
Artemisia californica I

B-18 HASTINGS CANYON SANDY FAN: (4.5-40 ft; 4.9 acres).

Spring annuals
Avena barbata F
Bromus diandrus F
Bromus rubens C
Bromus mollis F
Festuca megalura F
Schismus barbata C
Melilotus indicus I
Erodium cicutarium F-C
Erodium botrys I
Polypogon monspeliensis I
Brassica nigra I
Raphanus sativa R
Chrysanthemum coronatum F

Summer annuals
Heterotheca grandiflora C
Salsola australis C
Bassia hyssopifolia I
Stephanomeria virgata F
Xanthium strumarium I
Hemizonia paniculata I
Conyza canadensis F
Aster exilis I
Amaranthus albus I

Perennials
Carpobrotus edule F
Foeniculum vulgare I
Cynodon dactylon F
Citrullus lanatus I
Phacelia ramosissima I
Gnaphalium beneolens I
Gnaphalium bicolor I
Chenopodium ambrosioides I

Shrubs
Lotus scoparius A
Croton californica F
Artemisia californica I
Ricinus communis F
Cortaderia atacamensis F
Nicotiana glauca I
Salix lasiolepis I
Baccharis pilularis I

B-19 FLAT WITH SALICORNIA AND ATRIPLEX: (3.7-4.2 ft; 1.2 acres).

Annuals
Lolium perenne ssp. multicaulis C
Bromus diandrus I
Bromus rubens I
Salsola australis F
Bassia hyssopifolia F
Atriplex patula ssp. hastata C
Picris echioides C
Aster exilis F-C
Melilotus albus F

Perennials-Shrubs
Cynodon dactylon C
Cressa truxillensis F
Cortaderia atacamensis I
Salicornia virginica C

B-20 FLAT WITH ASTER EXILIS: (3.4-3.8 ft; 3.5 acres).

Annuals
Aster exilis A
Atriplex patula ssp. hastata F-C
Picris echioides F-A
Polypogon monspeliensis F
Lepidium virginica I
Rumex crispus F
Xanthium strumarium I

Perennials
Scirpus robustus I
Cyperus eragrostis I
Cynodon dactylon F
Sida leprosa var. hederacea F
Typha dominguensis F

Shrubs
Cortaderia atacamensis I
Salicornia virginica I

B-21 FLAT WITH MESIC HABITAT: (3.1-4.8 ft; 3.5 acres).

Herbs
Picris echioides F (local C)
Xanthium strumarium I
Lolium perenne ssp. multicaulis I
Aster exilis F
Stephanomeria virgata I
Polypogon monspeliensis F
Rumex crispis I
Rumex salicifolius F
Paspalum dilatatum F
Echinochloa crus-galli F
Festuca arundinacea I
Ehrharda erecta F
Cynodon dactylon I
Scirpus robustus I
Cyperus eragrostis F
Foeniculum vulgare I
Solidago occidentalis I
Stenotaphrum secundatum I
Typha dominguensis I-F
Plantago major I
Plantago lanceolata I

Shrubs and Trees
Cortaderia atacamensis F-A
Salix lasiolepis I
Washingtonia robustus I
Ricinus communis I
Schinus terebenthifolia I
Baccharis salicifolia I
Phoenix canariensis R

B-22 FLATS WITH SWEET CLOVER: (6-8.3 ft; 3.9 acres).

Annuals
Melilotus albus A
Bromus rubens F
Bromus diandrus F
Raphanus sativus I
Brassica nigra I-F
Chrysanthemum coronatum F
Xanthium strumarium I
Ambrosia psilostachya I
Lactuca serriola I

Perennials and shrubs
Cynodon dactylon I
Ricinus communis I
Salix lasiolepis I
Cortaderia atacamensis I

B-23 STANDS OF ARROYO WILLOW: (3.1-6.3 ft; 1.9 acres).

Annuals
Bromus diandrus C
Bromus rubens F
Rumex crispis I
Rumex salicifolius F
Brassica nigra F
Heterotheca grandiflora I
Xanthium strumarium I

Perennials
Paspalum dilatatum I
Setaria geniculata I
Ehrharda erecta I
Heliotropium curassavicum I
Cynodon dactylon F
Festuca arundinacea I
Cyperus alternifolius I
Foeniculum vulgare F

Shrubs
Solidago occidentalis I
Baccharis salicifolia I
Solanum douglasii R
Cortaderia atacamensis
Salix lasiolepis C
Phoenix canariensis I
Ricinus communis I

B-24 SANDY DISTURBED SLOPES: (6-20 ft; 3.8 acres).

Spring annuals
Bromus diandrus C
Bromus rubens C
Chrysanthemum coronatum F
Festuca megalura I
Sonchus oleraceus I
Avena barbata I
Raphanus sativus I
Picris echioides I

Summer annuals
Ambrosia acanthicarpa C
Heterotheca grandiflora F
Melilotus albus I
Xanthium strumarium I
Stephanomeria virgata I
Conyza canadensis I
Chenopodium ambrosioides I
Chenopodium berlandieri I
Salsola australis I

Perennials
Cynodon dactylon I
Datura meteloides I
Foeniculum vulgare I
Heliotropium curassavicum I
Oenothera hookeri I

Shrubs
Nicotiana glauca I
Ricinus communis I
Cynodon dactylon R
Brickellia californica R
Baccharis salicifolia I
Croton californica I
Artemisia californica I
Eucalyptus camaldulensis I
Acacia sp.

B-25 DEL REY BLUFFS: (15-50 ft; 6.0 acres).

Spring annuals
Bromus diandrus A
Avena barbata C
Bromus rubens C
Brassica nigra C
Raphanus sativus C
Lolium perenne ssp. multicaulis C
Hordeum leporinum F
Sonchus oleraceus F

Summer annuals
Lactuca serriola F
Lactuca virosa F
Stephanomeria virgata F
Malacothrix saxatalis F
Eriogonum gracile I
Conyza canadensis F
Heterotheca grandiflora F

Perennials
Cynodon dactylon I
Melica imperfecta I
Elymus condensatus I
Gnaphalium bicolor I
Gnaphalium beneolens I
Perezia microcephala I
Datura wrightii I
Foeniculum vulgare

Shrubs and trees
Artemisia californica C
Nicotiana glauca I
Baccharis salicifolia I
Salix lasiolepis R
Croton californius F
Lupinus longiflorus F
Ricinus communis I
Corethrogyne filaginifolia I
Galium angustifolium I
Cortaderia atacamensis I

VEGETATION AND FLORA OF AREA C:

The 66.3 acre Area C is a trapezoidal site delimited by Lincoln Boulevard on the west, by Ballona Creek on the south, by the Marina Expressway (Highway 90) on the northeast and by an angled series of apartments bordering Fiji Way on the north. The area is divided across its middle by a northeast-southwest running Culver Boulevard (Fig. 9). Like Area A, this area has been filled with materials dredged from various sources: from berms of the adjacent Railroad; from the adjacent Ballona Creek Channel (before 1924); from Marina del Rey Small Craft Harbor prior to 1960; and from the Marina Freeway. The 1950 USGS quad map, Venice, California, (Fig. 5) shows the elevations over the site ranging from somewhere above 5 ft above mean sea level (probably about 7 ft) in the western third, to slightly over 10 ft elevation (probably about 12-13 ft) in the far southwestern corner. Present elevations over the tract range from an artificial low of 4.6 ft in a man-made depression south of Culver Boulevard, just east of the tight-turning curve that runs from east-bound Culver Boulevard to north-bound Lincoln Boulevard to a high of 25.6 on the top of some dirt mounds in the southwestern portion of the site. There are some other depressions in the eastern portion of the site north of Culver Boulevard with elevations down to 9.4 and 7.4 ft elevation that partially drain off the site. The ditch that crosses the northern portion of the site extends down to 2.4-4.1 ft in elevation. Most of the site, however, ranges from about 12 to 20 ft above mean sea level and reflects the deposition of fill. The elevation of Culver Boulevard ranges from 12 ft in the east to 30 ft in the western portion of this site where it passes over Lincoln Boulevard.

In comparing overlays of the 1981 quad map with the 1896 map (Figs. 3, 6) the ditch that bisects the northern portion of area C corresponds with a northwestward turn in the old Ballona Creek that then continued to the west. In the past the western most portion of area C contained some ponds, but it appears the eastern portion of the area was marginal to the main marsh.

The site is presently vacant except for three baseball diamonds (and one new, but unfinished baseball diamond) and associated food-stand buildings south of Culver Boulevard. This tract of land was presented to the State of California by Summa Corporation in lieu of taxes on the estate of Howard Hughes. The land is being transferred back to the Maguire Thomas Partners-Playa Vista by the State of California in exchange for monetary payments.

Vegetation and Flora:

The vegetation and floristic composition of Area C is presented in a series of checklists numbered C-1 through C-11 that refer to areas indicated in Figure 9. Each checklist gives the species encountered in the plant association during surveys of the area, and the relative frequency of the species in the specific area. Most of the checklists distinguish between spring and summer flowering species.

In the discussions following, vegetation is presented from Lincoln Boulevard eastward. The acreage presented below was independently determined from the vegetation map and agrees completely with the official acreage provided by PSOMAS.

Area	Habitat	Acreage	Percent of total
C-1	Ditch with pickleweed	0.8	1.2
C-2	Disturbed open areas (north of Culver Blvd.)	24.3	36.7
C-3	Open sandy flats (with Everlasting)	1.4	2.2
C-4	Areas with Coyote brush and Pampas grass	5.8	8.7
C-5	Sand dune-like area	0.5	0.8
C-6	Depression with sparse pickleweed	0.5	0.8
C-7	Depression with more dense pickleweed	1.0	1.5
C-8	Depression with Frankenia	0.3	0.4
C-9	Disturbed open areas (south of Culver Blvd.-cent)	14.6	22.0
C-10	Disturbed open areas (south of Culver Blvd.-west)	1.7	2.6
C-11	Disturbed open areas (south of Culver Blvd.-east)	15.4	23.2
		66.3	100.1 %

Total pickleweed sites (C-6-7): 2.3 acres
Total disturbed areas (C-2-9-10-11): 57.4 acres (86.6 %)
Area north of Culver Blvd. 34.6 acres (52.2 %)
Area south of Culver Blvd. 31.7 acres (47.8 %)

1. DRAINAGE DITCH WITH PICKLEWEED (Salicornia virginica): (Area C-1; 0.8 acres). The drainage ditch is a continuation of the ditch paralleling Fiji Way west of Lincoln Boulevard and in maps corresponds to a portion of the original Ballona Creek. The bottom of the ditch is 2.4 ft above mean sea level near Lincoln Boulevard and extends upward to 4.1 ft in its easternmost extension. The sides are steep and extend above the surrounding lands and thus appears not to accept drainage from the adjacent areas. There is a concrete dam in the ditch about 25 ft east of its crossing under Lincoln Boulevard that stops the tidal water from passing east of that point during most of the year. Thus the water entering the ditch that supports vegetation appears to come from local rainwater or whatever percolates upward from the substrate.

The bottom and lower sides of the ditch contains a moderately dense but clumped association of Pickleweed. The area near Lincoln Boulevard contains small amounts of Tule (Scirpus californicus) and Threesquare (Scirpus olneyi) and a small patch of Brass buttons (Cotula coronopifolia). The upper steep slopes have a scattering of large shrubs of the dioecious Saltbush, (Atriplex lentiformis ssp. breweri) and a few Laurel-leaved sumac (Rhus laurina) and many annuals including the Chess grasses, Chrysanthemum, Wild mustards and Goosefoot (Chenopodium berlandieri).

2. DISTURBED OPEN AREAS (north of Culver Blvd.: (Area C-2; 24.3 acres). The flats throughout most of the area north of Culver Boulevard contain a diverse annual vegetation that develops each winter-spring following rains. The area ranges in elevation from 12 to 22 ft elevation with a few areas that are higher and a few lower. Most of the area develops a spring flora of various Chess grasses (Bromus rubens, B. diandrus and B. mollis), mixed with Wild oats (Avena barbata and B. fatua), Black mustard (Brassica nigra), Storksbill (Erodium cicutarium), Star thistle (Centarium melitensis) and an assortment of other annuals as present in the appendix table. Perennial herbs include Sweet fennel (Foeniculum vulgare), scattered Alkali mallow (Sida leprosa), Sweet alyssum (Lobularia maritima), and local, stands of Russian knapweed (Centaurea repens), and Everlasting (Gnaphalium beneolens) that becomes abundant in area

C-3 on sandy substrates. The area also includes local stands of Coyote brush, Tree tobacco (Nicotiana glauca) and Pampas grass. The areas bordering directly on Lincoln Boulevard and the apartments to the north are disked each summer to guard against fires and these areas develop very dense, often uniform, stands of the Garland chrysanthemum (Chrysanthemum coronatum) each spring. They flower profusely in April and dieback by summer only to be graded again after they have set their seed.

3. OPEN SANDY FLATS (with Everlasting Gnaphalium beneolens): (Area C-3; 1.4 acres). Some of the areas near Lincoln Boulevard and near the apartment buildings (at about 13.5 ft elevation) have a sandy substrate and develop a distinctive, very open vegetative cover clearly dominated by the tall perennial Everlasting (Gnaphalium beneolens) occurring in association with smaller Schismus grass (Schismus barbatus), Storksbill (Erodium cicutarium), with some Evening primrose (Camissonia lewisii), Filago sp., and scattered Star thistle (Centaruea meliteneis) and Chrysanthemum. Pampas grass, Coyote brush, and some Coastal sagebrush (Artemisia californica) also extend into this area from adjacent areas.

4. AREAS WITH COYOTE BRUSH AND PAMPAS GRASS: (Area C-4; 5.8 acres). The area north of Culver Boulevard contains several large areas on which Coyote brush (Baccharis pilularis ssp. consanguinea) is dominant forming shrubs to about 8 ft high. This mostly occurs mixed or with local stands of Pampas grass (Cortaderia atacamensis), Coastal sagebrush (Artemisia californica), Myoporum (Myoporum laetum), Seep willow (Baccharis salicifolia), Saltbush (Atriplex lentiformis ssp. brewerii), and Coastal Brickellia (Brickellia californica). The annual Chrysanthemum is often abundant in the understory occurring with Sweet clover (Melilotus indicus), Black mustard, and the various Chess grasses, Storksbill, and Star thistle. Most of these areas are flat but they also occur along some areas if unequal topography where soils were dumped on the flats.

5. SANDY DUNE-LIKE AREAS: (Area C-5, 0.5 acres). The slopes bordering western, elevated end of Culver Avenue (at 13-30 ft elevation) are sandy and have developed a typical sand dune flora with Croton (Croton californica), Bird's foot trefoil (Lotus scoparius), and local stands of Castor bean (Ricinus communis), Tree tobacco (Nicotiana glauca), Sweet fennel, and one large Arroyo willow (Salix lasiolepis). The annual component again consists mostly of weeds such as Chess grasses, Chrysanthemum, Wild radish (Raphanus sativus), Wild oats, Storksbill, Russian thistle (Salsola australis), but also contains some native annuals including Telegraph weed (Heterotheca grandiflora), Malacothrix (Malacothrix saxatilis) and the tall Stephanomeria (Stephanomeria virgata). This area is very similar to area A-12 in area A, which occurs just on the other side of Lincoln Boulevard.

6. DEPRESSIONS WITH PICKLEWEED (Salicornia virginica): Areas C-6 and C-7; 0.5 and 1.0 acres respectively). There are two types of Pickleweed flats. Area C-6 (9.8-10.3 ft elevation) occurs west of the deep ditch and occurs in an area that has been graded and contains many ridges left by the graders. The area is dominated with Chrysanthemum and Foxtail chess (Bromus rubens), and contains a scattering of Pickleweed and some Australian saltbush (Atriplex semibaccata) while Frankenia (Frankenia salina) is rare. Area C-7 occurs in the depressions at the northeastern portion of the site near a stand of Coyote brush and Pampas grass. These areas, ranging from 9 to 10.3 ft elevation, contain a denser stand of Pickleweed occuring with Australian saltbush and Foxtail chess,

Chrysanthemum, Star thistle, Wild barley (Hordeum leporinum) and in the summer populations of Annual iceplant (Gasoul nodiflorum), and Bassia (Bassia hyssopifolia) develop. The slight depressions apparently hold water during the spring, favoring development of Pickleweed. Most of this pickleweed area is considered Federal jurisdictional wetlands (Federal Interagency Committee for Wetland Delineation 1989).

7. DEPRESSION WITH FRANKENIA (Frankenia salina): (Area C-8; 0.3 acres). The far southeastern corner of the area north of Culver Boulevard consists of a depression with an elevation of 7.4 to 8.7 ft, about 3 ft lower than an adjacent old abandoned roadway that curves towards Culver Boulevard. This depression has a distinctive flora dominated by Wild raddish (Raphanus sativus), Chess grasses, and a scattering of Wild lettuce, (Lactuca serriola), Ox-tongue (Picris echioides), Cheeses (Malva parviflora and M. nicaeensis), Milk thistle (Silymbum marianum), Alkali mallow (Sida leprosa), and Castorbean. But among these weeds are a scattering of moderately large shrubs of Frankenia, a species characteristic of salt marshes. The Frankenia was doing very poorly this year and it appears to be a remnant of plants that had developed during better times.

8. DISTURBED OPEN AREAS SOUTH OF CULVER BOULEVARD: (Areas C-9, C-10, and C-11; 14.4, 1.7, and 15.4 acres respectively). The area south of Culver Boulevard consists entirely of disturbed areas. There are no regions containing native saltmarsh species and the native species on the site are weedy natives. The area contains only ruderal habitats. This area is divided into three intergrading habitats, all very similar. Overall the site ranges from 4.6 to 25 ft in elevation with most areas along Culver Boulevard ranging from 8 to 12 ft and the upper flats ranging from 15 to 20 ft above mean sea level.

Area C-9, is 14.6 acres in size and consists of roadsides and disturbed areas near the baseball diamonds. The area has a mixed weed flora with some cultivated plants and overall ranges from a low of 8.5 ft along Culver Boulevard to 19.4 ft along the Ballona Creek channel margin. The weed flora shows both a spring and summer annual component. The spring annuals include species of Chess grass, Wild oats, Fescue grass (Fescue megalura), Black mustard, Chrysanthemum, Star thistle, Ox-tongue (Picris echioides), and Sow thistle (Sonchus oleraceus). During the summer, other annuals develope such as Russian thistle, Tall stephanomeria, Telegraph weed (Heterotheca grandiflora), some Chichory (Cichorium intybus), and Wild lettuce (Lactuca virosa). Frequent perennials included Bermuda grass (Cynodon dactylon), Australian saltbush (Atriplex semibaccata), Yellow fennel (Foeniculum vulgare). Cultivated plants included Iceplant (Carpobrotus edulis), which was abundant along Culver Boulevard, and many trees including Peppertree (Schinus terebenthifolius), Spanish dagger (Yucca gloriosa), Canary Island date palm, (Phoenix canariensis), White mulberry (Morus albus), Orchid tree (Bauhinia variegata), Castor bean (Ricinus communus), St. John's bread (Ceratonia siliqua), and others. The site even contained some trees in boxes, namely a specimen of Podocarpus macrophylla.

Area C-10, of 1.7 acres, includes the western portion of this site, the area west of the baseball diamonds including the area within the circular Culver Boulevard offramp. Some of this area is outside the property of Maguire Thomas Partners. The site contains a large area of cultivated Iceplant, but the depression west of this (at 4.6 ft elevation) contains a dense, nearly pure stand of Russian knapweed (Centaurea repens) in an area largely surrounded by weeds and Yellow fennel (Foeniculum vulgare), Tree tobacco, and a Canary Island date palm. The rest of the area ranges from 10 to 25 ft elevation and contains the same weedy component that was noted in area C-9, with an additional component of Coyote brush and Seep willow (Baccharis salicifolia), and some Laurel-leaved sumac (Rhus laurina). Garland chrysanthemum was very common in the upland portions of this area.

Area C-11, of 15.4 acres, constitutes the western half of this site, the area west of the Baseball diamonds. This area ranges from 15 to 25 ft elevation and is dominated by annual grasses and contains a scattering of native and cultivated trees and shrubs. Again the annuals have a spring and summer component, with Chess grasses, Wild oats, Fescue grass, Storksbill, Star thistle, and Chrysanthemum being important components of the spring flora with a scattering of Telegraph weed, Everlasting (Gnaphalium beneolens), Russian thistle, Chichory, local stands of a native Tarweed (Hemizonia paniculata) being the more commonly observed summer species. Yellow fennel, Australian saltbush, were the common perennials, while Coyote brush, Seep willow, Pepper tree (Schinus terebenthifolius), and Pampas grass were the common shrubs-trees. The site also contained a scattering of Siberian elm (Ulmus parvifolia), Olive tree (Olea europea), Arroyo willow (Salix lasiolepis)--isolated trees) as indicated in Fig. 9.

Comments of the Vegetation and Flora:

Area C contains about 1.8 acres of Pickleweed and Frankenia habitat that has developed in depressions on the site (including about 1 acre of federal jurisdiction wetland), about 1.9 acres of sandy habitat containing some native species, and 5.8 acres dominated by Coyote brush. The rest of the area constituting 56.8 acres or 85.7 percent of the site, consists of weed-dominated flats. That some native species have redeveloped in this highly disturbed sites again speaks well for the resilence of segments of the native flora.

Flora Checklist of AREA C-1

C-1 Area of Drainage Ditch, dry except adjacent to Lincoln St.

Annuals
Chrysanthemum coronatum A
Bromus diandrus C
Bromus rubens C
Brassica nigra C
Cotula coronopifolia R
Chenopodium berlandieri I

Perennials
Salicornia virginica C
Atriplex lentiformis ssp. breweri A
Scirpus olneyi R
Scirpus californicus R
Rhus laurina R

C-2 Weedy areas in disturbed flats.

Spring annuals
Bromus rubens A
Bromus diandrus F
Bromus mollis F-C
Avena barbata I
Avena fatua C-F
Fescuta myuros I
Brassica nigra F
Erodium cicutarium A
Chrysanthemum coronatum C (local A)
Centaurea melitensis I-C
Sonchus oleraceus I
Rumex crispus I
Hordeum leporinum R
Picris echioides R
Sisymbrium irio R
Schismus barbatus
Gasoul nodiflorum I
Spergularia bacconii R
Salsola australis R
Chenopodium murale R
Bassia hyssopifolia R

Perennial herbs
Gnaphalium beneolens local A
Centaurea repens local A
Foeniculum vulgare
Lobularia maritima R
Sida leprosa R

Shrubs
Baccharis pilularis F
Artemisia douglasii R
Cortaderia atacamensis F
Nicotiana glauca F

C-3 Area with sandy substrate dominated by Gnaphalium beneolens

Annuals
Brassica nigra I
Erodium cicutarium A
Schismus barbata A
Chrysanthemum coronata I
Centaurea melitensis I
Camissonia lewisii U
Filago spp. R

Perennials
Gnaphalium beneolens A
Lotus scoparius I
Cortaderia atacamensis I
Artemisia californica R
Baccharis pilularis I

C-4 Area of Baccharis pilularis with Pampas grass and Chrysanthemum coronatum.

Annuals
Chrysanthemum coronatum A
Melilotus indicus C
Brassica nigra C
Bromus rubens C
Bromus diandrus I
Raphanus sativus I
Erodium cicutarium F
Centaurea melitensis I

Perennials and shrubs
Gnaphalium beneolens F
Foeniculum vugare I

Shrubs
Baccharis pilularis ssp. consanguinea C
Artemisia californica I
Cortaderia atacamensis F
Myoporum laetum I
Atriplex lentiformis ssp. brewerii I
Brickellia californica R
Baccharis salicifolia F

C-5 Sandy slopes along Culver Boulevard.

Annuals
Bromus diandrus C
Bromus rubens C
Chrysanthemum coronatum C
Erodium cicutarium F
Erodium botrys I
Stephanomeria virgata I
Salsola australis I
Malacothrix saxatilis I
Avena fatua I
Heterotheca grandiflora C
Raphanus sativus I

Perennials
Croton californica C
Atriplex semibaccata
Ricinus communis R
Salix lasiolepis R
Lotus scoparius I
Nicotiana glauca F
Foeniculum vulgare I

C-6 Depression with Pickleweed (Salicornia virginica), the soil with ridges from grading.

Annuals
Chrysanthemum coronatum C
Bromus rubens F
Hordeum leporinum R
Atriplex rosea R

Perennials
Salicornia virginica I
Atriplex semibaccata I
Frankenia salina R

C-7 Areas with dense Pickleweed (Salicornia virginica) in slight depressions.

Annuals
Bromus rubens F (dies off early)
Bromus diandrus I
Gasoul nodiflorum F
Bassia hyssopifolia F (marginal)
Chrysanthemum coronatum I
Centaruea melitensis I
Hordeum leporinum I

Perennials and shrubs
Salicornica virginica C
Atriplex semibaccata F

C-8 Depression area, 3 ft below rest of area.

Annuals
Raphanus sativa A
Bromus rubens C
Bromus diandrus C
Lactuca serriola I
Picris echioides I
Heliotropium currasavicum I
Malva nicaeensis I
Malva parviflora I

Perennials
Frankenia grandiflora I
Ricinus communis I
Sida leprosa var. hederosa
Malacothrix saxatalis I
Silymbum marianum I

C-9 Disturbed roadsides and areas around baseball diamonds.

Spring annuals
Avena barbata C
Bromus rubens C-A
Bromus diandrus C-A
Bromus mollis I
Festuca megalura I
Brassica nigra F-C
Chrysanthemum coronatum I-A
Sonchus oleracea F
Rumex crispus I
Centaurea militenis F
Picris echioides F

Summer annuals
Salsola australis F
Lactuca virosa I
Heterotheca grandiflora F
Stephanomeria virgata F
Cichorium intybus I

Perennial herbs
Cynodon dactylon I
Atriplex semibaccata C
Foeniculum vulgare I
Carpobrotus edule C
Plantago lanceolata I

Trees
Schinus terebenthifolius F
Phoenix dactylifera I
Morus albus I
Liquidambar styraciflua R
Bauhinia viriegata R
Acacia neriifolia I
Quercus x virginica R
Prunus sp. R
Ricinus communus I
Ceratonia siliqua R
Podocarpus macrophylla R
Yucca gloriosa F

C-10 Area of Iceplant, weedy depressions, and uplands at west end.

Spring annuals
Avena barbatus I
Bromus rubens C
Bromus diandrus C
Bromus mollis I
Brassica nigra F
Chrysanthemum coronatum F-A
Centaurea melitensis I
Centaurea repens (local A)

Summer annuals
Stephanomeria virgata I
Heterotheca grandiflora I
Atriplex rosea R
Picris echioides F
Salsola australis F

Perennial herbs
Foeniculum vulgare F-C
Malocothrix saxatilis I
Atriplex semibaccata I
Sida leprosa

Shrubs
Baccharis pilularis I
Baccharis salicifolia I
Phoenix canaryensis R
Nicotiana glauca I
Rhus laurina F

C-11 Area on west end of site, with open grasses with scattered shrubs and trees.

Spring annuals
Avena barbata C
Bromus diandrus C
Bromus rubens C
Bromus mollis F
Festuca megalura F
Chrysanthemum coronatum F-A
Erodium cicutarium F
Centaurea melitensis F
Rumex crispis I

Summer annuals
Heterotheca grandiflora I
Gnaphalium beneolens I
Atriplex rosea I
Salsola australis I

Hemizonia paniculata I
Amaranthus albus R
Lactuca virosa I
Cichorum intybitus I

Perennial herbs
Foeniculum vulgare I
Carpobrotus edule I
Atriplex semibaccata F
Ambrosia psilostachya I

Shrubs
Cortaderia atacamensis F
Olea europea I
Yucca gloriosa I
Ulmus parvifolia R
Baccharis salicifolia F
Baccharis pilularis F
Schinus terebenthifolia F
Salix lasiolepis R

VEGETATION AND FLORA OF AREA D:

The 462.0 acre Area D is the largest of the four Ballona sites. It is delimited on the west by Lincoln Boulevard, to the north by Jefferson Boulevard (with the exception of a additional 31 acre tract that extends to the Ballona Creek channel north of Jefferson Boulevard just east of Lincoln Boulevard), to the south by the Cabora Drive that parallels the Hyperion Sewage Treatment Plant line along the lower bluffs except to where the property extends higher than Cabora Drive on the bluffs in the eastern portion of the site, and its eastern border is marked by the convergence of the southward-turning Centinela Avenue (Figs. 1, 10).

The 1950 USGS quad map (Venice, Calif., Fig. 5) shows the elevations on the flat areas of the site ranged from under 5 ft on the western portion of the site to a high of just over 20 ft at the eastern extreme. Before man's intervention, the eastern portion of the site probably contained a freshwater marsh that may have died back or become brackish during the summer. As noted previously the USGS Water Supply Map (1904) reported that the water table in the region was at 10 ft elevation at that time and that lower areas in the region received artesian waters. The 10 ft elevational gradient ran through the middle of this east-west oriented site and it is expected that the area west of that site supported a mesic to wetland flora. Centinela Creek once passed freely through the site, but when the Hughs facilities were constructed in the 1940's, the pathway of the creek, which drains some 2000 acres to the east, was relocated to the south and straightened into what is now known as the Centinela Ditch that presently drains west of Jefferson just south of Teale Street.

Much, if not nearly all, of the land in Area D has been farmed in the past. A large portion of the site has been converted to an industrial site during and since World War II for the Hughes Aircraft manufacturing facilities. In the late 1970s, the Coastal Zone Commission was formed to regulate development of coastal areas of California. In this area they maintained jurisdiction as far east as Lincoln Boulevard. In 1983 the region received very heavy rainfall (25.61 inches recorded at Los Angeles International Airport) resulting in extensive flooding in Area B and the northwestern corner and the western portion of Area D in which lagoons developed and persisted for several months (R. Vogl, pers. comm.). In the years following that event, the western half of Area D were filled with dirt brought in from off the property. At the present time most of the filled flats in the western portion of the site range from (8.4-)11-19.6 ft in elevation, which represents about 10 ft of fill over the initial landscape as judged from the two areas north of Teale Street that were not filled but lie adjacent to filled areas. The process of adding fill to the site continued until after 1987 as a large flat-topped ridge about 2200 ft long and to 400 ft wide on the eastern half of the site is not shown on the base map used for vegetation mapping that was based on aerial photographs dated August and October 1987. It appears, overall, that the eastern portion of the site has not been extensively filled though all of it appears to have been graded or otherwise disturbed at some time. The western portion of the site contains several areas of concrete rubble added over the fill.

With development of the Hughes aircraft industries, an east-west running paved runway was constructed across nearly the entire site and this also appears to have involved fill and extensive substrate disturbance in its construction. However, portions of the northern portion of the western half of the site, i.e.

that along Jefferson Boulevard appear not to have not been disturbed for some time.

The Playa Vista Property continues above the flats along the southern border of the site up to the Hyperion sewer line which ranges from 61.9 ft in the western portion of the site to an elevation of 50 ft above mean sea level near Lincoln Boulevard. The adjacent bluffs continue rather abruptly upward to the terraces that lie at 130 to 160 ft elevation and recently several of these bluff areas have been added to the areas controlled by Maguire Thomas Partners and their vegetation and flora are included in this report and their acreage is included in the total acerage for area D.

Vegetation and Flora:

The vegetation and floristic composition of Area D is presented in a series of checklists numbered D-1 through D-16 that refer to areas indicated in Figure 10. Each checklist gives the species encountered in the plant association and indicates the relative frequency of the species, that is whether a particular species is abundant, common, frequent, infrequent, or rare in the association. Many of the checklists distinguish between spring and summer annuals and between perennial herbs and shrubs. Most of the checklists represent mere facies or subtle subsets of an omnipresent disturbed flora.

In the discussion below, vegetation of Area D is described on a geographical basis from widespread weedy areas to more specific habitats involved with potential wetland sites. The acerage determined from the vegetation map (Fig 10) came to 461.6 acres as compared to the 462.0 acres determined by PSOMAS.

Area	Habitat	Acreage	Percent of total
D-1	Disturbed open areas	121.8	26.4
D-2	Sandy open areas	3.7	0.8
D-3	Dirt-fill ridge	19.6	4.2
D-4	Grassy marginal slopes and terraces	61.3	13.3
D-5	Central depressions with Australian saltbush	3.0	0.6
D-6	Ponded areas	0.8	0.2
D-7	Wet depressions	0.6	0.1
D-8	Unvegetated filled flats	56.7	12.3
D-9	Filled flats with Coyote brush	3.5	0.8
D-10	Unfilled flats (near Teale Street)	5.2	1.1
D-11	Centinela Ditch	2.9	0.6
D-12	Sandy areas (south of Teale Street)	26.9	5.8
D-13	Wet depression in Sandy area	0.1	0.02
D-14	Dense Willow thicket with seepage	(0.8)#	0.2
D-15	Revegetated filled field	13.8	3.0
D-16	Revegetated filled field with Coyote brush	17.3	3.7
	Roads, industrial sites, parking lots	123.6	26.8
	# = outside but adjacent to area	461.6	99.9 %

Total disturbed areas (D-1-2-3-4-5-7-8-9-10-11-12-13-15-16): 336.4 acres (72.9 %)

Total disturbed, roads and industrial sites: 460 acres (99.6 %)

Total moist-wet areas (D-6-7-13-14: 2.3 acres (0.5 %)

1. DISTURBED OPEN FLATS: (Area D-1; 121.8 acres). Area D has extensive areas of weedy flats whose flora is at once uniform, in that nearly all the species present are naturalized weeds, and diverse, as throughout the site different associations of weedy species become locally dominant reflecting differences in substrate, drainage, and elevation. Area D-1 consists of the region south of Jefferson Boulevard and north of the Hughes facilities. All of this region has at one time or another been disturbed during construction of airstrips and roadways and is presently covered with species that have redeveloped on the site.

The appendix checklist B-1, lists some 81 species of plants found in this area, of which 43 are spring-developing annuals, the remainder divided between summer-developing annuals, perennial herbs and shrubs-trees. The most commonly encountered spring annuals on the site are the Chess grasses (Bromus diandrus, B. rubens and B. mollis), Wild oats (Avena barbata), Black mustard (Brassica nigra), Star thistle (Centaurea melitensis), Ox-tongue (Picris echioides), Storksbill (Erodium cicutarium, E. botrys), Sweet clover (Melilotus indicus), Bur clover (Medicago polymorpha), Wild lettuce (Lactuca serriola), Ox-tongue (Picris echioides), Wild barley (Hordeum leporinum), Italian rye grass (Lolium perenne), and Garland chrysanthemum (Chrysanthemum coronatum). In the summer, other annuals develop on these flats of which Russian thistle (Salsola australis), Bassia (Bassia hyssopifolia), Telegraph weed (Heterotheca grandiflora), Horseweed (Conyza canadensis), and Tall stephanomeria (Stephanomeria virgata) are the most common. Bermuda grass (Cynodon dactylon), Sweet fennel (Foeniculum vulgare), Russian knapweed (Centaurea repens), Malacothrix (Malacothrix saxatalis) are the most common perennial herbs while Australian saltbush (Atriplex semibaccata), and scattered Seep willow (Baccharis salicifolia), Coyote brush (Brassica pilularis ssp. consanguinia), Tree tobacco (Nicotiana glauca), Castorbean (Ricinus communis), and Pampas grass (Cortaderia atacamensis) are the most common shrubs.

In more sandy flats, Storksbill, Chess grasses, Fescue grass, Wild barley, Wild oats, Italian rye grass, Sweet clover, Bur clover, Star thistle, and Russian thistle form an open and sometimes sparse vegetative covering. Some of the areas along Jefferson Boulevard that are disked frequently contain dense, sometimes uniform, stands of Chrysanthemum and local areas Russian knapweed.

The area also contains some old cultivated trees including one large stand of Blue gum (Eucalyptus globulus) along Jefferson Boulevard that contains an active Red-tailed hawk nest in which young were fledging during the summer survey. The shaded understory of this tree contains much Russian knapweed, and a scattering of Bluegrass (Poa annua), Wild barley, Wild oats, Wild radish, Mallow (Malva parviflora and M. nicaeensis) London rocket (Sisymbrium irio), Goosefoot (Chenopodium murale and C. berlandieri) and Horehound (Marrubium vulgare). Fan palms (Washingtonia robusta), Canary Island Date palms (Phoenix canariensis), and one stand of Arizona cyperus (Cupressus arizonica) also in the flats along Jefferson Boulevard.

Most of the flats and ridges bordering the east end of the Airport runway contain dense and rather tall stands of Black mustard mixed with Russian thistle, Wild oats, Horseweed (Conyza canadensis), Malacothrix, Ox-tongue, Sow thistle (Sonchus oleraceus), Wild radish (Raphanus sativus), Mallow, some Sweet fennel, and Tall stephanomeria. In other areas Russian thistle is dominant and Black mustard less common. This dense weedy vegetation continues along the south side of the recent developed berm-ridge where the substrate is more moist and the species diversity greatly increases with the presence of such species as Hedge bindweed (Convolvulus arvensis), Wild lettuce (Lactuca virosa, S. serriola), Rescue grass (Bromus wildenovii), Curly dock (Rumex crispus) and occasional Plantain (Plantago lanceolata). The most moist sites in this area are described as area D-7.

Other flats on the north side of the east end of the Airport runway have a very sparse weedy vegetation with many open areas. Common species here include Yellow sweet clover (Melilotus indicus), Cat's ear (Hypochoeris glabra), Wild barley, Black mustard, Star thistle, Malacothrix, Storksbill, Heterotheca, Tall stephanomeria and scattered shrubs of Coyote brush, Seep willows and Tree tobacco.

This area also contains some ditches just west of the recently developed ridge that contains species adapted to more moist sites. The bottom of the ditches contain Alkali mallow (Sida leprosa), Italian rye grass (Lolium perenne), Spangletop grass (Leptochloe uninervia), Spurge (Euphorbia serpens), Beardgrass (Popypogon monspeliensis), Sweet clover (Melilotus indicus), Bermuda grass, Australian saltbush, Sedges (Cyperus eragrostis), Willow-leaved dock (Rumex salicifolia), Ox-tongue, and Willow-herb (Epilobium ciliatum). These ditches are mostly bordered with stands of Seep willow, Pampas grass, some exotic Wattles (Acacia longifolia), and occasional Arroyo willow (Salix lasiolepis). These areas represent wetlands.

2. SANDY OPEN AREAS: (Area D-2; 3.7 acres). There is an inset area within Area D-1 along Jefferson Boulevard that contains a sandy substrate with a slightly different flora. The site contains most of the species mentioned above but the vegetation is more open and contain more associates, some of which represent native annuals.

The shrub flora consists of scattered Coastal sagebrush (Artemisia californica), Bird's foot trefoil (Lotus scoparius), Seep willow (Baccharis glutinosa), Coyote brush (Baccharis pilularis), Pampas grass and occasional Bush lupine (Lupinus longiflorus). Interesting perennials include Croton (Croton californica), a species that occurs wherever sandy soils are present, another Bird's foot trefoil (Lotus purshianus), Horehound (Marrubium vulgare), and occasional stands of native Needlegrass (Stipa cernua).

Annuals here consist of the Chess grasses, Fescue grass, Schismus grass, Wild barley, Curly dock, Chrysanthemum, Wild radish, Sweet clover, Storksbill, Cat's claw along with a few native annuals such as a small-flowered lupine (Lupinus bicolor) and a Primrose (Camissonia lewisii).

The presence of an increased amount of the native Coastal sagebrush and Bush lupine and the native annuals distinguish this area from Area D-1.

3. DIRT FILL RIDGE: (Area D-3; 19.6 acres). The site contains a very large land-fill ridge that parallels Jefferson Boulevard. The ridge is not present on the topograhic map used for the base map for the vegetative mapping. As the base map was created from aerial photography from 1987, it is evident that the ridge dates from after 1987. The ridge is estimated to measure some

2200 ft in length and 400 in width and is of unknown height, but is probably about 30 ft in height. The present flora represents remnants of the initial pioneer flora that developed on the site. The slopes and top of the site contain an assortment of weedy pioneer species--species that are capable of establishing themselves on open disturbed surfaces.

The most abundant plants on the ridge at present are old dead carcasses of Russian thistle or Tumbleweed (Salsola australis) that develop a globose growth habit during the summer and then remain on the slopes covering much of the habitat. They also develop each year among the old plants increasing the thickness of the population. The common shrubs on the slopes and sloping top of the ridge are Tree tobacco (Nicotiana glauca), Castorbean (Ricinus communis), with widely scattered Acacia, Coyote brush and Myoporum. Other common weeds include Wild oats, Chess grasses, Black mustard, Wild barley, Italian rye grass, Wild radish, Curly dock, Ox-tongue, Chrysanthemum, Tall stephanomeria, Horseweed, Australian saltbush, Malacothrix, Bermuda grass, and Russian thistle. Overall the wide diversity of weeds on the slopes reflects the disturbed nature of the habitat and the aggressive nature of the weedy species present in the area.

4. GRASSY MARGINAL SLOPES AND TERRACES (Del Rey Bluff): Area D-4; 61.3 acres). The moderately steep marginal slopes begin at an elevation of about 20 ft and extend up to 50-56 ft to the sewer-line road the marks the southern boundry of much of the site, but in the western portion of the site the property continues well up the grassy bluffs to the margins of the upland terraces to an elevation of 125-160 ft. The slopes contain two distinctly different floras. The slopes below Loyola-Marymount College and many other areas contain nearly a pure stand of Iceplant (Carpobrotus edulis) that is often associated with Ripgut chess grass (Bromus diandrus) or Foxtail chess grass (Bromus rubens). Its distribution is indicated in Fig. 10. Other areas are dominated by Ripgut and Foxtail chess grasses occurring with Wild barley, Fescue grass, Wild oats, Black mustard, Storksbill, Wild radish, Curly dock, Goosefoot (Chenopodium murale) and many other species as indicated in the checklist for area D-4.

Common shrubs include the Coastal sagebrush (Artemisia californica), which can form some rather dense stands, scattered to rare Goldenbush (Haplopappus pinifolius), Tuna cactus (Opuntia littoralis), occasional Arroyo willow (Salix lasiolepis), Elderberry (Sambucus mexicanus), Tree tobacco, Peppertree (Schinus terebenthifolius), Castor bean, Acacia, Myoporum, Oleander, Canary-Island date palm, Peach, Apple, and Toyon (Heteromeles arbutifolia). Most of the latter are relicts of cultivars that have persisted on the site or are derived from seeds of adjacent cultivated trees.

5. CENTRAL DEPRESSION WITH AUSTRALIAN SALTBUSH (Atriplex semibaccata): (Area D-5; 3.0 acres). The central portion of site contains depressions that have developed a distinctive flora. The site lies immediately west of the artifical ridge, and adajcent to roadways, areas of concrete rubble, and other man-made depressions. This particular depression contains a very dense stand of Australian saltbush (Atriplex semibaccata) and several large stands of the perennial Leafy spurge (Euphorbia escula), scattered Seep willow, Tree tobbaco, Some Bird's foot trefoil (Lotus scoparius) that becomes locally abundant on adjacent flats, and an assortment of weeds. Further to the west in the depression, the Australian saltbush becomes less common while Black mustard, and the usually association of annual grasses and weeds becomes more prominent and

dominant. Again the flora consists almost entirely of weedy species, but the complete dominance of Australian saltbush is notable and the presence of the leafy Spurge is of interest. Both of these taxa are introduced.

6. PONDED AREAS: (Area D-6; 0.8 acres). In the flats in the eastern portion of the site a transverse ditch has been dug north of the runway that has caused rainwaters to accumulate. Because of the standing water, the site has developed a flora of species that can tolerate standing water. Specifically this small area is considered a wetland as per the federal guides for establishing federal wetlands (Conel 1990).

The small site contains an overstory of Seep willow (Baccharis salicifolia) and several small Arroyo willow (Salix lasiolepis). Interesting wetland annuals include Beardgrass (Polypogon monspeliensis), Lythrum (Lythrum hyssopifolium), Willow-leaved dock (Rumex salicifolia), and Brass buttons (Cotula cornopifolia, which is rare). A few other annuals develop on the flats after the water receeds including Sweet clover, Chess grasses, Wild barley, Fescue grass and an Everlasting (Gnaphalium chilensis).

7. WET DEPRESSIONS: (Area D-7; 0.6 acres). This area consists of some wet depressions south of the man-made ridge north of the Hughes industrial site. The weedy flats (Area D-1) become more moist in this area eventually forming a series of small wet depressions in which the flora shows a gradual change from that of the upland areas with Black mustard and Russian thistle to areas characterized by a dense, tall assortment of weedy species. The common annuals that form this dense vegetation include Ox-tongue (Picris echioides), Black mustard, Wild lettuce (Lactuca virosa), Ehrharta grass (Ehrharta erecta), Rescue grass (Bromus wildenovii), Spike-rush (Eleocharis macrostachya), Plantain (Plantago lanceolata), Broad-leaved peppergrass (Lepidium latifolium rare), Paspalum (Paspalum dilatatum), and two morning-glories. Nearly all the species are weeds though some are specific to wet areas and the sites represent a wetland as defined by the Federal guidelines.

8. UNVEGETATED FILLED FLATS: (Area D-8; 56.7 acres). Nearly all of the southwestern quarter of the site, except for two rectangular areas (area D-10), has been filled-in with dirt since 1979. The site previously was part of an active agricultural field. The flats have been strongly compacted and surprisingly have not developed much of an overstory of plants since they were formed. The existing vegetation consists of a sparse scattering of weedy species that can be divided into spring- and summer-developing annuals and are so listed in the appendix checklist. Within this area some areas having poor drainage develop a slightly different wetland flora and these species are so indicated within the checklist. The only shrubs present are the Pampas grass, Coyote brush and an isolated Pickleweed.

9. FILLED FLATS WITH COYOTE BRUSH: (Area D-9; 3.5 acres). The far southwest corner of area D-8 contains a stand of Coyote brush (Baccharis pilularis) that occurs with occasional Pampas grass, and isolated Fan palm and Arroyo willow. The understory again consists of weedy annuals of which Sweet clover (Melilotus indicus) and Foxtail chess (Bromus rubens) are the most common. The others occur only as scattered individuals. The site is very similar to the vegetation occurring in area D-16, north of Jefferson Boulevard.

10. UNFILLED FLATS (along Teale Street): (Area D-10; 5.2 acres). When

the southwestern corner of Area D was being filled with hauled-in dirt, two areas that contained farm machinery were not filled, and they occur at what was the original elevation of the flats. Both rectangular areas have developed a strong weedy flora and contain a number of woody species on the surrounding slopes and ditches. The area at present may be receiving runoff water from the adjacent flats which would result in a more dense vegetation than would normally occur on the flats.

The vegetation on the flats consists of an interesting mosiac of introduced species with some local areas dominated by Chess grasses, Storksbill, Star thistle, and other areas Sweet clover (Melilotus albus), or Ox-tongue (Picris echioides), Russian thistle, Mexican tea (Chenopodium ambrosioides), Everlastings (Gnaphalium spp.) and some local stands of Cattails (Typha sp.) are also present.

Coyote brush, Seep willos, Tree tobacco, Castorbean, Pampas grass also occur in the site and the western margin of the westernmost area has a ditch that contains a stand of Arroyo willow (Salix lasiolepis) with some Sand-bar willow (Salix hindsiana) and Cottonwood (Populus fremontii).

11. CENTINELA DITCH: (Area D-11; 2.9 acres). The remnant of Centinela Creek, now known as Centinela Ditch, extends from the Hughes Industrial site (north of Teale Street) to where it crosses under Teale Street and then parallels the street west to Lincoln Boulevard. Another ditch is located immediately north of Teale Street and the two join via an under-road culvert east of Lincoln. Both ditches have developed a scattered woody flora consisting of Arroyo willow, Cottonwood, scattered Pampas grass, which in some areas is very common in a linear series along the upper margins of the channel, Seep willow, along with some Castor bean, and Tree tobacco. The bottom of the ditch develops several wetland species including Cattails (Typha dominguensis), Tule (Scirpus californica), Threesquare (Scirpus olneyi), and Umbrella sedge (Cyperus eragrostis) along with many annuals including Beardgrass (Argrostis semiverticillata), Willow-leaved dock (Rumex salicifolia), and Willow herb (Epilobium ciliatum), Smartweed (Polygonum lapathifolium), Spangletop grass (Leptochloe uninervia) and Plantain (Plantago major, P. lanceolata). The site represents a wetland but the flora is annually cut by people concerned about the flow of flood waters from winter-fall rains. The presence of various tree species is indicated along this habitat on Fig. 10.

12. SANDY HABITATS (south of Teale Street): (Areas D-12 and 13; 26.9 and 0.1 acres respectively). The area north of Teale Street and east of Lincoln Boulevard contains a large area of sandy substrate tvhat has washed down from the adjacent bluffs. The central portion of the site has been disturbed and has a very sparse vegetative cover, but the marginal areas along Lincoln and Teale streets and the bluffs to the south show a diverse vegetative cover. This area could be divided into several minor vegetation sites (some moist depressions are recognized as area D-13) but the diverse flora is described separately. Here, as elsewhere on the site, vegetation carefully reflects substrate and elevation.

The areas bordering Lincoln Boulevard near Teale Street contains a local patch of Iceplant (Carpobrotus edulis), and several stands of Pampas grass mixed with a scattering of Seep willow, some Arroyo willow, Coyote brush, and Castor bean in the adjacent flats. The understory vegetation in this area consists of a mosaic of Russian thistle, Telegraph weed, Chess grasses, Storksbill, Wild oats, Wild barley, Black mustard, Malacothrix, Chrysanthemum, Sweet clover, Sweet fennel, Australian saltbush, Calabasis gourd (Cucurbita foetidissima), and Curly dock. Further to the south along Lincoln Boulevard there are local stands of Giant reed grass (Arundo donax) mixed with Arroyo willow, some Seep willow, Pampas grass, Coastal sagebrush (Artemisia californica), and Tree tobacco. The associates again consist of weedy annuals such as Chrysanthemum, Sweet clover, Telegraph weed, Star thistle, Storksbill, Black mustard, Tall Stephanomeria, Spiny-fruited ragweed (Ambrosia acanthicarpa), Russian thistle, and the ubiquitous Chess grasses.

The slightly higher and drier sandy areas further away from Lincoln Boulevard contain most of the same weeds as noted above. Some of the more open areas contain local stands of Bird's foot trefoil (Lotus scoparius), Loco weed (Astragalus trichopus ssp. leucopsis), or Tarweed (Hemizonia paniculata). Other areas contain local stands of Pampas grass and Seep willow that conform to the outline of a series of small ridges. The area also contains Seep willow, Coyote brush, Tree tobacco and a dense annual understory.

This region also contains a small depression (area D-13) that contains a distinctive flora dominated by more wetland species. The local and common species in this depression include Willow herb (Epilobium ciliatum), Willow-leaved dock (Rumex salicifolius), Tarweed (Hemizonia paniculata), Umbrella sedge (Cyperus eragrostis), Alkali mallow (Sida herdacea), White sweet clover (Melilotus albus), Star thistle (Centaurea melitensis), Cocklebur (Xanthium strumarium), Sand spurry (Spergularia villosa), Knotweed (Polygonum aviculare), Ox-tongue, and Spiny-fruited ragweed while the common local shrubs include Seep willows, Hastate-leaved Saltbush (Atriplex patula ssp. hastata), Australian saltbush, and one Gland willow (Salix laevigata). Adjacent areas also contain scattered Sunflowers (Helianthus annuus), Pigweed (Amaranthus albus), and Horehound (Marrubium vulgare).

The adjacent flats near Teale Street again are dominated by the weedy understory species as noted previously with a sparse scattering of shrubs, namely Pampas grass, Seep willow, Arroyo willow, Tree tobacco, Bird's foot trefoil. As noted previously the center portion of this area consists of a rather open sandy plain that contains several roadways and others areas of compacted soil that have failed to develop anything more than a sparse annual vegetative cover.

The southern portion of this open sandy area, in an area adjacent to a concrete-lined drainage, contains a local shrubland dominated by Tree tobacco, Castorbean, Coastal sagebrush, Seep willow, Coyote brush, some Cultivated Yucca (Yucca gloriosa) with an interesting association of smaller shrubs and herbs. The smaller shrubs include Bush aster (Corethrogyne filangifolia), Croton (Croton californica), while the common annuals include the Chess grasses, Chrysanthemum, Russian thistle, Spiny-fruited ragweed, Star thistle, and Black mustard. Common perennial herbs include Heliotrope (Phacelia ramosissima), Tall stephanomeria, Sweet fennel, Horehound, Willow-leaved dock, Sweet alyssum (Lobularia maritima), and Mullein (Verbascum virgatum).

The upper slopes along this area that lead into the landscaped areas associated with a new Hughes facility consist of a mixture of native and landscaped habitats. Most of the native areas contain a weedy understory with a scattering of shrubs such as Coastal sagebush and Castorbean. Adjacent areas have cultivated Acacia sometimes mixed with Seep willow, Coyote brush and an assortment of cultivated herbs.

13. DENSE WILLOW THICKET WITH SEEPAGE: (Area D-14; 0.8 acres). This area actually is just off the site as it occurs immediately above the roadway that lies over the sewerline. The site is remarkable as it contains some natural seepage and has thus developed a dense stand of Arroyo willow (Salix lasiolepis). The dense stand also contains a mixture of native trees and shrubs including some Coastal live oak (Quercus agrifolia), Wild rose (Rosa californica), Giant rye grass (Elymus condensatus), Seep willow, and a Bush cherry (Eugenia cf. paniculata). A large Canary Island date palm also occurs in the grove. Common perennials include Wild heliotrope (Phacelia ramosissima), Mexican rush (Juncus mexicanus), Western nettle (Urtica holosericea), Melic grass (Melica imperfecta), Mexican tea (Chenopodium ambrosioides), and Ehrharta grass (Ehrharta erecta), while the common annuals include Ripgut chess grass (Bromus diandrus), Wild radish (Raphanus sativus), Sow thistle (Sonchus oleraceus) and others.

14. REVEGETATED FILLED FIELD: (Areas D-15, D-16; 13.8 and 17.3 acres respectively). There exists a 31 acre field between Areas C and D, immediately east of Lincoln Boulevard and north of Jefferson Boulevard that is considered a part of Area D. The site has been an agricultural field but judging from the elevation of the site it has been filled with dirt. The present elevation ranges from a low of 4.2 ft in a depression in the southwestern corner of the site to a high of 18.6 ft on a mound in the extreme northeastern corner. Most of the site ranges from about 12 to 16 ft above mean sea level, which implies that it has been filled. Vegetation on the site is again mostly weedy but can be divided into two types. The southern portion of the site, particularly in the southwestern and southeastern corners is largely dominated by annual weeds such as Chrysanthemum, Chess grasses, Wild oats, Black mustard, Sweet clover, Ox-tongue, Bur-clover (Melilotus polycephala), Storksbill, and various other composites and mustards.

The largest portion of this parcel is dominated with Coyote brush (Baccharis pilularis ssp. consanguinea) that occurs with a sparse mixture of Seep willow, Pampas grass, and rare plants of Fan palm, Arroyo willos and a weedy elm. Overall the Coyote brush covers about 5 to 10 percent of the total plant cover. Coyote brush is very much dominant on the site. The other shrub species such as seep willow and Pampas grass are very scattered. One depression contains a few small plants of Arroyo willow. The annual flora here consists of most of the same species that are mentioned in the paragraph above. The most common annuals are the Chess grasses, Sweet clover, Bur clover, Russian thistle, Ox-tongue, Chrysanthemum, Storksbill and a scattering of other species as indicated in the appendix checklist D-15. This habitat shows the ability of disturbed areas to revegetate if left alone and watered completely by rainwater.

Comments on the Vegetation and Flora:

Area D has been so strongly modified with an active program of filling that perhaps no remnants of the original flora persist in the flats north of Teale Street. The only truly undisturbed sites in area D would be on the slopes of Del Rey Bluffs, where concentrations of Coastal sagebrush are present on the more protected areas. The slopes also contain a large willow grove associated with an active seep (area D-14), which is a very interesting stand that lies just off the site. The active program of filling Area D by the Summa Corporation has covered up whatever valuable native and wetland habitats existed on the site, although 3.5 acres of wetland habitat was scored for the site by Conel (1990) using the Federal wetland guidelines (Federal Interagency Committee for Wetland Delineation, 1989). All of this wetland habitat had developed on previously disturbed sites.

FLORA CHECKLISTS OF AREA D

D-1 DISTURBED OPEN AREAS: (121.8 acres).

Spring annuals

Avena barbata F-C
Avena fatua I
Bromus rubens F-A
Bromus diandrus F-A
Bromus mollis I-C
Bromus wildenovii I
Bromus wildenovii I
Lamarckia aurea R
Lolium perenne
ssp. multiflorum I-C
Horedum leporinum I-C
Schismus barbatus I
Festuca myuros I
Festuca megalura I-C
Brassica nigra F-A
Raphanus sativus I
Sisymbrium irio I
Medicago polycarpa I
Lupinus succulentus I
Melilotus indicus I-(local A)
Melilotus albus R-I
Chrysanthemum coronatum F-A
Erodium cicutarium C
Erodium botrys F
Centaurea melitensis F-locally C
Cuscuta sp. R
Chenopodium berlandieri R
Chenopodium plumio R
Picris echioides I
Malva niacaeensis R
Calystegia macrostegia ssp.
ssp. cyclostegia I
Cirsium vulgare I
Bassia hyssopifolia I
Sorgastrum nutans I
Rumex salicifolius R
Sisymbrium irio I
Sisymbrium altissimum I
Sonchus oleraceus I
Gnaphalium chilensis R
Eschscholzia californica I
Hypochoeris glabra I
Polypogon monspeliensis R
Ambrosia acanthicarpa I
Cirsium vulgare I
Lupinus succulentus F

Perennial herbs

Cynodon dactylon I
Foeniculum vulgare I-F
Stenotaphyrum secundatum I
Centaurea repens I (locally C)
Atriplex semibaccata I-C
Euphorbia serpens R
Ehrharta erecta R
Plantago lanceolata I
Calystegia macrostegia ssp. cyclostegia I
Cucurbita foetidissima

Shrubs-trees

Baccharis pilularis I-F
Baccharis salicifolia I-F
Nicotiana glauca I
Solanum xantii I
Artemisia californica I
Solanum douglasii I
Lotus scoparius I
Ricinus communis I
Cortaderia atacamensis I
Eucalyptus globulus I
Washingtonia robusta I
Schinus terebenthifolius
Phoenix canariensis R
Cupressus arizonica R
Chrysopsis villosa I

Wet Depressions

Arostis semiverticillata
Polypogon monspeliensis
Xanthium strumarium
Lythrum hyssopifolium
Dichondra occidentalis

Summer annuals

Salsola australis I-C
Malacothrix sasatilis O-C
Stephanomeria virgata I
Heterotheca grandiflora F
Conyza canadensis F
Latuca seriola F
Lactuca virosa R

D-2 SANDY OPEN AREAS: (3.7 acres).

Spring annuals

Avena barbata C
Bromus rubens A
Bromus diandrus A
Bromus mollis I
Festuca megalura C
Schismus barbatus A
Hordeum leporinum I
Bromus wildenovii R
Ambrosia acanthicarpa F
Rumex crispus I
Lupinus bicolor
ssp. microphyllus
Camissonia lewisii
Chrysanthemum coronatum F
Melilotus indicus
Hypochoeris glabrata I
Raphanus sativus I
Hypochoeris glabrta
Anagallis arvensis I
Erodium cicutarium I
Erodium botrys I

Summer annuals

Heterotheca grandiflora
Hemizonia paniculata I
Salsola australis I
Conyza canadensis I

Perennial herbs

Croton californica I
Lotus purshianus I
Marrubium vulgare I
Stipa cernua I
Plantago lanceolata I
Foeniculum vulgare

Shrubs

Artemisia californica F
Lotus scoparius F
Cortaderia atacamensis I
Baccharis pilularis I
Baccharis salicifolia I
Lupinus longiflorus

C-3 DIRT-FILL RIDGE: (19.6 acres).

Spring annuals

Avena barbata I
Bromus diandrus C
Bromus rubens A
Sonchus oleraceus F
Brassica nigra F
Hordeum leporinum F
Lolium perenne ssp. multiflora I
Melilotus indicus F
Melilotus albus I
Medicago polymorpha I
Malva parviflora I
Raphanus sativus I
Centaurea melitensis I
Chenopodium berlandieri I
Lupinus succulentus I
Sonchus oleraceus R
Euphorbia peplus I
Cirsium vulgare I
Rumex crispus R
Picris echioides F
Chrysanthemum coronatum F
Sisymbrium irio I
Gnaphalium chilense I
Gnaphalium californicum I

Summer annuals

Salsola australis C-A
Stephanomeria virgata C
Conyza canadensis I
Heterotheca grandiflora R

Perennials

Atriplex semibaccata I
Carpobrotus edulis I
Gnaphalium chilensis I
Convolvulus arvensis I
Malacothrix saxatilis F
Cynodon dactylon I
Foeniculum vulgare R
Gnaphalium bicolor R

Shrubs

Nicotiana glauca F
Baccharis pilularis I
Myoporum laetum R
Ricinus communis F
Solanum xantii var. intermedium R
Solanum douglasii R
Acacia sp. R

D-4 GRASSY MARGINAL SLOPES AND TERRACES: (61.3 acres)

Annuals

Bromus diandrus A
Bromus rubens C
Bromus mollis C
Festuca megalura F
Avena barbata F-A
Horedum leporinum F
Chenopodium murale I
Brassica nigra F-C
Erodium cicutarium F-C
Erodium botrys C
Raphanus sativus F
Chenopodium murale F
Rumex crispus F
Malva parvifolia F
Matricaria matricarioides R
Chrysanthemum coronatum I
Camissonia bistorta I

Perennials

Carpobrotus edulis A
Malephora crocea F (Local A)
Phacelia ramosissima R
Datura meteloides I
Agave americana var. striata R
Pelargonium zonale R
Elymus condensatus I
Foeniculum vulgare I

Trees and shrubs

Artemisia californica C
Opuntia littoralis I
Haplopappus pinifolius I
Ricinus communis I
Salix lasiolepis I
Sambucus mexicanus I
Nicotiana glauca I
Schinus terebenthifolius I
Acacia cf. longifolia I
Myoporum laeteus I
Nerium oleander I
Phoenix canariensis I

Heteromeles arbutifolia I
Prunus persica R
Malus sylvestris R
Callistemon citrinus I
Pinus spp. I
Crassula argentea I

D-5 CENTRAL DEPRESSION WITH AUSTRALIAN SALTBUSH: (3.0 acres)

Annuals
Bromus diandrus C
Bromus rubens C
Bromus mollis C
Bromus willdenovii I
Horedum leporinum I
Chrysanthemum coronata I
Erodium cicutarium I
Erodium botrys I
Salsola australis C
Festuca megalura F
Avena barbata I
Hordeum leporinum I
Lolium perenne ssp. multicaulis C
Melilotus indicus I
Brassica nigra C
Centaurea melitensis I
Malva parviflora I
Malva nicaeensis I
Lactuca serriola I
Sonchus oleraceus I
Stephanomeria virgata
Tetragonia tetragonioides I
Salsola australis C

Perennials
Atriplex semibaccata A
(clearly dominant)
Euphorbia escula C
Anagallis arvensis I
Foeniculum vulgare R
Convolvulus arvensis I
Plantago lanceolata I
Phacelia ramosissima I

Shrubs
Nicotiana glauca I
Baccharis salicifolia I
Lotus scoparius

D-6 PONDED AREAS: (0.8 acres).

Annuals
Bromus rubens C
Bromus diandrus F
Hordeum leporinum I
Festuca megalura F
Rumex salicfolius I
Melilotus indicus F
Polypogon monspeliensis F
Cotula cornopifolia R
Lythrum hyssopifolium F
Gnaphalium chilensis F
Amaranthus albus I

Shrubs
Baccharis salicifolia I
Salix lasiolepis I

C-7 WET DEPRESSIONS: (0.6 acres).

Annuals
Picris echioides A
Agrostis subverticellatus I
Bromus willdenovii
Brassica nigra C
Rumex crispus I
Lactuca virosa C
Polygonum aviculare I
Malva nicaeensis I
Lolium perenne ssp. multiflorum I
Avena barbata F
Lepidium latifolium I
Ehrharta erecta F
Conyza canadensis F

Perennials
Convolvus arvensis I
Calystegia macrostegia
ssp. cyclostegia I
Paspalum dilatatum F
Eleocharis macrostachya F
Plantago lanceolata I
Taraxacum officinale I

D-8 UNVEGETATED, FILLED FLATS: (56.7 acres).

Spring annuals
Bromus diandrus I
Bromus rubens I
Horedeum leporinum I*
Festuca megalura I
Erodium cicutarium F
Brassica nigra I*
Sisymbrium altissimum I
Sisymbrium irio I
Sonchus oleraceus I
Chrysanthemum coronatum I
Picris echioides I
Melilotus indicus I
Melilotus albus I
Medicago polymorpha F
Centaurea melitensis I
Polypogon monspeliensis R
Ambrosia acanthicarpa R
Raphanus sativus R
Gasoul nodiflorum I
Bromus mollis I*
Agrostis semiverticillata I*
Polypogon monspeliensis I*

Summer annuals
Stephanomeria virgata I
Salsola australis I
Conyza canadensis I
Bassia hyssopifolia I
Malva parviflora R
Artemisia psilostachya R*
Xanthum strumarium R*
Rumex salicifolius R*

Perennials
Cynodon dactylon I
Malephora crocea I
Carpobrotus edulis I
Heliotropium curassavicum R
Malacothrix saxatilis I

Shrubs
Baccharis pilularis I
Cortaderia atacamensis I
Salicornia virginica R

* = in seasonally wet depression

D-9 FILLED FLATS WITH COYOTE BUSH; (3.5 acres).

Annuals
Melilotus indicus A
Melilotus albus I
Hordeum leporinum I
Bromus diandrus F
Picris echioides I
Chrysanthemum coronatum I
Melilotus indicus I
Sonchus oleraceus I
Ambrosia acanthicarpum I
Conyza canadensis I
Salsola australis I
Heterotheca grandiflorum I
Stephanomeria virgata I

Perennial
Chenopodium ambrosioides I

Shrubs
Baccharis pilularis C
Cortaderia atacamensis F
Washingtonia robusta R
Salix lasiolepis R

D-10 UNFILLED FLATS (near Teale Street): (5.2 acres).

Spring annuals
Melilotus albus A
Melilotus indicus C
Bromus diandrus C
Bromus rubens C
Brassica nigra C
Brassica rapa ssp sylvestris I
Erodium cicitarium C
Picris echinoides C
Centaurea melitensis C
Salsola australis F
Lythrum hyssopifolia R
Polycarpon tetraphyllum R
Camissonia sp.
Ambrosia acanthicarpa I
Agrostis semiverticillata I
Polypogon monspeliensis I
Rumex salicifolius I
Conyza canadensis R
Xanthium strumarium R
Heterotheca grandiflorum I
Chrysanthemum coronatum I
Chenopodium botrys R
Polygonium aviculare I
Aster exilis I
Petunia parviflora R
Lythrum hyssopifolium R
Amaranthus albus R
Gnaphalium chilensis I
Spergularia villosa R**
Euphorbia serpens I

Perennials
Chenopodium ambrosioides I
Verberna lasiostachys I
Typha sp. I
Cypereus esculentus I
Plantago lanceolata I
Centaurea repens I
Anagallis arvensis R
Phacelia ramosissima R
Sida leprosa ssp. hederosa I

Shrubs and Trees
Baccharis salicifolia I
Baccharis pilularis I
Lotus scoparius R
Nicotiana glauca I
Ricinus communis F
Pyracantha sp. I
Cortaderia atacamensis I
Salix lasiolepis F
Salix hindsiana I
Populus fremontii R
Washingtonia robusta R
Lupinus longiflorus R

** New record for Southern California.

D-11 CENTINELA DITCH: (2.9 acres).

Annuals
Echinochloa crus-galli F
Leptochloa uninervia F
Sorghum halapense I
Picris echinoides F
Polygonum lapathifolium F
Bromus rubens C
Bromus diandrus A
Agrostis semiverticillata F
Rumex salicifolius I

Perennials
Typha dominguensis F
Cynodon dactylon F
Scirpus californica I
Scirpus olneyi I
Epilobium ciliatum I
Cyperus eragrostis R
Plantago major F
Chenopodium ambrosioides F
Plantago lanceolata F

Trees and Shrubs
Salix lasiolepis F
Populus fremontii I
Baccharis salicifolia F
Cortaderia atacamensis F
Nerium oleander I
Ricinus communis I

D-12 SANDY AREAS (south of Teal Street): (26.9 acres).

Spring annuals
Bromus rubens C
Bromus diandrus F
Bromus mollis I
Avena barbata I
Festuca megalura C
Schismus barbatus C
Erodium cicutarium C
Erodium botrys F
Melilotus indicus I
Melilotus albus F
Centaurea melitensis F
Chrysanthemum coronatum F
Raphanus sativus I
Rumex crispus I
Verbascum virgatum I
Lupinus bicolor F

Summer annuals
Heterotheca grandiflora C
Stephanomeria firgata F
Conyza canadensis F
Hemizonia paniculata I
Salsola australis F
Helianthus annuus R
Ambrosia acanthicarpa C

Perennial herbs
Cynodon dactylon I
Carpobrotus edulis I
Datura meteloides R
Marrubium vulgare I
Foeniculum vulgare I
Stenotaphrum secundiflorum R
Malacothrix saxatilis I
Astragalus trichopus I
Rumex salicifolius I
Centaurea repens I
Lobularia maritima I
Convolvulus arvensis I
Cucurbita foetidissima I
Atriplex semibaccata I
Euphorbia supina I
Phacelia ramosissima I
Gnaphalium beneolens
Oenothera hookeri I (C on banks)

Shrubs
Baccharis pilularis F-C
Baccharis salicifolia I
Salix lasiolepis I
Salix laevigata R
Cortaderia atacamensis F (local C)
Ricinus communis F
Nicotiana glauca F
Artemisia californica I
Lotus scoparius F
Croton californica F
Arundo donax I (local F)
Yucca gloriosa R

D-13 MOIST DEPRESSION IN SANDY AREA: (0.1 acre).

Annuals

Brassica nigra F
Bromus rubens C
Bromus diandrus F
Bromus mollis I
Festuca megalura I
Avena barbata I
Picris echioides C
Sonchus oleraceus I
Melilotus albus F
Hemizonia paniculata I
Ambrosia acanthicarpa F
Xanthium strumarium I
Helianthus annuus I
Polygonum lapathifolium F
Polygonum aviculare I
Epilobium ciliatum F-C
Atriplex patula ssp. hastata I
Cuscuta indecora I (on Polygonum aviculare)
Rumex salicifolius I

Perennials

Epilobium adenocaulon F
Atriplex patula F
Cyperus eragrostis
Sida herbacea F
Spergularia villosa I
Atriplex semibaccata I
Chenopodium ambrosioides I

Shrubs

Baccharis salicifolia F
Baccharis pilularis I
Salix lasiolepis I
Salix laevigata R

D-14 DENSE WILLOW THICKET WITH SEEPAGE: (0.8 acres).

Perennials and annuals

Chenopodium ambrosioides I
Elymus condensatus I
Phacelia ramosissima
Melica imperfecta I
Ehrharta erecta F
Lactuca virosa I
Bromus diandrus C
Bromus rubens I
Urtica holosericea F
Sonchus asper I
Avena barbata F
Raphanus sativa I

Shrubs and Trees

Salix lasiolepis A
Baccharis salicifolia I
Rosa californica I
Quercus agrifolia I
Eugenia sp.
Phoenix dactylifera R
Nicotiana glauca I

D-15 REVEGETATED FILLED FIELD: (13.8 acres).

Annuals

Chrysanthumum coronatum C-A
Bromus rubens C-A
Bromus diandrus F (local A)
Brassica nigra F
Picris echioides C
Rumex crispus I
Melilotus indicus C
Melilotus albus I
Heterotheca grandiflora F
Medicago polycephala F
Erodium cicutarium I-A
Avena fatua C
Sonchus oleracus I
Sisymbrium altissimum I
Sisymbrium irio I
Lactuca serriola R
Cirsium vulgare I

Perennials

Cynodon dactylon I
Convoluvlus arvensis I
Carpobrotus edulis I
Foeniculum vulgare R
Malva nicaeensis R
Malaxothrix saxatilis F
Malephora crocea R
Gazania longiscapa F
Heliotropium curassavicum R

Shrubs

Baccharis pilularis ssp. consanguinea I
Nicotiana glauca R
Salix laevigata R
Washingtonia robusta R
Rhus laurina I
Atriplex semibaccata I
Schinus terebenthifolius R

D-16 REVEGETATED FILLED FIELD WITH COYOTE BUSH: (17.3 acres).

Annuals

Bromus rubens C
Bromus diandrus F
Bromus mollis I
Bromus wildenovii F
Horedum leporinum F
Melilotus indicus A
Brassica nigra A
Melilotus albus I
Medicago polymorpha F
Salsola australis F
Chrysanthemum coronatum C
Picris echioides (local C)
Heterotheca grandiflora F
Conyza canadensis F
Erodium cicutarium C
Lolium perenne ssp. multiflorum I
Lactuca serriola I
Tetragonia tetragonioides R
Rumex crispus R

Perennials

Gnaphalium beneolens R
Foeniculum vulgare I
Carpobrotus edulis R
Malephora crocea R
Stenotaphrum secundatum I
Malva nicaeensis R
Solidago occidentalis R

Shrubs

Baccharis pilularis ssp. consanguinea A
Baccharis salicifolia F
Cortaderia atacamensis F
Ulmus parviflora R
Salix laevigata R
Washingtonia robusta R

RARE AND ENDANGERED SPECIES

The Playa Vista site contains living material of only one species of vascular plant that is considered of special status by the California Native Plant Society. Three other species are listed by the CNPS from the site, but they are locally extirpated. The one living species is the Suffrutescent Wallflower, Erysimum suffrutescens var. suffrutescens, that was found in low numbers in the flats just below the sand dunes in area B. The California Native Plant Society's Inventory of Rare and Endangered Vascular Plants of California (1988) place the species in their List 4, a "Watch list" reserved for species that are "not actually rare but are of limited occurrence in California and whose populations need to be monitored to guard at habitat loss." They give the taxon a Rarity-Endangerment-Distribution code of 1-2-3, indicating that it is rare, but found in sufficient numbers and distributed widely enough that the potential for extinction is low at this time; that it is endangered in a portion of its range; that it is endemic to California. It has no special state or federal protection.

Several other species have been found on or near the site in the past but are now considered extirpated from the area. These are:

The Ventura marsh milk Vetch, Astragalus pycnostachys var. lanosissimus, from the Legume family was once known from two populations in coastal marshes, one in Ventura (last seen in 1964) and the other in Ballona marsh (not seen since the late 1800's). It is presumed extinct and is placed in the extinct listing, List 1A by the CNPS.

The Coastal dunes milk vetch, Astragalus tener var. titi, also the Legume family, was known from sandy coastal dunes from San Diego to Monterey and from Ballona. It was last seen in 1964 and is presumed extinct in the area. It is listed on the List B1, and is considered endangered in California.

Ballona Cinquefoil, Potentilla multijuga, Rose family, was collected in brackish meadows in Ballona in the 1890's and has not been observed since and is presumed extirpated. It is on the CNPS extirpated list 1A and is listed as endangered in California.

The Salt marsh Bird's beak, Cordylanthus maritimus ssp. maritimus ~~has~~ been recorded from the Long Beach and Los Alamitos areas, but never from the Ballona Marsh.

THE FLORA

A total of 329 species of vascular plants are recorded from the Playa Vista site. These include 156 native species, 132 introduced, naturalized species and 41 cultivated species. Native species comprise 47.4 percent of the entire flora, and 54.2 percent of the non-cultivated flora. This is a much lower percentage of native species than is normal for local floras in Southern California and reflects the severly disturbed nature of the site.

In the listing below, the species are listed in their families, with conifers preceeding the dicots and monocots. The generalized location of each species within the Playa Vista area is indicated. The flora includes plants immediately outside the Playa Vista boundary such as cultivars along Fiji Way, and plants along the upper Del Rey Bluffs.

FLORA OF THE PLAYA VISTA SITE

GYMNOSPERMAE

CUPRESSACEAE - Cypress Family

#Cupressus arizonica, Arizona Cypress. One cluster of trees planted in area D near Jefferson Ave.

#Cupressus sempervirens, Italian Cypress. Cultivated along Fiji Way north of area A.

#Juniperus chinensis (cult. torulosa), Hollywood juniper. Common cultivar along Fiji Way bordering area A.

#Juniperus chinensis cult. low-growing, Juniper. Common low-growing cultivar along Fiji Way bordering area A and on the bluffs above of area D

PODOCARPACEAE - Podocarpus Family

#Podocarpus macrophylla, Podocarp. Cultivated and in a large box at baseball diamonds in area C.

PINACEAE - Pine Family

#Pinus sp. Several species of pines are cultivated above the Playa Vista property on the bluffs south of areas D and B.

ANGIOSPERMAE-DICOTYLEDONEAE

AIZOACEAE - Ice-plant Family

#Aptenia cordifolia, Cultivated iceplant. Cultivated succulent perennial grown around homes bordering the Playa vista property near area B, and rare within the site.

*Carpobrotis edulis, Hottentot fig. Forming dense carpets in area A (disturbed areas), area B (dense stands adjacent to good marsh habitats and near the dunes), rare in area C, and common on the slopes south of and bordering area D. Flowers yellow to purple and showing variation towards the rose-magenta-flowered C. aequilaterus.

*Carpobrotis edulis x C. aequilaterus. Growing and introgressing with the above-listed species.

*Gasoul crystalinum, Annual iceplant. Rare along dunes in western portion of area B.

*Gasoul nodiflorum, Annual iceplant. Low-growing succulent annual scattered in disturbed but particularly sandy areas throughout the site.

*Malephora crocea, Red-flowered iceplant. Succulent perennial forming patches on easterly facing slopes in far eastern area D, scattered in disturbed areas elsewhere.

*Tetragonia tetragonioides, New Zealand Spinach. Common to frequent fleshy-leaved annual growing with <u>Bassia</u> and grasses mostly in undisturbed flats.

---

* = non-native species, # = cultivated species. Frequency data: A = abundant and dominant in area; C = common throughout area; F = frequent, seen in 10-50 stations; I = infrequent, seen in 2-10 stations; R = Rare, seen in 1 station. Nomenclature follows P.A. Munz, "A Flora of Southern California", 1974, and L.H. Bailey, "Manual of Cultivated Plants", 1969, except where recent, widely accepted changes are followed.

AMARANTHACEAE - Pigweed Family

*Amaranthus albus, Tumbleweed. Frequent summer annual in disturbed areas and flats throughout the site.

Amaranthus californicus, California pigweed. Rare Summer annual in grassy slopes bordering south side of areas D and B.

*Amaranthus deflexus, Pigweed. Rare annual in disturbed areas on site.

*Amaranthus tamariscanus, Indehiscent pigweed. Rare annual weed in upland dry sites among grasses as along Fiji Way and the old Trolly line.

ANACARDIACEAE - Sumac Family

Rhus integrifolia, Lemonade berry. Rare shrub on slopes bordering areas D and B.

Rhus laurina, Laurel-leaved sumac. Locally frequent, often very large shrub as in southeast corner and west side of area A (I do not accept recognition of the genus Melosma).

#Schinus molle, Peruvian pepper tree. Infrequent tree, probably cultivated on and adjacent to site, present in area C.

*Schinus terebinthifolius, Pepper tree. Frequent tree around baseball diamonds and in open fields in area C, scattered elswhere as in southwest area D.

APIACEAE - Carrot Family

*Apium graveolens, Wild celery. Infrequent perennial herb in wet, mostly freshwater sites in area B.

*Apium leptophyllum Marsh parsely. Rare perennial in disturbed habitats.

*Conium maculatum Poison hemlock. Very infrequent perennial in wet habitats in area B.

*Foeniculum vulgare, Sweet fennel. Frequent large perennial in undisturbed, slightly moist flats with Bassia etc. and disturbed areas throughout.

APOCYNACEAE - Apocynum Family

#Nerium oleander, Oleander. Commonly cultivated along Teale Street and Fiji Way.

ARALIACEAE - Aralia Family

#Hedra canariensis, Algerian ivy. Cultivated along Fiji Way and near baseball diamonds of areas A and C.

ASTERACEAE - Sunflower Family

Ambrosia acanthicarpa, Spiny-fruited ragweed. Infrequent annual in disturbed, particularly sandy habitats throughout the site.

Ambrosia chamissonis, Dune ragweed. Infrequent perennial herb in sand dunes at west end of area B.

Ambrosia psilostachya ssp. californica, Western ragweed. Frequent perennial in disturbed roadsides and similar dry sites throughout the site.

Artemisia californica, Coastal Sagebrush. Very frequent to common shrub, often aggregated in grassy upper slopes south of areas B and D and in area A.

Artemisia douglasiana, Douglas' Mugwort. Infrequent subshrubs in moist mostly freshwater flats and disturbed areas, throughout the site.

Artemisia dracunculus, Mugwort. Very infrequent subshrubs in disturbed areas in area D.

Aster exilis, Marsh aster. Infrequent to locally common in margins of marsh and in wet, grassy areas in eastern end of area B and abundant in flats near Lincoln Blvd. in area B.

Baccharis pilularis ssp. consanguinea. Coyote bush. Common rounded shrub in

dry, previously disturbed flats throughout site, developing on fill.
Baccharis salicifolia (=B. glutinosa), Seep willow. Common shrub in moist microhabitats throughout the site, also in ditches and among willows.
Brickellia californica, Brickellia. Rare bush in sandy soil of area B near Lincoln Blvd. and the bluffs.
*Centaurea melitensis, Star thistle, Tocalote. Very common annual weed in disturbed and upland areas throughout the site.
*Centaurea repens, Russian knapweed. Frequent, blue-flowered, rhizomatous perennial, locally abundant in sandy flats, particularly in areas A, C and D.
Chaenactis glabriscula var. tenuifolia. Native annual scattered in dune and sandy sites in area B.
*Chrysanthemum coronatum, Garland Chrysanthemum. Very common to abundant yellow, spring-flowering annual on disturbed uplands, and some lower areas throughout the site, abundant and exclusively present on annually disked areas.
*Cichorium intybus, Chichory. Infrequent blue-flowered perennial weed in upland areas as near the baseball diamonds in area C, and in disturbed portions of area D.
*Cirsium vulgare, Bull thistle. Infrequent biennial in moist and upland disturbed areas throughout site.
*Conyza bonariensis, Horseweed. Infrequent annual weed in disturbed upland sites.
Conyza canadensis, Horseweed. Infrequent to frequent summer-flowering annual in weedy, disturbed areas throughout the site.
Conyza coulteri, Coulter's horseweed. Infrequent and widely scattered annual weed in upland disturbed areas throughout site.
Corethrogyne filaginifolia var. virgata, Bush aster. Infrequent to frequent subshrub in grassy slopes along the bluffs at the southern margin of site, mixed with Coastal sagebrush and occurring in sandy flats of area B bordering Lincoln Blvd.
*Cotula australis, Cotula. Inconspicuous weedy annual, infrequent in disturbed habitats on site.
*Cotula coronopifolia, Brass buttons. Rare, spring-flowering annual in wet habitats as along wetlands as in the ditch near Fiji Way, observed in area C in the continuation of the ditch.
#Euryops pectinatus, Euryops daisy. Infrequent cultivar along homes bordering the dunes at the far west end of area B.
Filago sp. Filago. Rare in sandy flats of area C.
#Filicia amelloides, Blue daisy. Common cultivated shrub along Fiji Way.
*Galinsoga parviflora, Galinsoga. Infrequent among irrigated plantings along Fiji Way north of area A.
*Gazania scaposa, African Daisy. Cultivated perennial herb around buildings, rarely escaped onto the site
Gnaphalium beneolens, Everlasting. Tall perennial forming rather dense stands on sandy flats in area C and D and on the bluffs south of the flats.
Gnaphalium bicolor, Cudweed. Infrequent subshrub in grassy slopes south of the flats in the Coastal sage scrub areas.
Gnaphalium californicum, Cudweed. Rare perennial in disturbed areas.
Gnaphalium chilense, Everlasting. Frequent annual in wet flats that develop on upland disturbed sites.
Gnaphalium microcephalium, Everlasting. Rare and rather inconspicuous annual in disturbed areas throughout the site
Gnaphalium ramosissimum, Everlasting. Rare, small, multistemmed annual in

disturbed areas above the floor of the site.
Haplopappus ericoides, Goldenbush. Rare shrub in sandy flats and dune sites of area B.
Haplopappus pinifolius, Goldenbush. Rare shrub in grassy slopes above area D, with Coastal sagebrush.
*Hedypnosis cretica, Hedypnois. Rare, spring-flowering annual in disturbed sites.
Helianthus annuus ssp. lenticularis, Sunflower. Infrequent, summer-flowering annual in roadsides of area B.
Hemizonia paniculata, Tarweed. Frequent, summer-flowering annual in disturbed grassy upland areas throughout site.
Heterotheca grandiflora, Telegraph weed. Common summer-flowering annual developing in disturbed areas throughout the site.
*Hypochoeris glabra, Cat's Ear. Infrequent, spring-summer flowering annual in disturbed sites as in area C and D.
Jaumea carnosa, Jaumea. Native, succulent-leaved perennial in mid-littoral zones of saltmarsh, growing among pickleweed, infrequent in area B.
*Lactuca serriola, Wild lettuce. Frequent, tall, summer-flowering weed in disturbed areas throughout site.
*Lactuca verosa, Wild lettuce. Infrequent, tall, summer-flowering weed in more moist disturbed areas as in areas D and B, rare in area A.
Malacothrix saxatilis var. tenuifolia, Malacothrix. Infrequent, summer-flowering perennial herb in disturbed upland areas throughout site.
*Matricaria matricarioides, Pineapple weed. Rare, low, summer-flowering annual in disturbed areas as along roadsides.
Microseris sp. Infrequent, spring-flowering annual in sandy fill sites in area D.
*Osteospermum fruticosum, African daisy. Rare cultivated perennial around buildings on site and occasional in disturbed areas where escaped.
Perezia microcephala (Acortia m.), Perezia. Infrequent on bluffs above area B.
*Picris echioides, Ox-tongue. Common, often abundant, spring-summer-flowering annual in grassy old fields, disturbed sites, fill areas throughout the site.
Rafinesquia californica. Rafinesquia. Infrequent to rare, spring-flowering annual in upper grassy slopes south of the site.
*Senecio vulgaris, Common goundsel. Very infrequent spring-flowering annual in disturbed areas throughout the site.
*Silymbum marianum, Milk thistle. Rare early-summer flowering perennial in disturbed upland areas as in the southwestern corner of area D.
Solidago occidentalis (Euthamia o.), Western goldenrod. Infrequent fall-flowering rhizomatous perennial in slightly more moist disturbed areas and on slightly raised areas within the saltmarsh areas in area B.
*Sonchus asper, Sow-thistle. Infrequent annual in disturbed upland areas throughout the site.
*Sonchus oleraceus, Sow-thistle. Frequent spring and summer-flowering annual throught upland areas and sometimes on slightly raised areas in saltmarsh areas.
Stephanomeria virgata, Tall stephanomeria. Tall, coarse, summer-flowering annuals scattered throughout disturbed areas on the site.
*Taraxicum officinale, Dandelion. Weed in cultivars along Fiji Way and in area D in moist area.
*Xanthium spinosum, Spiny cocklebur. Rare annuals in disturbed areas.
Xanthium strumarium var. canadense, Cocklebur. Infrequent fall-flowering annuals in moist depressions throughout the site, always occurring in

slightly more moist habitats.

BERBERIDACEAE - Barberry Family

#Nandina domestica, Nandina. Cultivated along Fiji Way north of area A.

BORAGINACEAE - Borage Family

Cryptantha intermedia, Popcorn flower. Infrequent native annual in sandy areas as in the dunes of area B and the sandy habitats in area D.

Heliotropium curassavicum var. oculatum, Heliotrope. Infrequent low perennial in upland waste places, in freshwater moist areas and along margins of marsh. Indicated by Reed (1988) as an obligate wetland plant but this designation not supported by its upland occurrences on the site and in Southern California.

BRASSICACEAE - Mustard Family

*Brassica geniculata, Field mustard. Frequent, spring-flowering, biennial to perennial in disturbed upland habitats throughout site, poorly distinghished from Black mustard.

*Brassica cf. hirta, White mustard. Rare annual weed along roadways as in area B.

*Brassica nigra, Black mustard. Very common, sometimes abundant spring annual weed in upland and marginal wet areas throughout the site.

*Brassica rapa ssp. sylvestris, Field Mustard. Infrequent, spring-flowering annual in moist disturbed areas of area D.

*Cakile maritima, Sea-rocket. Infrequent annual of sandy habitats in the dune area of area B.

Dithyria maritima, Coastal Spectacle-pod. A species of coastal strand previously from this area but now only in Islands and Central california dunes, presumed extinct locally.

Erysimum suffrutescens ssp. suffrutescens, Wallflower. Infrequent, spring-flowering subshrub in the dune system in area B, only 16 shrubs seen in 1991; listed as a list 4, "watch list" plant by the California Native Plant Society's Inventory of Rare and Endangered Vascular plants of California.

Lepidium virginicum var. pubescens, Peppergrass. Infrequent to rare spring-flowering annual in disturbed areas, observed in area A and bluffs above area B.

*Lepidium latifolium, Broad-leaved peppergrass. Rare, spring-flowering perennial in wet depressions in areas D and A.

*Lobularia maritima, Sweet alyssum. Locally common perennial herb in sandy habitats of areas B, A, and D.

*Raphanus sativus, Wild radish. Infrequent spring and summer-flowering annual in upland disturbed areas throughout site.

*Sisymbrium altissimum, Tumble-mustard. Infrequent spring-summer-flowering annual in disturbed areas, roadsides throughout site.

*Sisymbrium irio, London rocket. Infrequent, delicate, spring-flowering annual in somewhat moist areas throughout the site.

CACTACEAE - Cactus Family

Opuntia ficus-indicus, Tuna cactus. Large shrub-like tuna cactus without spines that has been cultivated for edible fruits. Establishing from seeds dispersed by birds, rare in peripherial area D and in dunes of area B.

Opuntia littoralis, Coastal tuna cactus. Rare small-shrub tuna cactus in area D, along slopes above the flats.

CAPARACEAE - Caper Family

Isomeris arborea, Bladderpod. Rare, spring-flowering shrub in bluffs above area B near Hastings canyon and with several historical records from the area.

CAPRIFOLIACEAE - Honeysuckle Family

Sambucus mexicana, Elderberry. Infrequent, spring and summer-flowering shrub-tree on slopes above and south of area D.

CARYOPHYLLACEAE - Pink Family

*Polycarpon tetraphyllum, Polycarpon. Rare, summer-flowering annual in disturbed flats in area D.

*Silene gallica, Catchfly. Rare spring-flowering weed in upland sites throughout area.

*Spergula arvensis, Spurrey. Very infrequent spring-summer-flowering annual in disturbed upland sites.

Spergularia bacconii, Sand spurrey. Infrequent on sandy sites in area C and in area B marshes.

Spergularia macrotheca var. macrotheca, Sand spurrey. Infrequent, fleshy-leaved, spring and summer-flowering perennial in salt marsh areas of area B.

Spergularia marina, Sand spurrey. Infrequent, but widely scattered annual in sandy areas of dunes and margins of salt marsh.

Spergularia villosa, Sand spurrey. Infrequent, spring and summer flowering perennial among pickleweed in the salt marsh of area B.

CHENOPODIACEAE - Goosefoot Family

Atriplex californica, California saltbush. Rare prostrate perennial subshrub in margins of saltmarsh in area B.

Atriplex lentiformis ssp. breweri, Coastal saltbush. Large dioecious shrubs along channels bordering Fiji Way. continuing into area C, and scattered in subsaline upper marsh areas of area A and B.

*Atriplex nummularia, Australian saltbush. Found on sandy coastal bluffs at Playa del Rey in 1940's and described as new species, A. johnstonii by C. B. Wolf, but it proved to be an Australian species, still persisting on the bluffs above the site.

*Atriplex patula ssp. hastata, Hastate-leaved saltbush. Frequent, large, summer-developing annual in salt marsh of area B.

*Atriplex rosea, Redscale. Frequent to common, summer-developing, conspicuous annuals in marginal pickleweed flats in area A.

*Atriplex semibaccata, Australian saltbush. Common, sometimes abundant perennial subshrubs in disturbed areas and depressions throughout the site, also marginal to saltmarsh on roadways etc.

*Bassia hyssopifolia, Bassia. Common, often abundant, summer-developing annual becoming dominant on subsaline flats of area B and along roadsides and upland areas throughout the site.

*Beta vulgaris, Garden beet. Rare summer-developing weed in disturbed upland habitats on the site.

Chenopodium album, Goosefoot. Infrequent summer-developing annual in disturbed moist and upland areas throughout site.

Chenopodium ambrosioides, Mexican tea, Epazote. Infrequent summer-developing perennial in moist flats along marsh in area B.

Chenopodium berlandieri var. sinuatum, Goosefoot. Infrequent summer weed in roadsides and sandy flats as along Hastings Canyon and other sandy

drainages below the bluffs along the southern border of the site.
*Chenopodium murale, Shiny-leaf goosefoot. Infrequent summer-developing annual in moist disturbed and subsaline areas throughout the site.
*Chenopodium pumilio, Glomerate goosefoot. Infrequent annual in disturbed areas in area D.
Salicornia subterminalis, Pickleweed. Spring-flowering, darker-green pickleweed scattered in the upper salt marsh areas of area B.
Salicornia virginica, Pickleweed. Late summer-flowering, more blue-green, very common shrub in the lower seasonally wet flats of area B, rare in area C, but common in the lower parts of area B.
*Salsola australis (S. iberica), Russian thistle. Common, sometimes abundant and dominant, summer-developing annual in subsaline and upland flats and disturbed areas throughout site, becoming dominant in flats of eastern area B and throughout area D.
Suaeda taxifolia (S. californica var. pubescens), Sea-blite. Locally frequent succulent-leaved shrub along the banks of Ballona Creek on the border of the best saltmarsh habitats in area B.
Suaeda depressa var. erecta. Annual sea-blite. Reported by Gustafson (1981) as present in the salt marsh areas of area B, not seen in this survey.

CONVOLVULACEAE - Morning-glory Family

Calystegia macrostegia var. cyclostegia, Morning-glory. Infrequent perennial herb in densely vegetated disturbed areas in area D.
*Convolvulus arvensis, Hedge-bindweed. Infrequent weed in upland disturbed areas throughout the site.
Cressa truxillensis ssp. vallicola, Alkali weed. Common summer-flowering annual developing in subsaline and some sandy flats in the summer. When overtopped by Bassia or Suaeda, doing poorly, when the habitat is open, developing very dense stands, also abundant along roadsides ditches where the overstory plants are cut back.
Cuscuta californica, Dodder. Common annual parasite on Abronia on the dunes, also infrequent on Suaeda in the disturbed areas through the site.
Cuscuta campestris, Dodder. Very infrequent annual parasite in disturbed, reported by Gustafson (1981).
Cuscuta indecora, Dodder. Rare parasite of Polygonum aviculare in flats of the southwestern corner of area D.
Dichondra occidentalis. Dichondra. Rare perennial herb in an area where water accumulates near the large ridge in area D.

CRASSULACEAE - Stonecrop Family

*Crassula argentea, Jade plant. Frequent succulent-leaved shrub in dune area where it has invaded from adjacent homesites.
Crassula erecta, Pigmy weed. Infrequent, spring-flowering annual in open, old disturbed areas without an overstory of annual grasses as in area B.

CUCURBITACEAE - Gourd Family

*Citrullus lanatus, Watermelon. Infrequent but persisting in the sandy outfall of Hastings Canyon on south margin of area B.
Cucurbita foetidissima, Calabizilla. Rare to infrequent perennial vine found in upland areas bordering the marsh in area B and area D.

EUPHORBIACEAE - Spurge Family

Croton californicus var. californicus, Croton. Locally common in sandy flats and slopes, dunes throughout area but mainly in areas A, B, and C.

Euphorbia albomarginata, Rattlesnake weed. Infrequent to rare perennial herb in disturbed areas.

*Euphorbia escula Leafy Spurge. Coarse perennial in depressions and among rubble in area D.

*Euphorbia peplus, Pretty spurge. Infrequent, slight annual in disturbed habitats in area D.

Euphorbia polycarpa var. polycarpa, Perennial spurge. Rare in dry, disturbed areas throughout the site.

Euphorbia serpens, Spurge. Infrequent perennial spurge in disturbed flats as in area D.

*Euphorbia supina (E. maculata), Annual spurge. Infrequent annual spurge in disturbed areas and roadsides of the site.

*Ricinus communis, Castor bean. Common large annual-perennial subshrub in disturbed upland areas, roadsides throughout the site, often dying back at present

FABACEAE - Bean Family

*Acacia decurrens var. dealbata. Reported by Gustafson (1981), but not seen in during this survey.

*Acacia longifolia, Australian wattle. Frequent spring, yellow-flowered small tree in disturbed areas throughout the site (Identification needs to be verified).

*Acacia nerifolia, Wattle. Infreqent fall-flowering small tree-shrub in disturbed areas bordering the marsh in area B near the tide gates.

*Albizia distachya, Albizia. Rare spring-summer-flowering shrub along Culver Blvd.

Astragalus pycnostachyus var. lanosissimus, Ventura milk vetch. Once known from two populations in coastal marshes, one in Ventura (last seen in 1964) and one at Ballona (not seen since late 1800's), presumed extinct.

Astragalus tener var. titi, Annual milk vetch. Known from sandy coastal dunes from San Diego to Monterey, and at Ballona, last seen in 1964, presumed extinct on site.

Astragalus trichopodus ssp. leucopsis, Loco weed. Infrequent, locally common perennial in sandy flats in the southwestern corner of area D, south of Teale Street.

#Bauhinia variegata, Orchid tree. Infrequent cultivar in dunes at west end of area B, and near baseball diamonds in area C.

*Ceratonia siliqua, St. John's bread. Rare small tree-shrub along roadway in area B north of Culver Blvd. and along bike trail south of area A.

#Erythrina sp. Naked-flowering coral tree. Infrequent cultivar along Fiji Way north of area A.

*Hoffmanseggia glauca (H. densiflora), Dwarf Caesalpinia. Local on the old trolly right-of-way ridge along Culver Blvd. in area B. near the large fields of Iceplant.

Lotus purshianus, Bird's foot trefoil. Infrequent spring and summer-flowering perennial in overgrown disturbed areas as in area A and D.

Lotus scoparius ssp. scoparius, Bird's foot trefoil. Locally common in areas of deep sand on dunes and flats of areas A, B, and D.

Lotus strigosus, Bird's foot trefoil. Infrequent spring-flowering annual in disturbed areas throughout the site.

Lupinus bicolor ssp. microphyllus, Lupine. Infrequent spring-flowering, annual herb particularly in sandy sites throughout the area and on the slopes south of the flats.

Lupinus camissonis, Coastal bush lupine. Infrequent spring-summer-flowering shrub in dune area of west end of area B.

Lupinus longiflorus, Bush lupine. Infrequent spring-flowering shrub in sandy sites as in northern area D, along Jefferson avenue and also on the slopes with coastal sagebrush.

Lupinus succulentus, Succulent lupine. Infrequent to rare spring-flowering annual in disturbed areas as along the new ridge in area D.

Lupinus truncatus. Infrequent to rare spring-flowering annual in disturbed areas throughout the site.

*Medicago polymorpha, Bur-clover. Infrequent to frequent, spring-, yellow-flowered annual in disturbed areas throughout the area.

*Melilotus albus, White-flowered sweet-clover. Frequent, spring and summer-flowering annual in slightly more moist disturbed areas, flowering in fall and winter.

*Melilotus indicus, Yellow-flowered sweet-clover. Frequent to common in disturbed open flats and ridges, very common in many sites in area D.

*Phaseolus limensis, Lima bean. Rare escape in disturbed areas, reported by Gustafson (1981).

*Spartium junceum, Spanish broom. Rare shrub in disturbed sites as in area C.

FAGACEAE - Oak Family

#Quercus x virginiana, Hybrid live oak. Cultivated near the baseball diamonds in area C.

FRANKENIACEAE - Frankenia Family

Frankenia salina (F. grandifolia), Frankenia. Infrequent, spring-flowering, small shrub in subsaline, sometimes sandy or disturbed areas in areas A, C, and B.

GERANIACEAE - Geranium Family

*Erodium cicutarium, Storksbill. Abundant, spring-flowering, annual in open disturbed, particularly sandy areas throughout the site.

*Erodium botrys, Storksbill. Common to frequent spring-flowering, annual in open disturbed areas throughout site, less common than E. cicutarium.

*Pelargonium zonale, Geranium. Infrequent escape from cultivation, growing in materials dumped on site and cultivated at the Playa Vista headquarters.

HAMAMELIDACEAE - Witch-hazel Family

#Liquidambar styraciflua, Sweet-gum. Rare cultivar near the baseball diamonds in area C.

HYDROPHYLLACEAE - Waterleaf Family

Phacelia parryi, Small canterberry bell. Rare annual in sandy flats along Jefferson Blvd. and in some disturbed areas in area D.

Phacelia ramosissima var. austrolitoralis, Wild heliotrope. Infrequent perennial herb in old disturbed sites that have redeveloped shrub covers, mostly in area A and D and along the bluffs south of areas D and B and in dunes of area B.

JUGLANDACEAE - Walnut Family

#Juglans regia, English Walnut. Rare, abandoned cultivated tree in the east end of area B, one tree only.

LAMIACEAE - Mint Family

*Marrubium vulgare, Horehound. Frequent perennial herb in old disturbed areas and roadsides throughout the site.

LYTHRACEAE - Lythrum Family

Lythrum hyssopifolia, Lythrum. Infrequent, low, annual to perennial herb developing only in areas with seasonally standing water in areas D and B.

MALVACEAE - Mallow Family

*Althaea rosea, Hollyhock. Rare escape from cultivation, growing along roadside of Culver Blvd.

Malacothamnus fasciculatus, Bush mallow. Rare in old disturbed flats, occurring mostly as solitary individuals on slopes above area D.

*Malva nicaeensis, Mallow. Infrequent to frequent annual, spring and summer-flowering weed in disturbed areas throughout the site.

*Malva parviflora, Cheeseweed. Common spring and summer-flowering annual weed in disturbed areas throughout the site.

Sida leprosa var. hederacea, Alkali-mallow. Frequent to very common spring to fall-flowering perennial herb in subsaline flats with Bassia and Salsola throughout the site, particularly common in area B.

MORACEAE - Mulberry Family

#Ficus elastica, Rubber plant. Infrequent cultivar along dunes in western portion of area B.

#Ficus macrophylla, Morton Bay Fig. Infrequent cultivar at the Playa Vista Headquarters.

#Morus albus, White mulberry. Rare small tree either cultivated or escaped from cultivation in area C.

MYRTACEAE - Myrtle Family

#Callistemon citrinus, Bottlebush. Frequent small tree along Fiji Way north of area A.

*Eucalyptus camaldulensis, Gum tree. Infrequent cultivar along buildings and roadways throughout the site.

*Eucalyptus globulus, Blue gum. Large trees forming groves in areas D and scattered in area B.

#Eugenia cf. paniculata, Australian bush cherry. Cultivated along Teale Street in area D.

#Melaleuca quinquenervia, White-barked Melaleuca. Cultivated at Playa Vista headquarters.

MYOPORACEAE - Myoporum Family

*Myoporum laetum, Myoporum. Common rounded, large shrubs occasionally in the true saltmarshes of area B, more common in upland areas and sandy sites throughout the site.

NYCTAGINACEAE - Four-O'Clock Family

Abronia umbellata, Sand-verbena. Frequent annual in the sand dunes in west end of area B.

OLEACEAE - Olive Family

Fraxinus velutina var. coriacea, Arizona ash. Infrequent tree peripherical to the marshes as in area B.

ONAGRACEAE - Evening-primrose Family

Camissonia bistorta, Camissonia. Developing in good years on the upper bluffs above area B, reported by David Verity as abundant in wet years.

Camissonia cheiranthifolia ssp. suffrutescens, Beach Camissonia. Frequent perennial in sand dunes at west end of area B.

Camissonia lewisii, Camissonia. Infrequent spring-flowering annual in sandy sites in area C and B.

Camissonia micrantha, Camissonia. Infrequent spring-flowered annual in dunes and other sandy sites in areas C and B.

Epilobium ciliatum ssp. ciliatum (E. adenocaulon var. prishii), Willow-herb. Infrequent annual in ditches and flats of area D, very common in depressions south of Teale Street near Lincoln Blvd.

Oenothera hookeri ssp. grisea, Evening primrose. Infrequent, evening-flowering, perennial in moist marsh margins, mostly freshwater areas as along bluffs and in Eucalyptus groves along south edge of area B and D.

OXALIDACEAE - Wood-sorrel Family

*Oxalis pes-caprae, Oxalis. Infrequent spring-flowering perennial in disturbed areas throughout the site.

Oxalis albicans ssp. pilosa, Oxalis. Infrequent spring-flowering annual in disturbed upland habitats throughout the site.

PAPAVERACEAE - Poppy Family

Eschscholzia californica, California poppy. Very infrequent perennial or annual in old disturbed sites as in area D along Jefferson and Culver Blvds.

PITTOSPORACEAE - Pittosporum Family

#Pittosporum tobira, Japenese Pittosporum. Cultivated along Fiji Way north of area A.

PLANTAGINACEAE - Plantin Family

*Plantago lanceolata, Slender-leaved Plantain. Infrequent to frequent, spring-active, perennial herb in disturbed, mostly more moist areas throughout the site.

*Plantago major, Plantain. Infrequent and local perennial in disturbed, slightly more moist flats of area B.

PLUMBAGINACEAE - Plumbago Family

#Limonium perezii, Sea-lavender. Cultivated along Fiji Way north of area A.

POLYGONACEAE - Buckwheat Family

Eriogonum fasciculatum ssp. fasciculatum, California buckwheat. Infrequent shrub on slopes above flats and on non-saline upland sites mostly in area D.

Eriogonum gracile, Annual buckwheat. Infrequent annual in sandy areas along bluffs south of areas B and D.

Eriogonum parvifolium, Dune buckwheat. Rare shrub in sand dune area on west margin of area B.

*Polygonum aviculare, Knotweed. Rare annual along roadside of Culver Blvd. in area B and in the southwestern corner of area D.

Polygonum lapathifolium, Smartweed. Infrequent annual in freshwater wet areas in area B and D.

*Polygonum persicaria, Lady's thumb. Infrequent annual in freshwater wet areas in area D, and B.

*Rumex crispis, Curly dock. Infrequent to frequent annual in grassy disturbed areas throughout the site, more common in slightly more moist areas with dense grasses.

Rumex fueginus, Dock. Very infrequent annual with denticulate fruit sepal margins in moist sites in area D.

Rumex salicifolius, Willow-leaved dock. Infrequent annual in moist microhabitats throughout the disturbed areas and ditches of the site but also present in sandy upland soils in the southwestern corner of area D.

PRIMULACEAE - Primrose Family

*Anagallis arvensis, Scarlet pimpernel. Infrequent annual in more moist disturbed areas throughout the site.

RANUNCULACEAE - Crowfoot Family

Clematis ligusticifolia, Virgen's bower. Rare at the margin of the bluffs in east-central area B where it forms one large local population.

RHAMNACEAE - Buckthorn Family

#Ceanothus sp. (cultivar), California lilac. Rare cultivar in area C near baseball diamonds.

ROSACEAE - Rose Family

#Raphiolepis indica, India hawthorn. Cultivated along Fiji Way and Teale Street.

Rosa californica, California rose. Infrequent on slopes along south border of flats in areas D and B, in the willow grove in on the bluffs in western area D.

Heteromeles arbutifolia, Toyon. Cultivated on slopes near Loyola Marymount University where it has escaped to the adjacent slopes.

#Malus sylvestris, Apple. Cultivated along bluffs of area D near old buildings and persisting.

Potentilla multijuga, Cinquefoil. Collected in brackish meadows Coastal sage scrub near Ballona in 1890's and not observed since. Considered to be extripated from the site.

#Prunus persica, Peach. Cultivated along bluffs of area D near old buildings and persisting along with apple.

#Pyracantha cf. crenulata, Firethorn. Cultivated along Teale Street in area D.

#Pyrus sp. Fruitless pear. Rare cultivar along baseball fields in area C.

RUBIACEAE - Madder Family

#Coprosma baueri?, Cosprosma. Cultivated among oleander along Teale Street in area D.

Galium angustifolium subsp. angustifolium. Bedstraw. Frequent shrub on the southern slopes bordering the flats in areas D and B.

SALICACEAE - Willow Family

Populus fremontii, Fremont's Cottonwood. Infrequent along freshwater streams bordering Teale Street in area D.

Salix laevigata, Red willow. Infrequent, small trees in freshwater wet areas in area D.

Salix lasiolepis, Arroyo willow. Frequent shrub-tree in freshwater areas along Teale Street and near dunes in areas B and D, infrequent elsewhere on the site; the most common willow on the site.

SAURURACEAE - Lizard-tail Family

Anemopsis californica, Yerba Mansa. Locally common but overall rare perennial in the upper marsh among iceplant in the far southwest border of area B south of Culver Blvd.

SAXIFRAGACEAE - Saxifrage Family

Ribes malvaceum, Chaparral Current. Reported by Gustafson (1981) in Dredge spoils near Ballona Creek in area A.

SCROPHULARIACEAE - Figwort Family

*Verbascum virgatum, Mullein. Infrequent annual in disturbed upland sites in area D.

SOLANACEAE - Potato Family

Datura wrightii (D. meteloides), Jimson weed. Frequent perennial on scrub and grassy covered slopes south of the flats, infrequent in roadside disturbed areas throughout the site.

*Lycium ferocissimum, Boxthorn. Infrequent shrub in slightly raised areas in the best of the salt marsh in area B.

*Lycopersicum esculentum, Cultivated tomato. Infrequent annual reported by Gustafson (1981) from the base of the slopes along the southern border of the site.

*Nicotiana glauca, Tree tobacco. Frequent shrub in disturbed upland sites throughout the site.

Petunia parviflora, Petunia. Rare in depressions in area D along Teale Street.

Solanum douglasii, Douglas' nightshade. Highly variable, sometimes very hairy perennial in shaded groves of eucalyptus and willows throughout the site.

*Solanum cf. nigrum, Black nighteshade. Infrequent in disturbed areas throughout the site.

*Solanum sarrachoides, nightshate. Reported by Gustafson (1981) from the coastal dune area on the site.

Solanum xantii var. intermedia, Nightshade. Rare along margin of large artificial ridge in area D.

TAMARISCACEAE - Tamarisk Family

*Tamarix ramosissima, Tamarisk. Infrequent, evasive, small shrub-tree in depressions in area D.

ULMNACEAE - Elm Family

#Ulmus parviflora, Chinese elm. Infrequently persisting from cultivation as in area B and the upland portions of area D.

URTICACEAE - Nettle Family

Urtica holosericea (U. dioica ssp. holosericea), Bull nettle. Infrequent but locally frequent in groves of Eucalyptus and willows throughout the site.

*Urtica urens, Dwarf Nettle. Infrequent in disturbed wet areas and rare on the coastal dunes mostly in areas B and D.

VERBENIACEAE - Vervain Family

*Lantana montevidensis, Lavender-flowered lantana. Cultivated shrubs along Fiji Way in Marina del Rey bordering area A, and from there entering area A.

*Lantana camara, Orange-flowered lantana. Rare shrub found in large Eucalyptus grove in the southwestern corner of area B.

Verbena lasiostachys, Verbena. Infrequent perennial herb in ditches and wet disturbed areas as in area D.

ZYGOPHYLLACEAE - Caltrop Family

*Tribulus terrestris, Puncture vine. Frequent summer-flowering annual along roadways and upland disturbed areas throughout the site.

MONOCOTYLEDONEAE

AGAVACEAE - Agave Family

#Agave attenuata, Agave. Infrequent in margins of dunes near homes in western portion of area B.

#Agave americana var. striata, Giant agave. Infrequent cultivar in disturbed areas where deposited in trash and persisting; also along dunes in western area B.

#Aloe vera, Medicinal aloe. Cultivated along dunes in western area B.

#Yucca gloriosa, Spanish dagger. Frequently persisting in disturbed areas where either planted or established from material dumped on site.

ALISMACEAE - Water-plantain Family

Sagittaria calycina, Arrowhead. Reported by Gustafson (1981) from the marsh areas of area B but not seen in this survey, apparently rare.

AMARYLLIDACEAE - Amaryllis Family

#Agapanthus africanus, Lily of the nile, Cultivated along Fiji Way north of area A.

Dichelostemma pulchella, Blue dicks. Infrequent in sage scrub areas on the slopes above area D and B.

#Phormium tenax, New Zealand flax. Cultivated along Fiji Way north of area A.

ARECACEAE - Palm Family

*Phoenix canariensis, Canary-Island date palm. Infrequent developing tree along roadsides and in disturbed sites throughout the site.

Washingtonia robusta, Slender fan palm. Frequent developing tree in disturbed sites and roadsides throughout the site, native to state but not to this area.

CYPERACEAE - Sedge Family

Carex praegracilis, Sedge. Perennial herb reported on site from freshwater marsh by Gustafson (1981), not observed in this survey.

*Cyperus alternifolius, Umbrella plant. Infrequent perennial herb in moist areas of area D and B.

Cyperus eragrostis, Umbrella sedge. Frequent to locally abundant perennial herb in freshwater ditches and moist sites of areas B and D.

Cyperus esculentus, Nut sedge. Infrequent perennial herb in freshwater ditches in area B.

Eleocharis macrostachya, Spike-rush. Infrequent perennial herb in moist areas within the marsh of area B, also among dense willow thickets on slopes above area D.

Eleocharis montevidensis, Spike-rush. Infrequent perennial herb in moist areas of area D.

Scirpus californicus, Tule. Infrequent but locally abundant perennial herb in freshwater ditches and other areas of standing water in area B and occasionally in area D.

Scirpus olneyi, Threesquare. Infrequent but locally abundant perennial herb in freshwater ditches throughout the site in areas C, D, and B.

Scirpus robustus, Robust sedge. Infrequent but locally abundant perennial herb in freshwater ditches in area B.

IRIDACEAE - Iris Family

*Chasmanthe aethiopica, Chasmanthe. Reported by Gustafson (1981) as present on the site.

*Iris pseudacorus "alba", Iris. Reported by Gustafson (1981) in disturbed dredge spoil on the site.

#Moraea iridioides, Moraea iris. Cultivated along Fiji Way north of area A.

JUNCACEAE - Rush Family

Juncus balticus, Rush. Rare perennial herb in moist freshwater sites in area B.

Juncus bufonius, Small rush. Infrequent but locally common annual herb in slightly raised areas in the dryer pickleweed marsh of area B south of Culver Blvd.

Juncus mexicanus, Mexican rush. Infrequent perennial in southwestern end of area D and D.

Juncus sphaerocarpus, Rush. Infrequent in saltmarsh areas of area B.

LILIACEAE - Lily Family

#Hemerocallis flava, Orange day-lily. Infrequent cultivar along Fiji Way north of Area A.

POACEAE - Grass Family

*Agrostis semiverticillata (Polypogon s.), Bentgrass. Infrequent annual herb in moist ditches in southern portion of the site in areas B and D.

*Agrostis stolonifera ssp. major, Redtop. Reported by Gustafson (1981) from the marsh areas.

*Arundo donax, Giant reed grass. Infrequent but locally common very large bamboo-like grass along Jefferson Blvd. in the southwest corner of area D, south of Teale Street.

*Avena barbata, Slender wild oat. Common annual in disturbed areas and in the drier marsh areas throughout the site.

*Avena fatua, Wild oat. Infrequent but locally common annual in some yearly disturbed sites of area C and D.

*Brachypodium distachyon, Brachypodium grass. Infrequent in disturbed area in area B.

*Bromus diandrus, Ripgut chess grass. Common, often abundant annual grass in disturbed areas, in some lowland areas and along the slopes above the marsh and flats throughout the area.

*Bromus mollis, Soft chess grass. Frequent to locally common annual grass in disturbed, often slightly more moist areas throughout the site.

*Bromus rubens, Foxtail chess grass. Abundant to common annual grass throughout disturbed areas on the site.

*Bromus wildenovii, Rescue-grass. Infrequent annual grass in slightly more moist, sometimes partially shaded areas of the site.

*Cortaderia atacamensis, Pampas grass. Common giant tussock grass, sometimes forming dense stands in upland, disturbed areas throughout the site.

*Cynodon dactylon, Bermuda grass. Frequent to common perennial grass, sometimes forming dense swards in moist marsh areas, common throughout disturbed areas on the site.

*Digitaria sanguinalis, Crabgrass. Infrequent annual grass in disturbed areas of areas D and B.

Distichlis spicata, Saltgrass. Infrequent perennial grass in the salt marsh, sometimes associated with Iceplant and spreading by rhizomes, most common in area B.

*Echinochloa crus-galli, Barnyard grass. Infrequent annual grass in sandy soils along bluffs in the south end of area D near Jefferson Ave.
*Ehrharta erecta, Ehrharta grass. Locally frequent to common perennial grass in more moist moist or shaded areas in area D and B, particularly in eucalyptus and willow groves.
Elymus condensatus, Giant rye grass. Large perennial, coarse grass in areas of Coastal sage scrub on the slopes bordering the south margin of the flats.
*Festuca arundinacea, Giant fescue. Infrequent in moist areas of area B near Lincoln Blvd.
*Festuca megalura (Vulpia megalura), Fescue grass. Very frequent to common annual grass in upland disturbed and disturbed marsh habitats throughout the site.
*Festuca myuros (Vulpia myuros), Fescue grass. Very frequent annual grass in upland areas throughout the site.
*Hordeum leporinum, Wild barley. Frequent annual in disturbed areas throughout the site.
*Hordeum vulgare, Barley. Rare annual weed along roadsides on the site.
*Lamarckia aurea, Goldentop. Infrequent annual grass in sandy disturbed areas throughout the site.
Leptochloa uninervia, Spangletop. Locally common late summer grass in slightly moist ditches and depressions in disturbed areas of area D.
*Lolium perenne ssp. multiflorum, Italian ryegrass. Common to abundant grass in the eastern portions of area B south of Jefferson Blvd. where it forms a dominant sward during the spring among the pickleweed, frequent elsewhere in relatively moist disturbed sites.
Melica imperfecta, Melic grass. Infrequent on the slopes among native Coastal sage scrub on the slopes along the southern border of the site.
Monanthochloe littoralis, Shoregrass. Infrequent perennial in moist marsh of area B.
*Oryzopsis miliacea, Ricegrass. Infrequent in disturbed areas that are slightly more moist than others.
*Parapholis incurva, Sickle-grass. Infrequent in the salt marsh in slightly raised areas in area B.
*Paspalum dilatatum, Paspalum grass. Coarse perennial grass in slightly more moist habitats in disturbed areas in areas B and D.
*Pennisetum setaceum, Fountain grass. Very uncommon in roadside areas of area B.
*Phalaris paradoxa, Canary grass. Infrequent coarse annual grass in disturbed areas of area B north of Culver Blvd.
*Poa annua, Blue grass. Infrequent annual grass in disturbed areas throughout the site.
*Polypogon monspeliensis, Beardgrass. Frequent in moist depressions, ditches and other spring-time wet often disturbed places throughout the site.
*Schismus barbatus, Schismus grass. Very common to abundant small annual grass particularly on sandy habitats throughout the site.
*Setaria geniculata, Bristlegrass. Infrequent annual grass in disturbed, slightly more moist areas.
*Sorghum halepense, Johnson grass. Infrequent along roadsides in the late summer.
*Stenotaphrum secundatum, St. Augustine Grass. Infrequent, but locally common wherever present in disturbed generally more moist areas and along some water-filled ditches in area B.
Stipa cernua, Needlegrass. Infrequent in sandy soils of area D near Jefferson Blvd.

POTAMOGETONACEAE - Pondweed Family

Ruppia maritima, Ditchgrass. Sumberged freshwater aquatic found by Gustafson (1981) but not found during the current survey.

TYPHACEAE - Cattail Family

Typha domingensis, Cattail. Locally common in wet freshwater ditches and in other seasonally inundated areas of the site, the common cattail.

Typha latifolia, Cattail. Infrequent in wet freshwater habitats on the site, not observed during this survey.

Totals	Family	Genera	Species:		
	69	218	Native:	156	(47.4 percent)
			Introduced:	132	(40.1 percent)
			Cultivated:	41	(12.5 percent)
			Total:	329	(100 percent)

Native vs. Introduced ratio (excluding cultivars)

Total native and introduced:		288
Percent native	156:	54.2 %
Percent introduced	132:	45.8 %
		100.0 %

It is important to note that salt marsh habitat is among the rarest natural communities in Southern California. They have been maligned and reduced continually over the past century. The loss of any pickleweed habitats to development is irreversable. We must consider the feasability of restoring this area to a viable and useful habitat for wildlife. As noted previously, the areas of picklweed marsh that meet the criteria as federal wetlands are being mitigated through the proposed development of a Freshwater corridor and marsh in areas D and the eastern portion of area B.

In my opinion the loss of this potential habitat of a federally endangered species of bird, the Belding's savannah sparrow, whose life is completely linked to Pickleweed habitats as it does not reside outside these habitats, can not be mitigated by Freshwater marsh and wetlands habitat that is not usable by this endangered species nor by any other endangered species known from this area.

Coastal wildlife habitat is too important to allow degraded habitat be written off as suitable for commercial development. Once the area is developed, it can never be returned to its original state that is useful to wildlife. Once lost, the potential to increase wildlife values in the area are decreased forever. While this site is strongly degraded, the pickleweed that has redeveloped on the site, shows that the site is capable of recovering even though it must rely completely on rainwater for its water. If water was brought into the site there is a potential to increase the diversity of plants on the site, and they in turn could serve as habitat for an increased insect fauna that may be able to provide resources for the federally endangered Belding's savannah sparrow. Pools of water could also provide habitat for invertebrates and small fish that would attract various wading birds to the site.

AREA B: The 337.9 acre area B contains the largest contiguous tracts of native marsh vegetation on the Playa Vista site. The site contains 84.2 acres of Pickleweed habitat, 11.6 acres of freshwater and willow habitat, about 8 acres of sandy and dune habitats. Many of the other habitats on the site have many wetland species. Much of the eastern portion of the site has been cultivated in the past, but a large portion of these old fields have redeveloped pickleweed since allowing to go fallow.

A large portion of area B will be retained as native habitat and two proposed revegetation plans, one considering a full-tidal flow, the other a muted-tidal flow, are being considered and are discussed below.

Area B contains a greater number of native species than all the other areas combined for it has the most balanced salt marsh flora. Only one of these is listed by the California Native Plant Society's inventory of rare and endangered vascular plants of California (1988), this is the Suffrutescent wallflower (Erysimum suffrutescens ssp. suffrutescens), of which 16 individuals were observed on the sandy dune habiatats during a spring 1991 survey. The taxon is on the CNPS list 4, a watch list and has no state or federal status, but is a species that is threatened by coastal development and off-road vehicle use. All the other potentially listed species are already extirpated from the site.

The valued native species occurring in Area B include:
*Ambrosia camissonis
Aster exilis
*Haplopappus ericoides   * = restricted to area B
*Jaumea carnosa
*Erysimum suffrutescens ssp. suffrutescens
*Spergularia macrotheca
*Spergularia marina
*Spergula villosa
*Salicornia subterminalis
Salicornia virginica
*Suaeda taxifolia
*Lupinus camissonis
Frankenia salina
Sida leprosa var. hederacea
Camissonia cheiranthifolia ssp. surfrutescens
*Eriogonum parvifolium
Salix lasiolepis
*Anemopsis californica
Scirpus californicus
Scirpus olneyi
*Scirpus robustus
Distichlis spicata
Typha domingensis

While area B presently contains the largest segment of salt marsh habitat on the Playa Vista site, the area has not been free of encroachments. Our earliest map of the site from 1896 (Figs. 2, 3) show the area was crossed by two roads, and that the eastern portion of the site along the bluffs was not even considered to be marsh habitat by the cartographers at that time. By 1924 Culver Boulevard (then known as the Speedway) extended across the site as did Jefferson Boulevard (designated as Playa Street), and the Pacific Electric Railway paralleled the railroad. In this 1924 map the marsh is indicated further to the east up to what would be the Lincoln Boulevard crossing and into the western portion of area D. Farming began near the intersection of Culver and Jefferson Boulevards by the late 1920's and continued in the area until the 1980's. Oil rigs sprouted up along the coast accompanyed by roads in the marsh. The 1940's found erection of houses on the dunes on the western portion of area B, and an increase in drilling rigs. After 1950, drilling towers were removed from area B, though storage tanks and other gas company facilities still remain at the base of the Del Rey Bluffs today.

In spite of all the alterations to the land, the site still retains some significant remnants of wetlands and portions of the site must be considered a viable habitat.

The proposed plans for area B incorporate redevelopment of salt marsh habitats and freshwater habitats in the area east of Lincoln, south of Jefferson Boulevard and west of the junction of Culver and Jefferson Boulevards, an area of about 200 acres (see Figs. 11, 12). The freshwater habitats are slated for development along Lincoln Boulevard.

The area north of Jefferson and east of the junction of Culver and Jefferson Boulevards is desingated for high-density housing. It is strongly felt that the presence of families with pets and children immediately adjacent to a biological reserve would result in very strong negative impacts on the natural system as: (1) even if the area is fenced, children would gain access to the marsh and roam through the marsh negatively impacting wildlife in the system and trampling vegetation; (2) cats and dogs from the adjacent development would eventually gain entrance into the marsh negatively impacting wildlife by hunting.

To remove the potential of the above-mentioned negative impacts, the developed inholdings within area B should contain office buildings, possibly the proposed baseball diamonds and not high-density housing. This should be located elsewhere on the site.

AREA C: The 66.3 acre area C has been filled with dirt during development of Ballona Creek Channal, the marina at Marina del Rey, by the Marina Freeway and but still contains some small areas of valued habitat.

The area contains about 1.8 acres of Pickleweed and Frankenia habitat that has developed in depressions on the site (including about 1 acre of federal jurisdiction wetland), about 1.9 acres of sandy habitat containing some native species, and 5.8 acres dominated by Coyote brush. The rest of the area constituting 56.8 acres or 85.7 percent of the site, consists of weed-dominated flats. That some native species have redeveloped in this highly disturbed sites again speaks well for the resilence of segments of the native flora.

Overall, Area C contained few native species. They include only two species characteristic of salt marshes: Pickleweed (Salicornia virginica) and Frankenia (Frankenia salina). Native annuals include the Everlasting (Gnaphalium beneolens) and a shrubby Croton californicus that form dense stands on sandy substrate along with some native herbs such as a small Evening primrose (Camissonia lewisii), and some native weedy annuals such as the Telegraph weed (Heterotheca grandiflora) and a native perennial herb Malacothrix saxatilis. Native shrubs include the Saltbush (Atriplex lentiformis ssp. breweri), Coyote brush (Baccharis pilularis ssp. consanginea), that form rather extensive stands, and some Seep willows and Laurel-leaved sumac. The Arroyo willows occurred as isolated individuals and did not form any riparian woodland. Several other native species also occur on the site but in low numbers.

Area C has been so strongly disturbed that, except for the small area of Salicornia and Frankenia wetland, it presently contains minimal vegetative values. The area, however, has been shown to have a good native small mammal fauna.

AREA D: The 460 acre area D is the largest of the four Ballona sites. It contains about 2.3 acres of wetland habitat, but about 99.6 percent of the site (460 acres) consists of industrial and disturbed habitats. Most of the site has been filled, graded or otherwise modified in the past. The best remaining habitats on the site occur in the flats near Lincoln Boulevard, south of Teale street. A portion of the site along Centinela ditch is slated for revegetation.

Area D has been so strongly modified with an active program of filling that perhaps no remnants of the original flora persist in the flats north of Teale Street. Richard Vogl (pers. comm.) looked over the site in 1983, while agriculture was still being practiced on the site and found no areas with concentrations of native vegetation at that time. The area did tend to retain flood waters after winter rains, a point also noted by Clark (1979) and Vogl noted seeing waterfowl on the ponds during the winter-spring of 1983. The only truly undisturbed sites in area D would be on the slopes of Del Rey Bluffs, where concentrations of Coastal sagebrush are present on the more protected areas. The slopes also contain a large willow grove associated with an active seep (area D-14), which is a very interesting stand that lies just off the site.

The active program of filling Area D by the Summa Corporation has indeed covered up whatever valuable native and wetland habitats existed on the site, although 3.5 acres of wetland habitat was scored for the site by Conel (1990) using the Federal wetland guidelines (Federal Interagency Committee for Wetland Delineation, 1989). All of this wetland habitat had developed on previously disturbed sites.

The most interesting native plants that occur on the site can be found in the sandy areas along Jefferson Boulevard (area D-2) and include Bush lupine (Lupinus longiflorus), Bird's foot trefoil (Lotus purshianus), a native Needle grass (Stipa cernua) as well as annual Lupines and Camissonias. The Del Rey Bluffs also contain some interesting native shrubs such as a Goldenbush (Haplopappus pinifolius) and some native cacti (Opuntia littoralis), though overall the area is badly choked with annual weedy grasses. Other areas of native plants occurs in the slopes south of Teale Street just east of Lincoln Boulevard where there are local concentrations of wetland plants.

Overall the site has been so modified that the flats must be considered to have minimal botanical value, though the weed flora is highly variable and interesting.

COMPARISON OF FULL-TIDAL vs. MUTED-TIDAL RESTORATIONS OF AREA B

The following analysis is based on the most recent salt marsh restoration diagrams of Area B provided by representatives of Maguire Thomas Partners (see Figs. 11 and 12). These diagrams, dated September 19, 1990, delineate the habitat types, based on topography, that will be created under the Full-tidal and Muted-tidal (=mid-tidal) systems. The nature and impacts of the Freshwater wetlands on the salt marsh are addressed in a subsequent section.

In the Full-tidal system there would be a total of four 60 inch pipes extending between Ballona Creek Channel and the marsh which would allow for "full tidal" flushing of the marsh (Fig. 11). Under the muted tidal system there would be two 18 inch pipes and two 24 inch pipes between Ballona Creek Channel and the marsh (Fig. 12) that would restrict the inflow of water into the system resulting in considerable differences in flooding and in habitats that would be sustained within the future marsh system. In the Full-tidal system, Culver Boulevard and the gas-wellhead areas and access roads would need to be raised to an elevation of 11 ft above mean tide, and berms would be needed along the southern portion of the site to protect adjacent areas from high tides. In the Muted-tidal system the roadways and wellheads and access roads would need to be raised to an elevation of 7 ft.

The Full-tidal diagram designates three habitat types. The lower drainages bordered by a solid line constitutes the areas of active drainage and many of these areas would contain water throughout the year. These would be marine, aquatic environments. The area indicated by diagonal hatch marks are mudflats that would be inundated by high tide waters, but would be open during lower tides. The extent of flooding is expected to be in excess of the amount that would allow development of terrestrial vegetation and the areas would remain as mudflats throughout the year. These, therefore, would be marine tidal habitats unavailiable to terrestrial plants. The areas inside the diagonally hatched areas surrounded by a broken line would be littoral habitats. The areas in the western portion of the site would be partially inundated by higher tides and would develop a lower-littoral vegetation, namely Cordgrass (Spartina foliosa); those areas in the eastern portions would receive less water and would be habitats for Pickleweed (Salicornia virginica) in a mid-littoral zone as defined by Maguire Thomas representatives.

The Muted-tidal diagram also designates three habitat types. However, these differ from those indicated in the Full-tidal map. The thick solid lines in the drainages indicate the potential water ways that will drain into and out of the site and maintain water throughout much of the year. The adjacent clear areas indicate mudflats adjacent to these waterways. Some of these would be flats, others would be sloping areas. The areas with diagonal cross marks designate lower-littoral zones that will receive higher monthly tides. Such areas would consist of inundated Picklweed habitats with a high diversity of associates. The areas inside the hatch line (inside the areas with diagonal markings) would be upper littoral-zones receiving only the highest of tides and would also be covered with Pickleweed, but in a drier phase. These areas also may include some upland maritime habitats. They would contain a rather depauperate pickleweed associate with some upland weedy interfaces.

To compare the habitats made available to plants and wildlife by the different tidal regimes, acreages of the proposed habitat types were determined from the Full-tidal and Muted-tidal diagrams. Acreages were determined by physically cutting out the various habitat types from the maps and weighing them, with weight per acre being determined from the weights of large samples from the paper maps of known size (this is the same method used for determination of acreages of present vegetation habitats throughout the site). The areas sampled from the two maps were identical and included all areas up to the Ballona Creek margin including some upland maritime habitats; areas east of the 5 ft contour along the western margin of the site; areas north of the old trolley line berm and the berms designated on the maps near the western end of Culver Boulevared; areas north of the base of the slopes of the adjacent hills along the southern border of the site, excluding the Hastings Canyon fan and also excluding the berm separating the Freshwater wetlands from the tidal habitats. Culver and Jefferson Boulevards and the areas north of Jefferson and east of Culver Boulevards are also excluded from the measurements.

The sample area included slightly over 200 acreas of terrain and the acreages and percent of acreages of the various habitat types are presented below. It must be emphasized that the restoration design maps are approximate indications of what may occur with Full and Muted tidal flows.

FULL-TIDAL DESIGN

	Acres	Percent
Drainage waterways	33.1	16.4
Mudflats	86.4	42.7
Littoral habitats	73.7	36.4
Gas wellheads and roadways	4.1	2.0
Berms	5.1	2.5
	202.4 acres	100.0 %

Roadways, some marginal berms and the freshwater wetlands are not included in this acreage.

MUTED-TIDAL DESIGN

	Acres	Percent
Drainages and mudflats	42.1	20.6
Lower-mid littoral	45.7	22.4
Mid-upper littoral	107.1	52.2
Gas wellheads and roadways	3.5	1.7
Berms	5.7	2.8
	204.1 acres	100.0 %

Roadways, some marginal berms and the freshwater wetlands are not included in this acreage

The Full-tidal restoration design would contain approximately 33.1 acres of waterways and drainage ways that would contain water through most of the year and an additional 85.4 acres of mudflats. These habitats are basically marine habitats that are unavailable to terrestrial marsh plants due to the extent of water inundation. This represents a total of 118.5 acres or 59.1 percent of the entire site that would be some form of marine habitat covered periodically with water.

Littoral habitats present on the site would, in contrast, occupy only 72.7 acres (36.3 percent) of the site and they would be diverse in their holdings. The littoral habitats (those habitats receiving occasional tides, but developing terrestrial vegetation) in the western portion of the site would be inundated by higher daily tides and would be expected to develop stands of Cordgrass (Spartina foliosa), a species that is not presently represented in the marsh and, as noted previously, may not have ever been a component of the Ballona marsh system. In the eastern portion of the site, the upper habitats would receive less frequent and less severe tidal influences and would be expected to develop stands of Pickleweed associated with a diversity of other salt marsh habitats.

The gas wellheads and associated roadways would occupy only a small percent of the site as would the berms within the marsh. The berms in this full-tidal system would include those associated with the gas company roads directly south of Bird Bay (that form the western margin of the East wetlands and those in the southwestern corner of the East wetlands.

The Full tidal regime would bring considerable waters into the marsh resulting in about 60 percent of the marsh consisting of waterways and mudflats and only 36 percent of the marsh as marsh vegetation (littoral) habitats. Just considering these acerages and excluding the acres of berms and the wellheads and associated roads, the mudflats and drainages would constitute 62 percent of the total marsh area and the littoral habitats of Cordgrass and Pickleweed would constitute 38 percent of the total marsh area.

The Muted-tidal restoration design, in contrast, would have only about 42.1 acres of drainages and mudflats, or only 20.6 percent of the entire site. Most of the mudflat habitats would be in the far eastern portion of the site where the drainages are made broader to increase the penetration of waters into the more remote portions of the marsh. The areas of water and mudflats (or sloping banks) is considerably reduced in the western portion of the site. The acreage of drainages and mudflats contrasts strongly with the 60 percent of such habitats present in the full tidal scheme.

The Muted-tidal design would contain approximately 45.7 acres of low-mid littoral habitats that would receive higher daily tides that would be expected to contain diverse stands of Pickleweed mixed with associates such as Frankenia, Jaumea, possibly Sea-blite (Suaeda esteroa) and Batis (Batis maritima) (if introduced from adjacent marshes) and about 107.1 acres of mid to upper littoral zones containing a drier phase of Pickleweed habitats containing a mixture of Pickleweed, Salt grass, some Atriplex, Sand spurrey etc. These two areas together represent a total of 152.8 acres or 74.9 percent of the restored marsh that would contain littoral vegetation. When considering just the areas of marsh and excluding the areas of gas wellheads and associated roadways and the berms on the site, the waterways and associated mudflats and slopes occupies 21.6 percent of the marsh and the littoral areas 78.4 percent of the site. This contrasts strongly with the configuration present in the full tidal design as indicated below.

	Drainage and mudflats		Littoral habitats	
	Acres	Percent	Acres	Percent
Full-tidal restoration design	118.5	61.9	72.7	38.0
Muted-tidal restoration design	42.1	21.6	152.8	78.4

The differences between the two plans are very clear with regard to the amounts of habitat created. The Full tidal design would consist of about 118.5 acres or 62 percent of waterways and periodically inundated mudflats creating much habitat for marine fishes and shore birds that could use the mudflats for feeding grounds. The Full-tidal design would create only about 72.7 acres or 38 percent terrestrial littoral habitats useful for terrestrial animals. Many of these areas would be completely surrounded by mudflats making access to some terrestrial animals difficult.

In contrast the Muted-tidal restoration design strongly favors terrestrial habitats presenting only 42.1 acres or 21.6 percent of drainages and associated muddy slopes or flats and a total of 152.8 acres of littoral marsh habitats useful to terrestrial species. It provides significantly more habitat for terrestrial plant and animal species.

It is important to note that the acreages given above are only approximate acreages and a more realistic indication of acreages would be to round off the acreages to the nearest 10 acres. The important point that the data makes here is that the two tidal designs provide for strongly different uses of the site by plants and animals.

Discussion of Impacts:

Development of either the Full-tidal or the Muted-tidal system would result in strong changes in the current marsh configuration. The Full-tidal design would completely inundate the present areas of good marsh in the western portion of area B and would completely destroy present habitats that are used by animals. The design would also completely change the areas of dry Pickleweed in the eastern portion of the marsh. The Muted-tidal design would, in contrast, alter, but not destroy, some of the high-value marsh habitats in the western portion of the site, but would still impact the dry Pickleweed flats in the eastern portion of the site as these would be completely altered by the construction of the relatively broad drainages that would extend into that area. In both designs strong impacts would be created by the raising of the major roadways (Jefferson and Culver Boulevards), the raising of the gas wellheads, and associated service roadways.

From the Botanical point of view, the Muted-tidal restoration design is much preferred over the Full-tidal design for several reasons:

1. The Muted-tidal design creates significantly more littoral habitat available for salt marsh species and creates a diversity of mid and upper littoral habitats. It creates minimal lower littoral habitat of the type that would support stands of Cordgrass, but this species may not have ever occurred in the Ballona marsh in the past.

2. The Full-tidal restoration would cause severe habitat impacts during construction. The Muted-tidal design creates significantly less impact from construction of roadways and gas wellheads necessitating only minor changes in the elevation of these roadways to protect them from high tides as compared to the Full-tidal design. Culver Boulevard presently lies at 4.5-5 ft above mean sea level and Jefferson Boulevard lies at about 6 ft above mean sea level. According to Maguire Thomas representatives these roadways would have to be raised to 7 ft elevation in the Muted-tidal design (a 1-2 ft addition), but would have to be raised to 11 ft elevation (a 5-6.5 ft addition) in the full tidal design. Elevating wellheads and their associated roadways would also demand more impact with the Full-tidal design.

3. Terrestrial Salt marsh habitats have been significantly reduced in Southern California by the activities of man. As noted previously, coastal wetland habitats in Los Angeles County at one time consisted of about 6,800 acres, this has suffered a 96 percent reduction. Ballona Marsh is estimated to have once consisted of about 1,800-2,000 acres of wetland habitat, and with this restoration (presuming a Muted-tidal marsh is accepted) this will be reduced to a total of about 152 acres of littoral salt marsh habitat and some 42 acres of drainages and

associated mud flats. The resulting 194 acres represents a paultry 10 percent of the initial marsh size.

4. The Muted-tidal design creates significantly more habitat for terrestrial animals including state and federally endangered Belding's savannah sparrow, a species restricted to Pickleweed habitats. To reduce the amount of Pickleweed in the Ballona Marsh, would severly restrict the population of the Belding's sparrow in favor of habitat for unlisted species.

Outside political considerations:

In a recent draft settlement agreement of a lawsuit filed in 1984 between the Friends of Ballona Wetlands et al. v. the California Coastal Commission et al. (Superior Court of the State of California, County of Los Angeles, Case No. C 525-826) challenging the certification of a coastal land use plan that authorized the building of a regional roadway, residential developments, and a golf course within the Ballona Wetlands, several broad actions were agreed upon by the parties involved. These include downscaling development on the site; elimination of development of contiguous wetlands; an increase in wetland acreage set aside; increasing wetland values through a revegetation plan; providing for a muted-tidal restoration of the site; and lastly by pursuing eventual full-tidal restoration of the site. The Full-tidal restoration is seen as a positive goal as it would create an overall excess of marine habitat mitigation acreage, thus making mitigation credits available to others, specifically to the ports of Los Angeles or Long Beach, for planned developments inside the harbor's breakwater. Such mitigation credits could be sold for considerable sums.

I strongly feel that such considerations should not be allowed to influence the selection process of Full- vs. Muted-tidal marsh. Due to the paucity of salt marsh habitats noted above, the decision must lie entirely on the basis of what is best for salt marsh habitats and those animal species whose lives are dependent on the marsh habitat, not on secondary goals or the potential financial rewards of the programs.

Recommendations:

1. The decision on whether the wetland habitat should be Full-tidal or Muted-tidal should be decided on the basis of what is best for the salt marsh habitats and for those species whose lives are dependent on these habitats, not on the basis of secondary goals such as the potential of flood control or the potential sales of mitigation credits.

2. While the consultants are asked to compare the Full- and Muted-tidal designs both plans (Figs. 11, 12) are hypothetical and must be designed and executed with considerable imput from biological consultants that can consider the impacts on living organisms that need to survive in these changed habitats. The source of both Full- and Muted-tidal plans is unknown and both need to be strongly revised before being approved for construction.

3. It is most important in the development of either tidal scheme that the project occur in steps, allowing normal migration of

animals from areas that are to be destroyed into areas that are considered to be their new habitats. Problems associated with this phasing are great, and must be carefully considered.

4. From the botanical standpoint, the Muted-tidal development would be greatly preferred over the Full-tidal system as the former would contain more littoral marsh habitats, particular mid-littoral habitats. These habitats develop the best and most diverse salt marsh floras and are the sole habitat of the state endangered Belding's savannah sparrow.

5. It is strongly recommended that the biological team play an major role in determine the revegetation program including the species to be used and the timing of the revegetation program to allow migration of animals from present habitats into the new habitats.

6. The redeveloped marsh must have a maximum inflow of freshwater from rains to encourage seed germination of saltmarsh plants and the natural establishment of these species in zones where they are most adapted. It has been established by the work of Barbour (1970) and others, that the seeds of most native salt marsh species germinate mainly in freshwater conditions that occur in a salt marsh after rains and freshwater inundation. By promoting an inflow of freshwater into the marsh it will increase secondary revegetation by means of natural seeding.

THE FRESHWATER WETLAND HABITAT:

The restoration plans for area B both incorporate construction of a Freshwater wetland habitat separated from the tidal wetlands by a berm (see Figs. 11, 12). The complete design for this plan has been published as a Draft Permit Application (dated July 7, 1990) allowing a more thorough analysis of the proposed project. This is part of a proposed Freshwater wetland system extending down a revised Centinella Creek between Centinella Avenue and Lincoln Avenue (the freshwater corridor) occupying 21.3 acres terminating in a 27 acre Freshwater marsh west of Lincoln Boulevard separated from the tidal marsh by a berm that would occupy an additional 7.7 acres of section 404 delineated wetlands. The berm would be restored to a mixture of riparian woodlands, saltmarsh, and upland transitional areas. This proposed freshwater system is designed to mitigate against loss of wetland habitat elsewhere on the site (areas A, B, and C) and and for some wetland areas lost in the construction of the berm itself. The 27 acre lake would have 9.7 acres of open water and 17.3 acres of vegetated areas. The plan indicates that holding area could hold 60 acre feet of water (a 1 year flood event) with the waters being discharged to Ballona Channel through three 60 inch pipelines, with excessive floodwaters being discharged over a spillway set at the 7 ft mean sea level height that would pour excess floodwaters into the tidal marsh. A single controllable 36 inch pipe is planned in the far southwestern corner of the site to allow some flow of water down what is now the western corridor of Centinela Creek.

The wetland corridor through Area D, contains a mostly straight-line channel that averages some 89 feet in width with a maximum width of 130 feet. The margins over most of its length are 3:1 slopes, but over 1800 ft of the corridor has vertical concrete margins.

The Freshwater marsh west of Lincoln Boulevard is also designed primarily to handle floodwaters and to discharge these waters outside the tidal marsh into Ballona Creek channel. During rains the marsh reservoir would hold the first 60 acre-feet of water and discharge only additonal waters into the salt marsh over a 600 ft wide spillway. In this case small rains would be entirely contained within the reservoir system and largely discharged into Ballona Creek. Only runoff in excess of the 60 acre-feet would be discharged into the tidal marsh which would then serve as a flood-control basin. There would be some discharge of water down the old Centinela Creek channel in the southern part of the marsh.

In the past, the Ballona Salt Marsh received waters from both Ballona and Centinela creeks (see the introduction) and also an artesian outflow of waters from the inland water table and the marsh contained many fresh to brackish water lagoons. These waters provided a strong freshwater interface to the marsh and overall the tidal influence on the marsh may have been moderately low. Where such interfaces occur in salt marshes today, they result in an increase in species and habitat diversity and result in an increase in wildlife utilization.

According to Maguire Thomas Partners and the Public Notice document, the freshwater marsh was designed in part due to a law suit by the "Friends of Ballona Wetlands" in 1984. The Freshwater marsh is seen to serve a multi-purpose function as it will: (1) cleanse the urban waters flowing down Centinela Ditch before they are released into the Ballona channel; (2)provide freshwater habitat for fish and wildlife; (3) enhance flood protection; as well as (4) provide biological mitigation credit.

However, in my opinion, there are many problems with the current design.

1. The physical design of the system is very much directed towards flood control with basically a straight stream terminating in a large pond that would hold up to 60 acre feet of water with any extra floodwater water being shunted into the salt marsh proper, which would serve as an emergency flood-water retention basin. Thus the primary design serves flood control. For all practical purposes, it appears that the system is a flood-control system overtopped with vegetation to allow it to serve as wetland mitigation.

2. The upper portions of the system with its straight broad channel (and 1800 ft of vertical conctete margin) would promote a straight flowing stream not a meandering stream. With an average width of 89 ft, the stream will have to meander widely within this broad corridor to maintain an equitable watering of the riparian vegetation. There is no guarentee that the system will retain any sort of meandering flow after any moderate flooding.

3. The catchment basin west of Lincoln Boulevard is designed primarily to shunt the water into Ballona Creek channel and to keep it from the salt marsh except along Centinela creek. It thus denys a freshwater interface from the marsh of a type that probably once occurred in the historic Ballona marsh.

4. The freshwater pond is intended to hold water to provide habitat for freshwater animals, but local mosquito abatement ordinances

will have jurisdiction over such bodies of water and will demand either poisioning of mosquitos or the introduction of Gambusia fish to control mosquitos. In either case these ordinances will interfere with development of a natural biological system.

5. While the freshwater system will be provided tertiary treated sewage during the winter months, there is is no guarentee of a continued water supply to the system during summer months as during this time such waters would be needed for air conditioning of buildings on the site. Additional treated waters, however, could be made available from the Hyperion sewage treatment plant during the summer months.

6. As designed, the marsh reservior system withholds the waters from all low and moderate rains from the tidal marsh system. It is important to note that seeds of most of the native saltmarsh species germinate in freshwater conditions (Barbour 1970). Seed germination and establishment of native saltmarsh species is very critical to insure secondary plant reproduction within the marsh. To enhance seed germination, waters from all low and moderate rains should be allowed to enter into the marsh system to lower substrate surface salinities. This will greatly increase the success of seed germination and eventual establishment of salt marsh plants. The present design is entirely backwards. It restricts the flow of waters from low rainfalls into the marsh, but allows additional waters into the tidal marsh in the event of a high-volume rainfall. If rainy season consists of a series of small rainfalls, no additional runnoff would be allowed to flow into the tidal marsh further decreasing the opportinity for the secondary spread of marsh species via seed germination. The presence of freshwater in salt marsh systems also allows for the plants to take in fresh water into their bodies to balance out the high internal salinities that develop during the summer months, thus stimulating vegetative growth.

7. It is reported that a secondary function of the Freshwater marsh is to cleanse these incoming waters before their discharge into Ballona Creek. Part of that process involves the deposition of undesirable materials into the marsh (the wildlife habitat) prior to discharge of the water. One would expect that this would lead to a long-term build up of these materials in the marsh proper where they could negatively affect the wildlife in time.

8. With regards to the proposed revegetation of the freshwater corridor and freshwater marsh, the revegetation plan provided in the permit application offers a combination of species native to the site (that are acceptable) and others that do not belong on the site, but are readily available in commercial nurserys. These include the desert Salix gooddingii, California Bay, White alder, probably Sycamore, Artemisia palmeri, Mimulus longiflorus, and dune species such as Camissonia cheiranthifolia, and Eriogonum parvifolium. They should not be planted on the freshwater site as they are not native to the immediate area or to this type of habitat. Also the planting of 15 gallon-sized trees onto the site is not defensible financially or biologically. While the larger trees will give instant woodland, the planting of smaller, vigorous trees will insure proper root growth and beter long-term establishment than root-bound, containerized older trees.

9. As designed, the freshwater marsh will stop or reduce the inflow of freshwater into the marsh from adjacent areas and would reduce the biological diversity, wildlife utilization, and the potential for germination of the native salt marsh species. The potential to have a year-round or long-season flow of freshwater into the marsh would be beneficial to the marsh, allowing development of greater species diversity. This may also conform to what was present in the historical Ballona marsh.

In the present design there is some inflow of freshwater into the salt marsh through the historic Centinella Creek channel west of Lincoln Boulevard. While this is fine, what is need is a much stronger interface between the freshwater system and the tidal marsh with several openings that would create a widespread interface between the two systems.

The inflow of larger amounts of freshwater into the tidal marsh would increase species diversity in the upper margins of the marsh and probably most of the fresh water would drain from the marsh in channels just as it does not through the remnants of Centinela Creek in area B resulting in areas of Cattails and Tules forming in the drainages that pass through areas of Pickle weed.

There is some concern that if freshwater is supplied to the marsh during the summer in strong amounts that it could change portions of the marsh back to a freshwater marsh. Pacific Estuarine Research Laboratory (PERL) is also known to have concerns regarding native fish utilization if frequent and excessive water is allowed into salt marsh. It is conceeded that some fish would not accept variable salinities, but what is can be done in this system is to provide specialized habitats for uncommon and rare species that are restricted to such fresh-salt water interface habiats (brackish-water habitats) such as the Tidewater goby.

Recommendations:

1. In light of the highly significant impacts on the function of the salt marsh system, it is imperative that any Freshwater system be designed by a multi-disciplined team utilizing input from the engineering and biologists together, not just by engineers with minor or secondary imput from biologists.

2. My own recommendations would be to remove the Freshwater marsh west of Lincoln Boulevard except to serve as a means of distributing freshwater into a broader interface with the tidal marshlands with several areas of outflow entering into the tidal marsh. A narrow corridor of willows could be grown immediately west of Lincoln Boulevard that would serve as a buffer between the automobile traffic on Lincoln Boulevard and the tidal marshlands, potentially encouraging greater use of the site by secretive animals. A stronger freshwater interface with the salt marsh would be in agreement with what was present in the original Ballona marsh.

3. Any revegetation plan should use species native to the immediate area. The species list and planting schedule needs to be revised to maintain congruity with the historic local flora. Containerized plantings should consist of smaller plants that will develop a better root system as they develop into adult plants thus avoiding root-bound plants.

4. To insure a meandering flow of water through the channel in area D, which will be necessary to insure development of wetland habitats across the broad width of the channel, a series of low concrete dikes should be set up alternating extending into the creekbed from the right and left margins forcing a meandering path for the waters.

5. From a botanical and terrestrial biology stand point, I strongly oppose any attempt to restrict freshwater flow into the salt marsh as the freshwater would promote a vigerous interface between the two systems, promote seed germination and establishment of native salt marsh species, increase growth of native salt marsh plants. The freshwater interface would also result in a brackish marine habitat of a type useable by fishes of restricted occurrence.

James Henrickson Ph.D.
Revised May 12, 1991

LITERATURE CITED

Barbour, M.C. 1970. Is any angiosperm an obligate halophyte? Amer. Midl. Natur. 84:105-120.

California Native Plant Society's Inventory of Rare and Endangered Vascular Plants of California. 1988. Special publication No. 1, 4th edition, California Native Plant Society.

Clark, J. 1979. Ballona Wetlands Study, UCLA Urban Planning Program; Environmental Planning Team. School of Architecture and Urban Planning, UCLA. (unpaged).

Conel, C. 1990. Quad. D, "Waters of the United States" delineation, in Environmental Management Services report for Maquire Thomas Parters, Playa Vista, August 30.

Federal Interagency Committee for Wetland Delineation. 1989. Federal Manual for Identifying and Delineating Jurisdictional Wetlands. U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and U.S.D.A. Soil conservation Service, Washington, D.C. Cooperative technical publication. 76 pps. plus appendices.

Gustafson, R. J. 1981. The Vegetation of Ballona. In Biota of the Ballona Region, Los Angeles County, Los Angeles County Natural History Museum Foundation, R. Schrieber (ed.).

Henrickson, J. 1976. Ecology of Southern California Coastal Salt Marshes, in J. Latting, ed., Plant Communities of Southern California, Special publication No. 2, California Native Plant Society. pps. 49-64.

Speth, J.W. 1969. The fuss of coastal wetlands. Outdoor California 30: 6-7.

Strauss, A. 1979. Section VI, Land ownership and use. in Clark, J. ed. Ballona Wetlands Study, UCLA Urban Planning Program; Environmental Planning Team. School of Architecture and Urban Planning, UCLA, 17 pps.

Figure 1. Map of the Playa Vista area showing location and outlines of the Playa Vista sites: Area A, Area B, Area C, and Area D. Location of main streets, Ballona Creek Channel and Los Angeles Airport (bottom) are shown.

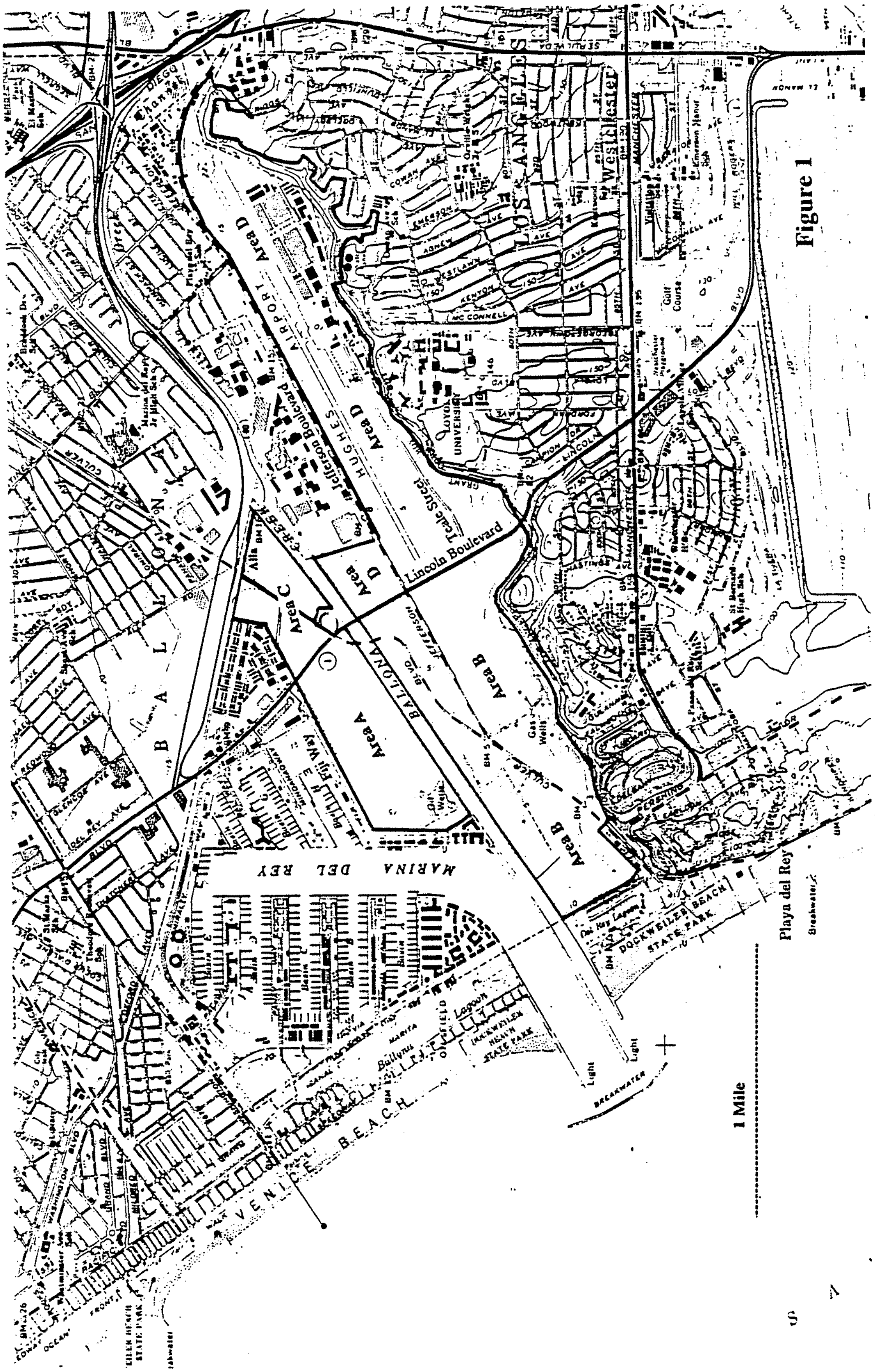

Area A
Area B
Area C
Area D
Lincoln Boulevard
Jefferson Boulevard
Tule Swamp
Hughes Airport
Ballona
Marina del Rey
Playa del Rey
Westchester
Loyola University
Dockweiler Beach State Park
Venice Beach
Breakwater
Golf Course
1 Mile

Figure 1

Figure 2. Map of the Ballona Marsh area from 1896 Redondo Quad map of U.S.G.S. 1:62,500 scale.

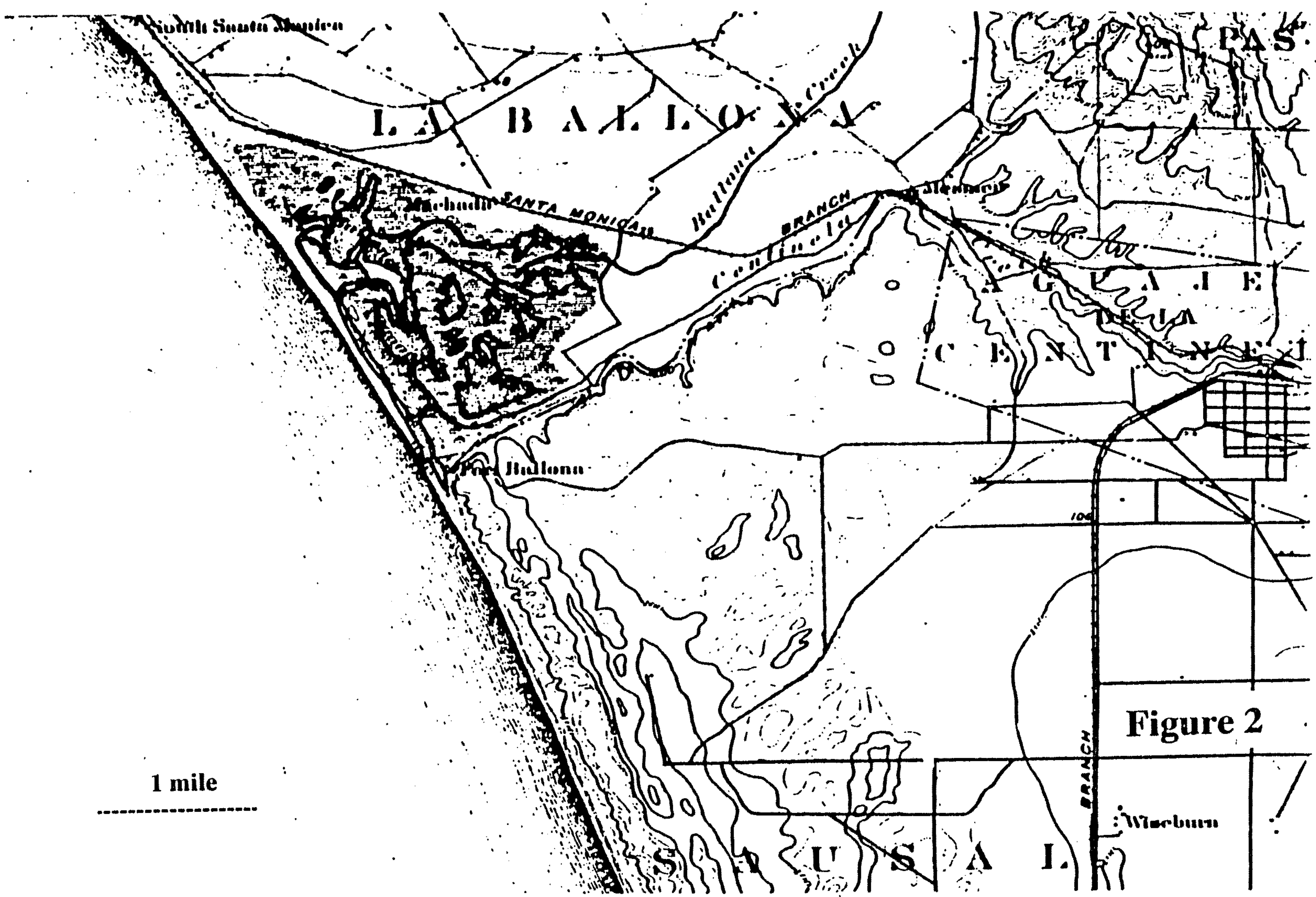
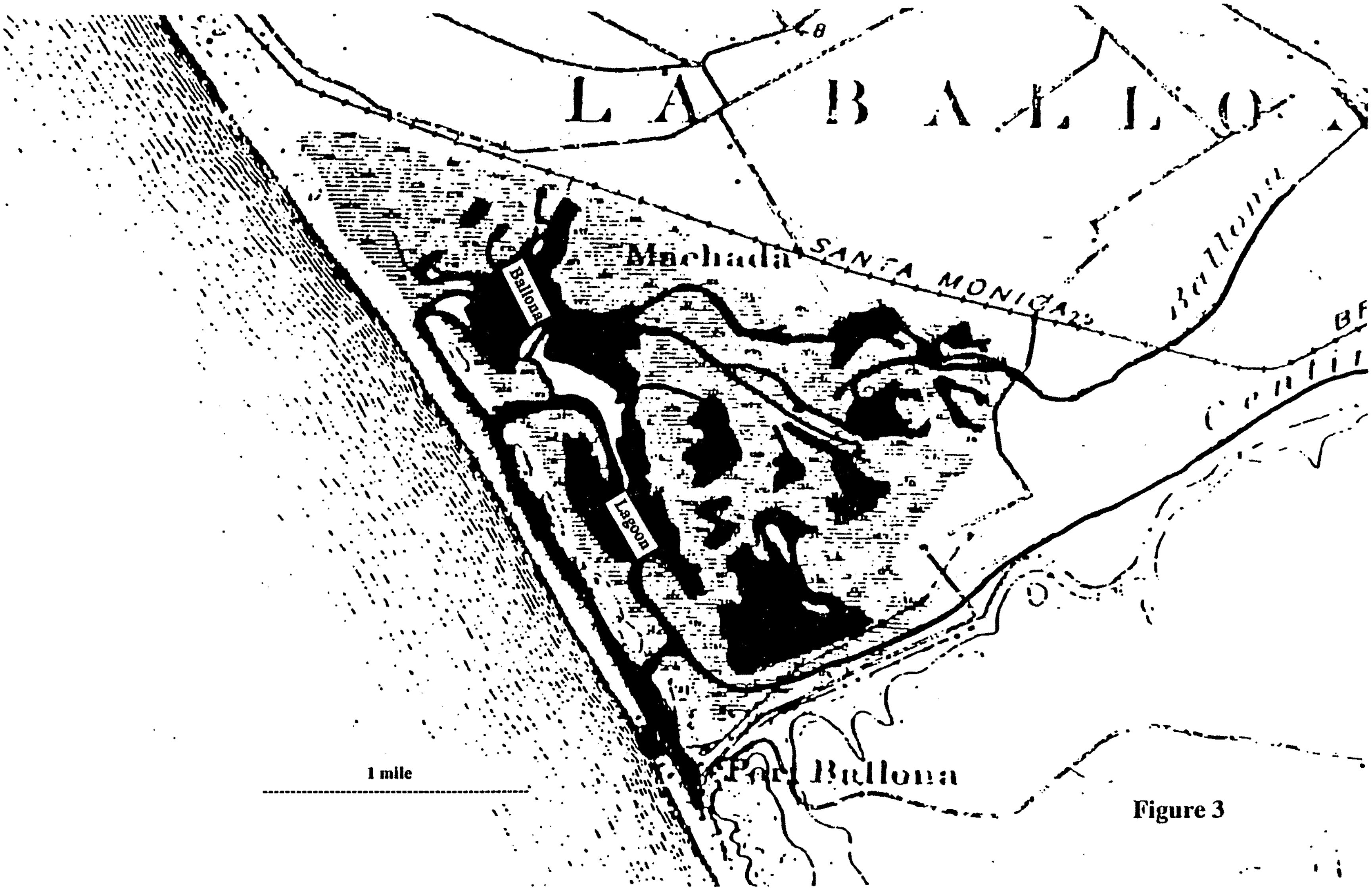

LA BALLONA
SANTA MONICA
BRANCH
Ballona Creek
Centinela
AGUAJE DE LA CENTINELA
SAUSAL
Ballona
Wiseburn
1 mile

Figure 2

Figure 3. Enlarged Ballona Marsh portion of the 1896 Redondo Quad map of U.S.G.S. as seen in Fig. 2, with pools, channels, and waterways darkened to show their distribution throughout the marsh. The estuary empties into the ocean at Port Ballona to the south. The mouths of Ballona Creek and Centinella Creek can also be seen. The lagoons take up 34 percent of the areas indicated as marsh. The white areas between the words "Ballona" and "Lagoon" apparently are upland islands.



LA BALLO
SANTA MONICA
Machada
Ballona
Lagoon
Ballona
Centin
Port Ballona
1 mile

Figure 3

Figure 4. Map of the Ballona Marsh area and environs from 1924 Venice Quad map of U.S.G.S., 1:24000 scale. The 5 ft and 10 ft contours have been enhanced in their passage south of the Pacific Electric Railroad line west of the point of Alla.

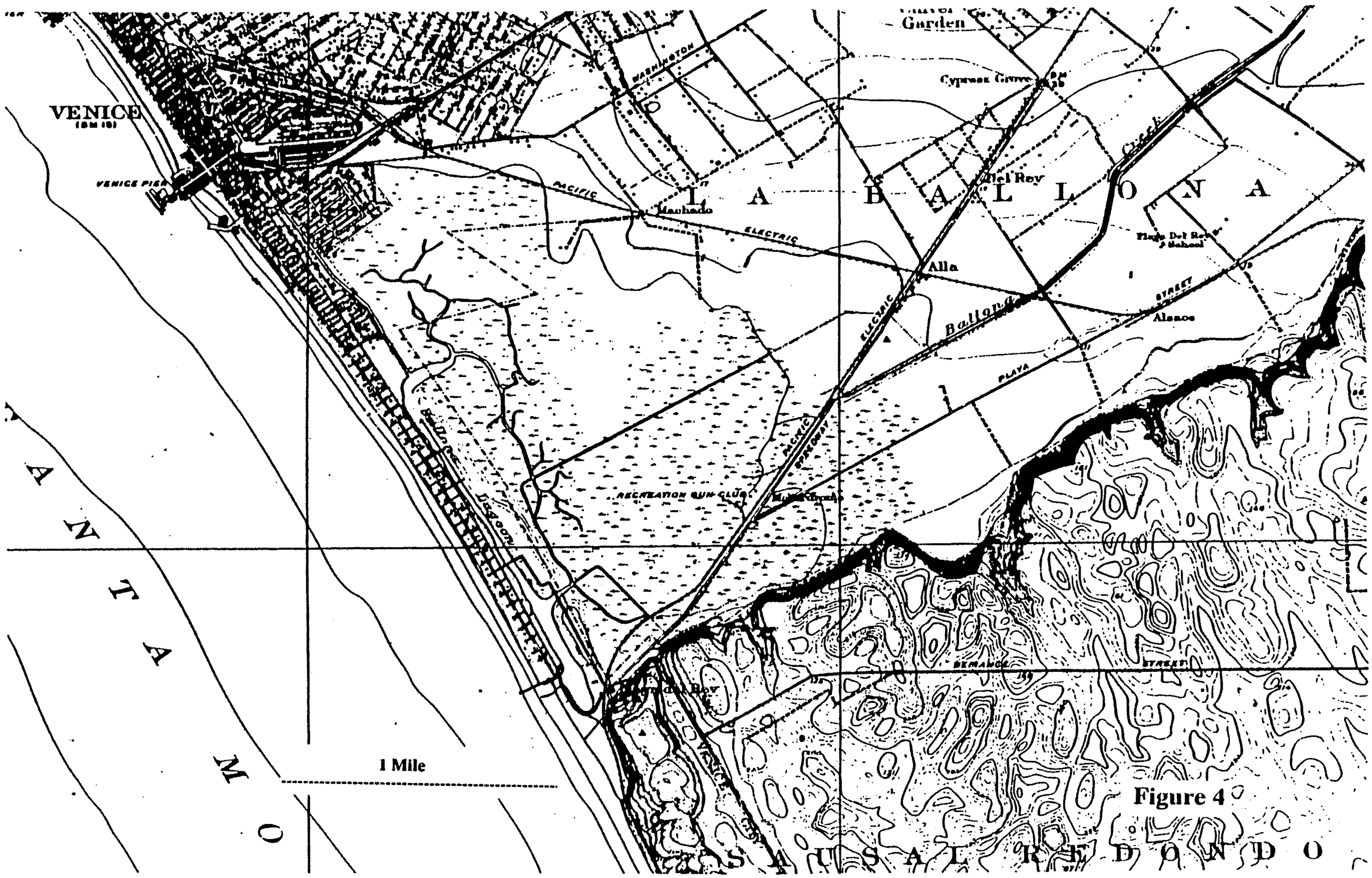

VENICE
VENICE PIER
Garden
Cypress Grove
Del Rey
L A B A L L O N A
Machado
PACIFIC
ELECTRIC
Alla
Ballona
Creek
Alsace
PLAYA
STREET
WASHINGTON
RECREATION GUN CLUB
Lagoon
1 Mile
S A N T A M O
S A U S A L R E D O N D O

Figure 4

Figure 5. Map of the Ballona Marsh area and environs from the 1950 Venice Quad map of U.S.G.S., 1:24000 scale.

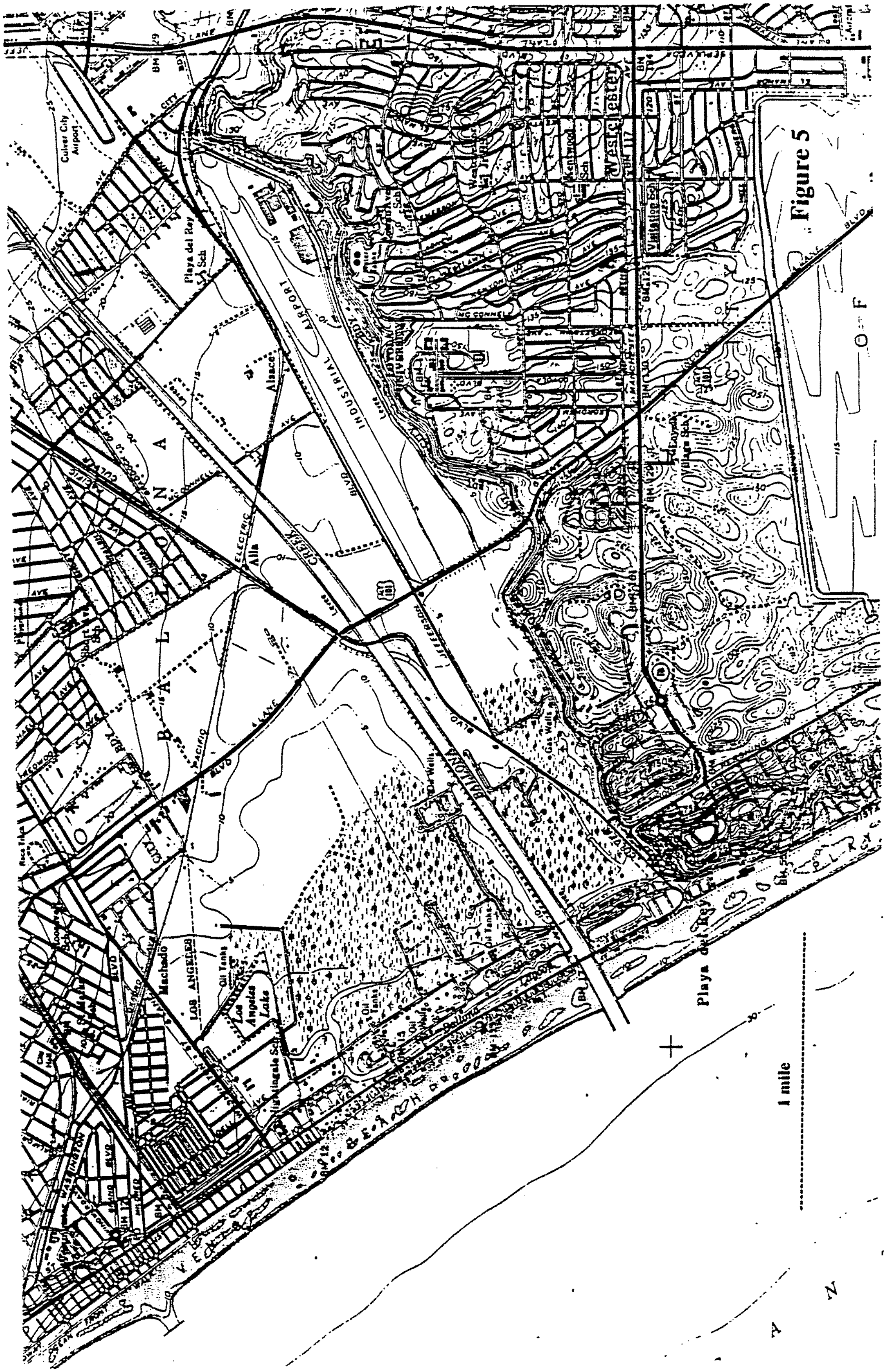

Culver City Airport
Playa del Rey Sch
AIRPORT
INDUSTRIAL
Westchester
Los Angeles Lake
LOS ANGELES
Playa del Rey
1 mile

Figure 5

Figure 6. Map of the Ballona Marsh area and environs from the 1964 map (revised 1981) of U.S.G.S., 1:24,000 scale. This represents the modern configuration of the site with Marina del Rey present.

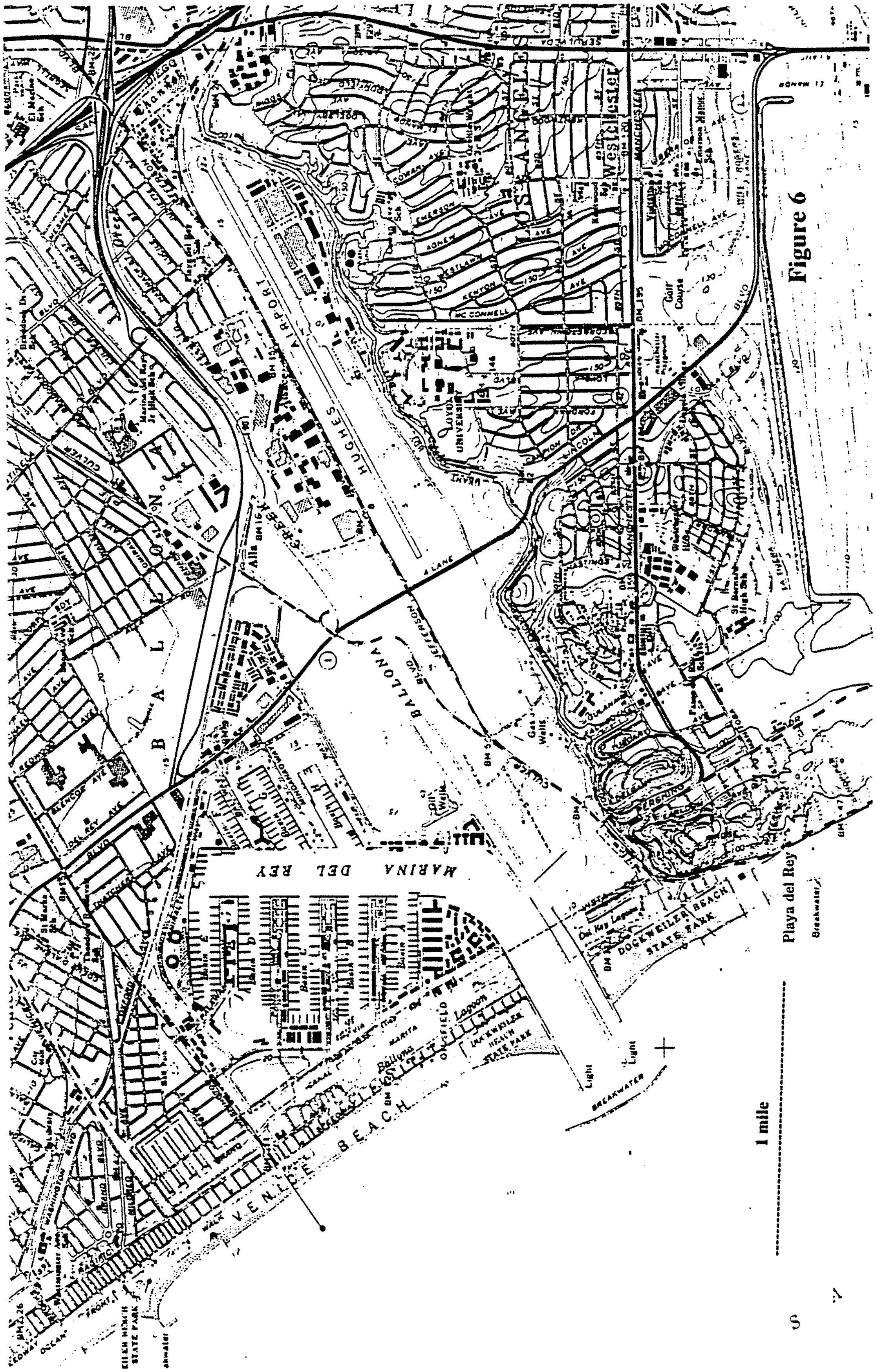


Figure 6

010684

Figure 7. Vegetation of Area A. See abbreviation legends and page 14 for an explanation of the vegetation and flora.

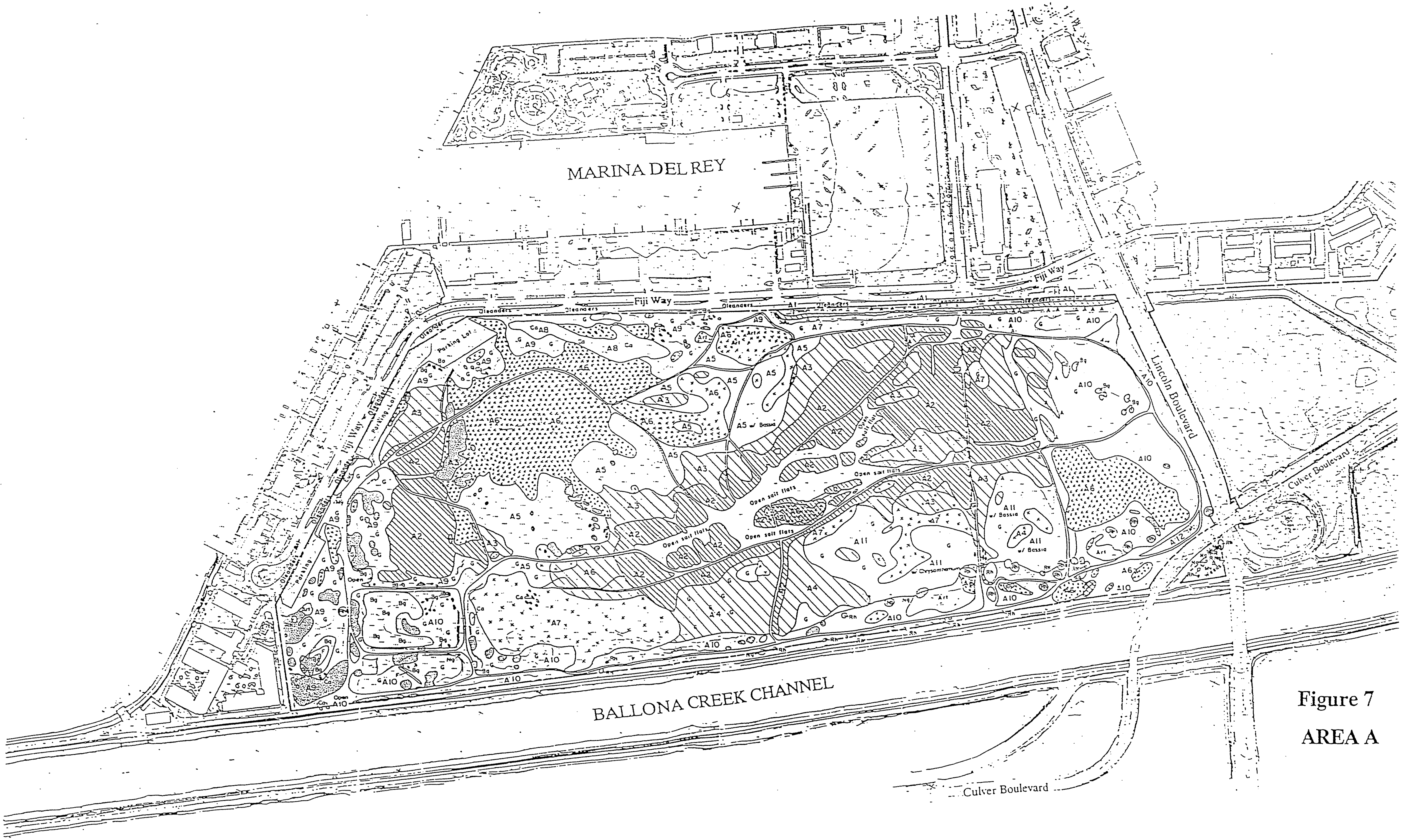


Figure 7
AREA A

010686

Figure 8. Vegetation of Area B. See abbreviation legends and page 25 for an explanation of the vegetation and flora.

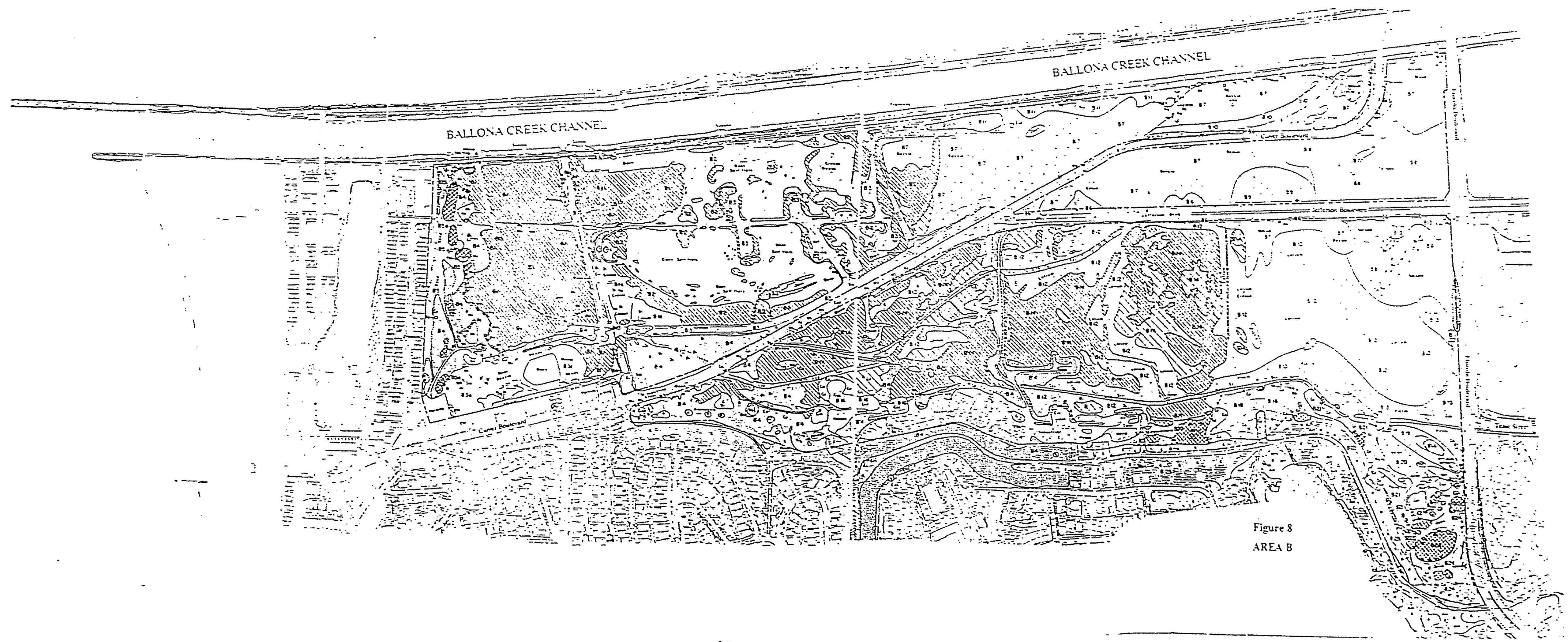


Figure 8
AREA B

010688

Figure 9. Vegetation of Area C. See abbreviation legends and page 45 for explanation of the vegetation and flora.

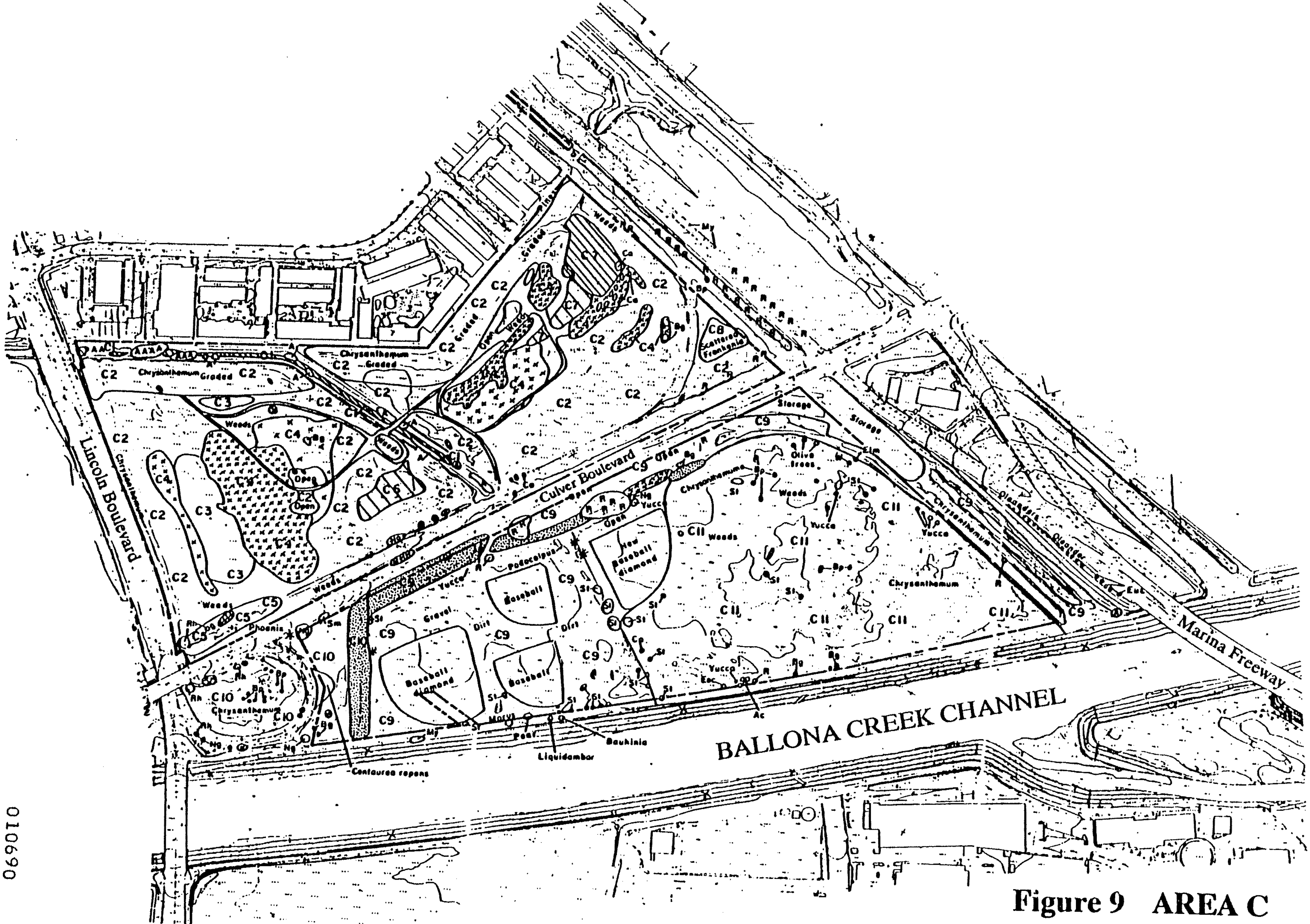


Figure 9 AREA C

Figure 10. Vegetation of area D. See abbreviation legends and page 54 for explanation of the vegetation and flora.

Figure 10
AREA D

Figure 11. Preliminary diagram of a Full-tidal restoration plan. Lowest areas bordered with solid lines are open water channels, the diagonal lined sections are mudflats, the upper areas bordered with dashed lines are littoral zones containing Cordgrass in the east and Pickleweed in the west.

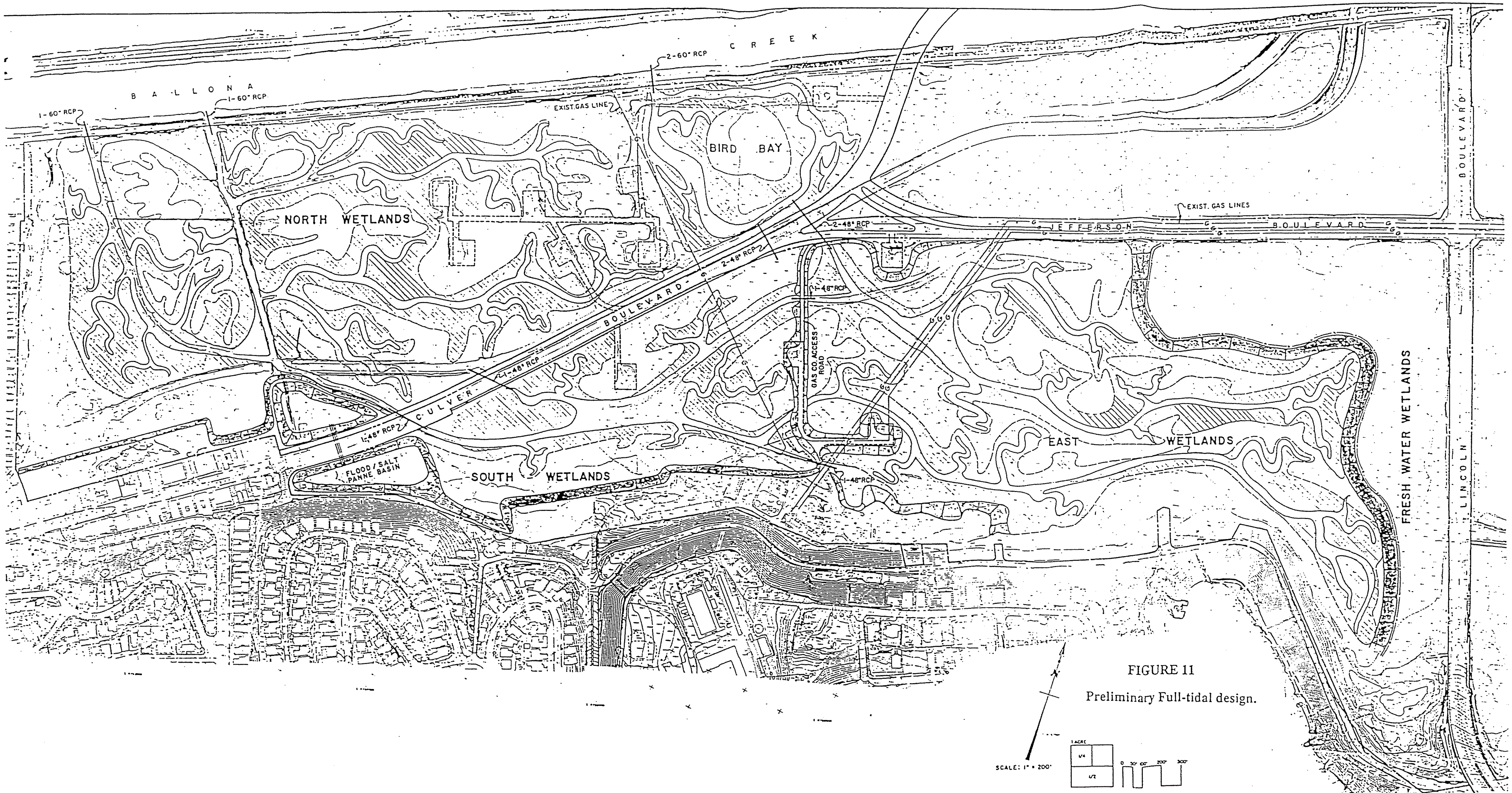


FIGURE 11

Preliminary Full-tidal design.

RESTORATION OF WETLANDS / FULL TIDAL FLUSHING
(SCHEMATIC PLAN)

PSOMAS

DATE : 8-30-90

BALLONA WETLAND PROJECT

PRELIMINARY SEP 13 1990

PV360

010694

Pop	Populus fremontii (Cottonwood)
Qa	Quercus agrifolia (Coastal live oak)
R	Ricinus communis (Castor bean)
Rh	Rhus laurina (Laurel-leaved sumac)
Salsola	Salsola australis (Russian thistle)
Sci	Scirpus californicus, S. olneyi (Tule)
Sol	Solidago occidentalis (Westerm goldenrod)
St	Schinus terebenthifolia (Pepper tree)
Toy	Heteromeles arbutifolia (Toyon)
Wa	Washingtonia robusta (Slender fan palm)
Weeds	Weedy herbs and grasses
Willow	Salix ssp. (Arroyo willow)
Yucca	Yucca gloriosa (Spanish dagger)

FIGURE LEGENDS

Salicornia virginica (Pickleweed) - dense

Salicornia virginica (Pickleweed) - Sparse

Baccharis pilularis ssp. consanguinia (Coyote brush) - Dense

Baccharis pilularis ssp. consanguinia (Coyote brush) - Sparse

Carpobrotus edulis (Iceplant)

Salix lasiolepis (Arroyo willow)

Phoenix canariensis (Canary Island Date Palm)

A	Atriplex lentiformis ssp. berweri (Saltbush)
Ac	Acacia spp. (Australian Wattles)
Anemopsis	Anemopsis californica (Yerba mansa)
Art	Artemesia californica (Coastal sagebrush)
Arundo	Arundo donax (Giant reed grass)
Bassia	Bassia hyssopifolia (Bassia)
Bg	Baccharis (glutinosa) salicifolia (Seep willow)
Bp	Baccharis pilularis ssp. consanguinia (Coyote brush)
Ca	Cortaderia atacamensis (Pampas grass)
Chrysanthemum	Chrysamthemum coronatum (Garland chrysanthemum)
Crassula	Crassula argentea (Jade plant)
Cressa	Cressa truxillensis (Cressa)
Con	Cynodon dactylon (Bermuda grass)
Cupressus	Cupressus arizonica (Arizona cypress)
Cyp	Cyperus eragrostis (Umbrella sedge)
Di	Distichlis spicata (Saltgrass)
Euc	Eucalyptus spp. (Gum tree)
F	Frankenia salina (Frankenia)
Fig	Ficus carica (Cultivated fig)
G	Grasses (Bromus spp., Lolium sp.)
Gn	Gnaphalium beneolens (Everlasting)
Graded	Area disked yearly
Jau	Jaumea carnosa (Fleshy Jaumea)
Juglans	Juglans regia (English walnut)
L	Lycium ferocissimum (Boxthorn)
Lolium	Lolium perenne ssp. multiflorum (Italian rye grass)
Morus	Morus albus (Mulberry)
My	Myoporum laetum (Myoporum)
Ng	Nicotiana glauca (Tree tobacco)
Open	Bare ground
Oleander	Nerium oleander (Oleander)
P (Picris)	Picris echioides (Ox-tongue)

Figure 12. Preliminary diagram of a Muted-Tidal restoration plan. The lowest areas with the solid line are the mud flats and drainages, the diagonal lined sections are lower-mid littoral zones and the upper areas bordered with dashed lines are the mid-upper littoral zones.

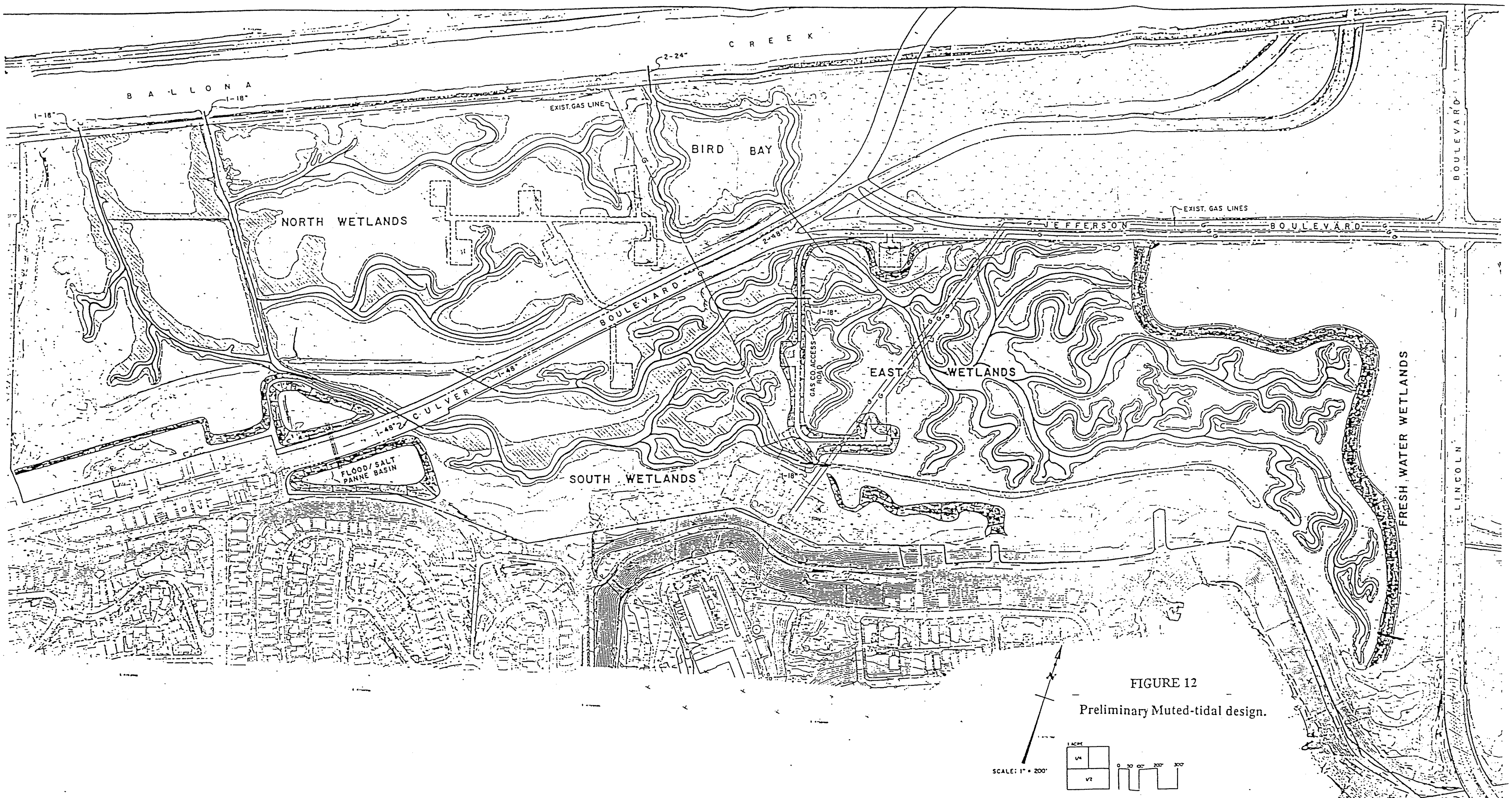


FIGURE 12

Preliminary Muted-tidal design.

RESTORATION OF WETLANDS/ MID TIDAL FLUSHING
(SCHEMATIC PLAN)

PSOMAS

DATE: 8-30-90

BALLONA WETLAND PROJECT

PRELIMINARY SEP 13 1990

PV359

010698

Appendix J-3: Biological Assessment -- Ballona Wetlands Terrestrial Arthropod Species

Rudi Mattoni, Ph.D

Biological assessment of the greater Ballona Wetlands region: Terrestrial Arthropod species

Rudi Mattoni

April 12, 1991

To keep every cog and wheel is the first precaution of intelligent tinkering
-Aldo Leopold

INTRODUCTION

The following report summarizes findings regarding the terrestrial Arthropod populations of the Playa Vista project area. The study was primarily designed to quantitatively assay two sets of species: those easily identified visually along a regular transect and those collected in pitfall traps situated to sample the major communities of areas most representative of historic conditions. The latter were all located in area B. Groups sampled included insects, arachnids, isopods, millipedes, and centipedes. A section is devoted to background information and discussion of all species of special interest, as efforts were made to survey their status. A comprehensive summary is presented of the total arthropod collections of Nagano (1981) and this study with comparative information from the nearby El Segundo sand dune system and coastal prairie at LAX.

Historical perspectives

The greater Ballona wetlands region was composed of five distinct communities: tidal salt marsh, freshwater marsh, riparian, coastal dune scrub, and coastal sage scrub. The first four communities are all highly degraded today with the entire ecosystem essentially collapsed. This assessment is inferred from the quantitative loss of species among all groups of organisms for which adequate documentation exists. The loss of native species is exacerbated by increases in alien species. Across much of the area alien plants and animals together approach 100% of the total biomass. A map of extrapolated historic community distributions, figure 1, presents one concept superimposed over the 1894 Geological survey quadrangle. Each community was essentially defined by functional relationships of the suite of plant species uniquely adapted to the Ballona physical environment. Resident herbivore arthropod populations historically must have been substantially different assemblages than today because of massive changes in the flora (Hendrickson, pers.

comm.). By the time the first aerial photographs were made in the late 1920's (figure 2), extensive change occurred and what is now the Playa Vista site had already been substantially denaturated. Today the sole vestiges of the historic eco-system with any native value are the coastal sage covered Ballona bluffs, small areas of freshwater marsh, sand dunes, and the pickleweed seasonal wetland. The remainder is an open space biological junkyard of trash species with a few flying charismatic jewels making periodic overflights.

Each of the five communities was physically discrete with clearly defined edges, excepting the tidal marsh/freshwater marsh. The latter provided a dynamic ecotone that varied both seasonally and spacially depending on the vagaries of weather conditions and interactions of floodwater with some constant stream flow, all of which were superimposed on the regular daily tidal cycles and high water table. This ecotone must have been relatively vast (Henrickson, pers. comm.). Today the ecotone is nonexistent. Its homolog may be that edge between introduced weeds as iceplant and the saltgrass-pickleweed marsh. The latter community is now supported by brackish water formed by rainfall and runoff that leaches the hypersaline substrate. It is completely unnatural in the absence of tidal flow.

The freshwater/brackish area of the marsh may have been far greater than indicated on the map (figure1) by three accounts: continuous drainage from Ballona Creek that must have been necessary to maintain the Ballona lagoon outlet, a high water table and a restricted tidal inflow from the small Ballona outlet relative to the large lagoon area. These factors defined the physical environment that fashioned the historic ecosystem. Although the landscape can never be restored to even approach the historic condition, an environment should be planned to provide for most of the original biota capable of re-introduction and with augmentation of the low density species still present that are approaching extirpation because of demographic and genetic stochasticity.

Arthropod study area

For general planning purposes the 1004 acre Playa Vista development site was divided into four areas: A, B, C, and D. Physical location of the sites is exhaustively described elsewhere in this document. Of the areas, only parts of B and D have any residual natural values with historic continuity. Although some native plant and animal species can be found on A and C, these are entirely vagrants that secondarily became established, in all likelihood from propagules or populations of the bluffs or area B. The survey of terrestrial arthropods, largely insects, reported here was confined to area B.

No formal arthropod surveys were conducted on areas A, C, and D because of their highly disturbed nature and improbability of significant findings. The conclusion was based on a walkover of most of the project and discussion with other biologists familiar to the area. Excepting the Centinela Creek riparian zone and a small part of the southwest corner of D, the vegetation on areas A, C, and D is all secondary and adventitious. Any arthropod associates would be secondary as well. Although succession *may* restore higher densities of some native shrubs, any introduced native arthropods would be immigrants. The chances of finding rare or unique species, especially endemics not present on quad B natural areas, seemed sufficiently remote to have represented a waste of the limited resources. Species likely to be of concern are mostly adapted to specialized habitats that are generally high in the required niche resources. Such resources simply do not occur on converted denatured sites. And the species themselves are even less likely without nearby large populations that can serve as reservoirs for recolonization. A few migrants of interest may occur on these sites, but their occurrence is trivial. Thus a small population of the wandering skipper butterfly (see below) occurs on A as a consequence of a small foodplant population. The magnitude larger population in area B deserves primary attention from a conservation standpoint.We elected to emphasize high concentrations of native plants on more natural areas for detailed treatment. The only native "hot spots" are restricted to area B.

Furthermore, continuing habitat deterioration mitigates against any identifiable arthropods with adapted traits to historic conditions having survived. On the sand dunes, two well known sand obligate populations have been recently extirpated. Neither the dunes ecotype of the Mormon metalmark or Belkin's tabanid fly persist although both were present in the mid-1980's. The western elfin butterfly has also recently been extirpated. Since all three species are associated with habitats that have some, albeit very poor, qualities remaining, the evidence strongly rules against any narrow endemics having survived on the wastelands outside of quad B.

The significance of Arthropods compared with Vertebrates in ecosystem evaluation.

Vertebrates for the most part can be characterized by long lives, low reproductive rates and resource utilization across a number of communities. Arthropods, particularly insects, on the other hand generally have short lives, very high reproductive rates, and highly specialized habitat requirements. The consequence of these life history variables to the understanding of biological values within limited preserves is that they must be provided for. For these reasons vertebrate populations, especially large species, are sensitive to habitat size and fragmentation while persistence of most arthropods at high densities within very small areas require habitats that provides specific resources and suitable abiotic environmental factors (Terborgh, 1988).

Attention to a few flagship or charismatic species as umbrellas or indicators (Noss, 1990) may overlook the value of habitat quality for a large segment of biodiversity. Serious impacts may be occurring for many small vulnerable species while attention is garnered by a few large species. Range requirements of large vertebrates that theoretically provide an umbrella encompassing the distribution of many small invertebrates may overlook specialized habitat quality factors. Consequently, assessment of biotic integrity at any site must consider all life forms and species without prejudice of anthropocentric bias. This view is especially true when viewing open space without regard to species composition (Murphy, 1989).

Prior surveys and taxonomic information

Unfortunately there are no systematic records of the biota of any of these communities prior to the extensive degradation and alteration of the Ballona ecosystem. A few isolated species were recorded early on, such as the sand obligate moths *Copeblepheron sanctaemonicae* and *Euxoa riversii*, which were taken in the 1890's on the "Santa Monica" (Playa del Rey) sand dunes. Terrestrial vertebrates provide the richest historic records with summaries by von Bloeker (1943) and Willets (1933) for birds, von Bloeker (1941) for reptiles and amphibians, and von Bloeker (1938-1940 unpublished notes, Los Angeles County Natural History Museum) for mammals. Early botanizing was sporadic indicated there were three narrow endemics, including two *Astragalus* and one *Potentilla*, genera which tend to support rich guilds of insects. All three endemic plants were extirpated long ago along with any of their monophagous predators. Other data on plant communities can be found in a series of notes of early collectors as Hasse, Munz, Johnson, Davidson, etc. which are archived in local herbaria. These data have not been systematized, but should be prior to specifying a meaningful restoration effort.

The only comprehensive data of terrestrial Arthropods across the Playa Vista site are from the report of Nagano et al. (1981). The study did not include sites C or D, nor any of the bluff area. The recent report by Mattoni (1990a) provides qualitative and quantitative surveys of the El Segundo sand dunes and Los Angeles coastal prairie. Many taxa of both communities occurred into what is now the Playa Vista site. Community composition of the sand dunes must have been virtually identical as the Ballona dunes were a northern extension of the El Segundo dunes. These data are consequently important to both the assessment of expected patterns of biodiversity and in the design of restoration projects. The data of both the Nagano and Mattoni reports are summarized in table 1.

Inspection of table 1 reveals a number of unidentified species, including several that could only be identified to family. This state of affairs is only too common when dealing with most invertebrates and is due to lack of support of taxonomic research by contemporary society. With increasing concerns over conservation issues the inability of conservation-biologists to have simple names available for the large segment of terrestrial natural communities represented by invertebrates is appalling. Beyond the inability to find names for many species lies our total ignorance of life histories and adaptive relationships. The shortcomings of this neglect were sharply focussed by Disney (1989) and Ehrenfeld (1989).

STUDY PLAN AND METHODS

The purpose of this study was to provide baseline information and begin a long term field study on patterns of diversity in the arthropod populations across the entire ecosystem. Such work requires quantitative information that can be simply and repeatably gathered at low cost. Two basic techniques were employed: 1) a routine transect walk to visually census all species that are unequivocally sight determinable and 2) pitfall traps. The pitfall traps were quart plastic tubs 12 cm in diameter and 12 cm deep containing about 200 ml glycol anti-freeze. Wooden lids placed over the traps protected them from rain and blow in. The traps were identical to those used for the LAX sand dunes (Mattoni, 1990a).Specimens were collected by decanting the entire fluid into a large vial and then refilling the trap with fresh glycol. All specimens were later classified, labelled and stored in alcohol. At such time that site is protected from vandalism, two additional quantitative methods will be used: malaise and yellow pan traps. All studies were terminated on 1 April, 1991.

A total of 35 traps were distributed along the transect path to sample all the major extant communities. Servicing was efficient with sample pick-up coinciding with the transect walks. Trap locations are shown in figure 3. All specimens collected were labelled and preserved. The material will be deposited in the Natural History Museum of Los Angeles County. The collections of Nagano (1981) are in that depository.

The transect walk was conducted at regular intervals. The transect path, illustrated in figure 3, extended across the dunes and salt marsh towards the south and east, traversing salt and mud flats, brackish water channels, into the freshwater and upland sites in the vicinity of the gas plant and continuing along the bluff base to the south east end of the site at Lincoln Blvd. Each visual sighting was recorded. All butterflies, dayflying moths, dragonflies, beeflies, robber flies, other large flies and obvious bee and wasp species were noted (table 2). All data were collected by one individual (Rick Rogers) walking at the same time and pace each sampling day. In cases of any question of identity, specimens were netted for close examination. Voucher specimens of most species were collected for future reference.

Other miscellaneous observations and collection efforts were made, including searching for tiger beetles and several flies that were known present in earlier surveys. These were special efforts to locate species that had special interest. Overall emphasis was to establish a simple, repeatable sampling program.

RESULTS

Arthropod communities of the recent past and present

The information of Nagano et al. (1981) included semi-quantitative estimates of abundance and associations of each species to specific communities tabulated. The greatest diversity of arthropods in 1980 was in the sand dunes area. Communities of both brackish and fresh water marshes, with their bordering mud- and salt-flats were well sampled, but monotonous. The riparian community was exemplified by collections taken in the willow groves found in the sand dune area. This community is not normal to the area and will be lost once tidal flushing is restored. Communities of the coastal sage community across the bluff slopes, which should far exceed the dunes areas in species richness, were not sampled. Furthermore, information for the bluff communities are almost altogether lacking and may remain always unknowable. This coastal sage associated community has never been thoroughly sampled, under the assumption that it shares a common biota with the geographically related scrub communities across the Los Angeles plain. Unfortunately, the native wildlife of all of these communities met catastrophic change before any were studied and coastal sage is now a *de facto* endangered community (Westman, 1987). The contiguous Baldwin Hills are included in this assessment.

Pattern of present day arthropod populations

The list of all specimens collected for this study are summarized in table 1 along with the data of Nagano et al. (1981). These data are presented in comparison with those from the El Segundo dunes ecosystem survey by Mattoni (1990a). The latter provide an historical baseline since both the sand dunes proper and the coastal prairie communities extended to Ballona. Historically the prairie community was continuous across the Ballona bluffs and onto the western alluvial floodplain of Ballona Creek. Altogether these lists are unique for any part of the Los Angeles coastal plain thereby providing an estimate of arthropod diversity patterns nowhere else available for the general region.

The list includes all species collected by all methods, without regard to relative abundance. Species found only at Ballona in communities other than sand dune are cited at the end of the table. The lack of comparative information on the wetland sites in the table lies in these habitats having never been well sampled historically. Comparisons of the 1980 with the 1990 can only be made with certainty for only those families of insects that were equally sampled. Biases exist because of the different experiences of field workers and methodology. There are also misidentifications and systematic disagreements to deal with and substantial undersampling by everyone. In our study sampling was based almost entirely on pitfall trapping and visual counts, with periodic random collections of aerial netting and foliage beating. We did no light trapping nor used special attractant traps. Thus nocturnal groups, as moths, were poorly documented. On the other hand, ground dwelling insects, as the rove and ground beetles, were very thoroughly sampled. As an example, while Nagano et al. recorded a number of Hymenoptera, we only noted the visually identifiable species along the transects. Conversely, we noted 17 species of beefly against 4 of Nagano et al., a function of Roger's expertise in this group. Overall, however, when the dunes are compared with the LAX dunes, Ballona is clearly depauperate of species in all groups that were equally sampled.

TRANSECT COUNTS. Results of the visual records from the transect walks are given in table 3. A total of 88 species was expected (table 2), with 86 species observed, including 11 seen only once. The pattern of distribution of all the species adequately sampled was highly non-random with only 2 of the 16 species occurring equally across all habitats. Taking samples greater than 30 as meaningful, two general patterns emerge:

1. In overall richness, the sand dune-pickleweed ecotone has twice the density of individuals (2.3 per meter annually), followed by the sand dunes and alluvium (1.2 and 1.2 per meter annually), with fresh and salt marsh communities poorest (0.37 and 0.43 per meter annually).

2. Individual species have highly non-random associations as:

Sand dunes: *Coniophorus fenestratus*

Alluvial wash: *Villa atrata*

Sand dunes and alluvial wash: *Glaucopsyche lygdamus, Callophrys perplexa, Leptotes marina, Strymon melinus*

Dunes-pickleweed ectone: *Polites sabuleti, Panoquina errans, Bembex comata*

Pickleweed marsh: *Perizoma custodiata, Villa lateralis*
Freshwater marsh: *Pyrgus albescens, Bombus sonorus, B. vosnesinskii.*
All habitats: *Poecilanthrax arethusa, Lepidanthrax sp.*

Monarch butterflies were the most commonly seen of all insects. Their distribution is highly non-random because their abundance was entirely due to a roosting site in the Eucalyptus grove. When in flight the butterfly can be found anywhere as they are very strong fliers. They would be expected to breed on the bluff given the presence of their milkweed larval foodplant. A maximum of 5000 individuals were noted in January, with populations of over 500 from mid-October until the end of February, when all dispersed. These insects are discussed below.

PITFALL TRAP DATA. All animals collected from the pitfall traps are summarized by community in table 4. The key to species code is given in table 5, and the 60 infrequently encountered species (ten or fewer captures) are listed in table 6. The 20 traps placed across the entire sand dunes complex produced a total of 4718 individuals over a one year cycle, or 235 per trap year. In comparison with the LAX sand dunes, 27178 were trapped in 60 traps, or 453 per trap year. These results provide a crude estimate that the Ballona dune remnant carries an arthropod population half the size of LAX in what were formerly almost contiguous biotas.

The density of individuals within the different communities correlates fairly well with the visual transect data. The alluvium produced the highest (334 per trap) and the dunes/pickleweed marsh ecotone the second highest value (328 per trap), with the salt panne the most barren (65 per trap). These results are not surprising given the relative amount of native plant cover on these sites.

Species richness is also lower at Ballona, where 109 species were captured from the dunes, compared with 153 species at LAX. Curiously, 18 of those species are unique to Ballona. In addition, individual species abundance differs widely from LAX. Among the eight most common species, there are only three shared between the two habitats. Of these three, the Argentine ant, *Iridomyrmex humilis*, is an introduced species. Each locality has a second introduced species in the top 8, but they are different. Numerical ranking of the Ballona species is shown in figure 4. Species code for the figure in table 5. What this means is unclear, except it must be recalled that the plant communities of the two localities differ widely, with only 14 native plant species at Ballona to 51 extant native plants at LAX.

The dunes fauna has some overlap with coastal sage, riparian and upper salt marsh communities with some dune species only tourists into the dunes area-and vice versa. In spite of overall habitat degradation, the ecotone or edge between dune and upper salt marsh remains a relatively species rich zone as indicated by both transect and pitfall counts. Historically this was a dynamic ecotone that is presently reduced to an edge between terrestrial iceplant and pickleweed upper marsh.

All the communities found on the Playa Vista property are highly degraded, if not essentially collapsed. This assessment is inferred from quantitative species loss among all groups of organisms for which there are complete data (see discussion below). In spite of limited data, arthropod populations exhibit similar patterns of extirpation. Butterfly losses include 8 of 31 resident species while among beeflies (Diptera: Bombyliidae), 12 of at least 30 species have probably disappeared. The diminution in the number of Carabid beetles between 1980 and 1990, from 13 to 9, is probably valid since this group was very thoroughly sampled both by Nagano and ourselves. For specific communities, three butterfly species of the riparian, formerly common in the Los Angeles basin, are not present. The extinct Ballona cinquefoil and Ventura milk vetch may have hosted several endemic herbivores. Both plants are in groups with many herbivore dependents. A cascade of extinctions would then be expected to follow extinction of these plants.

Native ants are a highly impacted insect group across the site, but past data are limited. Only three species now occur, as was also true in 1980, and though three additional species are expected, the historic populations were at least three times that rich (Roy Snelling, pers. comm.). Since as a group ants are keystone animals providing many ecological services, the loss of these native species probably had significant impact through the system. The loss of natives was probably due to introduction of the Argentine ant, *Iridomyrmex humilis,* which is now dominant on all sites, as well as being the commonest insect from the traps (figure 4, #2). This particular exotic species is uneradicable and irrevocably changed all Ballona communities.

Summary of arthropod species of special concern and interest

In order to identify arthropod species of more than usual interest that may be found in Ballona habitats, four groups are considered:

1) species listed in the "priority" category of the California Department of Fish and Game NDDB inventory database and found within the Venice quadrangle,

2) species which have been identified as limited distribution endemics restricted to sand dunes/coastal strand and wetlands habitat in the vicinity by Mattoni (1990a),

3) species identified by Nagano et al. (1981),

4) the highly visible and popular monarch butterfly.

A narrative of these taxa follows, with comments on the potential occurrence of significant species as they are associated with the identifiable community remnants.

NDDB listings/Venice quadrangle

Sands dunes/ sand obligate species

1. *Euphiloptes bernardino allyni* (=*E. battoides allyni*). El Segundo Blue butterfly. A detailed description of this taxa, its biology, distribution, and conservation biology, is in press (Mattoni. 1991. The endangered El Segundo blue butterfly. J. Res. Lepid. 28). In summary, the species now has three geographic locations: The Chevron Refinery, the LAX sand dunes, and Malaga Cove. It is secure at the first two sites, with the population expanding in response to the ecosystem restoration underway at LAX. At LAX the 1990 total adult population was in the order of 3000-5000. Historically the species occurred on the Playa del Rey dunes, extending into what is present day Venice. One male was sighted at Playa del Rey in the mid 1980's. The hostplant *Eriogonum parvifolium* population, then about 20 plants, has subsequently declined to 7 individuals. In the same time frame, the small population of the dunes ecotype of the Mormon metalmark butterfly, also dependent on this foodplant, disappeared. There is little question that the El Segundo blue can re-establish when the habitat is restored. However, populations of all the sand dune obligate species will have tentative long term viabilities because of random processes in the small sized fragment.

2. *Lorita scarifica* (=*L. abornana*). Lora Aborn's moth. A recent, yet unpublished, revision of the Cochylidae by M. Pogue at the Smithsonian Institution synonomized *L. abornana* to a widespread, common, neotropical species. However, J. Donahue (pers. comm.) found the situation may be more complex as his survey of genitalia morphology implies there may be several taxa hidden in a

complex species group. Several foodplants are used by the species, including *Eriogonum, Ambrosia,* and *Cuscuta*. The species flies throughout most of the year. On the LAX dunes the species is not only one of the commonest moths, but also is involved with regulating the El Segundo blue butterfly (Mattoni, l.c.). The species should not be considered of concern until additional work is undertaken.

3. *Eucosma hennei*. Henne's eucosman moth. The species is restricted to the El Segundo dunes and the Osa Flaco dunes complex. It's only known foodplant resource is *Phacelia ramosissima* in which the larvae are borers in the stems and roots of very mature plants. The adult flight period is from July through September. The moth is not common at LAX and has not been taken at Ballona. It is unlikely to occur at Ballona because the foodplant is not dense, nor are there enough individual plants robust enough to support more than a few larvae. Even with the anticipated restoration of foodplant densities, the number of suitable plants would be incapable of supporting a viable population of the moth. Evidence at hand indicates the moth is sand obligate as the foodplant is found over a wide geographic area and range of plant communities, while the moth is only found on coastal sand dunes. This hypothesis may be tested at such time that the foodplant may become widely established on the Ballona Bluffs. The *Phacelia* presently grows on the bluffs, at least across sections west of Lincoln Boulevard. It is not a common plant, however, and may naturally remain in a low density if and when historic flora values are re-established.

4. *Coelus globosus*. Globose dune beetle. A detritivore tenebrionid that is rare even on the LAX dunes system. During a one year trapping program at LAX only 28 were taken by comparison with 88 of the related *Coelus ciliatus*. Both species are sand obligate and at LAX were most abundant at undisturbed sites. In the monitoring program at Ballona *C. ciliatus* has been taken only once on the relatively native dune fragment. *C. globosus* has never been found, but if so would occur on the sand dunes. Nothing is known of the life history of these beetles.

5. *Cicindella hirticollis gravida*. This tiger beetle is a sand obligate species restricted to undisturbed barrier dunes above the strand line. It has not be observed at the LAX dunes and the habitat at Ballona is in all likelihood unsuitable for its persistence. Although recorded historically (1906) from along the strand from Playa del Rey to Santa Monica, there are no recent records. The species would not be expected in the Playa Vista area.

6. *Cicindella senilis frosti.* A tiger beetle species known historically only from the Manhattan Beach area. Not taken on the LAX dunes. Presumably extirpated from the site, if it ever occurred.

7. *Onychobaris langei.* Lange's El Segundo dune weevil is known from a few specimens taken on the LAX dunes and from the sand dune area of Ballona. The Ballona specimens were taken both by Nagano et al. (1981) and our last collection from a pitfall trap on the sand dune/salt marsh ecotone. Nothing is known of the life history except a note of being associated with the roots of *Camissonia chieranthifolia* (Sleeper, pers. comm.). Collecting records are from May through September. The most recent take at LAX was in 1986 . None were obtained during the LAX survey in spite of special efforts to locate the animal. Barine weevils as a group are not well studied.

8. *Trigonoscuta dorothea dorothea.* Dorothy's El Segundo dune weevil. The species is one of the most abundant weevils on the dunes, both at LAX and Playa del Rey. It is usually found at the base of the dunes bush lupine and is commonly found in pitfall traps. It is the 15th most common insect trapped in pitfalls. A sand obligate species taken over most of the year. In traps at Playa del Rey it has been taken under iceplant and in the salt marsh interface to the dunes. There has been questions of taxonomic validity of the subspecies (Miller, pers. comm.), but the total of all populations of the species are sand obligate in California and thus merit concern.

9. *Brennania belkini.* Belkin's dune tabanid fly. A sand obligate species that is one of the few tabanids not requiring a blood meal for successful egg production. As adults they are taken on flowers during the flight time of late May to early July. Larvae are burrowing predators with undetermined hosts, most likely beetle larvae. The species occurs on dunes areas from the Los Angeles area south to Ensenada. Because of land conversion of other dune sites, including massive development to Ensenada, the species should be considered threatened. Taken at Playa del Rey in 1980. The population at LAX provided 40 individual sightings in 1989. None were seen across the Ballona transect in 1990, and it was rare at LAX during 1990 as well.

Intertidal and wetland species

1. *Panoquina panoquinoides errans.* The saltmarsh skipper. The species is restricted to upper salt marsh habitat where its sole natural foodplant, Saltgrass, *Distichlis spicata,* is found. The skipper appears highly sedentary and has an adult flight period from April through October in most years. In the Ballona wetland, the species is found throughout the area where the foodplant occurs. At present

saltgrass is distributed at the interface of pickleweed and the large masses of iceplant. The skipper is relatively abundant and is regularly counted along the transect established to monitor visually identifiable insects. Quantitative information is available and can be continuously updated to monitor population status. Removal of the exotic iceplant will result in an expansion of the saltgrass resource to which the skipper populations would correspondingly respond. Because of the foodplant, the insect is probably drought insensitive by comparison with most Lepidoptera. The chief nectar sources are *Heliotropium* and *Frankenia*. Maintenance of high reproductive success will require that these plant species be expanded as well.

During the current survey another species of skipper butterfly(Hesperiidae) has been sighted that appears exclusively associated with *Distichlis*: *Polites sabuleti sabuleti*. Results of the transect counts validate this hypothesis (table 3 and above). Three additional species, *Hylephila phyleus, Ochlodes sylvanoides,* and *Paratrytone melane* may also share this same food resource. The latter three species also use other grasses, although this aspect of their life histories is not well investigated. The transect data for the species is unclear as they are not common.

In addition to the above taxa from the NDDB, several unrecognized species of special interest are expected to occur and most likely occurred prior to denaturation of the Ballona area. These species are sand obligate endemics found at LAX and Ballona. Since all were found on the adjacent dune system, they are briefly cited for completeness.

Sands dunes/ sand obligate species

1. *Ebo undescribed species.* El Segundo crab spider. A species in one of the better studied groups of crab spiders. Apparently dunes restricted, found chiefly on the flowers of *Haplopappus ericoides*. The dunes fragment at Playa del Rey should support a population of this very small species, although it has not been found at the site.

2. *Scythris undescribed species*. Two distinct species occur on the LAX dunes. They are members of a very large genus of micro moths that are usually endemic and restricted to specialized localities in sandy areas. Because of dependence on native plants in undisturbed landscapes, their occurrence has not been established at Ballona. Nothing is known of the life histories, but larvae usually make distinctive silk tunnels at the base of their perennial foodplants.

3. *Comadia intrusa*. El Segundo dunes cossid moth. A large species known only from the El Segundo dunes. Apparently biennial, flying in even numbered years during late June and early July. Larvae feed on bush lupine (*Lupinus chamissonis*) with a large plant required to satisfy nutritional needs of a dozen larvae. Persistence at Playa del Rey problematical because of the small area and hence low number of potential host plants. No evidence of their occurrence, but they can be easily monitored.

4. *Psammobotys fordii*. Bob Ford's dune pyralid. A small dayflying moth only known from the type series collected at the LAX dunes March 8, 1955. Apparently globally extinct, as it has not been seen since and is not known from any other localities. Nothing is known of its life history.

5. *Carolella busckana busckana*. Busck's gall moth. Fish and Wildlife Service category 2 candidate species. A formerly widespread species in sandy areas and known from the LAX dunes. The *Encelia californica* foodplant will be reintroduced at Playa del Rey dunes, but the moth species is presumably extirpated at nearby LAX. The only remaining populations could be on the upper Santa Ana river drainage, but no moths have been sighted at any locality for many years.

6. *Stenopelmatus undescribed species l*. El Segundo jerusalem cricket. The species is restricted to the Playa del Rey and LAX dunes where it occurs together with a more widespread species that is also undescribed. Mature specimens found at both localities in the fall, immatures year round. Restoration of the dunes may augment the populations, but they are found, as generalist omnivores, under any vegetation. Monitored by pitfall trapping. Casual observation indicate that the species has been substantially reduced in numbers during 1990 from previous seasons. The reductions may be draught related. This, and a second undescribed Ballona species that is widespread, will be described in the near future by David Weissman, expert in the group.

7. *Exoprosopa* undescribed subspecies of, or species near *arenicola*. El Segundo beefly. For a current study to provide a field guide of the beeflies of the Los Angeles basin, Rick Rogers, field entomologist for this project, determined that the beefly he earlier classified as *E. butleri* was in fact misidentified and is part of a species complex heretofore unrecognized. The new species occurs on the LAX dunes in the fall and is expected at Ballona. *Exoprosopa* has several species groups which contain narrowly distributed species. Such species are valuable for ecosystem assessment.

8. *Bombylius* undescribed species near *flavipilosus*. This species has not yet been found at Ballona, but is common on the LAX sand dunes. Nothing is known of

its life history. The species flies in the spring. Our 1990 transect study was started too late in the season to find the species.

Saltwater marsh, saltflat and mudflat dwelling species

Although the mudflats and saltflats are harsh and highly specialized habitats, there are several insects highly adapted to them. At Ballona the Insect families of Coleoptera, Hemiptera, and Diptera provide most of these specialized species. Species we particularly looked for have all decreased in density or disappeared since from the 1980 survey. None of these species have been listed in the NDDB.

1. *Cicindella trifasciata sigmoidea*. The western mudflat tiger beetle occurs in most, if not all, estuaries in southern California that have not been totally degraded. The adults have a longevity of several months and can be found from late winter through early fall. At Ballona we have sighted less than a dozen individuals, all on the mud banks of the channel adjacent to the dunes area. The following two tiger beetles were present in the mudflat of lower Ballona Channel in 1980. We were unable to find them in 1990. The reason for the apparent population declines is not clear, but should be viewed with concern.

2. *Cicindella haemorrhagica haemorrhagica*.The red belly tiger beetle.

3. *Cicindella oregona oregona*. The Oregon tiger beetle.

4. *Dolichopodidae*. Long legged flies. Two unidentified species were found to be common by Nagano in 1980. Dolichopod flies are usually common in salt marsh habitats, along with a few other specialized flies as the brine flies, Ephydridae. However, although the brine flies remained very common during our survey, Dolichopodids were scarce, numbering in the tens at any one place on any day. The apparent decline cannot be interpreted given current knowledge. The case is another matter of lack of experts and insufficient support for research for invertebrates.

5. *Saluda species* . Shore bugs. According to Polemus (1985) four species should be found. Nagano et al. (1981) listed two species, but the more recent revision makes the earlier conclusions questionable. Although we periodically observed shore bug activity in the salt marsh areas, we did not collect *Saluda* species.

Riparian and upland coastal sage community species

There is only one species associated with these plant communities at Ballona that can be considered a rare or narrow endemic. A camel cricket of the genus *Ceuthophilus*, apparently undescribed, has been found exclusively in the freshwater marsh near Hastings canyon. Specimens will sent to the expert in this group for further evaluation. It is clearly different from the related C. *californianus* that

commonly occurs on the sand dunes. Presence of what may be a unique species re-emphasizes the very high value of the small freshwater marsh.
There are a number of insect species feeding in several guilds in the willow community. Although the riparian areas were not intensively surveyed, a rich community of both herbivorous Lepidoptera and Coleoptera plus some members of virtually every insect order is associated with riparian species, especially willows. The willows were not specifically inventoried, but would no doubt yield lower diversity than is to be found in the relatively undisturbed communities of the Santa Monica mountains. A re-introduced set of freshwater fish will depend on high insect productivity for sustenance. Although Dragonflies are not uncommon, mayflies (Ephemerida) that occurred in the 1930's, have disappeared.

Both the extinct Ballona cinquefoil and the Ventura milk vetch probably hosted several endemic herbivores each as these plants are in groups well known for their rich dependent herbivores. A cascade of extinctions could have followed the loss of these two plants. Both were associated with the freshwater marsh, as are their extant sister species today

Monarch butterflies

Monarch butterflies are found as overwintering residents because of the presence of a blue gum grove in area B. Whether the butterfly roosts were natural is unknown, but certainly were dependent on native tree species had they been so. Usually the species rests on native pines, as at the famous Monterey grove. This spectacular butterfly depends on coastal winter rooting sites and populations have apparently been decreasing in recent years in part because of roost destruction.

DISCUSSION

Additional species may well be of concern, but limited systematic information on their taxonomic relationships and distributions make assessment difficult at this time. The dwindling corps of taxonomists who can deal competently with the identification of arthropod species, particularly in obscure groups, seriously limits studies of community structure and ecological interactions. The absence of simple taxonomic evaluations and concurrent biological data in turn leaves estimation of environmental significance tentative for a large number of taxa. The best that can be hoped for is that the better known threatened and endangered species, listed or candidate, will provide an umbrella to preserve the multitude that remains unrecognized. Care must therefore be taken in remedial actions to emphasize restoration of general ecosystem values and not only conditions that benefit target species.

Quantitation of degradation of the entire site is reflected by known changes in both flore and fauna of the area, including the status of Arthropods as only a part of the whole. For the case with flowering plants, 75 native sand dunes species were originally recorded from the El Segundo sand dunes (The Ballona dunes are a northern extension of this dunes system). Of these, 51 survive today on the 370 acre LAX fragment while only 14 survive at Ballona, representing 81% species loss at the latter site, assuming the entire suite was present historically. The flora of the bluff face and alluvial extentions of the former coastal prairie and coastal sage communities has not been formally calculated, but must be of the same order of magnitude. The salt water marsh has an expected 20 plant species of which only 10, or 50% have persisted. Among animals, 18 native mammals are expected, but no more than 6 remain, a 67% loss. The six species of (coastal sage) scrub obligate birds are no longer present, all now only memories. The Arthropods have likewise not faired well, but precise estrimates are impossible except for butterflies and possibly beeflies, data for which are given above.

The utimate causes of these losses in natural biodiversity are complex. but primarily involve substrate disturbance and consequent massive invasions by opportunistic exotic plants and animals that destroyed historic ecosystem functions. Changes in arthropod populations have not escaped these negative impacts as all species are related. The ecosystem has also clearly not stabilized, but remains in flux as the exotics are expanding with new relationships being established. Thus the red fox expansion has eliminated those species dependent on the many small mammals formerly extant. The rapidly expanding Mediterranean chrysanthemum, pampas grass, iceplant and *Myoporum* have co-opted native food webs. Recent flooding of the brackish water channels by freshwater from a de-watering project has further insulted any aquatic remnants. The details of these changes must be addressed in a more than superficial manner.

IMPACT ANALYSIS

Direct and indirect impacts

By community

Arthropod populations across all areas and biotic communities of the Playa Vista project are depauperate compared with communities of similar habitats nearby. The effect is reflected by reduced numbers of native species, numbers of individuals, and biomass. This degradation correlates with high densities of non-native vegetation and is further manifest by several introduced insects as the commonest species. However, natural successional changes are occurring that may lead to increases in the natural vegetation densities, as evidenced by the increasing cover of sage, sumac and coyote bush in areas A, C, D, and the earlier farmed eastern section of B. On the other hand, at present open accessibility of most areas to foot traffic, domestic animals, trail bikes, encampments by the homeless, off road vehicles, and even illegal dumping unfortunately promotes continuing disturbances that provide habitat to alien species at the expense of natives. In places human impact is sufficiently severe to overcome beneficial succession processes.

Riparian

Except the sections of Centinela creek that lie in area D, all significant riparian and freshwater marsh fragments are in area B and will not be effected by proposed development of structures. During the course of habitat restoration extant riparian values, at least in area B, must be maintained so that the remaining arthropod populations species are not lost through mitigation processes in order to achieve other objectives. Presence of the ornate shrew, and its arthropod prey, wholly depend on keeping the marshes intact. Similarly, the richest riparian fragments of area D, slated for total modification, should be retained intact to provide an inoculum of riparian animals during proposed construction.

Sand dunes

The sand dunes are wholly located where they will not be disturbed by any construction activity. Furthermore, the dunes restoration plan is predicated on no disturbance of native plants. Native biomass here is so low that dependent arthropods must all be in danger of chance extinction. The proposal of adding fill sand to augment the dunes configuration must be conducted with care to minimize losses of fossorial species.

Bluffs/coastal sage community

The bluffs are not involved in any development process and hence will be free from disturbance of construction. Nevertheless, substantial negative impact will result from inproperly conceived mitigation. Accordingly, the proposal presented for restoration does not take into account the fundamental biological requirements of animals, nor does it recognize patch phenomena of the whole biota. Revegetation of the bluffs must be restricted to replacement of exotic plants taking care to minimize disturbance effected by clearing and the use of chemicals. The proposed high density use of exotic species does not merit comment.

Salt marsh

The remaining primary salt marsh fragments are restricted to portions of area B that will not be subjected to development activity. Available proposals for salt marsh revegetation do not recognize present values, however, and the extensive recontouring these proposals suggest will have serious negative impacts on the already poor arthropod species encountered. A significant quantity of pickleweed stand will be lost. In spite of the low apparent species densities in this habitat, the large area may preclude irreversible losses of species adapted to these sites.

Impacts to Area A

The substrate of this area is wholly dredge spoil that was placed over the native salt marsh across what was a tidal zone (Schreiber 1981) and see figure 1. The elevation was raised to about 8 ft. msl. A mixed community of native (*Rhus, Baccharis,* etc.) and exotic (*Cortaderia, Carpobrotus, Myoporum,* etc.) plants has become established over part of the area. The only known arthropod of interest on the site would be the wandering skipper, *Panoquina errans*. Elimination of its small population here, which exists on the mix of larval saltgrass foodplant, *Distichlis spicata,* and a few nectar sources, would not be significant to survival of the metapopulation of area B.

Conversion of area A to use as a marina would not impact any known arthropod species of special interest. All species would be expected to originate from native metapopulations that are now restricted to area B or the Ballona bluffs, as the wandering skipper exemplifies.

However, because of the indirect value of a healthy and diverse population of arthropods, especially insects, in both aquatic and terrestrial food webs, restoration of area A to approximate historic values would provide a greater buffer to preserve denser populations of all vertebrates and enhance their probability of survival.

Impacts to area B

This area provides the centerpiece of the Ballona wetland ecosystem. Virtually all natural values are restricted to the site. It serves as the major source of populations upon which the entire ecosystem depends. Apart from Phase 1 impacts, discussed separately below, extensive modifications have been proposed in attempting to "restore" the tidal salt marsh, lagoon, and mud and salt flats that were historically found on area B (figure 1).

A restoration plan for the sand dune of area B has been approved by the California Coastal Commission. Work to be undertaken is simple and straightforward, allowing three years for the complete removal of the extensive (about 90% cover and increasing) non-native plant cover, restocking and re-introduction of native plants. The three year period for restoration was predicated on replacement planting cycles that would permit the ground dwelling arthropods to re-establish populations. Only about 6 acres, or 2%, of area B is involved. In the meantime the dunes area is being heavily impacted by trampling because of failure to reduce accessibility (as noted above). Implementation of the plan will be positive. Native plant cover will exceed 90% after five years with insect species and population sizes increasing five fold if LAX dune restoration results are applied.

The other terrestrial sites are the bluffs and the Hastings Canyon alluvial wash. At the foot of the latter formation lies the largest freshwater marsh, and contiguous willow grove, of the entire property. These two communities have over 90% native plant cover, although pampas grass is rapidly invading both as well as the alluvial wash itself. The impact of pampas grass is to produce a virtual desert as no animals use this plant except European rats prefer them for nests.

At Playa Vista the *Eucalyptus* grove will most likely die when tidal action is restored. A plan to provide an appropriate roosting grove on higher ground, preferably involving native trees, would be highly desirable. Since several organizations are attacking the general problem of monarch conservation, a cooperative effort should be established to provide the optimal solution. The bluff revegetation plan includes augmenting populations of the milkweed foodplant for monarch larvae. Milkweed has greatly reduced numbers in the urban area from a few decades ago and larvae are now rarely seen where they were formerly commonplace. Foodplant provision may be trivial compared with the value of the roosting sites, however.

Tide land restoration: mid or full tidal?

All the arthropod data show that the richest habitats, in both individuals and species density, are the ecotone between dunes and pickleweed stands and the freshwater marsh associated with Centinela Creek. With respect to both terrestrial and halophyllic aquatic insects, the optimal management program for diversity and probably productivity would unquestionably be a mid-tidal system. The mid-tidal scenario would provide the greatest extent of edge or ecotone, as well as a larger area of upper salt marsh. Grading must be minimal in all natural areas. The keystone plants in the zone would be *Frankenia, Distichlis, Heliotropium* and *Atriplex*. Some tidal activity is necessary for not only plant reproduction (Zedler & Beare, 1986), but for saltmarsh insect communities (Cameron, 1972, 1976).

Channel formation in the tidal areas must be accomplished by natural erosion from tidal flows as far possible to avoid killing the mud dwelling species across such sites. Particularly, existing pickleweed beds, mud flats and salt pannes should not be tampered with by heavy machinery. Sites of the old agriculture fields and berms of iceplant cover have been sufficiently disturbed that recontouring can be legitimately undertaken in these areas. These precautions are required because of the scarcity of the mud flat tiger beetle and reduction of Dolichipodid fly populations. Decreases of these indicator species imply all is not well and restoration efforts in the wetland proper must be implemented with care.

A full tidal system would not provide the expanses of ecotone and would also cause loss of the freshwater marsh at the base of Hastings Canyon and a substantial part of Centinela Creek. Not only would this be historically improper, but would substantially reduce all terrestrial ecological values.

Impacts to area C

Area C was originally encompassed the area that was the mouth of Ballona Creek as it discharged into the lagoon system (figure 1). The groundwater at this point was probably quite close to the surface. With a year round flow of Ballona Creek this area of the marsh was probably freshwater. Today there are no traces of the historic community with over 95% of the cover non-native plants. The arthropod populations are probably equally poor with the only native species secondary and trivial. The area could be restored to marsh or alluvial coastal shrub, in which case there would be rich arthropod habitat. Area C is surrounded by barriers, however, including major highways, Ballona channel, and dense housing. The relatively small size of the area coupled with its isolation leave it the least appealing site to preserve. Loss of the area by conversion would remove open space. Biological resources, as native species biomass of both plants and animals, would be mitigated by restoration of the more appropriate areas.

Impacts to area D

Area D is the second most valuable biological resource area on the Playa Vista site. In addition to providing the channel of Centinela Creek, now represented by a ditch re-aligned from it's historic course, there are over 30 acres of the Ballona bluff and several acres of alluvium at the base of the bluff along the south-west corner. The proposed phase 1 plan will seriously impact this habitat. It is discussed in detail below. The alluvium is covered by a fairly rich native coastal sage community occupied by several keystone plants that are foodplant to a number of species of insects. The few specimens of rattlepod, *Astragalus leucopsis*, suggests this micro site has remained relatively undisturbed. Rattlepod has been extirpated at the LAX dunes. It is a keystone plant with a number of insects dependent upon it.

Development of area D into housing will remove a large open space acreage from the area. It will also permit easy access by residents, their children and pets, to the remnant native bluff biota. Although there are no identifiable arthropod species of special interest across area D, the bluff portion is covered with coastal sage scrub, a suggested endangered plant community (Westman, 1987).

Impacts of Phase 1

The phase 1 development includes a presumptive habitat augmentation scheme with mitigation value. Centerpiece is a freshwater marsh extending along the west side of Lincoln Blvd and covering some 20 acres. Ancillary to this marsh is a re-aligned and partially concreted channel for Centinela Creek extending along the toe of the bluff from the easternmost project boundary to Lincoln.

In addition to providing questionable functional service, phase 1 implementation will be a disaster for the populations of ground dwelling arthropods destroyed during construction. The plan involves completely clearing and contouring the land for both structures. Later re-planting will presumably "restore" riparian communities. Revegetation is the simplest part of "restoration" with almost guarantied success. Replacing lost animal populations, even of most insects, is extremely difficult (Ehrlich, 1989, Mattoni, unpub.). The land to be cleared involves all freshwater habitat on the project site. Any manipulations of this habitat can only intelligently be accomplished by minimal interruption by heavy machinery.

The lined and contoured Centinella channel would also not be protected from local residents, but then it is designed for heavy maintenance. The effect is that the channel will be an artificial landscape with few and superficial native resources. The freshwater marsh likewise qualifies only as a engineering phenomenon. The marsh will not function in any way as the historic marsh did, which was as a broad conduit to the lagoon that supported not only its own biota, but provided regular freshwater flow that permitted persistence of the lagoon plants and probably many animal species as well. Ecological function will be precluded as the marsh serves as a flood control structure, its spillways quitely awaiting a 50 year storm event, while providing superb habitat for mosquitoes and weedy plants.

Restoration by destruction of native habitat it is an oxymoron.

Cumulative impacts: effects of development

The major negative cumulative impact will be reduction of potential habitat size by the Playa Vista project. The animals most affected by this reduction have, unfortunately, already been impacted. Scrub obligate birds are essentially eliminated, and most reptiles and mammals are only memories. The flip side of open habitat reduction will be economic resources that will permit restoration of the best of the degraded remainder. The degradation may be more severe among the arthropods because of massive replacement of native by exotic plant species. In the process of plant extinction and extirpation their dependent herbivore animal species no doubt also disappeared. Comparative data from ground dwelling species to those of the El Segundo dunes and vicinity underscore this loss of nature.

At the present time fairly large stands of native flora survive in the Baldwin Hills and on the El Segundo sand dunes at LAX. To the extent that corridors remain, at least for volant animals, there is a positive impact. These situations may be reduced in value, however, with increasing urbanization and denaturation of their habitat value.

In conclusion I return to the opening quote of Aldo Leopold. The primal goal of the project must be to save all the cogs and wheels and not be romanced by tinkering. For both plants and animals more than a third of the native species have been lost, with even greater proportional native biomass, across the ecosystem encompassed by the Playa Vista project. Impacts of certain parts of the mitigation plans will reduce resident biodiversity further. At this time, additional biological data gathering is not necessary as an alternative to planning that involves input of informed conservation biologists armed with data gathered for this report.

LITERATURE CITED:

Cameron, G. N. 1972. Analysis of trophic diversity in two salt marsh communities. Ecology 57:58-73

Cameron, G. N. 1976. Do tides affect coastal insect communities? Am. Mid. Nat. 95:279-287.

Clausen, J., D. D. Keck & W. M. Heisey. 1940. Regional differentiation in plant species. Carnegie Inst. Wash. Publi., 520, 1-452.

Disney, R. H. L. 1989. Does anyone care? Conservation Biology 3:414.

Ehrenfeld, D. 1989. Is anyone listening? Conservation Biology 3:415.

Ehrlich, P. R. 1989. The machinery of nature. Simon and Schuster, NY.

Karr, J. R. 1990. Avian survival rates and the extinction process on Barro Colorado Island, Panama. Conservation Biology 4:391-397.

Mattoni, R. H. T. 1989. The *Euphilotes battoides* complex: recognition of a species and description of a new subspecies. J. Res. Lepid. 27:173-185.

Mattoni, R. H. T. 1990a. Species diversity and habitat evaluation on the El Segundo sand dunes at LAX. Report to the Los Angeles Board of Airport Commissioners.

Mattoni, R. H. T. 1990b. Butterflies of greater Los Angeles. 20 pp. Lepid. Res. Found. Beverly Hills, CA.

Mattoni, R. H. T. 1990b. Unnatural acts: Succession on the El Segundo sand dunes in California. *in* Hughes and Bonnickson, eds. Proc. 1st SER conf. Berkeley, CA 1989. Soc. Ecol. Rest. Madison WI.

Mattoni, R. H. T. 1991. The endangered El Segundo blue butterfly (Lycaenidae). J. Res. Lepid. 29: (in press).

Murphy, D. F. 1989. Conservation and confusion: wrong species, wrong scale, wrong conclusions. Conservation Biology 3:82-84

Nagano, C., J. Donahue, C. Hogue, and R, Snelling. 1981. in R. W. Schreiber, ed., The Biota of the Ballona Region, Los Angeles County. Los Angeles County Natural History Museum Foundation, Los Angeles.

Noss, R. F. 1990. Indicators for monitoring biodiversity: A hierarchial approach. Conservation Biology 4: 355-365.

Polemus, J. T. 1985. Shore Bugs (heteroptera: Hemiptera; Saldidae). Different Drummerm Englewood, CO.

Quinn, J. F. & A. Hastings, 1987. Extinction in subdivided habitats. Conservation Biology 1:198-208

Schreiber, R. W. 1981. The Biota of the Ballona Region, Los Angeles County. R. W. Schreiber, ed., Los Angeles County Natural History Museum Foundation, Los Angeles.

Smith, R. I. & J. T. Carlton, 1975. Light's Manual: Intertidal invertebrates of the central California coast. 3rd ed. Univ. Calif. , Berkeley.

Soule, M., et al. 1988. Reconstructed dynamics of rapid exinctions of chaparral-requiring birds in urban gabitat islands. Conservation Biology 2:75-92.

Terborgh, J. 1988. The big things that run the world-A sequel to E. O. Wilson. Conservation Biology 2:402-403.

Thomas, J. A. 1983. A quick method for estimating butterfly numbers during surveys. Biol. Conservation 27:195-211.

Usinger, R. L. 1959. The Aquatic Insects of California. Univ. Calif. Berkeley.

Westman, W. E. 1987. Implications of ecological theory for rare plant conservation in coastal sage scrub. in Elias, T. S. (ed.) Conservation and Management of Rare and Endangered Plants. Sacramento, CA. CNPS.

Zedler, J. B. & P. A. Beare, 1986. Temporal variability of salf marsch vegetation: The role of low-salinity gaps and environmental stress. Pp. 295-306 *in* Wolfe, D. A. ed. Estuarine variability. Academic. NY.

Table 1

List of arthropod species from the Ballona vicinity given on the background of the comprehensive database of arthropod species from the adjacent El Segundo sand dunes and coastal prairie. The basic database includes species noted in the surveys of 1938-1939 and 1987-1988 at El Segundo. Species now extant are numbered, species not noted in recent years unnumbered and followed by the notation ext. Numbers in parentheses after species names are the identification number for pitfall trapped species.

Species found at Ballona/Playa del Rey sand dunes only are indicated by underlining. Species found in other than dune habitat at Ballona/Playa del Rey only are listed in the last section of this table .

Two data sets from Ballona/Playa del Rey are summarized: Nagano et al. in 1980 and this survey in 1990-1991. Presence in 1980 and /or 1990 from the current survey indicated by X under the proper year. Species or groups not sampled, sampling not comparable, or identification not available indicated by NS. See text for further explanation.

Higher systematics follow Borror, et al. 1981. Phyla, classes, and orders indicated. Family and subfamily names in bold face italics. The systematics of the Lepidoptera follows Hodges (1985), except the ordination has been changed.

MOLLUSCA GASTEROPODA	1980	1990
1. *Helix aspersa*		X
2. *Otala lactea*		X
3. *Helminthoglypta traskei*		
Vertigo trinotata		
Vertigo californica		
ARTHROPODA DIPLOPODA		
Spirobolida		
1. *sp. no. 1* (71)	X	
2. *sp. no. 2* (107)		
CHILOPODA		
Geophilomorpha		
1. *sp. no. 1* (106)		
Lithobiomorpha		
1. *Lithobius sp.* (105)		
MALACOSTRACA		
Isopoda		
Bathytropidae		
1. *Alloniscus peronvexus* (72)		
2. *Mauritanicus littorinus* (114)		
Porcellionidae		
3. *Armadillium vulgare* (146)	X	
4. *Porcellio dillitatum* (113)		
5. *P. laevis* (113)	X	
ARACHNIDA (det. Hebert)		
Scorpiones		
Vejovidae		
1. *Paraoroclonus silvestri* (68)		
Pseudoscorpiones		
1. *Garypus californicus* (67)		

Solfugae		
1. *Eremobates sp.* (66)	X	X
Opiliones		
1. *Protolophus* nr. *singularis* (102)		X
Acari		
Trombididae		
1. *Trombidium sp.* (69)		
2. *sp. no. 2* (70)		
3. *sp. no. 3* (103)		
4. *sp. no. 4* (104)		
Family		
5. *sp. no. 5* (122)		
Araneae		
Ctenizidae		
1. *Apostichus simus* (108)	X	X
Zodariidae		
2. *Lutica sp.* ( )	X	X
Oonipidae		
3. *Scapiella hesperus* (97)	X	X
4. *Opopaea sp.*		
Oecobiidae		
5. *Oecobius sp.*	X	
Dysderidae		
6. *Dysdera crocata* (57)	X	X
Clubionidae Sac spiders		
7. *Chiracanthium inclusum* (62)	X	X
8. *Trachelis sp.*		
9. *Castianeira sp. no. 1* (100)		X
10. *Castianeira sp. no. 2* (163)		X
Phrurotimpus sp.	X	
Agelenidae Sheetweb or grass spiders		
11. *Hololena curta n ssp.?* (62)		X
12. *Calilena angelina*		
13. *Calymmaria sp.*		
14. *Agelenopsis sp.*		X
Theridiidae Cobweb spiders		
15. *Theridion sp.*		
16. *Tidarron sp.*		
17. *Steatoda grossa* (98)		X
18. *S. fulva*		
19. *Crustulina sp.*		
20. *Latrodectus hesperus* (65)	X	X
Thomasidae Crab spiders		
21. *Misumenoides formosipes*		
22. *Misumenops rothi*		
23. *Xysticus gulosus* (63)		X
24. *X. montanensis*		
Philodromidae Crab spiders		

25. *Ebo pepinensis*		
26. *Ebo n. sp.*		
27. *Tibellus nr. californicus* (147)		
Araneidae Orbweaver spiders		
28. *Argiope argentata*		
29. *Eustala conchlea*	X	
30. *Neoscona oaxacensis*		X
31. *Cyclosa turbinata*		
32. *C. conica*		
33. *Tetragnatha sp.*		
Lycosidae Wolf spiders		3 unident. species
34. *Allocosa sp.*		
35. *Alopecosa sp.*		
36. *Pirata sp.*		
Salticidae Jumping spiders		
37. *Habronnatus sp. no. 1* (173)		X
38. *Habronnatus sp. no. 2*		
39. *Metacybra sp.*		
Phidippus johnsoni		X
Anyphaenidae		
40. *Anyphaena sp.*	X	
Gnaphosidae Running or mouse spiders		2 unident. species
41. *Zelotes sp. no. 1*	X	
42. *Zelotes sp. no. 2*		
43. *Herpyllus propinquis*	X	
44. *?Trachyzelotes sp.*		
45. ? *Gnaphosa sp.*		
46. *Micaria sp.* ?		
47. *Mimetus hesperus*	X	
Poecilochroa oscellata (162)		X
Pholcidae		
48. *Psilochorus sp.* (58)		X
Oxyopidae Lynx spiders		
49. *Oxyopes sp no. 1*		
50. *Oxyopes sp. no. 2 (?different)*		
51. *Peucetia viridens*		
Linyphiidae		
52. *gen. sp. no. 1*		
53. *gen. sp. no. 2*		
at least one more sp.		
Filistatidae		
54. *Filistatinella sp.*		

HEXAPODA Class Insects

Collembola Order Springtails (det. P. Bellinger) sampling by both Nagano et al and ourselves was not comparable

Entomobryidae		1 unident. species
1. *Entomobrya atrocinta*		
2. *E. multifasciata*		
3. *E. unostrigata*		
4. *E. californica*		

5. *Xenylla wilsoni*	X	
Thysanura Order Silverfish		
Lepismatidae		
1. *Lepisma sacharina*		
Allacrotelsa spinulata	X	
Microcoryphia Order Jumping Bristletails		
Machilidae		
2. *Sp. no. 1* (35)	X	X
3. *Sp. no. 2* (36)		X
Ephemeroptera Order Mayflies		
Family & species undet. coll by Pierce 1939 ext		
Odonata Order Dragonflies and Damselflies		
Aeshnidae		
1. *Aeshna multicolor*	X	X
2. *Anax junius*	X	X
Libellulidae		
3. *Tarnetrum illotum*		
4. *T. corruptum*	X	X
5. *Tramea onusta*		X
Pantala hymenea	X	X
P. flavescens	X	X
Coenargionidae		
6. *Sp. no. 1*	X	X
Enallagma sp.	X	X
Orthoptera order Grasshoppers, crickets, mantids, cockroaches (det. D. Weissman)		
Acrididae		
1. *Conozoa texana*		
2. *Trimeritropis californica*	X	X
3. *T. pallidipennis*	X	X
4. *Schistocerca vaga*		
5. *Melanoplus devastator*	X	X
6. *Psoloessa thamnogaea*		
Tettigonidae		
7. *Scudderia mexicana*	X	X
8. *Neduba morsei*	X [illegible]	
Nebuda new species		X
9. *Brachyinsara hemiptera*		
10. *Ideostatus aequalis*		X
Gryllidae		
11. *Gryllus integer*	X	
12. *Oecanthus argentinus*	X	
13. *Cycloptilum distinctum*		
13a. *Acheta assimilis* (42)		X
Myrmycophila sp. (166)		X
Stenopalmatidae		
14. *Stenopalmatus n. sp.* I, Weissman	X	X

15. *Stenopalmatus n. sp.* II, Weissman	X	X
Raphidophoridae		
16. *Ceuthophilus californianus*		X
Phasmatidae		
17. *Parabacillus hesperus*		
Mantidae		
18. *Litaneutria minor*		
19. *Stagmomantis californica*		
20. *Iris oratoria*		
Polyphagidae		
21. *Arenivaga n. sp.* Nickel	X	X
Mogoplistidae		
Hoplosphyrum boreale	X	
Dermaptera Order Earwigs		
Forficulidae		
1. *Forficula auricularia*	X	X
Isoptera Order Termites		
Rhinotermitidae		
1. *Reticulotermes hesperus*		
Psocoptera Order Psocids		
Sp. no. 1.	X	X
Thysanoptera Order Thrips (det. W. H. Ewart)		
Phlaeothripidae	NS	NS
1. *Haplothrips robusta*		
2. *H. clarisetis*		
Thripidae	NS	NS
3. *Apterothrips apteris*		
4. *Neohydatothrips moultoni*		
5. *Limothrips cerealum*		
6. *Aphanothrips obscurus*		
7. *Frankliniella minuta*		
8. *F. occidentalis*		
9. *Taeniothrips sp. 1*		
10. *Thrips madronii*		
11. *T. tabaci*		
Hemiptera Order Bugs		
Corixidae		
1. *Sp. no. 1*		
Reduviidae		
2. *Zelus sp.*	X	X
3. *Rhinocoris ventralis* ext		
Alydidae		
4 *Stachyonemus sp.*		
5. *Alydus sp.* (152)		
Lygaeidae		
6. *Geocoris sp.* (25)		X
7. *Emblethis vicarius* (21)		

8. *Lygaeus kalmii*
9. *L. reclivatus* ext
10. *Melanopleuris bicolor* (20)
11. *Nysius ericae*

Coreidae

13. *Stachyocnemus* (23)
14. *Scolopocerus sp*
15. *Narnia inornata* ext

Rhopalidae

16. *Arhyssus*
17. *Liorhyssus ?hyalinus* (22)

Miridae

18. *Lopidea nigridea*
19. *L. marginata*
20. *Lygus hesperius*
21. *Closterocoris amoenus*
22. *Zelus sp.*
23. *Dacurla sp.* (27)
24. *Sp. no. 124*
25 *Sp. no. 125*
26. *Sp. no. 128*
27. *Sp. no. 129*

Largidae

28. *Largus cinctus*

Pentatomidae

29. *Petidia uhleri*
30. *P. sayi*
31. *Acrosternum hilari*
32. *Banasa sp.*
33. *Thyanta custator accerra*
34. *Chlorochroa congrua* ext
35. *T. rugulosa* ext

Eurygaster alternata ext

Scutellaridae

36. *Acanthoma sp.*
37. *Sp. no. 1 138* (26)
38. *Sp. no. 2 139* (28)
39, *Euptychodera corrugata* ext

Cydnidae

40. *Pangaeus bilineatus* (24)
41. *Sp. no. 1* (153) X

Nabidae

42. *Nabis sp* ext

Veliidae

43. *undet sp.* ext

HomopteraOrder Cicadas, Leafhoppers, Aphids, Scales, Whiteflies Not sampled by Nagano et al.

Dictyophoridae

1. *Orgerius triquestra complex* (29) X

Cicadellidae (30) & (31) XX unident.

2. *Aceratagallia pallida* ext

3. *Alconeura necopinata*
4. *Amblysellus grex* ext
5. *Amphigonalia bispinosa*
6. *Balclutha sp.* ext
7. *Ballana sera*
8. *Ballana sp.*
9. *Carneocephala fulgida* ext
10. *Circulifer tenellus* ext
11. *Calladonis geminatus*
12. *Dikrania carneola*
13. *Empoasca cerea* ext
14. *Exitianus exitiosus*
15. *Friscanus friscanus*
16. *Giprus angulata*
17. *Lystidea nuda*
18. *Momoria rufoscutella*
19. *Osbornellus n. sp?* ext
20. *Osbornellus sp.*
21. *Penestragania robusta*
22. *Ponana punctipennis*
23. *Prairiana sp.*
24. *Scaphytopius sp.* ext
25. *Texananus sp.*
26. *Tiaja interrupta*
27. *Xerophloea brunnea*
28. *X. vanduzeei*
29. *X. peltata*

Cixiidae

30. *Oliarus sp.*

Membracidae

31. *Stictocephala bubalis*
32. *Tortistylus albidosparsus*

Delphacidae

33. *Stobaera sp.*
34. *Stobaera muiri*
35. *Toya propinqua* ext

Cercopidae

36. *Clastoptera brunnea* ext

Margarodidae

37. *Icerya purchasi*

Coccidae

38. *Pulvinaria sp.*
39. *Saissetia hemispherica*
40. *S. oleae*
41. *Odonaspis ruthae*
42. *Sp. no. 1* (33)

Psyllidae

43. *Calophya californica*

Paratrioza lavaterae Foodplant *extirpated* ext

Flatidae

44. *Mistharnophantia sonorana*

Issidae

45. *Danepteryx robusta* ext		
Pseudococcidae		
46. *Pseudococcus maritimus*		
47. *P. eriogoni*		
48. *P. citri*		
49. *P. aurilanatus*		
Eriosomatidae		
50. *Sp. no. 1*		
Aphididae (32) unident. species		X
51. *Uroleucon katankae*		
52. *U. rudbeckiae*		
53. *Acrythosiphon kondoi*		
54. *A. pisum*		
55. *Myzus persicae*		
56. *Cryptomyzus ribis*		
57. *Aphis eriogoni*		
58. *A. helichrysi*		
59. *A. medicaginis*		
60. *Brevicoryne brassicae*		
61. *Macrosiphon albifrons*		
62. *M. ambrosiae*		
63. *M. sp.*		
64. *Rhopalosiphon lactucae*		
65. *Capitophrus glandulosis*		
66. *Lipaphis pseudobrassicae*		
67. *Myzus convolvulae*		
68. *M. persicae*		
Neuroptera Order Lacewings, Antlions		
Myrmeleontidae		
1. *Myrmeleon arizonicus*	X	
2. *Brachynemurus brunneus*	X	
Hemerobiidae		
3. *Hemerobius pacificua*	X	
4. Sp. no. 2		
Chrysopidae 1 unident. species		
5. *Chrysoperla ploribunda*		
6. *Eremochrysa punctinervis*		
<u>*Chrysopa carnea*</u>	X (misiden?)	
Coleoptera Order Beetles		
Cicindelidae		
Cicindella hirticollis gravida ext		
Carabidae		
1. *Calosoma semilaeve* (120)	X	
2. *Pterostichus californicus* (75)	X	X
3. *Amara californica* (76)	X	X
4. *Calathus ruficollis* (77)	X	X
5. *Tanystoma maculicolle* (78)	X	
6. *Agonum crenistrictum*	X	
7. *A. californicum*	X	
8. *Bembidium nr. quadrulum*	X	X
9. *Tachys corax*	X	

10. *Anisodactylus californica*	X	
11. *Bradycellus sp.*	X	
12. *Stenolophus sp.*	X	
13. *Apristus laticollis*	X	
Histeridae not adequately sampled		
14. *Xerosaprinus fimbriatus* (7)	X	X
15. *Geomysaprinus pasminosus*		
16. *Spilodiscus sellatus* (150)		
17. *Hypocaecus lucidolis*		
Saprinus discoidalis (=bigemmeus Pierce det.) ext		
Scarabaedae		
17. *Parathyce palpalis*	X	X
18. *Diplotaxis sp.*		
19. *Serica sp.* (16)		X
20. *Aegialia convexa*		
21. *Psammodius mcclayi*		
22. *Aphodius rugatus* (80)	X	X
23. *A. militaris*		
24. *A. fuscosus*	X	
25. *A. lividus*	X	
Ligyrus gibbosus (Haplopappus) ext		
Dichromina dimidiata (Datura) ext		
Heteroceridae		
26. *Heterocerus gnatho*		
Buprestidae		
27 *Acmaeodera fenyesi*	X	
Agrilus lacustris (Croton) ext		
Elateridae NS		
28. *Hypolithus sp.* (81)		
29. *Anchastus cineripennis*	X	
30. *Sp. 1* (82)		X
31. *Sp. 2* (83		X
32. *Sp. 3*		
Aeolus sp. (160)		X
Cantharidae		
33. *Cantharis consors*		
Dermestidae		
34. *Dermestes sp.* (124)	X	X
Anthrenus lepidus ext	X	
Anthrenus verbasci	X	
Anobiidae		
Megorama viduum (Corethrogyne stems & roots) ext		
Ptinidae		
35. *Ptinus fur*	X	X
Gen. sp. 1	X	
Melyridae 1 unident. species		
36. *Collops cribrosus* (84)		
37. *C. marginicollis*	X	
38. *Attalus lobulatus*		
39. *Sp. no. 1*		
40. *Trichochrous squalidus*		
41. *T. antennatus*		

Dasytastes bicolor ext		
Eschatocrepis constrictus ext		
Coccinellidae		
42. *Rodolia cardinalis*		
43. *Crytolaemus montrouzieri*	X	
44. *Oila v-nigrum*	X	
45. *Psyllobora taedata*		
46. *Cycloneda munda* (138)		X
47. *C. polita*		
48. *Coccinella californica* (137)	X	X
49 *Hippodamia convergens* (139)	X	X
50. sp. 1 Hawks (19)		
51. sp. 2 Hawks		
Scymnus marginicollis ext		
<u>*Chilocorus bivulnuris*</u>	X	
Colydiidae		
52. *Anchomma costatum* (11)	X	X
53. *Rhagodera ? tuberculata*		
Tenebrionidae (John Doyen)		
54. *Metaponium convexicolle*		
55. *Eleodes omissa* (6)		
56. *E. gracilis* (5)	X	X
57. *E. nigropilosa* (13)	X	X
58 *E. littoralis* ext		
59. *Blapstinus sp.* ext		
60. *Nyctoporis carinata* (118)		X
61. *Cratidus osculans* (14)	X	X
62. *Helops blaisdelli*		
63. *Stenotrichus rufipes* ext		
64. *Coelus globosus* (12)		
65. *C. ciliatus* (8)	X	X
66. *Coniontis affinis* (10)	X	
67. *Hylocrinus longulus* (15)		
<u>*Epantius obscurus*</u>	X	X
Staphylinidae NS		
68. *Sepedophilus sp.* (125)		X
69. *Sp. no. 1* (9)		X
70. *Sp. no. 2* (79)		
71. *Sp. no. 3*		
72. *Sp. no. 4*		
Alleculidae		
73. *Isomira sp.*		
Mordellidae		
74. *gen &sp* (139)	X	X
Cerambycidae		
75. *Ipochus fasciatus* (17)	X	X
Bruchidae		
76. *Stator limbratus*		
77. *S. pruininus*		
Chrysomelidae		
78. *Exema conspersa*		
79. *Lema trilineata daturiphila*		

80. *Diabrotica undecimpunctata*	X	X
81. *D. soror (Curcubita)* ext		
82. *Cryptocephalus sanguinicollis*		
83. *C. sprucus*		
84. *C. confluentus*		
85. *Altica obliterata*	X	
86. *Altica sp. no. 1*		
87. *Diachus auratus*	X	
88. *Microrhopala rubrolineata (Heterotheca)* ext		
Curculionidae		
89. *Cleonus cristatus (Chaenactis stems and roots)* ext		
90. *C. sparsus (Erysimum stems and roots)* ext		
91. *Cleonidius pericollis* (88)		
92. *Apion proclive*	X	
93. *Pantomorus cervinus (Lupinus chamissonis)* ext pest		
94. *Rhigopsis effracta* (86)		X
95. *Listeroderes obliquua*	X pest	
96.. *Sitona cylindricollis* (87)	X	
97. *Trigonoscuta dorothea* (18)	X	X
98. *Trichobaris compacta*		
99. *Onychobaris langei*	X	
100. *Smicronyx calaenus*	X	
101. *S. cuscutiflorae*		
102. *S. elsegundis(Cuscuta flowers)* ext ?		
103. *Baris sp.*		
104. *Cylindrocopturus sp.* (123)	X	
Pselaphorhynchites aeratoides (Eriogonum parvifolium) ext		
Scolytidae		
105. *Phloeosinus sp.*		
106. *Chaetophloeus hystrix (Rhus integrifolia leaves)* ext		
undet. fam.		
107. *Octinodes sp.*		
Dinocleus albovestitus		ext

Lepidoptera Order (det. R. Leuschner)

GEOMETROIDEA Superfamily

Geometridae

Ennominae

1. *Elpiste marcesaria*
2. *Semiothisa californiaria*
3. *S. napensis*
4. *S. irrorata*
5. *Animomyia morta*
6. *Pero macdunnoughi*
7. *Anacamptodes fragilaria*
8. *Neoterpes edwardsata*
9. *Sabulodes aegrotata*

Geometrinae

10. *Nemoria leptalea*
11. *Dichorda illustraria*
12. *Synchlora aerata liquoraria*
13. *Chlorochlamys appellaria*

13.1 *Cheteoscelis faseolaria*	X	
Sterrhinae		
14. *Cyclophora nanaria*		
15. *Idaea microphysa*		
Larentiinae		
16. *Archiroe neomexicana*		
17. *Perizoma custodiata*	X	X
18. *Spargania magnoliata*		
19. *Euphyia implicata multilineata*		
20. *Zenophleps lignocolorata*		
21. *Orthonama obstipata*		
22. *Eupithecia misturata*		
23. *E. miserulata zela*		
24. *E. maestosa*		
SPHINGOIDEA Superfamily		
Sphingidae		
25. *Manduca sexta*		
26. *Hyles lineata*	X	X
NOCTUOIDEA Superfamily		
Arctiidae		
27. *Apantesis proxima*		
28. *Estigmene acrea*	X	
29. *Arachnis picta*		
Leptarctia californiae ext		
Notodontidae		
30. *Furcula scolopendrina*		
31. *F. cinerea cineriodes*		
Lymantridae		
32. *Orgyia magna*		
Noctuidae		
Herminiinae		
33. *Tetanoleta palligera*		
Hypeninae		
34. *Hemeroplanis finitima*	X	
Catocalinae		
35. *Caenurgia togataria*		
36. *Zale lunata*		
Plusiinae		
37. *Autographa californica*	X	X
38. *A. biloba*		
39. *Trichoplusia ni*		
Nolinae		
40. *Nola apera*		
Acontiinae		
41. *Eumicremma minima* n.ssp?		
Tarachidia candefacta ext		
Heliothinae		
42. *Heliothis virescens*		
43. *H. zea*		
44. *H. phloxiphagus*	X	

45. *Schinia scarletina*		
46. *S. pulchripennis*		
Noctuinae		
47. *Agrotis ipsilon*		
48. *A. subterranea*		
48. *Peridroma saucia*		
49. *Copeblepharon sanctaemonicae*		
50. *Xestia adela*		
51. *Hemieuxoa rudens*		
52. *Spaelotis havilae*		
53. *Euxoa messoria*		
54. *E. septentrionalis*		
55. *E. (wilsoni) riversii*		
Hadeninae		
56. *Lacinipolia stricta ssp?*	X	
57. *L. leucogramma*		
58. *L. quadrilineata*		
59. *L. vicina acutipennis*		
60. *Zosteropoda hirtipes*	X	
61. *Leucania oaxacana*		
62. *Protorthodes alfkeni*		
63. *P. melanopis ssp?*		
64. *P. rufula*		
65. *Pseudaletia unipuncta*		
66. *Dargida procincta*		
Discestra chartaria	X	
Cuculiinae		
67. *Stylopoda cephalica*		
Amphipyrinae		
68. *Platypergia extima*		
69. *P. mona*		
70. *Apamea cinefacta*		
71. *Spodoptera exigua*		
72. *Prodenia ornithogalli*		
73. *Catabena esula*		
PYRALOIDEA Superfamily		
Pyralidae		
Odontinae		
Psammobotys fordi ext		
Glaphyriinae		
74. *Abegesta remellallis*		
74.1 *Stega salutalis riparialis*		
75. *Dicymolomia metaliferalis*		
75.1 *Hellula rogatalis*		
Pyraustinae		
76. *Uresiphita reversalis*	X	X
77. *Loxostege immerans*	X	X
78. *Udea profundalis*		
78.1 *Pyrausta laticlava*		
79. *Lineodes integra*		
80. *Nomophila nearctica*		
81. *Diastichtis fracturalis*		

82. *Achyra occidentalis*
Crambinae
83. *Tehama bonifatella*
84. *Crambus sperryellus*
85. *Euchromius ocelleus ocelleus*
Chrysauginae
86. *Arta* n. sp. nr.*epicornalis*
Epipaschiinae
87. *Jocara trabalis*
Galleriinae
88. *Alphaias transferrans*
Phycitinae
89. *Etiella zinckenella*
90. *unident. n. sp./genus nr. Etiella*
91. *Adelphia ochripunctella*
92. *Heterographis morrisonella* misident of 92.2?
92.1 *Staudingeria albipenella*
92.2 *Hulstia undulatella*
93. *Phycitodes albatella mucidella*
94. *Ephestiodes gilvescentella*
95. *Vitula edmondsii bombylicolelis*
96. *Elasmopalpus lignosellus*

PTEROPHOROIDEA Superfamily
Pterophoridae
Platyptiliinae
97. *Platyptilia williamsi*
98. *Anstenoptilia marmarodactyla*
Pterophorinae
99. *Oidaematophorus* nr. *grisescens*

TINEOIDEA Superfamily
Tineidae
100. *Opogona omoscopa*
101. *Opogona* sp.
102. *Amydria* sp.
102.1 *Tinea sp*

SESIODEA Superfamily
Sesiidae
Synanthedon polygoni ext

COSSOIDEA Superfamily
Cossidae
102.2 *Comadia intrusa*

YPONOMEUTOIDEA Superfamily
Heliodinidae
103. *Lithariapteryx abroniella*
104. *Heliodines* sp.
Plutellidae
105. *Plutella xylostella*

TORTRICOIDEA Superfamily		
Tortricidae		
Olethreutinae		
106. *Eucosma hennei*		
Endemic, LAX dunes		
107. *Bactria verutana chrysea*		
108. *Phaneta apacheana*		
109. *Anapina triangulana*		
Tortricinae		
110 *Argyrotaenia citrana*		
111. *Platynota stultana*		
Cochylidae		
112. *Lorita scarfica (abornana)*		
Carolella busckana busckana ext		
GELECHIOIDEA Superfamily		
Blastobasidae		
113. *Holcocera sp.*		
Coleophoridae		
114. unident.		
Oecophoridae		
114.1 *Pressariodea gracillis*		
<u>*Martyhilda gracilis*</u>	X	
Momphidae		
115. *Mompha sp.*		
Cosmopterigidae		
116. *Walshia miscecolorella*		
117. *Pyroderces badia*		
118. *Telodoma helianti*		
Scythrididae		
119. *Scythris* sp. 1		
120. *Scythris* sp. 2		
Gelechiidae		
121. *Gelechia paraplutella*		
122. *Anacampsis lacteusocrella*		
123. *Aristotelia argentifera*		
124. *Chionodes mediofuscella*		
125. *C. lophocella*		
126. *Syncopacma nr nigrella*		
127. *S.* n. sp.		
128. *Aroga nr, unifasciella*		
129. *Rifseria fuscotaenirella*		
Dichomeris baxa (endemic?)		
PAPILIONOIDEA		
Papilionidae		
130. *Papilio zelicaon*	X	X
131. *P. rutulus*		
132. *Battus philenor philenor* (rare migrant)		
Pieridae		
133. *Pieris rapae*	X	X
134. *P. protodice*	X	X

135. *Anthocharis sara sara ext*		
136. *Colias eurytheme*	X	X
137. *C. hardfordii ext*		
138. *Phoebis sennae marcellina* (periodic migrant)		X
139. *Eurema nicippe* (periodic migrant)		X
Nymphalidae		
140. *Nathalis iole* (periodic migrant)		
141 *Coenonympha tullia california* ext		
142.*Danaus gilippus strigosus*	X	X
143.*D. plexippus*	X	X
144. *Agraulis vanillae incarnata*	X	X
145. *Chlosyne gabbii gabbii* ext.		
146. *Vanessa atalanta rubria*		X
147. *V. cardui*	X	X
148. *V. anabella*	X	X
149. *V. virginiensis*	X	X
150. *Nymphalis antiopa*	X	X
151. *Precis coenia*		X
Lycaenidae		
152. *Apodemia mormo* nr. *virgulti*	X	ext
153. *Strymon melinus*	X	X
154. *Callophrys augustus iroides*	1984 (RR)	
155. *C. perplexa*	X	X
156. *Brephidium exilis*	X	X
157. *Leptotes marina*	X	X
158. *Everes amyntula* ext.		
159*Plebejus acmon acmon*	X	
160. *Glaucopsyche lygdamus australis*	X	X
161. *Euphilotes battoides allyni ext*		
HESPEROIDEA		
Hesperidae		
162. *Polites sabuleti sabuleti*		X
163. *Hylephila phyleus*	X	X
164. *Pyrgus albescens*		X
165. *Erynnis funeralis*	X	X
166. *Panoquina errans*	X	X
167. *Paratrytone melane*		X
168. *Lerodea eufala*		X
169. *Atalopetes campestris*		X

Strepsiptera Order Stylops

Halictophagidae

1. *Diozocera comstocki* ext

Diptera Order Flies

Tipulidae

1. *Tipula sp. 1* (111)
2. *Tipula beatula*
3. *Gonomyia flavibasis*
4. *Limonia communis*

Psychodidae

010742

5. *Sp. no. 1*		
Culicidae		
6. *Culex sp.*		
7. *Culiseta sp.*	X	
8. *Aedes squamiger*	X	
Chironomidae NS, identification		
9. *Chironomus stigmaterus*		
10. *Crictopus sp.*		
11. *Dicrotendipes sp.*		
Simulidae NS, identification		
12. *Gen.& sp. no.l*		
Bibionidae		
13. *Bibio hirtus*		
Bibio albipennis	X	X
14. *Gen.& sp. no.1*		
15. *Gen.& sp. no.2*		
Sciaridae NS, identification		
16. *Gen.& sp. no.*		
Cecidomyiidae NS, identification		
17. *Asphondylia sp.*		
18. *n. gen. n. sp.1*		
Stratiomyidae		
19. *Nemotelus sp.*		
Nemotelus arator	X	
Tabanidae		
20. *Brennania belkini*	X	ext.
Therevidae		
21. *Cromolepidia sp.*		
22. *Psilocephala aldrichi*	X	
23. *Thereva sp. 1*	X?	
24. *Thereva sp. 2*	X?	
25. *Gen.& sp. no.1*		
Thereva nebulosa ext?	X	X
Scenopinidae		
26. *Scenopinus sp.*		
Apioceridae		
27. *Rhaphiomidas terminatus terminatus* ext		
Mydidae		
28. *Nemomydas pantherinus*	X	X
Asilidae		
29. *Metapogon pictus*		
30. *Ablautus coquilleti* (132)	X	X
31. *Stenopogon brevisculus*	X	
32. *Cophura clausa*	X	
33. *Mallophora fautrix*	X	
34. *Proctocantha coquilleti*		
35. *Asilus sp.*		
36. *Nicocles sp.*		X
37. *Leptogaster sp.*		X
38. *Saropogon luteus*		X
Acroceridae		
39. *Opsebius diligens*		

40. *Ogcodes sp.*		
Turbopsebius diliogens	X	
Bombyliidae		
41. *Conophorus collinius*		X
42. *C. fenestratus*		X
43. *C. cristatus*		
44. *Villa atrata*	X	X
45. *V. lateralis*	X	X
46. *V. molitor*		X
47. *Ligyra gazophylax*		X
48. *Poecilanthrax arethusa*	X	X
49. *Thyridanthrax hugator*		X
50. *Lepidanthrax homologus*	X	X
51. *L. oribates*		
52. *L. agrestis*		
53. *Neodiplocampta mira*		X
54. *Bombylius new species*		
55. *Exoprosopa doris*		X
56. *Exoprosopa nr. arenicola*		
57. *Exoprosopa sp. np. 1*		
58. *Paravilla syrtis*		
59. *Poecilognathus loewi*		
60. *Acreophthiria similis*		
61. *Phthiria sp. no. 1*		X
62. *Phthiria sp. no. 2*		X
63. *Geron nigripes*		X
64. *Geron New Sp. no. 23*		
65. *Mythicomyia pictipes*		
66. *Mythicomyia sp.*		
67. *Anastoechus melanohalteralis*		X
67 a. *Chrysanthrax sp.*		X
Heterostylum robustum		X
Dolichopodidae 2 unident. species		
68. *Gen.& sp. no.1*		
69. *Gen.& sp. no.2*		
70. *Gen.& sp. no.3*		
71. *Gen.& sp. no.4*		
72. *Gen.& sp. no.5*		
Phoridae		
73. *Gen.& sp. no.1*		X
74. *Gen.& sp. no.2*		
Pipunculidae NS		
75. *Pipunculus sp.*		
Syrphidae		
76. *Copestylum mexicana*	X	X
77. *Volucella tau*		X
78. *Syrphus sp.*		X
79. *Metasyrphus sp.*		
80. *Eristalis tenax*	X	X
E. aenus	X	X
81. *Sphaerophoria sp.*		
82. *Syritta pipiens*		
83. *Allograpta micrura*		

84. *A. obliqua*		X
85. *Scaeva pyrastri*	X	X
86. *Eupeodes volucris*	X	X
87. *Baccha clavata*	X	X
88. *Paragus tibialis*	X	X
89. *Carposcalis sp.*		
Copestylum marginatum ext		
Conopidae		
91. *Physocephala texana*		X
Otitidae		
92. *Melieria occidentalis*	X?	
93. *Gen.& sp. no.1*		
Tephritidae		
94. *Euaresta bellula*		
96. *Proceidochares minuta*		
97. *Trupanea signata*		
98. *T. jonesi*		
<u>*T. californica*</u>	X	
99. *Tephritis sp.*		
Coelopidae NS		
100. *Gen.& sp. no.1*		
Lauxaniidae NS		
101. *Calliopium sp 1*		
102. *Calliopium sp.2*		
Chamaemyiidae NS		
103. *Leucopis sp.*		
Piophilidae NS		
104. *Gen.& sp. no.1* ext?		
Lonchaeidae NS		
105. *Gen.& sp. no.1*		
Ephydridae		
106. *Gen.& sp. no.1*	X	X
Drosophilidae		
107. *Drosophila melanogaster*		
Chloropidae NS		
108. *Gen.& sp. no.1*		
109. *Gen.& sp. no.2* ext?		
Agromyzidae NS		
110. *Melanagromyza sp. 1*		
111. *Gen.& sp. no.1*		
Heleomyzidae NS		
112. *Gen.& sp. no.1* (46)		X
113. *Gen.& sp. no.2*		
Trixoscelididae NS		
114. *Gen.& sp. no.1*		
Asteiidae NS		
115. *Gen.& sp. no.1*		
Anthomyiidae NS		
116. *Gen.& sp. no.1* (91)		X
117. *Gen.& sp. no.2* (92)		X
118. *Gen.& sp. no.3* (110)		X
119. *Gen.& sp. no.4*		
120. *Gen.& sp. no.5*		

121. *Gen.& sp. no.6*
122. *Gen.& sp. no.7*

Muscidae
123. *Musca domestica*
124. *Stomoxys calcitrans*
125. *Gen.& sp. no.1*

Calliphoridae NS

126. *Calliphora sp. 1* (89)	X
127. *Calliphora sp. 2* (95)	X
128. *Luciliini Gen.& sp. no.1* (96)	X

Sarcophagidae NS

129. *Sarcophaga sp. 1* (47)	X
130. *Sacrophaga sp. 2* (48)	X
131. *Sarcophaga sp. 3* (93)	X
132. *Eumacronychia sp.* (49)	X
133. *Eumacronychia sp.* (90)	X
134. *Miltogrammini:Gen.& sp. no.1* (94)	X

Tachinidae NS
135. *Ptilodexia sabroskyi*
136. *Archytas california*
137. *Peleteria texensis*
138. *Deopalpus gemminatus*
139. *Chaetogaedia vilis*
140. *Eriothrixini Gen.& sp. no.l*
141. *Gonia sp*
142. *Microglossa hesperidarum*
143. *Gen.& sp. no.1*
144. *Gen.& sp. no.2*
145. *Gen.& sp. no.3*
146. *Gen.& sp. no.4*
147. *Gen.& sp. no.5*
148. *Gen.& sp. no.6*
149. *Gen.& sp. no.7*

Hymenoptera Class Wasps, Bees, Ants, Sawflies
The identification of this order was largely performed by R. Snelling for both the 1980 Ballona study and the LAX study. There is sufficient disagreement among these two studies as to question the validity of comparisons in some groups without further study.

Braconidae NS
1. *Apanteles thurberi*
2. *A. nr. aristoteliae*
3. *Diadegma sp.*
4. *Campoplex sp.*
5. *Opius sp.*
6. *Agathis sp.*
7. *Aphidinae Gen.& sp. no.1.*
8. *Aphidinae Gen.& sp. no.2*
9. *Aphidinae Gen.& sp. no.3*
10. *Gen.& sp. no.1*
11. *Gen.& sp. no.2*
12. *Gen.& sp. no.3*

13. *Gen.& sp. no.4*		
14. *Gen.& sp. no.5*		
15. *Gen.& sp. no.6*		
16. *Gen.& sp. no.7*		
Ichneumonidae NS		
17. *Ichneumona sp. no. 1* (126)		
18. *Gen.& sp. no. 1*		
19 *Gen.& sp. no. 2*		
20 *Gen.& sp. no. 3*		
21 *Gen.& sp. no. 4*		
22 *Gen.& sp. no. 5*		
23 *Gen.& sp. no. 6*		
24 *Gen.& sp. no. 7*		
25 *Gen.& sp. no. 8*		
26 *Gen.& sp. no. 9*		
27 *Gen.& sp. no. 10*		
28 *Gen.& sp. no. 11*		
29 *Gen.& sp. no. 12*		
30 *Gen.& sp. no. 13*		
Trichogrammatidae NS		
31. *Trichogramma nr. minuta*		
32. *Trichogramma sp.*		
Eulopidae NS		
33. *Necremnus sp.*		
34. *Chrysocharis sp.*		
Encyrtidae NS		
35. *Homalotylus sp.*		
36. *Anysotylus sp.*		
Eupelmidae NS		
37. *Anastatus*		
Bradynobaenidae NS		
38. *Chyphotes petiolatus*		
Torymidae NS		
39. *Podagrion sp.*		
40. *Megastigmus sp.*		
41. *Torymus sp.*		
Pteromalidae NS		
42. *Gen.& sp. no.1*		
Eurytomidae NS		
43. *Eurytoma sp.*		
Chalcididae NS		
44. *Spilochalis sp.*		
Figitidae NS		
45. *Gen.& sp. no.1*		
Cynipidae NS		
46. *Gen.& sp. no.1*		
Scelionidae NS		
47. *Gen. & sp. no.*		
Dryinidae NS		
48. *Gen.& sp. no.1* (116)		X
Formicidae		
49. *Pogonomyrmex californicus* (1)	X	X
50. *Iridomyrmex humilis* (2)	X	X

51. *Conomyrma sp.* (3)		
52. *Formica piliformis* (4)		
53. *Monomorium minimum* (53)		
Pheidole hyattii extirpated		
Camponotus clarathorax extirpated		
Tiphiidae		
54. *Gen.& sp. no.1* (141)		X
55. *Gen.& sp. no.2* (142)		X
Mutillidae		
56. *Dasymutilla californica*		
Dasymutilla sackeni ext		
57. *Sphaeropthalma sp. 1* (51)	NS	
58. *Sphaeropthalma sp. 2* (52)		
Scoliidae		
59. *Campsomeris tolteca*		X
60. *Crioscolia alcione*		
Pompilidae		
61. *Ageniella blaisdelli*		
62. *Aporus hirsutis*		
63. *A. luxus*		
64. *A. sp.*		
65. *Episyron snowi*		
66. *E. quinquenotatus hurdi*		
67. *Pepsis chrysothemis*		
69. *Evagetes hyacinthus*	X	
70. *Tachypompilus unicolor*		X
71. *Aproenellus medianus*		
72. *A. yucatanensis*		
73. *Pompilus angularis*		
Vespidae NS		
74. *Polistes aurifer*		X
Sphecidae NS		
75. *Tachysphex amplus*		
76. *T. ashmeadi*		
77. *T. texanus*		
78. *T. sp.*		
79. *Clypeadon californicus*		
80. *Larropsis tenuicornis*		
81. *Sphex ichneumoneus*		
82. *Isodontia elegans*		
83. *Ammophila azteca*		X
84. *A. pruinosa*		
85. *A. cleopatra*		X
86. *A. aberti*		
87. *Microbembix californica* (55)		X
88. *Bembix americana comata*		X
89. *Steniola duplicata*		
90. *Plenoculus sp.*		
91. *Mimesia cahuilla*		
92. *Mimesia sp.*		
93. *Miscophis sp. no. 1*		

94. *Miscophis sp. no. 2*		
95. *Tachytes distinctus*		
96. *Prionyx parkeri*		
97. *P. atratus*		
98. *Astata sp.*		
Colletidae		
99. *Colletes angelica*		
100. *C. slevini*	X	X
101. *C. hyalinus gaudialis*	X	X
Halictidae		
102. *Lasioglossum sisymbrii*		
103. *L. pavonotum*		
104. *Agapostemon texanus* (129)	X	X
105. *A. femoratus*		
106. *Dialictus pilosicaudis*		
107. *D. microlepoides*		
108. *D. perichlarum*		
109. *D. brunneventis*		
110. *D. sp. 3*		
Andrenidae		
111. *Andrena oenothera*		
Melittidae		
112. *Hesperaspis fuchsi*		
Megachilidae		
113. *Anthidium palliventre*		
114. *Megachile lippae*		
115. *Osmia integra*		
116. *Osmia sp.*		
O. clarescens	X	X
Anthophoridae		
117. *Habropoda tristissima*		
118. *Micranthophora curta*	X	
119. *Peponapsis pruinosa*		
120. *Anthophora urbana*	X	X
121. *Melissodes lupina*	X	
122. *M. moorei*		
123. *Emphoropsis sp.*		
Apidae		
124. *Apis mellifera*	X	X
125. *Bombus sonorus*	X	X
126. *B. crotchii*	X	
127. *B. californicus*	X	X
128. *B. vosnesenskii*	X	X
B. edwardsii	X	X

Species found by Nagano et al.(1981), but not in the sand dunes community. Species location in Quad A and/or B indicated by the appropriate letter. Phenology , abundance and plant association given. Collection in 1990 indicated.

Theridiidae Cobweb spiders
Dipoena sp. Willow, B, summer, occasional
Anyphaenidae
Teudis sp. Salicornia, B, winter, occasional
Gnaphosidae Running or mouse spiders
Poecilochroa sp . Saltflat, B, summer, occasional
Orodrassus sp. Salicornia, B, summer, occasional
Mircryphantidae
gen. sp. 1 Willow, B, spring, very common
Dictynidae
gen. sp. 1 Willow, B, spring, very common
Araneidae Orbweaver spiders
Argiope aurantia Freshwater marsh, summer, common
A. trivitata Freshwater marsh, fall, common

Dermaptera Order Earwigs
Labiduridae
Euborella annulipes Freshwater marsh, B, summer, common (1990)

Isoptera Order Termites
Kalotermitidae
Incistermes minor Willow, B, summer, occasional (1990)

Orthoptera
Raphidophoridae
Ceuthophilus sp. Freswater marshs, willow , year round, occassional. This was probably confused with *N. morsei* by Nagano. (1990)

Hemiptera Order Bugs
Corixidae
Trichocorixa reticulata, Saltmarsh, salt and mudflat, Salicornia, B, year, very common indicator of hypersaline conditions (1990)
Saldidae
Saluda pallipes, mudflat,Vicinity, rare

Homoptera
Flatidae 1 unidentified common species on *Salicornia*

Coleoptera Order Beetles
Cicindelidae
Cicindellaoregona oregona Ballona Flood Control Channel mud, Feb-Oct, occassional not found 1990
C. haemorrhagica haemorrhagica Ballona Flood Control Channel mud, Feb-Oct, common not found 1990
C. trifasciata sigmoidea Mud and salt flat, A B, Feb-Oct., common (rare, 1990)
Carabidae
Agonum multicolle Salicornia, B, spring, rare (1990)
Calosoma cancellatum. Freshwater marsh, fall, rare, local, 1990 only

Dytiscidae

Rhanus gutticollis Salicornia, B, summer, occasional

Hydrophilidae

Tropisternus sp. Salicornia, A B, summer,occasional

Enochrus sp. Salicornia, A B, summer,occasional

Staphylinidae

Bledius strenus Salicornia, mud-, saltflat, A B, summer fall, common

B. sp., Salicornia, mud-, saltflat, A B, summer fall, common

Philothonus sp. 1. Salicornia, A, summer, rare

Oedemeridae

Nacerdes melanura Saltflat, A, summer, common

Chrysomelidae

Cryptocephalus castaneus Willow, A, fall, very common

Stenopodius flavidus (Malva) fields,A, rare

Pachybrachus sp. Willow, A, Feb-Jul, common

Coccinellidae

Psyllobora viginmaculata Willow, A, summer, occasional

Bostrichidae

Gen sp. Interface, Salicornia litter, A, summer, rare

Cleridae

Phyllobaenus subfasciata Fields, A, summer, rare

Lepidoptera

Pterophoridae

Aqdistis americana Salicornia, B, spring, occasional

Sessidae

Paranthene robinae Willows, B, summer, occasional

Hesperiidae

Ochlodes sylvanoides Coastal sage, B, summer, rare (1990 first recd)

Diptera

Tephritidae

Eutreta angusta Willows, B, summer, occasional

Ephydridae

Ephydra riparia Salt marsh, Salicornia, A B, all year, very common

E. sp. Salt marsh, Salicornia, A B, all year, very common

Hymenoptera

Formicidae

Leptogaster andrei. Willow, Interface, B, Mar-Sept, rare

Pomplilidae

Hemipepsis texana. (172) marshes, bluffs, summer, common

Table 2. List of insects visually identified and counted during the transect traverses across the Ballona Wetlands (map as figure 3). Species expected but not observed are also noted.

Lepidoptera	Diptera	Hymenoptera
L-1 Glaucopsyche lygdamus	D-1 Coniophorus collini	H-1 Bombus vosnesinskii
L-2 Callophrys perplexa	D-2 C. fenestrata	H-2 B. sonorus
L-3 Pieris rapae	D-3 Thyridanthrax nugator	H-3 B. californicus
L-4 P. protodice	D-4 Lepidanthrax sp.	H-4 B. edwardsii
L-5 Leptotes marina	D-5 Poecilanthrax arethusa	H-5 B. crotchii*
L-6 Danaus plexippus	D-6 Villa lateralis	H-6 Megachilid sp
L-7 Brephedium exilis	D-7 V. atrata	H-7 Osmia sp
L-8 Vanessa cardui	D-8 V. molitor	H-8 Ammophila sp. 1
L-9 Strymon melinus	D-9 V. agrippina	H-9 Ammophila sp. 2 1
L-10 Perizoma custodiata	D-10 Heterostylum robustum	H-10 Anthophorid sp.
L-11 Polites sabuleti	D-11 Paravilla fumosa	H-11 Bembix comata
L-12 Noctuid, unident	D-12 P. edititoides*	H-12 Anthophora urbana
L-13 Nymphalis antiopa	D-13 Anastoechus melanohalteris	H-13 Apis mellifera I
L-14 Hylephila phyleus	D-14 Exoprosopa doris	H-14 Hemipepsis texanus
L-15 Panoquina panoquinoides	D-15 Ligyra gazophylax	H-15 Campsomeris tolteca
L-16 Pyrgus albescens	D-16 Hemipenthes lepidota	H-16 Agapostemon texanus
L-17 Loxostege immerans	D-17 Systoechus sp.	
L-18 Paratrytone melane	D-18 Chrysanthrax sp. I	
L-19 Precis coenia	D-19 Eristalis tenax	**Orthoptera**
L-20 Danaus gilippus	D-20 Sarcophaga sp.	G-1 Melanoplus sp.I
L-21 Synanthedon sp.	D-21 Brennania belkini*	G-2 Scuddaria mexicana 1
L-22 Lerodea eufala	D-22 Thereva nebulosa	
L-23 Atalopetes campestris	D-23 Scavia pyraste	**Arachnids**
L-24 Ochlodes sylvanoides	D-24 Ablautus coquilleti	A-1 Psidius johnsoni
L-25 Papilio zelicaon I	D-25 Sarapogon luteus	A-2 Argiope trivitata
L-26 Vanessa carye I	D-26 Volucella tau	A-3 A. aurantica
L-27 V, atalanta I	D-27 V. mexicana	
L-28 Eurema nicippe	D-28 Neomydas pantherinus	
L-29 Phoebis sennae	D-29 Metapogon pictus I	
L-30 Nathalis iole I	D-30 Baccha clava I	
L-31 Colias eurytheme	D-31 Geron sp.	
	D-32 Neodiplocampta mira	**Odonata**
		O-1 Tarnetrum corruptum
		O-2 Pantala flavescens
		O-3 Tramea onusta
		O-4 Anax junius

* indicates species expected but not yet observed (Sept. 1990)
O indicates species observed but not on transect
1 indicates species observed only once (singleton)

Table 3. Distribution and abundance of all species visually identified across the transect segments defined on the map in figure 3. Key to species cited given in table 2. This table contains 8 pages.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM
1	Subsites	length m																										Diptera											
2	Date III	20 90	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
3	Dunes 1	105	1	2								1						1										3	1										
4	Dunes 2	113	1						1	1	1																												
5	D/SM In	486	1	1									1															1	1										
6	SM 1	437										4		1																									
7	SM 2	243							1			1	2																										
8	SM 3	259			2			4				10			2	1																							
9	SM 4	275										6																											
10	FM 1	154																	1																				
11	Hastings	211	27	6							2						1																						
12	FM 2	518			3					1		1			1																								
13																																							
14	Date IV	17 90	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
15	Dunes 1	105	2	1	1																							1											
16	Dunes 2	113	2	1					1					2				3																					
17	D/SM In	486										3				3																							
18	SM 1	437							1																														
19	SM 2	243																																					
20	SM 3	259			3			6																															
21	SM 4	275										1																											
22	FM 1	154																																					
23	Hastings	211	20	2																																			
24	FM 2	518																																					
25																																							
26	Date V	8 90	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
27	Dunes 1	105					2				3																			1		1							
28	Dunes 2	113																																					
29	D/SM In	486									1		7						6																				
30	SM 1	437										3																											
31	SM 2	243																																					
32	SM 3	259																																					
33	SM 4	275																																					
34	FM 1	154																		1																			
35	Hastings	211					5						1																										
36	FM 2	518																																					
37																																							
38	Date V	25 90	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
39	Dunes 1	105					5				4																					1							
40	Dunes 2	113																	2																				
41	D/SM In	486									1		3						11																				
42	SM 1	437										4																											
43	SM 2	243																																					
44	SM 3	259																																					
45	SM 4	275																																					
46	FM 1	154																		1																			
47	Hastings	211					12				2																					1							
48	FM 2	518			1																																		
49																																							
50	Date VI	15 90	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
51	Dunes 1	105					3													3															5				
52	Dunes 2	113																																					
53	D/SM In	486										2	1	1	1				7																				
54	SM 1	437										1	1						1																				2
55	SM 2	243																																					
56	SM 3	259							1				1						2													4				2			3
57	SM 4	275															2															6							
58	FM 1	154			3										1		2			2	1																		
59	Hastings	211					3				1						2													1					1				
60	FM 2	518			1																1																		
61																																							
62	Date VI	30 90	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
63	Dunes 1	105																																					
64	Dunes 2	113																																					
65	D/SM In	486											5						11													2	1			2			
66	SM 1	437										3																											
67	SM 2	243																																					
68	SM 3	259																														1		1					3
69	SM 4	275															1															2							1
70	FM 1														1		4			1	1																		
71	Hastings						6				2																												1
72	FM 2																				1																		

010753

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM
73	Date: VII	17 90	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
74	Dunes 1	105					1													1						1									3				
75	Dunes 2	113																	15																				
76	D/SM In	486				1			2				12						38													1							
77	SM 1	437			1								2						2																				
78	SM 2	243			2								2																										
79	SM 3	259							1										20					3								2							1
80	SM 4	275											2																										
81	FM 1	154									1						2			3		1			3														
82	Hastings	211					4		2												1														44				1
83	FM 2	518			2																2		2											2			6	3	
84																																							
85	Date VIII	3 90	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
86	Dunes 1	105			1										1					2												2			3				
87	Dunes 2	113																																					
88	D/SM In	486							16				7						56											1									
89	SM 1	437							1				1																						1				2
90	SM 2	243				1	3												20		2									1		1			1	1			
91	SM 3	259																																					
92	SM 4	275																																					
93	FM 1	154																																					
94	Hastings	211																			1																		
95	FM 2	518																			1														1		1		1
96																																							
97																																							
98	Date: VIII	20 90	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
99	Dunes 1	105																																	1				
100	Dunes 2	113																																	1				
101	D/SM In	486							95		3								13											1		1	1		3				
102	SM 1	437													1				3		3																1		
103	SM 2	243																																					
104	SM 3	259																																					
105	SM 4	275																													1	1							
106	FM 1	154															5																						
107	Hastings	211																																	3				
108	FM 2	518												1							3										2			1					
109																																							
110	Date: IX	4 90	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
111	Dunes 1	105														1															1							1	
112	Dunes 2	113									1	3							15																			1	
113	D/SM In	486							200				16						34												3	6						1	
114	SM 1	437										1																											
115	SM 2	243																	15		1	3		1							1								
116	SM 3	259																				1																	
117	SM 4	275																													1								
118	FM 1	154															7																						
119	Hastings	211															3				1										10				1	1		3	
120	FM 2	518						1													2										3					1		3	
121																																							
122	Date: IX	17 90	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
123	Dunes 1	105																		1											3							1	
124	Dunes 2	113			1						1								12																				
125	D/SM In	486							100		1		3						36																				
126	SM 1	437							100			7							2												1								1
127	SM 2	243						1					2						10												3					1			
128	SM 3	259																	2																				
129	SM 4	275																																					
130	FM 1	154						1									3																						
131	Hastings	211																			1										1				2			1	
132	FM 2	518													1						1																		
133																																							
134	Date: X	5 90	L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
135	Dunes 1	105																																					
136	Dunes 2	113																																					
137	D/SM In	486						3	80			1	1			1			3		1																		
138	SM 1	437																	2		2																		
139	SM 2	243						3																															
140	SM 3	259																																					
141	SM 4	275																	2																				
142	FM 1	154								1																													
143	Hastings	211																													1					1			
144	FM 2	518																			2																		

010754

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM
145																																							
146	Date : X 15 90		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
147	Dunes 1	105														1				1																			
148	Dunes 2	113																																					
149	D/SM In	486					2	2	75										19																				
150	SM 1	437										2							2																				
151	SM 2	243						500					2						10		1																		
152	SM 3	259							1												1																		
153	SM 4	275										1					7				3																		
154	FM 1	154								1										1											1								
155	Hastings	211																																					
156	FM 2	518																																					
157																																							
158	Date: XI 21 90		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
159	Dunes 1	105																																					
160	Dunes 2	113																																					
161	D/SM In	486						1	50			2							1																				
162	SM 1	437																																					
163	SM 2	243						5000				2																											
164	SM 3	259																	1																				
165	SM 4	275						1									1																						
166	FM 1	154											2				3				2										1								
167	Hastings	211																																					
168	FM 2	518																																					
169																																							
170	Date XII 14 90		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
171	Dunes 1	105																																					
172	Dunes 2	113											2						20																				
173	D/SM In	486						6	4			4	1																										
174	SM 1	437						1													2																		
175	SM 2	243						4													2																		
176	SM 3	259																			1																		
177	SM 4	275															3		5																				
178	FM 1	154																													1								
179	Hastings	211																																					
180	FM 2	518																			1																		
181																																							
182	Date: I 23 91		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
183	Dunes 1	105																																					
184	Dunes 2	113																																					
185	D/SM In	486										1																											
186	SM 1	437										2																											
187	SM 2	243						500													1																		
188	SM 3	259																																					
189	SM 4	275																																					
190	FM 1	154																																					
191	Hastings	211																																					
192	FM 2	518							1																														
193																																							
194	Date: II 15 91		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
195	Dunes 1	105																																					
196	Dunes 2	113																																					
197	D/SM In	486			2			2			7	2																											
198	SM 1	437			1			1				2																											
199	SM 2	243										1	1					0																					
200	SM 3	259										12																											
201	SM 4	275																																					
202	FM 1	154													1																								
203	Hastings	211	6	1			1				4																												
204	FM 2	518						1													1																		
205																																							
206	Date: III 18 91		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12	L-13	L-14	L-15	L-17	L-16	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D-13	D-14	D-11	D-8
207	Dunes 1	105	2																									25											
208	Dunes 2	113																																					
209	D/SM In	486									4	2																											
210	SM 1	437										1																											
211	SM 2	243																																					
212	SM 3	259																																					
213	SM 4	275	2	1								3																											
214	FM 1	154																																					
215	Hastings	211																																					
216	FM 2	5																																					

010755

	A		C	D	E	F	G	H	I	J	K	L	M	N
217	Summary		L-1	L-2	L-3	L-4	L-5	L-6	L-7	L-8	L-9	L-10	L-11	L-12
218	Dunes 1	105	5	3	2	0	11	0	0	0	7	1	0	0
219	Dunes 2	113	3	1	1	0	0	0	2	1	3	3	2	2
220	D/SM in	486	1	1	2	1	2	14	622	0	17	17	57	1
221	SM 1	437	0	0	2	0	0	2	102	0	0	30	4	1
222	SM 2	243	0	0	2	1	3	6008	1	0	0	4	9	0
223	SM 3	259	0	0	5	0	0	10	3	0	0	22	1	0
224	SM 4	275	2	1	0	0	0	1	0	0	0	11	2	0
225	FM 1	154	0	0	3	0	0	1	0	2	1	0	2	0
226	Hastings	211	53	9	0	0	31	0	2	0	11	0	1	0
227	FM 2	518	0	0	7	0	0	2	1	1	0	1	0	1
228	Totals		64	15	24	2	47	6038	733	4	39	89	78	5

	A	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
217	Summary	L-13	L-14	L-16	L-17	L-15	L-18	L-19	L-23	L-22	L-21	L-24	L-20	L-25
218	Dunes 1	1	2	0	1	0	8	0	0	0	0	0	1	0
219	Dunes 2	0	0	0	3	64	0	0	0	0	0	0	0	0
220	D/SM in	1	4	0	0	237	0	1	0	0	0	0	0	0
221	SM 1	1	0	0	0	12	0	7	0	0	0	0	0	0
222	SM 2	0	0	0	0	55	0	7	3	0	1	0	0	0
223	SM 3	2	1	0	0	26	0	2	1	0	3	0	0	0
224	SM 4	0	0	14	0	7	0	3	0	0	0	0	0	0
225	FM 1	3	0	26	0	1	9	4	1	0	0	3	0	0
226	Hastings	0	0	6	0	0	0	4	0	0	0	0	0	0
227	FM 2	2	0	0	0	0	0	15	0	2	0	0	0	0
228	Totals	10	7	46	4	401	17	43	5	2	4	3	1	0

	A	AB	AC	AD	AE	AF	AQ	AH	AI		AK	AL	AM
217	Summary	D-1	D-2	D-3	D-5	D-4	D-10	D-6	D-7	D	-14	D-11	D-8
218	Dunes 1	29	1	1	4	4	0	0	12	0	0	2	0
219	Dunes 2	0	0	0	0	0	0	0	1	0	0	1	0
220	D/SM in	1	1	2	3	10	2	0	3	2	0	1	0
221	SM 1	0	0	0	1	0	0	0	1	0	1	0	5
222	SM 2	0	0	1	4	1	0	0	1	2	0	0	0
223	SM 3	0	0	0	0	7	0	1	0	2	0	0	7
224	SM 4	0	0	0	2	11	0	0	0	0	0	0	1
225	FM 1	0	0	0	1	0	0	0	0	0	0	0	0
226	Hastings	0	0	1	14	1	0	0	51	2	0	4	2
227	FM 2	0	0	0	5	0	0	3	1	1	7	6	1
228	Totals	30	2	5	34	34	2	4	70	9	8	14	16

	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY
1															Hymen																Spiders							
2	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
3															28	2			2	1																		
4															2																							
5															2																							
6																																						
7																																						
8																																						
9																																						
10																																						
11																																						
12																					1									1								
13																																						
14	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
15															3	1	1			1																		
16															1																							
17										3	1																											
18																1																						
19																																						
20																																						
21															1																							
22																																						
23										5							1																					
24																																						
25																																						
26	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
27												1		1		1	1	1			1	2	1				1											
28																																						
29														1																								
30																															1							
31																																						
32																																						
33																																						
34																																						
35																9		2																				
36																																						
37																																						
38	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
39																1	2																					
40																																						
41																						1																
42																															1							
43																2																						
44																																						
45																																						
46																																						
47			2												5	5																						
48																																						
49																																						
50	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
51													1		1												1											
52																																						
53																																						
54																						2																
55																																						
56				2											5																							
57	1																																					
58															1																							
59															1						1																	
60																																						
61																																						
62	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
63																																						
64																																						
65																						10																
66																																						
67																																						
68	1						7																															
69																																						
70																																						
71	1																																					
72																																						

010757

	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW		BY
73	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
74																																					
75																						8															
76							3								1						1	10			1							1						
77																																					
78																																					
79	1				5		3								5							10							1									
80																										1												
81																																					
82	5																																					
83		1			1										20	3						2				1												
84																																					
85	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
86													2																									
87													1													1												
88						1									1	1					1					1												
89																																					
90	3					2																			3													
91																																					
92																										2												
93															5																							
94																																					
95															5	5										2												
96																																					
97																																					
98	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
99																																					
100	1																																					
101																5						27																
102	2				1																				3													
103																																					
104																																					
105																																					
106																																					
107																																					
108															20	18										1												
109																																					
110	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
111																																					
112																																					
113																					8																	
114																																					
115																																				1		
116			1																																			
117																																					
118																																1	3					
119		1				5																																
120																30																	1					
121																																					
122	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
123																																					
124																1																						
125																																					
126																													1									
127																																					
128																2																						
129																													1									
130																																1	1					
131						2										2																						
132																																					
133																																					
134	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
135																																					
136																3																						
137																																					1
138																													1								1	
139																3																						
140																													1									
141																2																2						
142																																3						
143																14																						
144																																					

010758

	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY
145																																						
146	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
147																																						
148																																						
149																5																						
150																																						
151																													1							1		
152																													1							3		1
153																													6									
154																																4						
155																																						1
156																																						
157																																						
158	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
159																																						
160																																						
161																2																						
162																																						
163																													1									
164																													1									
165																																						
166															1																							
167																											1											
168																																						
169																																						
170	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
171																																						1
172																																						
173																1																			1		1	
174																																						
175																																						
176																													1									
177																																						
178																																						
179																																						
180																1																						
181																																						
182	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
183																																						
184																																						
185																																						
186																																						
187																																						
188																																						
189																																						
190															2																							
191																																						
192																																						
193																																						
194	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
195																																						
196																																						
197																																						
198																																						
199																																						
200																																						
201																																						
202																																						
203															1																							
204																																						
205																																						
206	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
207															1												1											
208															1																							
209																																						
210																																						
211																																						
212																																						
213															1																							
214																																						
215																																						
216																																						

	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE
217	D-15	D-31	D-9	D-19	D-16	D-32	D-17	D-20	D-21	D-22	D-23	D-24	D-28	D-26	H-1	H-2	H-3	H-4
218	0	0	0	0	0	0	0	0	0	0	0	1	3	1	33	5	4	1
219	1	0	0	0	0	0	0	0	0	0	0	0	1	0	4	4	0	0
220	0	0	0	0	0	1	3	0	0	3	1	0	0	1	4	14	0	0
221	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0
222	3	0	0	0	0	2	0	0	0	0	0	0	0	0	0	5	0	0
223	2	0	1	2	5	0	10	0	0	0	0	0	0	0	10	2	0	0
224	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0
225	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0
226	6	1	2	0	0	7	0	0	0	5	0	0	0	0	7	30	1	2
227	0	1	0	0	1	0	0	0	0	0	0	0	0	0	45	57	0	0
228	15	2	3	2	7	10	13	0	0	8	1	1	4	2	114	120	5	3

	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW		BY
217	H-6	H-7	H-8	H-11	H-10	H-16	H-15	H-14	H-12	Crypt	0 1	C-1	A 1	A 2	A 3	0 2	0 3	0 4	L 29	
218	2	2	1	2	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	154
219	0	0	0	8	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	106
220	0	0	10	48	0	0	1	1	0	0	0	0	0	1	0	0	1	0	1	1093
221	0	0	0	2	0	0	3	0	0	0	2	0	2	0	0	0	0	0	1	183
222	0	0	0	0	0	0	3	0	0	0	2	0	0	0	0	0	0	2	0	6120
223	0	0	0	10	0	0	0	0	0	0	5	0	0	0	0	0	0	3	0	142
224	0	0	0	0	0	0	0	3	0	0	7	0	0	2	0	0	0	0	0	72
225	0	0	0	0	0	0	0	0	0	0	0	0	0	9	4	0	0	0	0	79
226	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	255
227	0	0	1	2	0	0	0	4	0	0	0	1	0	0	1	0	0	0	0	169
228	2	2	13	72	1	0	7	9	4	0	16	1	2	12	5	0	1	5	2	8373

010760

TABLE 4. SPECIES ABUNDANCE IN PITFALL TRAPS LOCATED AMONG SIX GENERAL BIOLOGICAL COMMUNITIES ACROSS THE BALLONA WETLANDS: SM =SALT MARSH, SF=SALTFLAT, M=FRESH WATER MARSH, W2=WILLOW GROVES ALONG CENTINELA CREEK, AF=HASTINGS ALLUVIAL WASH. THE SAND DUNE SITES ARE GIVEN UNDER TOTAL, WHICH INCLUDES N="NATIVE" DUNE, W=WILLOW GROVES, C=ICEPLANT CARPETS AND I=ECOTONE BETWEEN ICEPLANT AND PICKLEWEED. IDENTIFICATION GIVEN IN TABLE 5.

Species Number	N	W	C	I	Subtotal	SM	SF	M	W2	AF	Total
1	2				2					10	12
2	65	90	357	310	822	28	30	95	162	160	1297
5		1	4		5	1	4	5	2	30	47
7	93			8	101					1	102
8	6				6						6
9	2	1		2	5						5
10	2				2						2
11	1				1				1	1	3
13	39	30	17	1	87				4	197	288
14	3	2			5				1	2	8
15		5	2	2	9		1		3	7	20
16	4				4					3	7
18	45		96	2	143						143
22			1		1						1
24		3	1	4	8						8
25	1		1	8	10		1				11
26	2				2						2
28			1		1						1
29	3				3						3
30	2	3			5					1	6
31				2	2						2
32				5	5		1	2			8
34		15	13		28		1	3		12	44
35	111	20	8	43	182	7	5	1			195
36	24	87	37	3	151				1		152
37	4				4			1			5
38		1	2	2	5	1					6
39	18				18					1	19
41		3		1	4					5	9
42	4	37	64	96	201	128	14	1	2	1	347
45	42				42				2	1	45
46	2	1	7	1	11	8			2	55	76
47	6	2		3	11	3	3			2	19
48	99	38	26	61	224	34	39	7	20	144	468
49	59	6	1	1	67	3	5			51	126
50	6	3		2	11	3		3	4	7	28
51				1	1						1
54	4	3	3	5	15	5	4				24
56	1	4	4		9						9
57	3	19	55	95	172	10	2	13	20	4	221
58	1	8	2	2	13			1	1	13	28
59	9	12	1	2	24	6	5	1			36
60	9	63	22	85	179	4	3	34	68	3	291
61	5	2	1	1	9			1		4	14
62	2			3	5						5
63		13		2	15				3	1	19
64	1				1						1
65	1	2			3	1	6				10
66	38	2			40	1				3	44
67	2			1	3					2	5
69	4				4						4
71	1	3			4			1	12		17
73	10	1			11						11
74	1				1					6	7
75	2	94	76	168	340	176	1	1	2	1	521
76				1	1						1
77	1	11	4	12	28	6		15	134	203	386
78					0					3	3
80	1				1						1

Species Number	N	W	C	I	Subtotal	SM	SF	M	W2	AF	Total
82		28	23	23	74		1	2	5		82
83			1		1						1
84			1		1						1
85					0					1	1
86					0					4	4
89				1	1	1			7		9
90	8				8						8
91	3	3	1	32	39	27	1	2		30	99
92				1	1		2	3	5	2	13
93	55	4	6	14	79	8	3		4	1	95
94	2			1	3						3
95					0				1		1
96	1	1			2				1		3
97	13		1		14		4			3	21
98				1	1						1
99			13		13						13
100	5	25	42	77	149	96	17	3	1		266
101	2	1	2	1	6		3	1	5	1	16
102				1	1					4	5
105		2			2						2
108	3	2			5						5
112	2	2	4		8				1		9
113	12	103	14	7	136	2	5	192	10	1	346
116		4	4	4	12				1	1	14
118					0			1	1		2
123				1	1						1
124	2				2						2
125		94	2		96						96
128	1				1						1
135	4	3		1	8						8
136	1				1						1
139	3	1	1	2	7		3				10
145				4	4						4
146	1	223	51	22	297		3	192	35	10	537
149				1	1		3				4
153	2	2			4				2		6
154	12	9	2	1	24				1	2	27
155	2		11	15	28	1	7	3			39
156			3	393	396	3	3	1			403
157			1	4	5		11	1			17
158			19	21	40	3	1				44
159		2	6	8	16	2			4	4	26
160			2	19	21	2					23
161				8	8						8
162		36	2	24	62					1	63
163		4	2	10	16	4	1	1			22
164		2	3		5	1					6
165		1	2	3	6	2					8
166	2			1	3		2				5
167				4	4			2			6
168			2		2			21			23
169					0				1	3	4
170	16		1	1	18					1	19
171					0			4			4
172	1				1			2			3
173	7	5	6		18		2				20
Totals	901	1142	1034	1641	4718	577	197	616	529	1003	7640

Table 5. List of all species collected in pitfall traps across all sites in the Ballona wetlands. Each taxa identified to order and family of insects and class and family of arachnids. Genus and species names cited where classifiable. Non-identified species classified by labelled exemplars in the permanent collection.

Species Number	Family	Order	Genus	Species
1	Hymenoptera	Formicidae	*Pogonomyrmex*	*californica*
2			*Iridiomyrmex*	*humilis*
5	Coleoptera	Tenebrionidae	*Eleodes*	#1
7		Histeridae	*Xerosaprinus*	#1
8		Tenebrionidae	*Coelus*	*ciliatus*
9		Staphylinidae		#1
10		Tenebrionidae	*Coniontis*	#1
11			*Anchomma*	*Costatum*
13			*Amphidora*	*Nigripilosa*
14			*Cratidus*	*Osculans*
15				#1
16		Scarabaeidae		#1
18		Curculionidae	*Trigonoscuta*	*dorothea*
22	Hemiptera	(Coriscid)		#1
24		(Cydnid)		#1
25		Lygidae	*Geocoris*	#1
26		Scutelleridae	*Small Black*	#1
28		Scutelleridae		#2
29		Fulgoridae	*Orgerius*	*triquesteris*
30		(Cercopid)		#1
31		Cicadellidae		#1
32		Aphididae		#1
34	Collembola			#1
35	Thysanura	Machilidae		#1
36				#2
37				#3
38	Dermaptera	Forficulidae	*Furficula*	*auricularia*
39	Orthoptera	Polyphagidae	*Arenivaga*	
41		Gryllicrididae	*Rhachocnemis*	*validus*
42		Gryllidae	*Acheta*	*assimilis*
45	Diptera	Bombyliidae		#1
46		Heleomyzidae		#1
47		Sarcophagidae		#1
48				#2
49			*Eumacronychia*	#1
50		Phoridae		#1
51	Hymenoptera	Mutillidae	*Sphaeropthalma*	#1
54		Pompilidae		#1
56	Arachnida	Gnaphosidae		#1
57		Dysderidae	*Dysdera*	*crocata*
58		Pholcidae	*Psilochorus*	#1
59		Lycosidae		#1

60				#2
61				#3
62		Clubionidae	*Chiracanthium*	#1
63		Thomisidae	*Xysticus*	#1
64		Oxyopidae		#1
65		Theridiidae	*Lactrodectus*	*mactyans*
66		Erematobidae	*Eremobates*	#1
67	Pseudoscorpionids			#1
69		Trombidiidae	*Trombidium*	#1
70				#1
71		Spirobolidae		#1
73		Zodariidae	*Lutica*	#1
74	Lacertia			
75	Coleoptera	Carabidae	*Pterostichus*	#1
76			*Amara*	#1
77			*Calathus*	*ruficollis*
78			*Agonum*	*maculicolle*
80		Scarabaeidae	*Aphodius*	#1
82		Elateridae		#1
83				#2
84		Melyridae	*Collop*	#1
85		Tenebrionidae	*Epantius*	*obscurus*
86		Curculionidae	*Rhigopsis*	#1
89	Diptera	Calliphoridae	*Calliphora*	#1
90		Sarcophagidae	*Eumderomychia*	#1
91		Anthomyiidae		#1
92				#2
93		Sarcophagidae	*Sarcophaga*	#1
94			*Miltogrammimi*	#1
95		Callophoridae		#2
96				#3
97	Arachnida	Oonopidae	*Scaphiella*	#1
98		Theridiidae	*Steatoda*	*grossa*
99		Thomosidae	*Philodromus*	#1
100		Clubionidae	*Castianeira*	#1
101		Gnaphosidae		#2
102		Phalangiidae		#1
105		Lithobiomorphidae	*Lithobius*	#1
108			*Aptostichus*	*simians*
112	Psocoptera	Psocidae		#1
113	Isopoda		*Porcellio*	*laevis*
116	Hymenoptera	Dryinidae		#1
118	Coleoptera	Tenebrionidae	*Nyctoporis*	*carinata*
123		Curculionidae	*Cylindrocopturus*	*new species*
124		Dermestidae	*Dermestes*	#1
125		Staphilinidae	*Sededophilus*	#1
128	Diptera	Therevidae	*Ceromolepida*	#1
135	Coleoptera	Ptinidae	*Ptinus*	*fur*
136		Coccinelidae	*Hippodamia*	*convergens*

139		Mordellidae		#1
145	Neuroptera	Chrysopidae		#1
146	Isopoda		*Armadillium*	*vulgare*
149	Coleoptera	Anobeidae		#1
153	Hymenoptera	Cydinidae		#1
154	Orthoptera	Gryllacridae	*Stenopelmatus*	*dark*
155	Dermaptera		*Euberellia*	*annulipes*
156	Amphipoda			#1
157	Embioptera	Embiidae		#1
158	Coleoptera	Carabidae	*Pterostichus*	#1
159		Tenebrionidae		#2
160		Elateridae	*Aeolus*	#1
161		Carabidae		#1
162	Arachnida	Gnaphosidae	*Poecilochroa*	*ocellata*
163		Clubionidae	*Castianeira*	#1
164	Diptera	Therevidae	*Thereva*	*nebulosa*
165		Empidae	*Empis*	#1
166	Orthoptera	Myrmecophila		#1
167	Coleoptera	Carabidae		#2
168		Carabidae		#3
169		Tenebrionidae	*Eleodes*	*acuticauda*
170	Hymenoptera	Formicidae	*Leptothorax*	*andrei*
171	Coleoptera	Carabidae	*Calosoma*	*cancelatum*
172	Hymenoptera	Pompilidae	*Hemipepsis*	*texana*
173	Arachnida	Salticidae		#1

Table 6. List of species collected in pitfall traps for which the total number of individuals taken was ten or less. Listing as in table 5. Actual number taken given in the last colume

Species Number	Family	Order	Genus	Species	N
8		Tenebrionidae	*Coelus*	*ciliatus*	6
9		Staphylinidae		*#1*	5
10		Tenebrionidae	*Coniontis*	*#1*	2
11			*Anchomma*	*Costatum*	3
14			*Cratidus*	*Osculans*	8
16		Scarabaeidae		*#1*	7
22	Hemiptera	(Coriscid)			1
24		(Cydnid)		*#1*	8
26		Scutelleridae		*#1*	2
28		Scutelleridae		*#2*	1
29		Fulgoridae	*Orgerius*	*triquesteris*	3
30		(Cercopid)		*#1*	6
31		Cicadellidae		*#1*	2
32		Aphididae		*#1*	8
37				*#3*	5
38	Dermaptera	Forficulidae	*Furficula*	*auricularia*	6
41		Gryllicrididae	*Rhachocnemis*	*validus*	9
51	Hymenoptera	Mutillidae	*Sphaeropthalma*	*#1*	1
56	Arachnida	Gnaphosidae		*#1*	9
62		Clubionidae	*Chiracanthium*	*#1*	5
64		Oxyopidae			1
65		Theridiidae	*Lactrodectus*	*mactyans*	10
67	Pseudoscorpionids			*#1*	5
69		Trombidiidae	*Trombidium*	*#1*	4
74	Lizards				7
76			*Amara*	*#1*	1
78			*Agonum*	*maculicolle*	3
80		Scarabaeidae	*Aphodius*	*#1*	1
83			*Medium size*	*brown*	1
84		Melyridae	*Collop*	*#1*	1
85		Tenebrionidae	*Epantius*	*obscurus*	1
86		Curculionidae	*Rhigopsis*	*#1*	4
89	Diptera	Calliphoridae	*Calliphora*	*#1*	9
90		Sarcophagidae	*Eumderomychia*	*small*	8
94			*Miltogrammimi*		8
95		Callophoridae		*#2*	1
96				*#3*	3
98		Theridiidae	*Steatoda*	*grossa*	1
102		Phalangiidae		*#1*	5
105		Lithobiomorphidae	*Lithobius*	*#1*	2
108			*Aptostichus*	*simians*	5
112	Psocoptera	Psocidae		*#1*	9
118	Coleoptera	Tenebrionidae	*Nyctoporis*	*carinata*	2
123		Curculionidae	*Cylydrocopturis*	*new species*	1
124		Dermestidae	*Dermestes*	*#1*	2
128	Diptera	Therevidae	*Ceromolepida*	*#1*	1
135	Coleoptera	Ptinidae	*Ptinus*	*fur*	8

136		Coccinelidae	*Hippodamia*	*convergens*	1
139		Mordellidae		*#1*	10
145	Neuroptera	Chrysopidae		*#1*	4
149	Coleoptera	Anobeidae		*#1*	4
153	Hymenoptera	Cydinidae		*#1*	6
161		Carabidae		*#1*	8
164	Diptera	Therevidae	*Thereva*	*nebulosa*	6
165		Empidae	*Empis*	*#1*	8
166	Orthoptera	Myrmecophila		*#1*	5
167	Coleoptera	Carabidae		*#3*	6
169		Tenebrionidae	*Eleodes*	*acuticauda*	4
171	Coleoptera	Carabidae	*Calosoma*	*cancelatum*	4
172	Hymenoptera		*Hemipepsis*	*texana*	3
174	Coleoptera	Curculionidae	*Onychobaris*	*langei*	1

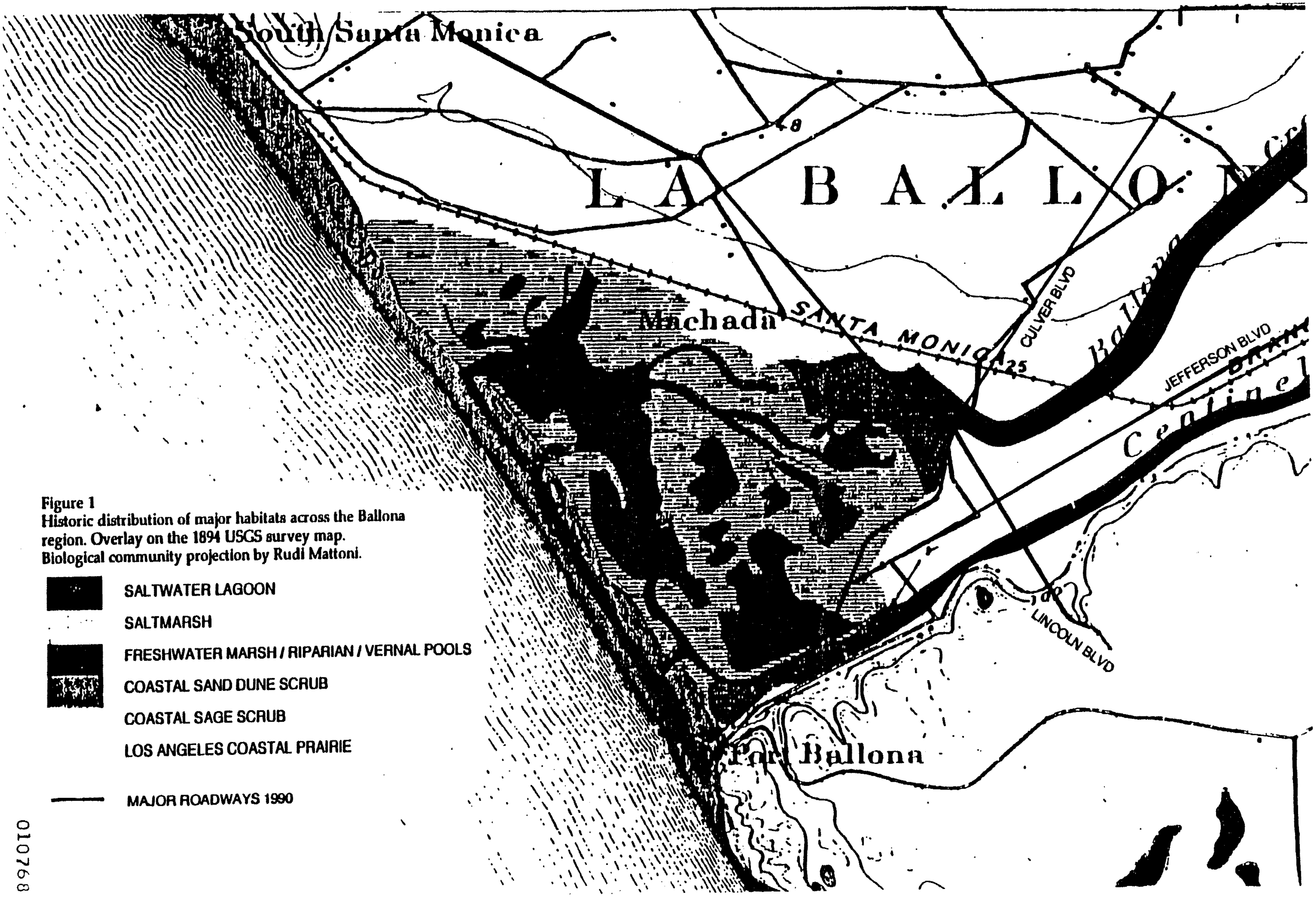
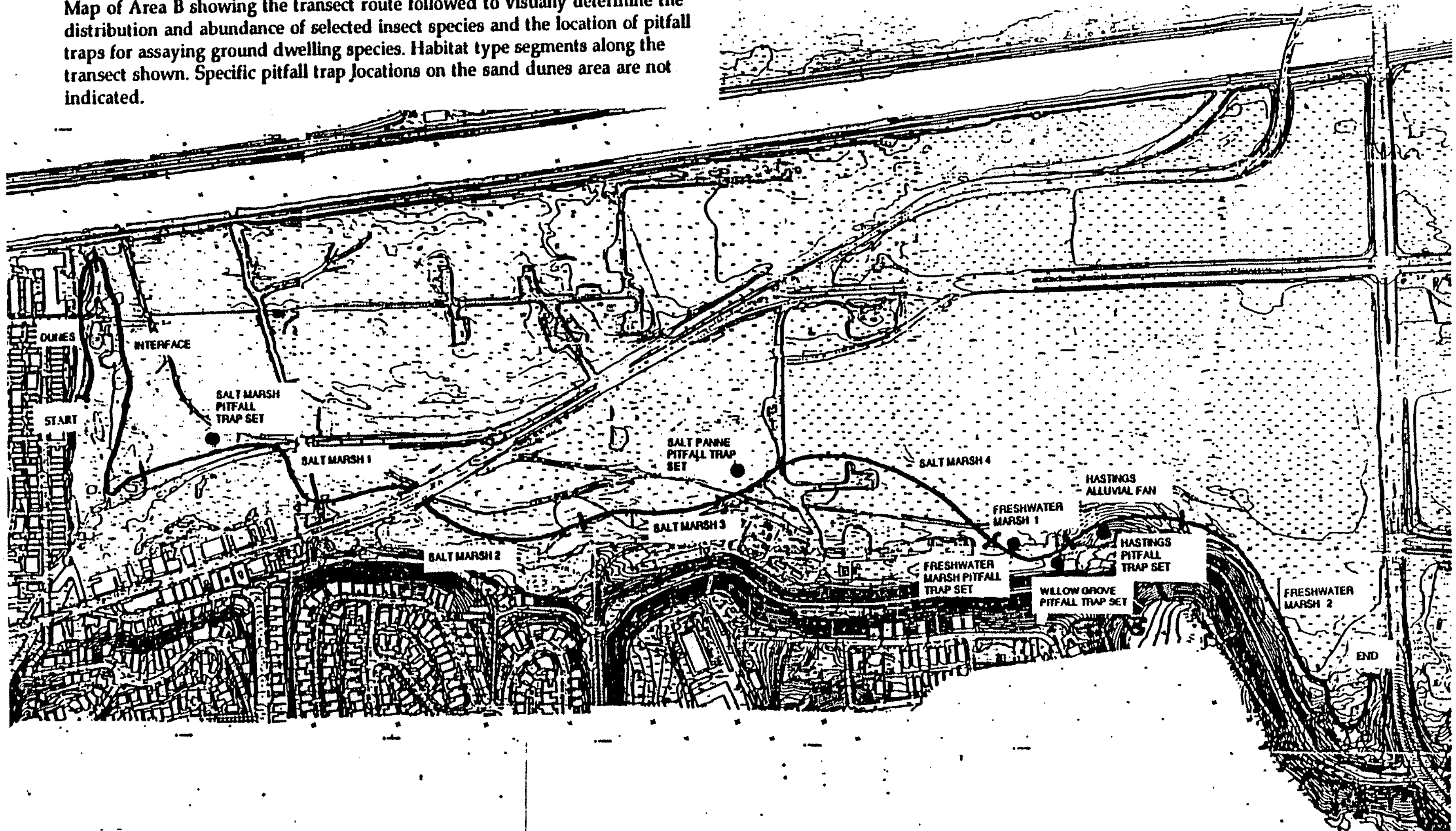


Figure 1
Historic distribution of major habitats across the Ballona region. Overlay on the 1894 USGS survey map. Biological community projection by Rudi Mattoni.

Figure 3.
Map of Area B showing the transect route followed to visually determine the distribution and abundance of selected insect species and the location of pitfall traps for assaying ground dwelling species. Habitat type segments along the transect shown. Specific pitfall trap locations on the sand dunes area are not indicated.



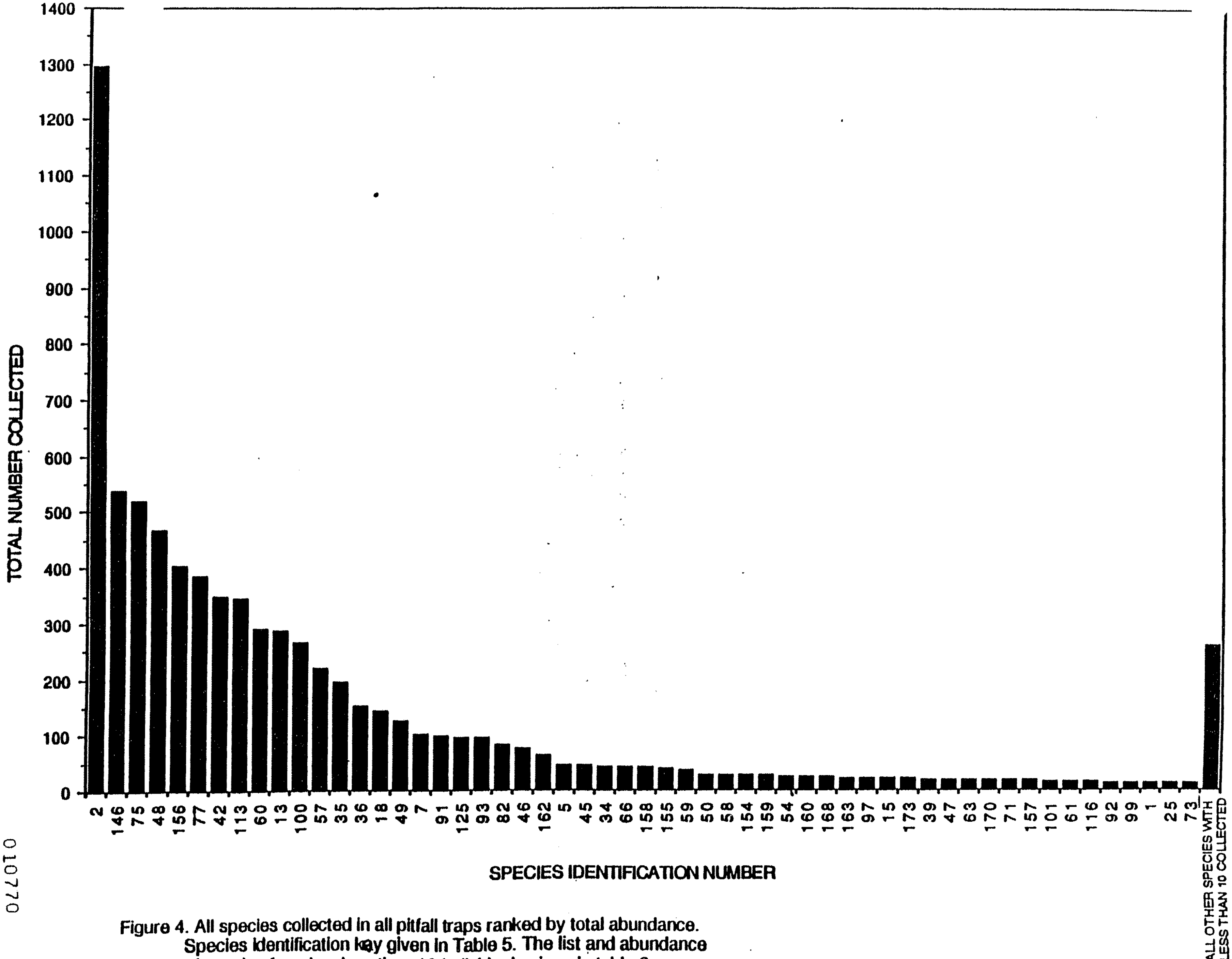


Figure 4. All species collected in all pitfall traps ranked by total abundance. Species identification key given in Table 5. The list and abundance of species found as less than 10 individuals given in table 6.

010770

Appendix J-4: Ballona Wetlands/Playa Vista Non-Insect Invertebrate Survey

Cassie R. Carter, M.S.

CASSIE R. CARTER
Consulting Biologist
4136 Baldwin Avenue
Culver City, CA 90232
(213) 559-7758

April 1991

BALLONA WETLANDS/PLAYA VISTA DEVELOPMENT NON-INSECT INVERTEBRATE SURVEY FINAL REPORT

I. BASELINE INVESTIGATION

A. Introduction

Field surveys of the non-insect invertebrates of Ballona Wetlands were conducted quarterly. Preliminary field studies were conducted in April 1990. The site was surveyed in the summer, (June and July, 1990) in the fall, (October and November, 1990) in the winter, (February and March, 1991) and the final survey was in the spring (April, 1991). All four areas included in the proposed project were sampled and have been labeled Areas A, B, C, and D. The areas are defined and identified below in the Project Area section. All areas were visited with emphasis placed on areas slated (B and D) to undergo restoration, including the area of the proposed riparian corridor alignment and bluff base.

The purpose of this study is to identify the species composition and relative distribution of the wetland's non-insect invertebrates over a one year period. Although often inconspicuous and overlooked, invertebrates comprise the base of the ecosystem food web, and as such are essential to the maintenance and/or establishment of a healthy, diverse wetlands habitat. Therefore, this study will also assess the adverse and beneficial impacts of the proposed project on the non-insect invertebrate fauna of Ballona Wetlands.

B. Project Area

The proposed Playa Vista project site is an asymmetrical area located south of Marina del Rey and the Marina Freeway, west of the San Diego Freeway, north of Los Angeles International Airport, and east of the community of Playa del Rey.

The site is along the southern margin of the historic Ballona Creek floodplain. The southern border of the floodplain is the Westchester/Playa del Rey bluff system. This system of bluffs are approximately 300 feet in height. Cabora Road is located along and about one-third up the bluffs' face. The road was used to establish approximately the irregular southern boundary of the project site.

For planning purposes, the site has been divided into four areas. These areas, labeled A, B, C, and D, are divided by the Ballona Flood Control Channel (Ballona Channel) on a easterly-westerly axis and by Lincoln Boulevard on northerly-southerly axis. Area A is located immediately adjacent to Marina del Rey and is within the County of Los Angeles. Area B, C, and D are in the City of Los Angeles. Area B is immediately south of Area A; Area C is immediately east of Area A and Area D is southeast of Area A. Table 1 provides the acreage associated with each area.

Table 1 : Acreage in each Area

AREA	ACREAGE
Area A	138.6
Area B	337.9
AreaC	66.3
Area D	462.0
TOTAL	1004.8

Area A

Area A is bounded by Marina del Rey to the north and west, the Ballona Channel to the south, and Lincoln Boulevard to the east. The topography of the site is largely the result of anthropogenic activities. The naturally occurring topography of the site was altered by the disposal of dredge material during the construction of the Ballona Flood Control Channel in the 1930's and Marina del Rey in the 1960's (Schreiber, 1981). Oil wells are located in the southwest corner, a parking lot is located along the northwest margin, and a drainage ditch is located along northeast margin. The drainage ditch is tidally influenced. The site is criss-crossed by off-road vehicle roads and pedestrian trails. A bike path/access road boarders the southern margin of the site. The path is on the northern levee of the Ballona Channel. The Channel is tidally influenced within the boundaries of the Playa Vista project area.

Area B

Area B is bounded by the Ballona Channel to the north, the community of Playa del Rey to the west, the Playa del Rey bluffs to the south and Lincoln

Boulevard to the east. It is the least disturbed on the four areas. The natural topography of the site is largely present.

Jefferson and Culver Boulevards cross the central portion of the area. A gas company staging area is located along the south central margin of the area at the base of the Playa del Rey Bluffs. Centinela Ditch is also located at the base of the Playa del Rey Bluffs. Jefferson Drain empties into the area southeast of the Jefferson/Culver Boulevards intersection. An access road borders the northern margin of the site. This road is the southern levee of the Ballona Channel.

This area contains the largest contiguous wetland. The main tidal channels into the wetlands have been cut-off from tidal flows by the installation of four tide-gated structures in the south levee of the Ballona Channel. Some salt water does enter the norhtwest corner of the wetlands through these flap gates. Tidal amplitude has been reduced by approximately 63% (Boland and Zedler, 1991). Salinity of the waters in the tidal channels near the tidegates is approximately that of seawater, 35 ppt (Boland and Zedler, 1991). Culverts under Culver Boulevard provide a hydrologic link between the wetlans to the north and south of this roadway. The salinity of the water in the channels south of Culver Boulevard varied throughout the year from close to seawater to freshwater (Stoltz, 1990, Boland and Zedler, 1991).

Area C

Area C is bounded by commercial/residential development to the north, Lincoln Boulevard to the west, the Ballona Channel to the south, and the Marina Freeway to the east. Like Area A, this areas current condition is largely the result of anthropogenic activities. The naturally occurring topography of the site was altered by the disposal of dredge material during the construction of the Ballona Flood Control Channel in the 1930's and Marina del Rey in the 1960's. The area is dissected by Culver Boulevard. The area north of Culver Boulevard is largely vacant. A small drainage ditch flows from the middle of the site to the northwest and into Area A. This ditch usually does not contain standing water. Baseball fields are located south of Culver Boulevard.

Area D

Area D is bounded by Lincoln Boulevard to the west , the Westchester Bluffs to the south, commercial/industrial parcels to the east, and Jefferson Boulevard and the Ballona Channel to the north. It is the most developed of the four areas. It is the site of the offices and manufacturing facilities occupied by MacDonald Douglas and Hughes Aircraft Company. These facilities are located in the southeastern portion of the site. The southwestern portion of the site contains Centinela Ditch and a debris basin. Centinela Ditch is an intermittent freshwater stream carrying urban runoff. An abandoned airstrip is located in the central section of the site. Stockpiles of material are located along the northern margin. The Playa Vista site offices are located on the northwest portion of the parcel.

C. Methods and Materials

For the purposes of sampling invertebrates, Ballona Wetlands may be divided into four more-or-less distinct habitat types, each with a distinct fauna. Sampling methods varied depending upon the habitat and fauna being surveyed. Habitat types, the area of occurrence, and sampling methods are described below.

HABITATS

1) **Terrestrial** (with subdivisions for freshwater and saline-influenced systems); collection methods include hand sampling, sweep sampling, and soil excavation. Sampling was conducted along both uniform transect lines and subjectively where invertebrates were likely to be found. Terrestrial habitat occured on all four areas (A, B, C, and D).

2) **Freshwater** (including the riparian corridor); seine-netting, substrate sifting, dip-netting and hand collecting were employed in the sampling. Stations, collections and replications were done in conjunction with the freshwater fish survey conducted by Dr. David Soltz. Freshwater habitat occured in areas B and D primarily on the south side.

3) **Brackish water channels**; methods of collecting included seine-netting, substrate sifting, dip-netting and hand collecting. This sampling was also done in coordination with the fish survey. Brackish water habitat occured in area B on both sides of Culver Blvd.

4) **Marine** saline systems; included seine netting, otter trawling and bottom sampling. Sampling of the saline channels located on the north side of Culver Blvd. in area B was conducted using the same techniques as described above for the fresh and brackish water habitats.

Sampling periods occur four times during the year, encompassing all seasons and habitat changes. Each sampling session requires approximately one to two field days, with some differentiation of timing to adjust for differences in sampling techniques (ie. terrestrial vs marine) or work within optimal collecting circumstances (high tide vs low tide) for specific groups.

Live organisms were returned to the habitat that they were collected from, promptly after identification, with the exception of a few voucher specimens, and in the cases where immediate classification was not possible. Voucher specimens were preserved in 70% ethanol solution. For many species dead shells or carapaces were available and in those cases they were often collected in lieu of live organisms.

Species from each habitat are relatively distinct, with small percentages of overlap within ecotonal systems (ie. brackish water). The only other major habitat types on site are the sand systems, including the remnant dunes, and these are being sampled as part of the terrestrial insect survey. Very few non-arthropod invertebrates would be expected to occur there, except ubiquitous, introduced isopods.

D. Results

The results of the field surveys are listed in Table 2. Areas A, C, and most of D yielded almost no non-insect invertebrates. In the terrestial regions most abundant invertebrate observed was the introduced African land snail, *Otala lactea*. During the summer survey snails were active foliage predators on the pickleweed, *Salicornia*, wherever it occured, and in some instances it appeared to be entirely defoliating individual plants. The majority of the snails were estivating and not active, probably to avoid desiccation, during the fall collection period. By the end of March they were active and feeding again.

The freshwater stream located near the bluffs in Area D had been dry since approximately June 1990. The only invertebrate encountered in the streambed was the Louisiana swamp crayfish, *Procambarus clarki*, found living in a discarded bottle.

Area B and the Ballona Channel appear to be the only regions on the property currently supporting any diversity of non-insect invertebrates. At least thirty species, representing four phyla, were found in area B during the summer and fall collections. With the exception of terrestrial snails, almost all of the non-insect invertebrates were found in the saline and brackish water channels leading to (or from) the tidal gates at Ballona Channel in area B. The most abundant organism found in the saline channels was the California horn snail, *Cerithidea californica*, with a population in the thousands. Other organisms that occured in some abundance included bent-nosed clam, *Macoma nasuta*, razor clam, *Tagelus subteres*, California paper snail, *Bulla gouldiana*, fiddler crab, *Uca crenulata*, striped shore crab, *Pachygrapsus crassipes*, and polychaete worms, such as *Capitella capitata* . Several brackish water and marine fish that were collected as part of the fish survey had leeches attached to them. Crayfish were also encountered commonly in the brackish and freshwater regions of the channels.

Several molluscs were collected and observed in the winter and spring 1991 surveys that were not found in the summer or fall 1990 surveys. Encrusting worm shells from the family Vermetidae were found on the shells of several larger molluscs, such as mussels and oysters. Several onyx slipper shells, *Crepidula onyx* , and a second species of jackknife or razor clam, *Tagelus californianus,* were observed in the 1991 samples but not noted in the 1990 ones. The California paper snail, *Bulla gouldiana,* were laying eggs in large numbers during the summer survey period but were not observed at all in the winter and spring samples.

E. Discussion

The majority of the organisms found occuring in Ballona Wetlands during the summer and fall surveys were common and fairly hearty species which are capable of persisting in degraded systems. Some species, such as the polychaete worm, *Capitella capitata*, are able to sucessfully invade habitats with high levels of disturbance. They are considered to be pollution indicators when they are found occuring in large populations in an ecosystem that is otherwise species poor (Grassle & Grassle, 1974).

It should be noted that the salinity of the channel water, especially on the south side of Culver Blvd. in area B, was greatly decreased in the fall sample. There was a large influx of freshwater, probably from the Jefferson storm drain, due to an unrelated project at least a mile upstream, beginning in mid October 1990. The water went from hypersaline conditions to hyposaline in what was probably a few days. (Please see Soltz, 1990 Fall report for exact figures). This estimate is based primarily on the fact that the overflow of water, which went out of the normal stream banks, was still on the surface and had not yet soaked into the soil, and thus appeared to be a recent event.

The composition of organisms that had colonized the saline water channels on the south side of Culver Blvd. in area B changed considerably after the freshwater influx. Clams, primarily the genus *Chione*, bubble snails, *Bulla gouldiana*, and the marine Annelids, all died or disappeared. Individual California horn snails, *Cerithidea californica*, were still surviving in October but had moved from the channel bottoms to the surface of the algal mats and appeared stressed. It was observed, in a brief visit to the site in December, that very few live horn snails were remaining on the south side of Culver Blvd. Previous studies have shown that almost no intertidal invertebrates would be able to survive freshwater conditions of two weeks or longer (Zedler & Magdych, 1984). It is reasonable to assume that recolonization of the channels could eventually occur if previous (or similar) salinity levels were restored and organism recruitment was possible from the north side of Culver Blvd.

An extensive study of the marine environment of Marina del Rey conducted by D. Soule and M. Oguri, for the Department of Beaches and Harbors, County of Los Angeles, was released February 1990. It is a comprehensive report, and probably the most complete information available to date on the invertebrate fauna of the Ballona Channel/Marina del Rey area. I highly recommend that this report be used as a primary resource base for the marine invertebrate fauna of Ballona Channel. It would not productive to extensively survey the area when such a recent and complete study is available.

The only non-insect invertebrate that is a candidate (category 2) for Federal listing as a rare or endangered species, that possibly occurs in the area is the California brackishwater snail, *Tryonia imitator*, and it has not be observed in the Ballona Wetlands. It should, however, continue to be surveyed for and taken into consideration during the proposed restoration.

CRC/4-91

F. Conclusions

Based upon the surveys, my assessment is that general habitat quality appears to have degraded considerably since the Biota of the Ballona Region, Los Angeles County (Schreiber, 1981) was completed. Habitat quality is relatively poor, non-insect invertebrate diversity is low, and it may be currently unsuitable to maintain diverse populations of invertebrates necessary to serve as a broad food chain base. Introduced, non-native species, or a single species (such as California horn snail, *Cerithidea californica*), appear to be predominant in certain habitats, limiting the number of other organisms able to sustain themselves on these resources. Restoration of any level of tidal flow to the wetlands would increase the health and stablity of the habitat considerably. It is likely that a wide number of species would be able to recolonize with minimal human intervention. Some organisms that no longer occur in the area, but are beneficial to the balance of a dynamic and productive wetlands may have to be actively recruited to insure their presence.

Invertebrates tend to be inconspicious and frequently hidden, and consequently they are often overlooked in biological studies. They form the food base for numerous wetland vertebrates and are essential in a natural habitat. The invertebrate species composition and populations need to be closely monitored and managed during the restoration of Ballona Wetlands.

Table 2

NON-INSECT INVERTEBRATES OF BALLONA WETLANDS

SPECIES	AREA
PHYLUM MOLLUSCA	
CLASS PELECYPODA (BIVALVES)	
Speckled Scallop *Argopecten aequisulcatus*	B
California Chione *Chione californiensis*	B
Bent-nosed Clam *Macoma nasuta*	B
Bay Mussel *Mytilus edulis*	B

Pacific Oyster *Ostrea lurida*	B
Little-neck Clam *Protothaca staminea*	B
California Jacknife Clam *Tagelus californianus*	B
Razor Clam *Tagelus subteres*	B
Gaper Clam *Tresus nuttalli*	B

CLASS GASTROPODA (MARINE SNAILS)

California Assiminea *Assiminea california*	B
California Paper Bubble *Bulla gouldiana*	B
California Horn Snail *Cerithidea california*	B
California Cone Snail *Conus californicus*	B
Onyx Slipper Shell *Crepidula onyx*	B
Green Paper Bubble *Haminoea virescens*	B
Salt Marsh Snail *Melampus olivaceus*	B
Mud Nassa *Nassarius tegula*	B
Worm Shell Vermetidae	B

CLASS PULMONATA (LAND SNAILS)

African Land Snail (non-native) *Otata lactea*	A, B, C, D

PHYLUM ARTHOPODA

CLASS CRUSTACEA (CRUSTACEANS)

Acorn Barnacle *Balanus glandula*	B
Fiddler Crab *Uca crenulata*	B
Yellow Shore Crab *Hemigrapsus oregonensis*	B
Striped Shore Crab *Pachygrapsus crassipes*	B
Louisiana Swamp Crayfish *Procambarus clarki*	B, D
Pacific Coast Crayfish *Pacifastacus sp.*	B, D
Amphipod *Corophium sp.*	B
Unidentified Copepods	B
Unidentified Ostracods	B

PHYLUM ANNELIDA

CLASS POLYCHAETA (SEGMENTED WORMS)

Red-banded Bamboo Worm *Axiothella sp.*	B
Polychaete Worm *Capitella capitata*	B
Tube Worm *Hydroides norvegica*	B
Spionidae Worm *Polydora sp.*	B
Nereid Worm *misc. unidentified*	B

CLASS OLIGOCHAETA (EARTHWORMS & RELATIVES)

Misc Oligochaets *unidentified species*	B

CLASS HIRUDINEA (LEECHES)

Fish Leech *Family Piscicolidae*	B, D

PHYLUM NEMERTEA

Unidentified Nemertean Worm	B

Literature Cited

Boland, J.M. & J.B. Zedler. 1991. The Functioning of Ballona Wetland in Relation to Tidal Flushing, Part I--Before Tidal Restoration, January 1991. Project sponsored by the National Audubon Society.

Grassle, J. F. & J. P. Grassle. 1974. Opportunistic Life Histories and Genetic Systems in Marine Benethic Polychaetes. J. Mar. Res. 32(2):253-284.

Soltz, D. 1990. Preliminary Report on Fishes of Ballona Wetlands.

Schreiber, R. W., editor. 1981. Biota of the Ballona Region, Los Angeles County. Los Angeles Natural History Museum, CA.

Soule, D. F. & M. Oguri., editors. 1990. The Marine Environment of Marina Del Rey, October 1988 to September 1989. Studies of San Pedro Bay, California Part 20E. A report to the Department of Beaches and Harbors, County of Los Angeles.

Zedler, J. B. & W. P. Magdych. 1984. Review of Salinity and Predictions of Estuarine Responses to Lowered Salinity. State of California, Water Resources Control Board. Association of Governments, San Diego. pp 51.

Appendix J-5: Fish Populations -- Low Marina del Rey Harbor and Ballona Channel

Larry G. Allen, Ph.D

THE FISH POPULATIONS INHABITING LOWER MARINA DEL REY HARBOR AND BALLONA CHANNEL FROM JULY 1990 TO APRIL 1991

Technical Report

for

The Playa Vista EIR,
MacGuire Thomas Partners

by

Larry G. Allen, Ph.D.
Professor of Biology,
California State University
Northridge

APRIL 10, 1991

BASELINE INVESTIGATION:

INTRODUCTION

The goal of this monitoring study was to assess the current status of the fish populations of lower Marina del Rey Harbor and Ballona Channel just prior to possible construction of a new marina and restoration of the Ballona Marsh complex. Lower Marina del Rey was included in the study since the fish assemblages of the new marina should be very similar to those found in the existing marina.

Southern California harbors are relatively productive and heterogeneous environments which support abundant diverse fish assemblages. Harbors combine the attributes of extensive, nearshore soft bottom habitat with those of nearshore pelagic, sandy and rocky shores, and shallow rock reefs. Harbors are numerically dominated by two species of croaker, the white croaker (Genyonemus lineatus) and queenfish (Seriphus politus) and the juveniles of northern anchovy (Engraulis mordax), but also possess high species diversity. However, diversity is dependent on the water quality. In heavily eutrophic and/or polluted areas where water circulation is poor diversity is generally low with only a few, tolerant species (e.g., white croakers and queenfish) being abundant. Harbors share some characteristics with bays and estuaries as fish habitats, but do not adequately replace them (Allen, 1990).

PROJECT AREA

This baseline study and impact analysis deals exclusively with Area A and the portion of lower Marina del Rey immediately northwest of Area A. Area A is bounded by Marina del Rey to the north and west, the Ballona Channel to the south, and Linclon Boulevard to the east. The topography of the site is largely the result of anthropogenic activities. The naturally occurring topography of this site was altered by the disposal of dredge material during the construction of the Ballona Flood Control Channel in the 1930's and Marina del Rey in the 1960's. The area is now largely vacant and is of no to extremely low value as a marine habitat. The Ballona Channel which forms the southern border to Area A is a levied, flood control channel which drains a total of approximately 76,700 acres of urban area largely within the City of Los Angeles. The channel is tidally influenced within the boundaries of the Playa Vista project area. Tidal ranges within the channel approximate those found along the open coast.

METHODS

The sampling program targeted the juvenile and adult fishes near the bottom. Large (7.6m) otter trawls were used to effectively sample larger bottom associated fishes. The 2m otter trawls targeted young-of-the-year and juvenile fishes which utilize these areas as nursery grounds.

Each station was divided into a nine-square grid. Four of the squares were randomly selected for occupation during each survey. Sampling was conducted on a quarterly schedule (July 1990 - April 1991) at two stations (lower Marina del Rey Harbor and Ballona Channel). One day was required to sample both stations. The 24.5 m R/V YELLOWFIN served as our base of operation. The YELLOWFIN is owned and operated by the Ocean Studies Institute of the California State University.

Two types of sampling gear were employed:

1) A small otter trawl a horizontal opening of 1.6 m and a vertical opening of 0.343 m. The netting of the trawl consisted of 3 mm mesh. All tows were made within the randomly selected squares at both stations.

2) A 7.6 m semi-ballon otter trawl (2 cm mesh in wings and 8 mm mesh in codend) towed behind the R/V Yellowfin was used to sample bottom juvenile and adult fishes in the main channel of Marina del Rey. Due to limited space two replicate, five minute tows were made during each survey.

Ballona Channel was not sampled in April 1991 due to an oil spill upstream. The channel was completely closed off by a boom which denied access to the station. Overall , 12 tow samples were taken in Ballona Channel and 24 in lower Marina del Rey.

Replicate tows were vital to offset the high variance always encountered among individual tows. Our studies over the last 15 years have consistently shown a high degree of variance (variance to mean ratios >1.0 usually) among replicates due to patchy distributions of the most species.

Sample catches were transported back to the R/V YELLOWFIN in individually marked buckets for work-up. All fishes or subsamples of large catches were identified, counted and weighed.

RESULTS AND DISCUSSION

A total of 6,063 individual fishes representing 29 species (and other taxa) were collected over the course of the study (Table 1). The catch was numerically dominated by four species. Queenfish (Seriphus politus) ranked first contributing 39% of all fishes caught, followed by northern anchovy (Engraulis mordax; 38%), cheekspot goby (Ilypnus gilberti; 11%), and white croaker (Genyonemus lineatus; 5%) (Table 1). Queenfish, northern anchovy, and white croaker occurred exclusively in Marina del Rey while cheekspot was the most abundant fish captured in Ballona Channel (Table 1; Figure 1). Another group of common, nearshore fish species were found in comparable numbers in both areas, these included: California halibut (Paralichthys californicus), barred sand bass (Paralabrax nebulifer), arrow goby (Clevelandia ios), and diamond turbot (Hypsopsetta guttulata) (Table 1; Figure 1). The post-larval goby taxon probably consisted mainly of cheekspot gobies and arrow gobies which were too young for positive identification.

About 90% (5469) of the individuals were taken from Marina del Rey and about 10% (594) from Ballona Channel. Catch-per-unit-effort was also higher at the Marina del Rey station (CPUE = 228 inds/tow) than at the Ballona Channel station (CPUE = 49 inds/tow) (Table 2). In addition, more species were taken in Marina del Rey (23) than in Ballona Channel (12) with the former having almost twice the mean number of species per survey (12 spp/survey vs. 7 spp/survey).

The fish species found to inhabit lower Marina del Rey during the course of this investigation were very characteristic of harbor habitats found throughout southern California. The fish assemblage within Ballona

Channel appeared to be depauperate relative to the marina due mainly to the absence of the highly abundant species (queenfish, northern anchovy, and white croaker) in the shallow, channel habitat. The overall species composition in Ballona Channel appeared similar to that found in shallow marina habitats adjacent to estuaries and marshes in southern California (Allen, 1985). Noticeably absent were fish species known to be indigenous to salt marshs and estuaries such as, California killifish (Fundulus parvipinnis), longjaw mudsucker (Gillichthys mirabilis), striped mullet (Mugil cephalus), barred pipefish (Syngnathus auliscus), and shadow goby (Quietula ycauda).

The catches from both stations varied greatly on a seasonal basis (Tables 3 and 4). The abundance was high at both stations in the summer (July) and fall (October) of 1990 and low in winter (January 1991). An oil spill precluded sampling in Ballona Channel in April 1991, however, the catch in the marina remained low at that time (Table 4). Heavy rains during the month of March 1991 could have played a role in depressing the numbers of fish in April. These seasonal patterns are not surprising since fish assemblages of bays, estuaries, and harbors in southern California are know to be highly seasonal in both abundance and diversity (Allen, 1990).

IMPACT ANALYSIS:

If the design of the new marina provides adequate circulation, a highly diverse fish assemblage should occupy the area. The typical harbor fish species occur in abundance in Marina del Rey Harbor which is adjacent to both the proposed marina site and Ballona Channel. These fishes should have no trouble becoming established in the marina and channel. The current condition of Area A obviously serves no function as a marine fish habitat. Conversion of this area into a marina would certainly provide habitat for marine fish which currently does not exist.

Ballona Channel appears to be a degraded or, at least marginal habitat for both marine and estuarine fishes at this time. An improvement in the quality of water traversing the channel should improve its potential as a functional fish habitat.

A functional Ballona Channel and new marina with an estimated inhabitable area of 37 ha may produce between 252 and 592 Kg of harbor and nearshore, bottom fishes each year (Allen, 1990).

LITERATURE CITED

Allen, L.G. 1985. A habitat analysis of the nearshore marine fishes from southern California. Bull. So. Cal. Acad. Sci., 84(3): 133-155.

Allen, L.G. 1990. Fishes of bay, estuary and harbor habitats in southern California; a perspectus and predictions regarding_Ballona Wetlands restoration. Consultation for MacGuire Thomas Partners. 25 p.

Figure 1. Species composition of the fish assemblages occupying Ballona Channel and Marina del Rey from July 1990 to April 1991. Catch-per-unit-effort (CPUE) for the ten most abundant species is compared between the two areas. SERPOL = Seriphus politus; ENGMOR = Engraulis mordax; ILYGIL = Ilypnus gilberti; GENLIN = Genyonemus lineatus; PARCAL = Paralicthys politus; PARNEB = Paralabrax nebulifer; PL GOBY = post-larval goby; CLEIOS = Clevelandia ios; HYPGUT = Hypsopsetta guttulata; and SYMATR = Symphurus atricauda.

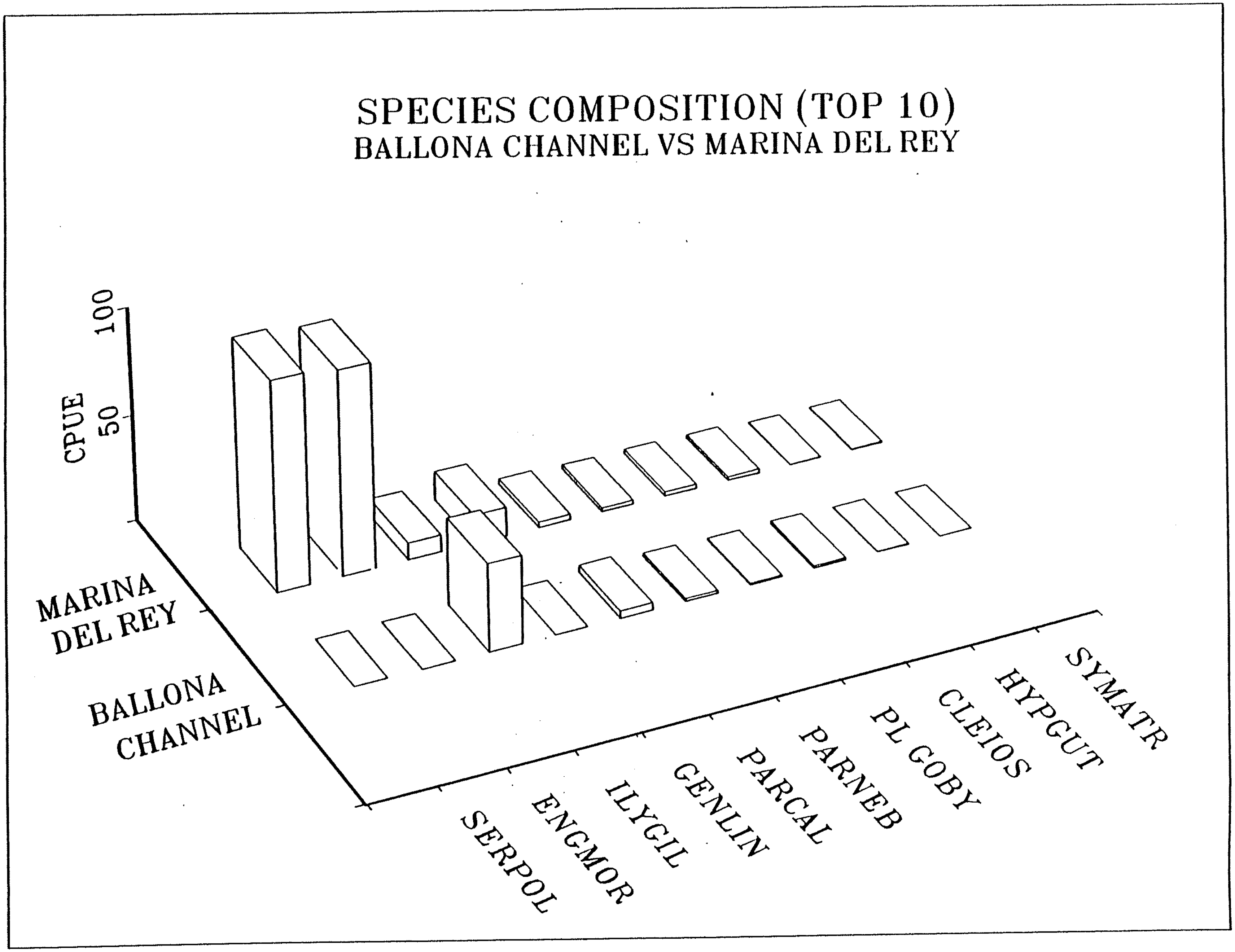

SPECIES COMPOSITION (TOP 10)
BALLONA CHANNEL VS MARINA DEL REY
CPUE
100
50
MARINA DEL REY
BALLONA CHANNEL
SERPOL
ENGMOR
ILYGIL
GENLIN
PARCAL
PARNEB
PL GOBY
CLEIOS
HYPGUT
SYMATR

Figure 1

TABLE 1. SUMMARY OF OVERALL CATCH BY AREA (BALLONA CHANNEL AND AND MARINA DEL REY) FOR ALL SURVEYS.

SPECIES/TAXON	AREA: BALLONA CHANNEL	AREA: MARINA DEL REY	TOTAL	%
Seriphus politus	0	2375	2375	39.17
Engraulis mordax	0	2316	2316	38.20
Ilypnus gilberti	492	193	685	11.30
Genyonemus lineatus	0	325	325	5.36
Paralichthys californicus	40	63	103	1.70
Paralabrax nebulifer	15	45	60	.99
post-larval goby	9	49	58	.96
Clevelandia ios	14	43	57	.94
Hypsopsetta guttulata	4	8	12	.20
Symphurus atricauda	0	9	9	.15
Paralabrax clathratus	5	3	8	.13
Acanthogobius flavimanus	0	8	8	.13
Heterostichus rostratus	0	7	7	.12
Pleuronichthys ritteri	4	3	7	.12
Hypsoblennius jenkinsi	1	5	6	.10
Leptocottus armatus	0	6	6	.10
Atherinops affinis	4	0	4	.07
Atractoscion nobilis	0	2	2	.03
Myliobatis californicus	0	2	2	.03
Pleuronichthys verticalis	2	0	2	.03
Sardinops sagax	2	0	2	.03
Sphyraena argentea	0	2	2	.03
Cymatogaster aggregata	0	1	1	.02
Gibbonsia elegans	0	1	1	.02
Gibbonsia sp.	1	0	1	.02
Gobiesox rhessodon	0	1	1	.02
Strongylura exilis	1	0	1	.02
Urolophus halleri	0	1	1	.02
Xenistius californiensis	0	1	1	.02
TOTAL	594	5469	6063	

TABLE 2. SUMMARY OF CATCH-PER-UNIT-EFFORT (CPUE) BY AREA BALLONA CHANNEL AND MARINA DEL REY) FOR ALL SURVEYS.

SPECIES/TAXON	AREA BALLONA CPUE	 MDR CPUE	 TOTAL CPUE
Seriphus politus	.00	98.96	65.97
Engraulis mordax	.00	96.50	64.33
Ilypnus gilberti	41.00	8.04	19.03
Genyonemus lineatus	.00	13.54	9.03
Paralichthys californicus	3.33	2.63	2.86
Paralabrax nebulifer	1.25	1.88	1.67
post-larval goby	.75	2.04	1.61
Clevelandia ios	1.17	1.79	1.58
Hypsopsetta guttulata	.33	.33	.33
Symphurus atricauda	.00	.38	.25
Paralabrax clathratus	.42	.13	.22
Acanthogobius flavimanus	.00	.33	.22
Heterostichus rostratus	.00	.29	.19
Pleuronichthys ritteri	.33	.13	.19
Hypsoblennius jenkinsi	.08	.21	.17
Leptocottus armatus	.00	.25	.17
Atherinops affinis	.33	.00	.11
Atractoscion nobilis	.00	.08	.06
Myliobatis californicus	.00	.08	.06
Pleuronichthys verticalis	.17	.00	.06
Sardinops sagax	.17	.00	.06
Sphyraena argentea	.00	.08	.06
Cymatogaster aggregata	.00	.04	.03
Gibbonsia elegans	.00	.04	.03
Gibbonsia sp.	.08	.00	.03
Gobiesox rhessodon	.00	.04	.03
Strongylura exilis	.08	.00	.03
Urolophus halleri	.00	.04	.03
Xenistius californiensis	.00	.04	.03
TOTAL CPUE	49.50	227.88	169.79

TABLE 3. SUMMARY OF CATCH IN BALLONA CHANNEL BY SURVEY PERIOD. SPECIES ARE RANKED IN ORDER OF OVERALL ABUNDANCE.

SPECIES/TAXON	SURVEY JUL90	OCT90	JAN91	TOTAL	%
Ilypnus gilberti	323	169	0	492	82.83
Paralichthys californicus	17	22	1	40	6.73
Paralabrax nebulifer	0	14	1	15	2.53
Clevelandia ios	5	1	8	14	2.36
post-laval goby	9	0	0	9	1.52
Paralabrax clathratus	0	4	1	5	.84
Atherinops affinis	4	0	0	4	.67
Hypsopsetta guttulata	4	0	0	4	.67
Pleuronichthys ritteri	0	4	0	4	.67
Pleuronichthys verticalis	0	2	0	2	.34
Sardinops sagax	0	2	0	2	.34
Gibbonsia sp.	1	0	0	1	.17
Hypsoblennius jenkinsi	1	0	0	1	.17
Strongylura exilis	0	1	0	1	.17
TOTAL	364	219	11	594	

TABLE 4. SUMMARY OF CATCH IN MARINA DEL REY BY SURVEY PERIOD. SPECIES ARE RANKED IN ORDER OF OVERALL ABUNDANCE.

	SURVEY					
SPECIES/TAXON	JUL90	OCT90	JAN91	APR91	TOTAL	%
Seriphus politus	2361	14	0	0	2375	43.43
Engraulis mordax	210	2101	5	0	2316	42.35
Genyonemus lineatus	210	106	7	2	325	5.94
Ilypnus gilberti	12	153	20	8	193	3.53
Paralichthys californicus	16	29	4	14	63	1.15
post-larval goby	0	0	0	49	49	.90
Paralabrax nebulifer	7	27	1	10	45	.82
Clevelandia ios	0	41	2	0	43	.79
Symphurus atricauda	1	8	0	0	9	.16
Acanthogobius flavimanus	7	1	0	0	8	.15
Hypsopsetta guttulata	2	3	0	3	8	.15
Heterostichus rostratus	0	0	2	5	7	.13
Leptocottus armatus	6	0	0	0	6	.11
Hypsoblennius jenkinsi	1	2	2	0	5	.09
Paralabrax clathratus	0	0	2	1	3	.05
Pleuronichthys ritteri	2	0	0	1	3	.05
Atractoscion nobilis	0	2	0	0	2	.04
Myliobatis californicus	0	2	0	0	2	.04
Sphyraena argentea	0	2	0	0	2	.04
Cymatogaster aggregata	0	0	0	1	1	.02
Gibbonsia elegans	0	0	0	1	1	.02
Gobiesox rhessodon	0	0	0	1	1	.02
Urolophus halleri	0	1	0	0	1	.02
Xenistius californiensis	0	0	1	0	1	.02
TOTAL	2835	2492	46	96	5469	

Appendix J-6: Fish Survey of Ballona Wetlands Playa Vista Areas B and D

David L. Soltz, Ph.D

FISH SURVEY OF BALLONA WETLANDS

Areas B and D
of the
Playa Vista Project

Prepared by
David L. Soltz, Ph.D.

June 1991

Prepared for Maguire Thomas Partners

INTRODUCTION

Ballona Wetlands is a remnant salt marsh on Santa Monica Bay that has been highly modified by humans activities. Yet, it is the largest coastal wetland system remaining in Los Angeles County. There is an extensive system of relic diked tidal sloughs running throughout the salt marsh (Figure 1). These sloughs have had very restricted tidal flushing for over 60 years, since tide gates were installed which greatly restrict seawater access from Ballona Channel.

As part of the Playa Vista Project, Maguire Thomas Partners is planning to restore the wetland by modifying the openings to the ocean, via Ballona Channel, and restoring either mid-tidal (partial) or full-tidal flushing.

The purpose of this study is to survey the fishes in the relic diked tidal sloughs, channels, and Centinela Ditch on a quarterly basis and, thereby, to determine the current status of the estuarine fish community in Ballona Wetlands. Coastal sloughs, small lagoons and tidal creeks of Southern California have been studied infrequently and their community structure is poorly know. Larger bays and lagoons have been characterized and their fish communities studied to varying extents; e.g. Anaheim Bay (Lane and Hill 1977), Mugu Lagoon (Onuf and Quammen 1983, Onuf 1987), Newport Bay (Allen 1980, 1983, Horn and Allen 1981), and Tijuana Estuary (Zedler 1977, 1982, Zedler and Nordsby 1986). The fish communities of two small lagoons on the coast of Los Angeles County have been characterized, e.g. Alamitos Bay (Allen and Horn 1975) and Malibu Lagoon (Soltz 1986). None of these habitats have small relict sloughs similar to those in Ballona Wetlands. However, Swift (1981) conducted an extensive monthly survey of fishes in the sloughs and channels throughout Ballona Wetlands.

The study by Swift (1981) provides an excellent baseline for the present study of the fishes of Ballona Wetlands. The present study was funded for only 4 quarterly samples from Summer 1990 through Spring 1991, whereas the previous study sampled fishes monthly for a full year. It should be noted that one of the large tide gates was broken during the entire Swift (1981) study allowing considerably more tidal flushing (not directly measured by Swift,1981), and therefore access for fishes and their eggs and larvae, than during this study. The tide gate was repaired in 1982 (S. Lockhart, pers. comm.) and, although occasionally propped partially open by vandals, greatly restricted the flushing and tidal range in the remnant sloughs throughout the present study. The tidal range in the sloughs never exceeded one meter and diminished considerably with distance from Ballona Channel during the study period (Boland and Zedler 1991).

This study characterizes the fish community in the relic sloughs and channels of Ballona Wetland during an extended period of highly restricted tidal flushing. The baseline study (Swift

1981), in contrast, was conducted during a period of less restricted flushing because of the broken flap gate. The conditions present in 1980-81 were an exception to the 60 year history of Ballona Wetlands since the installation of tide gates into Ballona Channel.

PROJECT AREA

The proposed Playa Vista project site has been divided into four areas. Only two of the areas, Area B and D, contain sufficient water to support fishes.

Area B

Area B is bounded by the Ballona Channel to the north, the community of Playa del Rey to the West, the Playa del Rey Bluffs to the south and Lincoln Boulevard to the east. Centinela Ditch enters the area from Area D and continues along the base of the Playa del Rey Bluffs to merge with the relict slough system. Jefferson Drain empties into the area southeast of the Jefferson/Culver Boulevards intersection. These two drainages provide most of the freshwater, with some additional urban runoff coming from the Playa del Rey Bluffs, entering the wetlands.

Ballona Wetlands, the largest contiguous wetland remaining in Los Angeles County, is entirely within Area A. The main tidal channels into the wetland have been cut-off from full tidal flows for approximately 60 years by four tide gates in the south levee of the Ballona Channel. Tidal range has been reduced by over 60% (Boland and Zedler 1991) and saltwater entry is almost entirely from leakage around the flap gates. Therefore, access for fishes, fish eggs and larvae is also greatly reduced. Salinity of the water in the tidal channels near the tide gates is approximately that of seawater (30 to 35 ppt). The wetlands north and south of Culver Boulevard are linked by two culverts under the roadway. The channels south of Culver Boulevard vary from freshwater to hypersaline (e.g. 0 to 40 ppt) depending upon season and amount of urban runoff, principally form the Jefferson Drain.

Area D

Area D is bounded by Lincoln Boulevard to the west, the Westchester Bluffs to the south, commercial/industrial parcels to the east and Jefferson Boulevard and the Ballona Channel to the north. It is the most developed of the four areas. Centinela Ditch, the channelized remnant of Centinela Creek, runs along the bluffs in the southwestern portion of the area. Centinela Ditch is an intermittent freshwater stream carrying urban runoff.

METHODS

The 13 sampling stations in Area B used by Swift (1981) were visually surveyed and dipnet sampled in July 1990. The 3 stations on Centinela Ditch upstream of station 10 (nos. 11-13) were dry. The other 2 stations south of Culver Boulevard were so choked with emergent vegetation that there was no open water. Therefore, only station 10 was sampled in the relatively non-tidal area of the salt marsh south of Culver Boulevard. Two of the 7 stations north of Culver Boulevard were not sampled in this study. Station 5 was excluded because it was not flooded on a +4.1 ft high time in July 1990. Station 2 was so shallow, algae filled and warm (32.4 C) that it contained only a few mosquitofish (Gambusia afffinis) and California killifish (Fundulus parvipinnis). Stations 1, 3, 4, 6 and 7 were considered appropriate for characterizing the remnant tidal sloughs north of Culver Boulevard. Station 7 was a deeper hole at the end of the culvert under Culver Boulevard along the ditch originating at the Jefferson Drain. The other stations were relatively shallow remnant sloughs characteristic of the wetland. In summary, we conducted quarterly samples of 6 of the 13 stations sampled in the Swift (1981) fish survey of Ballona Wetland (Figure 1). One (no. 10) was in the upper salt marsh south of Culver Boulevard. Six (nos. 1, 3, 4, 6 and 7) were in the remnant tidal sloughs north of Culver Boulevard.

Each of the six stations were 25 m long and were sampled with the following protocol:

Salinity (in parts per thousand with a refractometer), temperature and dissolved oxygen (in mg/liter with a YSI Oxygen meter) of 3 surface samples were taken at two locations with in the 25 m station and averaged.

Fish sampling -- Both ends of the 25 m long stations were blocked with a 3.2 mm mesh seine. Four hauls of the entire length of the channel were taken and the fish collected from each haul were processed separately. Typically the first 2 hauls were with a 10 ~~x 1.8~~ m, 6.3 mm mesh seine that spanned the entire channel. The second 2 hauls were with a 5 x 1.8 m, 3.2 mm mesh seine that did not span the channel at the wider stations (nos. 3 and 4). When appropriate only 2 hauls were taken with the smaller net from the narrower and/or shallower stations (e.g. nos. 6, 7, and 10). Most collections were made within 2 1/2 hours of low time, however, water level usually did not fluctuate more than 0.6 m due to the functional tide gates.

Fishes were counted, measured to the nearest 2 mm standard length, weighed if sufficient mass was available and released. A subsample of 100 individuals of abundant species were measured and the entire sample was counted. Occasional representative samples and specimens difficult to identify in the field were preserved in 10% formalin and returned to the laboratory of ichthyology at CSULB.

Centinela Ditch, in Area D, was surveyed visually and with a dipnet during a preliminary reconniscence trip in late April 1990. At that time it contained a shallow flow 3 - 10 cm for the entire distance along the south side of Teale Street and through the culvert under Lincoln Boulevard into Area B. During the Summer and Fall 1990 sampling periods the entire ditch in Area D was dry. A 25 m section, approximately 50 m east of Lincoln Boulevard, was seined (1 haul with the 3.2 mm mesh net) in April 1991.

RESULTS AND DISCUSSION

Salinity, Temperature and Dissolved Oxygen

The salinity of the water was rather consistant within 3 of the 4 seasons, amoung the 6 stations in Area B (Figure 2). In Summer all stations had typical seawater salinities, except station 10, the furthest from Ballona Creek, which was hypersaline (40 ppt). There was no freshwater entering Ballona Wetland at the time of sampling. The Winter pattern was similar with the only station 7 with an average salinity significantly below seawater (21 ppt). Station 7 is directly connected with the channel from Jefferson Drain, one of the two primary sources of freshwater input into the wetland.

The Spring salinity profile was indicative of significant freshwater input from Centinela Ditch rather than Jefferson Drain. Salinities were below 10 ppt at the upper 2 stations (nos. 6 and 10). There was a mixing zone at station 4 (25 ppt), and also station 7 on the channel from Jefferson Drain. The stations near the tide gates (nos. 1 and 3) were nearly full seawater.

The Fall salinity profile was very different and atypical. A dewatering project upstream along Jefferson Boulevard discharged 500 gal of water per minute (~1.1 cfs) into Jefferson Drain which discharges directly into Ballona Wetland approximately 1000 m upstream of station 7. The October average salinities ranged from a low of 4 ppt at station 7 to a high of only 11 ppt at stations 1 and 3, the two stations nearest the tide gates from Ballona Channel.

This unusual and unfortunate large discharge of freshwater into the wetland system in late summer and fall probably had a detrimental effect on the abundance and diversity of the fishes living in the channels and relict sloughs (see below). The impacts are due both to the prolonged period of low salinity in what is normally a seawater system and the flushing and scourering effects of a strong current, particularly at low tides. These factors make it difficult to compare the results of the fall and probably winter fish surveys with those of Swift(1981). The Ballona Wetland system is normally a seawater system in the north section, except for relatively brief periods after winter rain storms. At these times, such as April 1991, there is a salinity gradient from full seawater near Ballona Channel (35 ppt at station 1) to brackish at the stations furthest from the tide gates (6 ppt at station 6). The section south of Culver Boulevard varies from hypersaline to freshwater (Boland and Zedler 1991) depending upon ther amount of freshwater input, be it from rainfall or urban runoff.

Summer water temperatures varied from slightly above normal ocean temperatures (e.g. 23 - 26 C) at stations most influenced by tidal flushing (stations 1, 3, and 4) to above 30 C at stations 6, 7 and 10. Fall water temperatures were moderate throughout the system (e.g. 19 - 23 C). Spring water temperatures were also moderate (e.g. 16 - 26 C), with a greater range than Fall, and depended upon seawater influence and water depth. Water temperatures during the Winter sampling period were very cold throughout the wetland (e.g. 12.5 - 16), with temperature decreasing with increased distance from Ballona Channel. The cold winter temperatures, associated with a period of unusually cold coastal air temperatures, probably contributed to the very low number of fishes (243 individuals total) collected suring this period. The extremes of temperature at the upper marsh stations (nos. 6, 7, 10) were 12.5 C in winter and 32 C in summer. These extreme thermal conditions limit the diversity of fishes in upper marsh habitats (Horn and Allen 1981, Zedler 1982). The greatly restricted tidal flushing further exascerbates these effects in Ballona Wetlands under present conditions.

The dissolved oxygen levels amoung all stations were never at levels stressful to fishes during the day. No station had an average dissolved oxygen reading of less than 5.5 mg/l at any season or water temperature. Areas with dense algal growth (e.g. nos. 7 and 10) often had supersaturated levels. These areas may go to very low (<2 mg/l) oxygen levels before dawn. Fishes in area with low oxygen would be able to migrate into open water.

Fish Diversity and Abundance

A total of 9726 individuals of 11 species of fishes were collected in four quarters of sampling (Table 2). The total sample was strongly dominated by mosquitofish, an introduced exotic species. This species accounted for 61% of all individuals collected, and comprised 46.5% to 65.5% of the quarterly total samples. Mosquitofish were present at all 6 station (Table 3). They were strongly dominant at the upper marsh stations (nos. 6, 7 and 10), with total abundances of 241 to 1740 fish per 10 meters of channel. At the 3 lower marsh stations mosquitofish total abundances were less than 10 fish per 10 meters of channel. There presence in the lower marsh was associated with lowered salinity in Fall 1990 and Spring 1991.

The other numerically dominant species was the California killifish, a common resident of small bays and tidal sloughs in Southern California. California killifish accounted for 25% of the individuals collected and together with the mosquitofish made up 86% of the total sample of fishes. They were collected at all 6 stations and were the numerically dominant species at the most tidally influenced stations (nos. 1, 3 and 4) in Summer 1990. In Spring 1991, California killifish were numerically dominant only at station 4 and were absent from the stations nearest Ballona Channel where their abundance had been extremely high the previous summer. A similar pattern of marked change in abundance and distribution of California killifish among seasons and years has been reported for Malibu Lagoon (Soltz and Feldmeth 1986).

Three additional species characteristic of sloughs and shallow bays, i.e. longjaw mudsucker (Gillichthy mirabilis), topsmelt (Atherinops affinis) and striped mullet (Mugil cephalis) accounted for an additional 11% of the fish community (Table 2). The next most abundant species was an introduced, exotic species, the sailfin molly (Poecilia latipinna), which accounted for approximately 2% of the fishes collected. This recent introduction, it was not collected by Swift (1981), was essentially restricted to station 7 which had the greatest input of freshwater.

The arrow goby (Clevelandia ios), normally an abundant species in similar shallow systems with mud substrates, was uncommon in our collections (52 individuals or 0.54%). The shadow goby (Quietula y-cauda), a regionally less common species (Miller and Lea, 1972) typically occurring on mudflats, was present in Spring 1991 only (Table 1). The 34 shadow gobies collected at station 7 ranged from post-larvae to small adults. Their absence in other seasons suggests that they pass through the leaking tide gates irregularly and in limited numbers as larvae. As a mudflat species they should be able to survive the high summer temperatures in this shallow, muted tidal system. The least abundant species, i.e. yellowfin goby (Acanthogobius flaviimanus), staghorn sculpin (Leptocottus armatus) and an unidentified goby, accounted for only 0.1% of the total collection. One of these species, staghorn sculpin, is typically common in similar systems.

Seasonality

Seventy percent of the fishes (6802) were collected in the Summer quarter (Table 1). The dramatic decline in abundance of virtually all species in Fall quarter (only 13% of the number of individuals collected in Summner) was artificially induced by the 3 month period of excessive freshwater input into the system. The decline was probably due to a combination of osmotic stress, flushing, and scouring of the substrate. The species comprising the Ballona Wetland fish community are characteristically abundant during the fall months in similar systems. Of the native fishes present in the system, only longjaw mudsucker and California killifish, the two most stress tolererent species, were common in the Fall quarter collections.

Much lower fish abundance in Winter, as found in this study, is typical of similar systems (Malibu Lagoon - Soltz 1986; Upper Newport Bay -- Allen 1983, Horn and Allen 1931) and was the case during the 1980-81 fish surveys of Ballona Wetland (Swift 1981). Ballona Wetland in Winter 1991 had the typical pattern of absence of topsmelt and presence of young of the year striped mullet (Swift 1981).

Spring 1991 was the only season when all 10 identified, species were collected in the wetlands. A total of 1775 individuals, or 18% of all fishes collected, were taken in Spring (Table 1). Of these, 411 (23%) were striped mullet. There presence in the system in high numbers was an anamoly. They were traped by the tide gates. Thousands of small (3-5 cm standard length) striped mullet were present in the culverts between station 3 and Ballona Channal at low tide. They had entered the sloughs in the Winter as post-larvae and could not return to the ocean throught the tide gates. Striped mullet juveniles characteristicly enter sloughs and lower reaches of streams in winter and return to the deeper water of bays and offshore after a few months (Allen 1983, Soltz 1986).

Distribution

The distributions and abundance of fishes within Ballona Wetland (Area B) is summarized in Table 3 and illustrated in Figure 3A-F. Table 3 ranks the 6 sampling stations by abundance given as a rough density measure -- fish per 10 meters of channel. Figure 3 presents the same information in absolute abundance per station.

The greatest number of species were found at stations 3 (9 species) and 4 (7 species) which are along the main channel connecting with Ballona Channel through the two larger tide gates. Topsmelt were collected at these two stations only. California killifish were the numerical dominant species at both stations. Arrow goby, which was the most abundant fish collected by Swift (1981) was present only at stations 3 and 4 in this study and only 52 individuals were collected. There were as many shadow gobies present at station 3 as there were arrow gobies. The abundance of fishes at the two stations varied dramatically. Station 4 had the second lowest overall fish abundance of 249 fishes per 10 m, whereas, station 3 had the second highest abundance (720/10m). This difference is due to the presence of a deeper hole near the flap gates at station 3, as compared to shallow habitat at station 4 that drains almost completely at low tide. The density pattern reversed in the Winter quarter when few fishes were present at either station and a group of small juvenile striped mullet were collected at station 4.

Station 10, in the upper marsh, south of Culver Boulevard, had the lowest species diversity (3 species) and the lowest abundance (248/10m). This station had the most stressful habitat with very high summer temperatures (32.5 C) and low winter temperatures (12.5 C). The high summer temperatures were combined with hypersalinity (40 ppt), dense algae and presumably anoxic conditions at night. Consequently, the extremely environmentally tolerant mosquitofish made up 97% of the total collection. The two most temperature and salinity tolerant native bay species, longjaw mudsucker and California killifish, were represented by only 6 and one individuals respectively.

Station 1 is located near the smaller set of tide gates which had less seepage of seawater than the larger gates (near station 3) during the study. As a result fewer fishes had access to the area and it drained rapidly and almost completely at low tide. Although 5 species of fishes were collected, 95% were California killifish. Arrow goby should normally be present at a station this near the ocean with a mud substrate. The absence of arrow goby was probably due to the long periods of exposure of most of the substrate at low tide.

Station 6 was downstream of Station 10, just below the culvert under Culver Boulevard. It was also dominated by mosquitofish, which represented 97% of the collection. Killifish were underrepresented in the Summer quarter collection because they would move upstream into the culvert when the blocking seine was placed in the channel.

Station 7 contained a large, relatively deep (to 0.8 m) hole just below the culvert under Culver Boulevard connecting it to the channel from Jefferson Drain. This section had the highest overall fish abundance (2003/10m) due largely to the tremendously high density of mosquitofish (1315/10m) present in Summer 1990. Almost all of the recently established, sailfin molly were collected from station 7. Interestingly, this station had the second highest density of longjaw mudsucker (41/10m). It also supported a very high density of striped mullet in Spring (127/10m). The deep hole at this station acts as a refuge for fishes at low tide.

The following is a brief summary of the distribution of the dominant species. Mosquitofish were dominant at the upper marsh stations (nos. 6, 7 and 10). They were collected from all 6 stations during the low salinity event in Fall 1990. California killifish were the dominant species at the 3 stations nearest Ballona Channel (nos. 1, 3 and 4) which receive the greatest tidal flushing. Longjaw mudsucker were collected from all 6 stations. They were common at one lower station (no. 3) and one upper station (no. 7) and were the dominant native species during the low salinity event in Fall 1990. Striped mullet were relatively abundant in the 2 deep water habitats (stations 3 and 7) in Spring because they could not leave the sloughs through the tide gates. No other species made up more than 2% of the overall collections. Topsmelt were uncommon due to a combination of restricted access through the tide gates for reproductive adults and general lack of water column space required by this species. Arrow goby were uncommon and had declined dramatically since the 1980-81 fish survey (Swift 1981).

Area D

Mosquitofish were present in Centinela Ditch during a preliminary field survey in late April 1990. However, Centinela Ditch within Area D was completely dry during the Summer, Fall and Winter quarter sampling periods. The ditch again contaned water in Spring 1991. Only 3 mosquitofish were collected, along with 9 crayfish and 2 hylid tadpoles. All 3 mosquitofish were large, gravid females, suggesting that they had been recently introduced for mosquito control.

GENERAL DISCUSSION

The composition of the fish community of the relic tidal sloughs and channels of Ballona Wetland in this study is similar to the fish community present 10 years earlier (Swift 1981). Nine of the 10 species of fish present as adults in 1980-81 were present in 1990-91. The species not collected in this study, diamond turbot (Hypsopsetta guttulata), was considered to be rare by Swift (1981). Sailfin molly have become established in the system since the 1980-81 surveys.

In comparison to the fish community present in 1980-81 there has been a general decline in abundance and diversity. Mosquitofish were the second most abundant species. Now they are highly numerically dominant, representing 61% of all species collected. The arrow goby, which was the numerically most abundant species (Swift 1981) is now rare (i.e. only 0.54% of the total fish collect). Topsmelt, the third most abundant species in 1980-81, were represented by only a few juveniles in Summer and Fall 1990 and numerous post-larvae in Spring 1991 (i.e. 1.87% of the total fish collected). Although the fish community at Ballona Wetland still has the overall species composition found in similar systems, there are generally fewer species and the native species are less abundant (Allen 1983, 1990; Allen and Horn 1975; Boland and Zedler 1991; Horn and Allen 1981; Soltz 1986).

There are several probable reasons for the continued decline of the fish community at Ballona Wetland. They are all directly or indirectly related to the greatly restricted tidal flushing of the sloughs and channels because of the tide gates. One of the large flap gates was broken during the period of the Swift (1981) study and for an unknown period before, allowing for greater flushing and fish access. The reasons for the decline in the past 10 years and the generally depauperate condition of the fish community include, but are not restricted to:

-restricted access for fish, fish eggs and larvae
-lack of water column habitat
-lack of access to the pickleweed flats except at the highest tides
-exposure of much of the substrate to air and dessication for extended periods of time
-decreased salinity following rainstorms and unusual urban runoff events
-hypersalinity, particularly in the upper marsh, during summer and drought periods
-increased diurnal temperature fluctuations
-extreme seasonal high and low temperatures
-excessive algal growth and associated smothering of the benthos and anoxia in the water at night
-increase effects of toxic components of urban runoff due to the reduced water volume.

Any increase in tidal flushing of Ballona Wetlands is expected to improve all of the above conditions and consequentlylead to increased abundance and diversity of the fish community.

LITERATURE CITED

Allen,L.G. 1980. Structure and productivity of the littoral fish assemblage of upper Newport Bay, California. Ph.D. Dissertation. University of Southern California, Los Angeles.

Allen,L.G. 1983. Seasonal abundance, composition, and productivity of the littoral fish assemblage in Upper Newport Bay, California. Fishery Bulletin, 80(4):769-790

Allen,L.G. 1990. Fishes of bay, estuary and harbor habitats of Southern California: A perspectus and predictions regarding Ballona Wetlands restoration. Prepared for Maguire Thomas Partners.

Allen,L.G. and M.H. Horn. 1975. Abundance, diversity, and seasonality of fishes in Colorado Lagoon, Alamitos Bay, California. Estuarine and Coastal Marine Science 3(3):371380.

Boland,J.M. 1988. The ecology of North American shorebirds: lattudinal distributions, community structure, foraging behaviors, and interspecific competition. Ph.D. Dissertation. University of California, Los Anqeles.

Boland,J.M. and J.B. Zedler. 1991. The functioning of Ballona Wetland in relation to tidal flashing, Part I - Before tidal restoration. Project sponsored by the National Audubon Society.

Davis, N. 1991. Comparison of ecological values of the restored Ballona Salt Marsh with lost ecological values from implementation of the Port of los Angeles/Long Beach 2020 Plan. Chamber Group, Inc. Prepared for Maguire Thomas Partners-Playa Vista.

Horn,M.H. and L.G. Allen. 1976. Numbers of species and faunal resemblance, of marine fishes in California bays and estuaries. Bulletin of the Southern California Academy of Sciences 75(2):159-170.

Horn,M.H. and L.G. Allen. 1981. Ecology of fishes in upper Newport Bay, California: Seasonal dynamics and community structure. California Fish and Game, Marine Resources Technical Report No. 45, 102 pp.

Lane,E.D. and C.W. Hill (Editors). 1977. The Marine Resources of Anaheim Bay. California Department of Fish and Game. Fish Bulletin 165. 195 pp.

Onuf,C.P. 1987. The ecology of Mugu Lagoon, California: an estuarine profile. U.S. Fish and Wildl. Serv. Biol. Rep. 85(7.15).

Onuf,C.P. and M.L. Quammen. 1983. Fishes in a California coastal lagoon: Effects of major storms on distribution and abundance. Mar. Ecol. Prog. Ser. 12:1-14.

Soltz,D.L. and C.R. Feldmeth. 1986. Malibu wastewater treatment project: biological and input assessment of Malibu Creek and Lagoon, and Corral Creek. Submitted through JMM Consulting Engineers, Inc. to Los Angeles Co.

Swift, C. 1981. Estuarine fishes of Ballona Marsh. In: Schreiber, R.W. (ed.) 1981. Biota of Ballona Region, Los Angeles County. Los Angeles county Museum of Natural History.

Zedler,J.B. 1977. Salt marsh community structure in the Tijuana Estuary, Calif. Estuarine and Coastal Marine Science 5:39-53.

Zedler,J.B. 1982. The ecology of Southern California coastal salt marshes: a community profile. U.S. Fish and Wildlife Servcie, Biological Services Program, Washington, D.C. FWS/OBS-31/54.

Zedler,J.B. and C.S. Nordby. 1986. The ecology of Tijuana Estuary: an estuarine profile. U.S. Fish Wildl. Serv. Biol. Rep. 85(7.5). 104pp.

FIGURE LEGENDS

Figure 1. Distribution of fishe sampling stations in Ballona Wetland. The 13 sampling stations from Swift (1981) are indicated and the numbers of the 6 stations sampled in this study are enclosed in triangles. The map is modified from Swift (1981).

Figure 2. Seasonal distribution of mean salinity of the 6 fish sampling stations in Ballona Wetland.

Figure 3. Absolute abundance of fishes by season for the 6 sampling stations in Ballona Wetland.

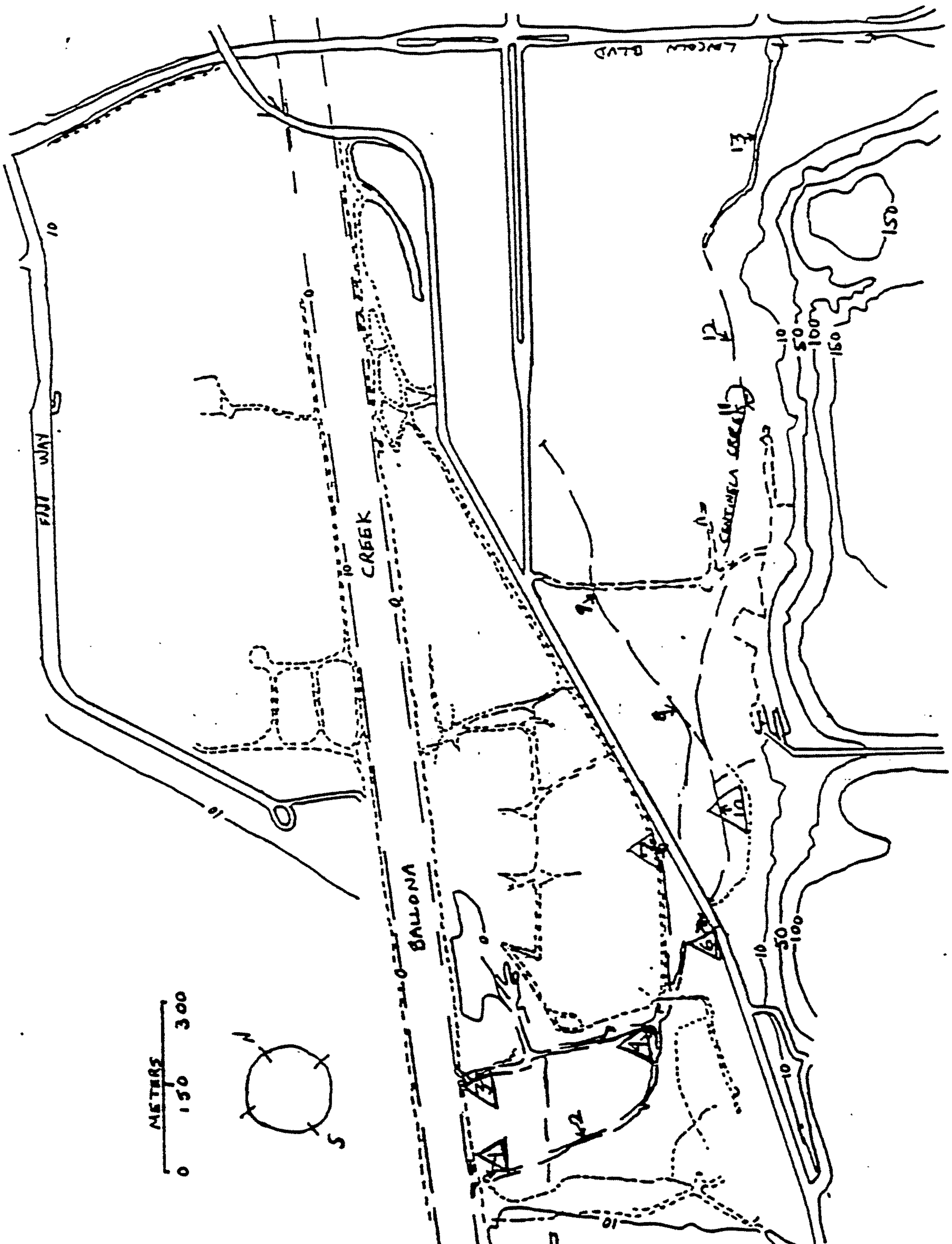

LINCOLN BLVD
FIJI WAY
BALLONA
CREEK
CENTINELA CREEK
METERS
0 150 300
N
S

FIGURE 1.

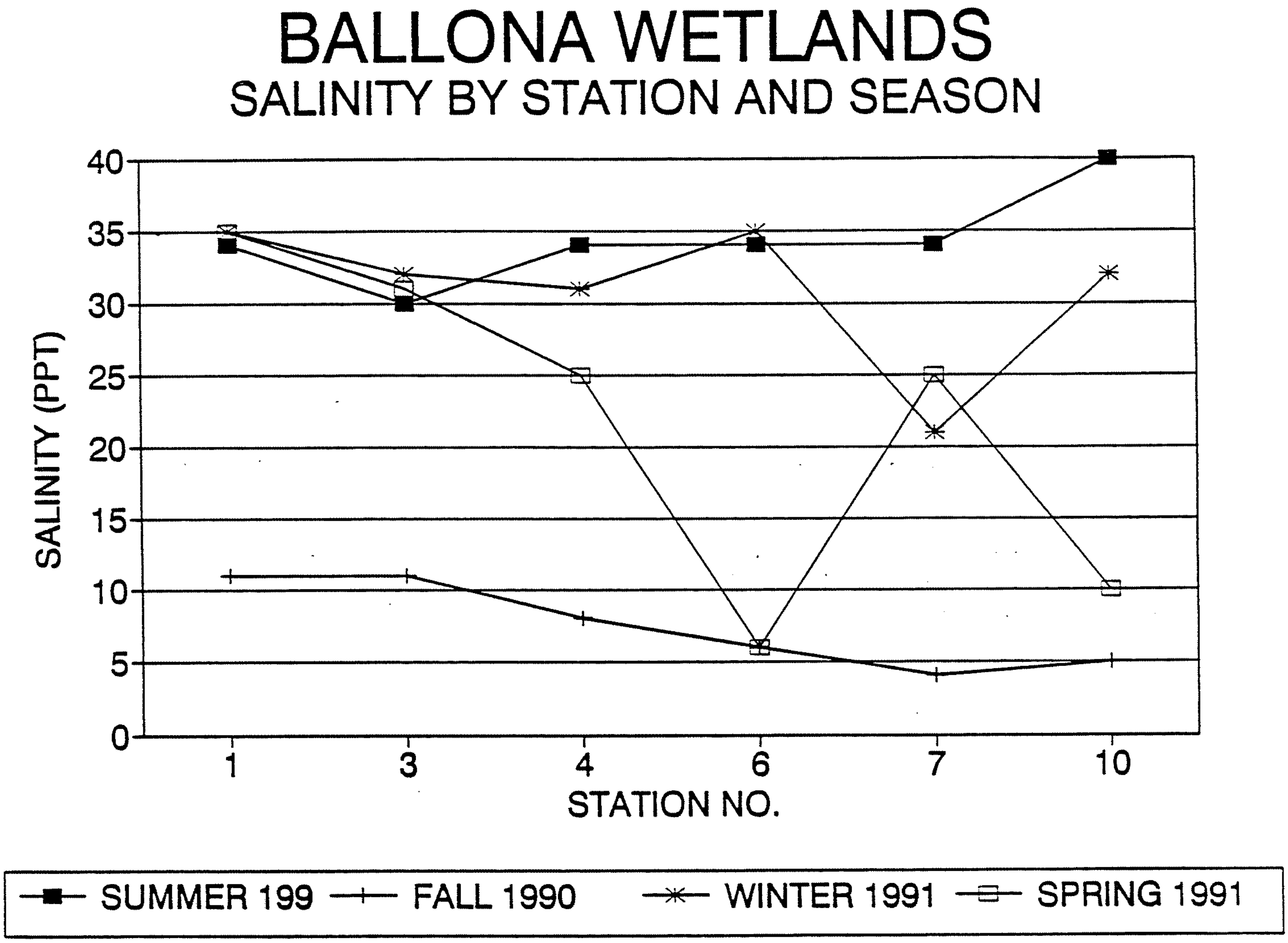

BALLONA WETLANDS
SALINITY BY STATION AND SEASON
40
35
30
25
20
15
10
5
0
SALINITY (PPT)
1
3
4
6
7
10
STATION NO.
SUMMER 199
FALL 1990
WINTER 1991
SPRING 1991

FIGURE 2.

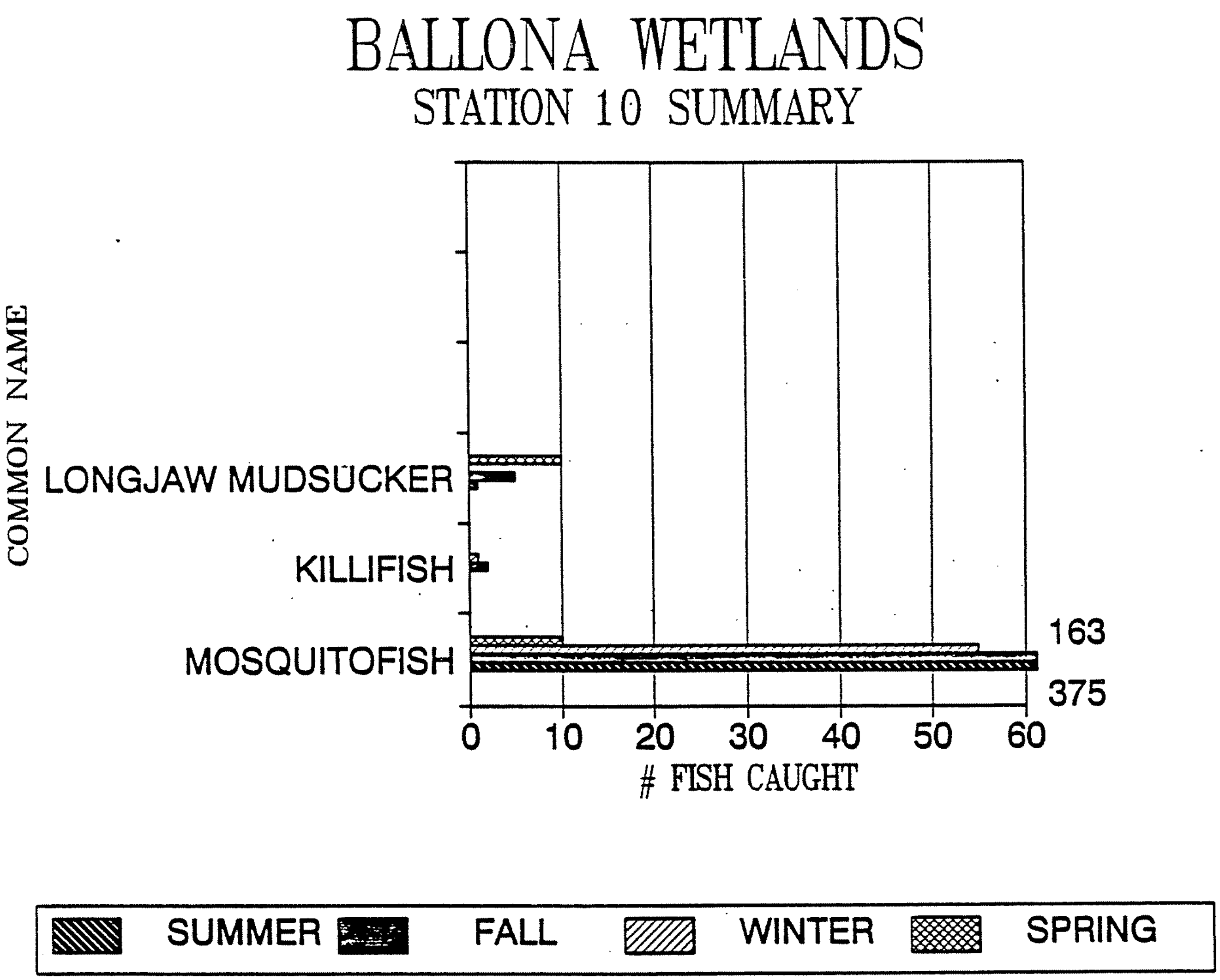

BALLONA WETLANDS
STATION 10 SUMMARY
COMMON NAME
LONGJAW MUDSUCKER
KILLIFISH
MOSQUITOFISH
163
375
0
10
20
30
40
50
60
FISH CAUGHT
SUMMER
FALL
WINTER
SPRING

FIGURE 3A.

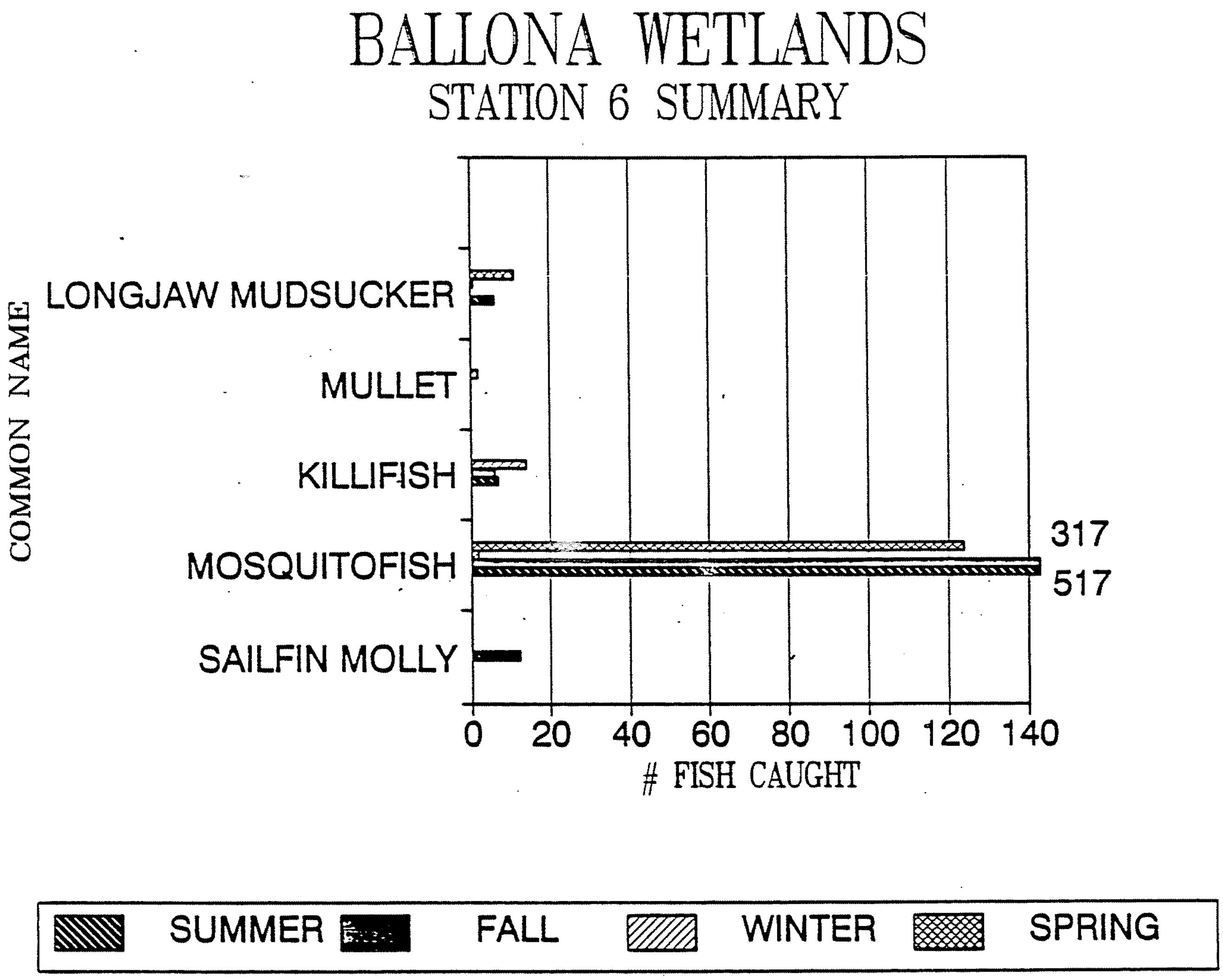

BALLONA WETLANDS
STATION 6 SUMMARY
COMMON NAME
LONGJAW MUDSUCKER
MULLET
KILLIFISH
MOSQUITOFISH
SAILFIN MOLLY
317
517
0
20
40
60
80
100
120
140
FISH CAUGHT
SUMMER
FALL
WINTER
SPRING

FIGURE 3B.

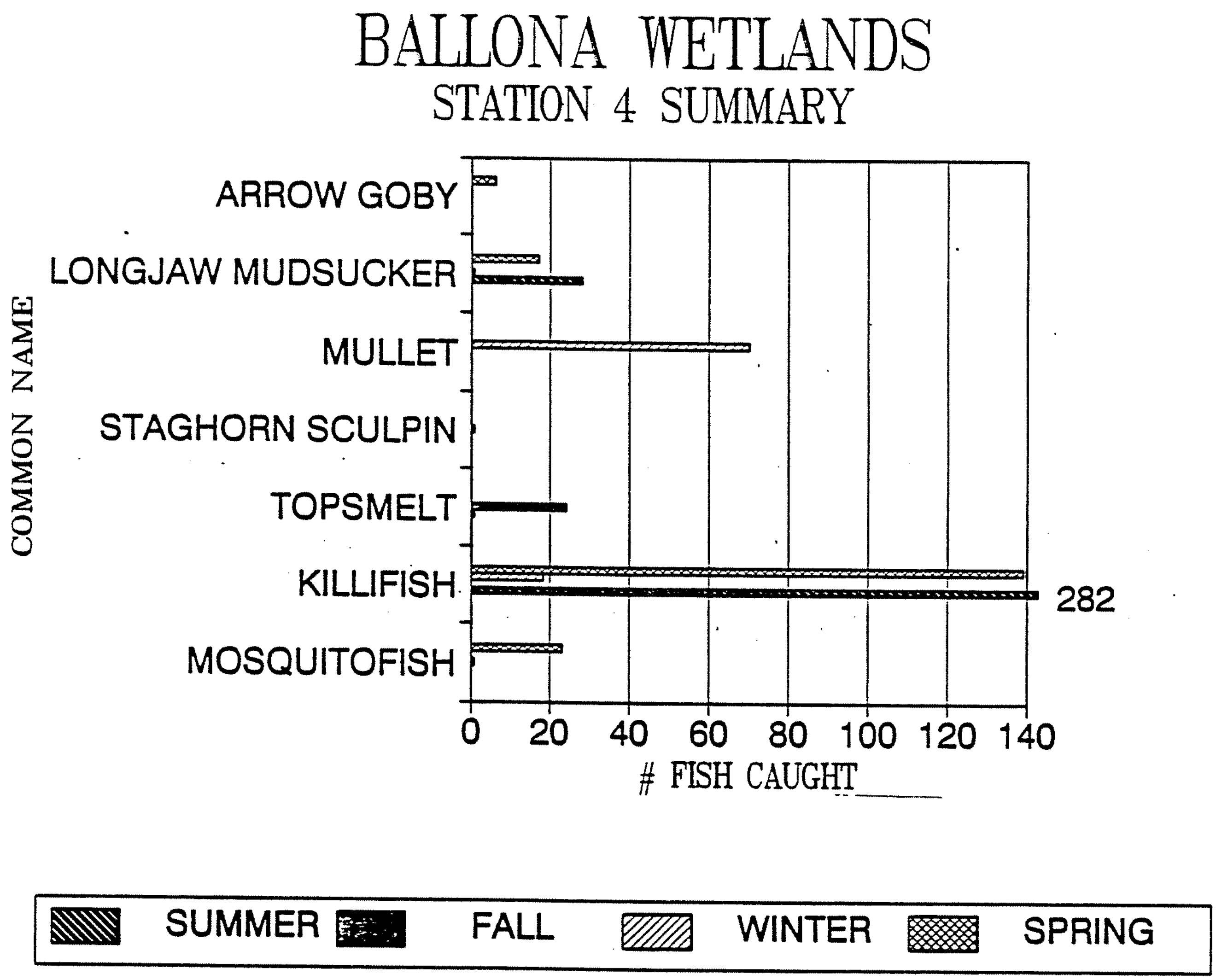

BALLONA WETLANDS
STATION 4 SUMMARY
ARROW GOBY
LONGJAW MUDSUCKER
MULLET
STAGHORN SCULPIN
TOPSMELT
KILLIFISH
MOSQUITOFISH
COMMON NAME
282
0 20 40 60 80 100 120 140
FISH CAUGHT
SUMMER
FALL
WINTER
SPRING

FIGURE 3C.

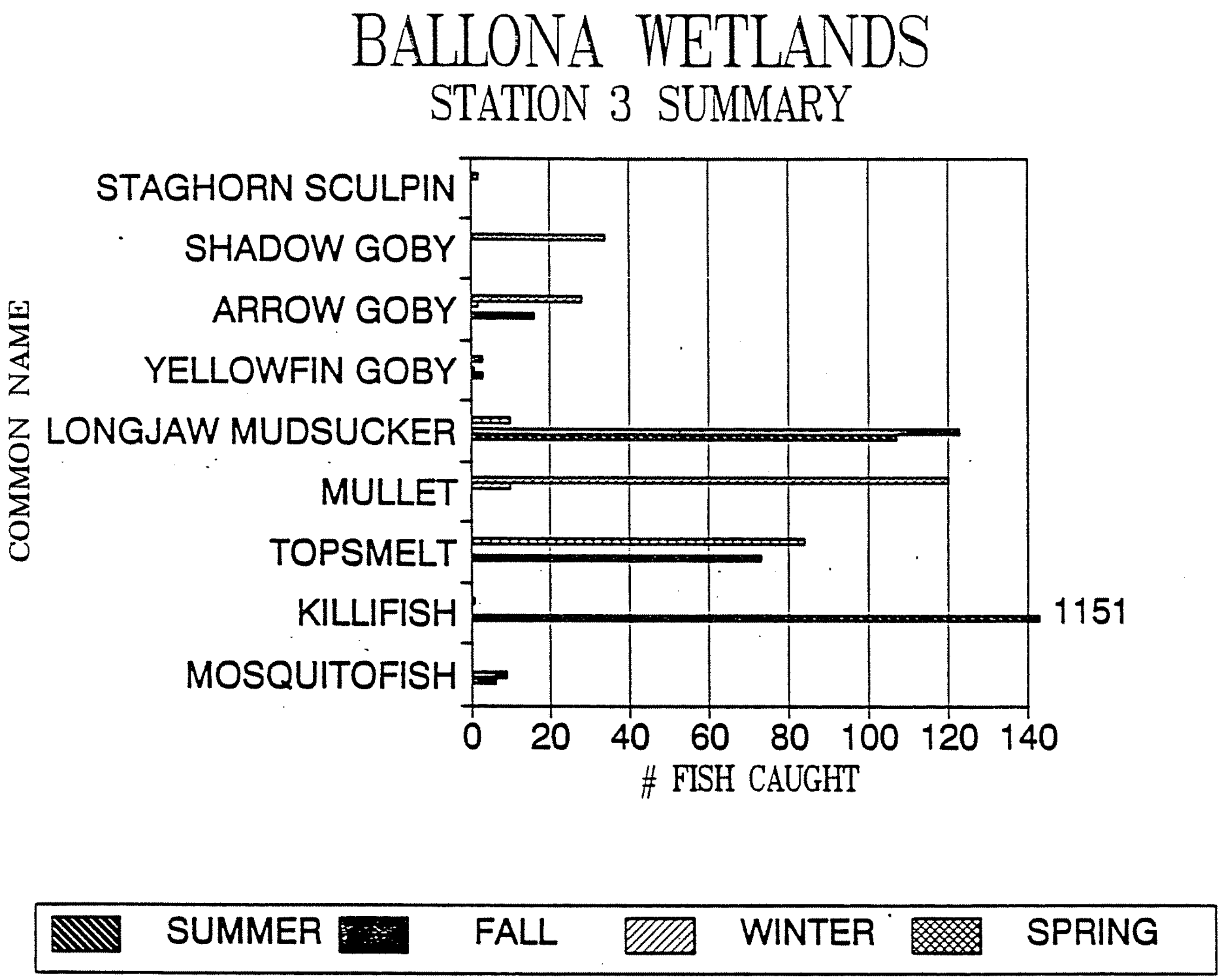

BALLONA WETLANDS
STATION 3 SUMMARY
STAGHORN SCULPIN
SHADOW GOBY
ARROW GOBY
YELLOWFIN GOBY
LONGJAW MUDSUCKER
MULLET
TOPSMELT
KILLIFISH
MOSQUITOFISH
COMMON NAME
1151
0 20 40 60 80 100 120 140
FISH CAUGHT
SUMMER
FALL
WINTER
SPRING

FIGURE 3D.

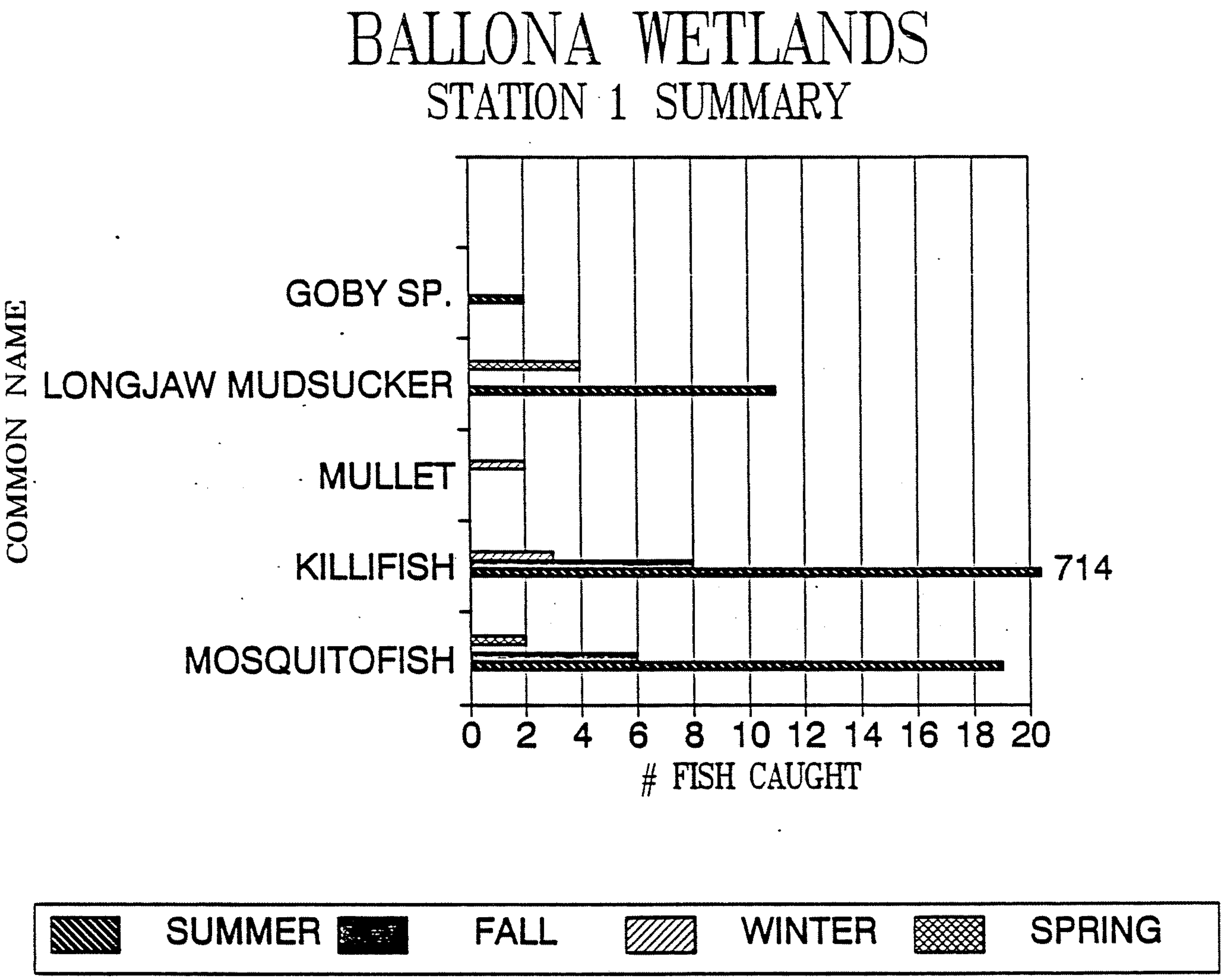

BALLONA WETLANDS
STATION 1 SUMMARY
COMMON NAME
GOBY SP.
LONGJAW MUDSUCKER
MULLET
KILLIFISH
MOSQUITOFISH
714
0 2 4 6 8 10 12 14 16 18 20
FISH CAUGHT
SUMMER
FALL
WINTER
SPRING

FIGURE 3E.

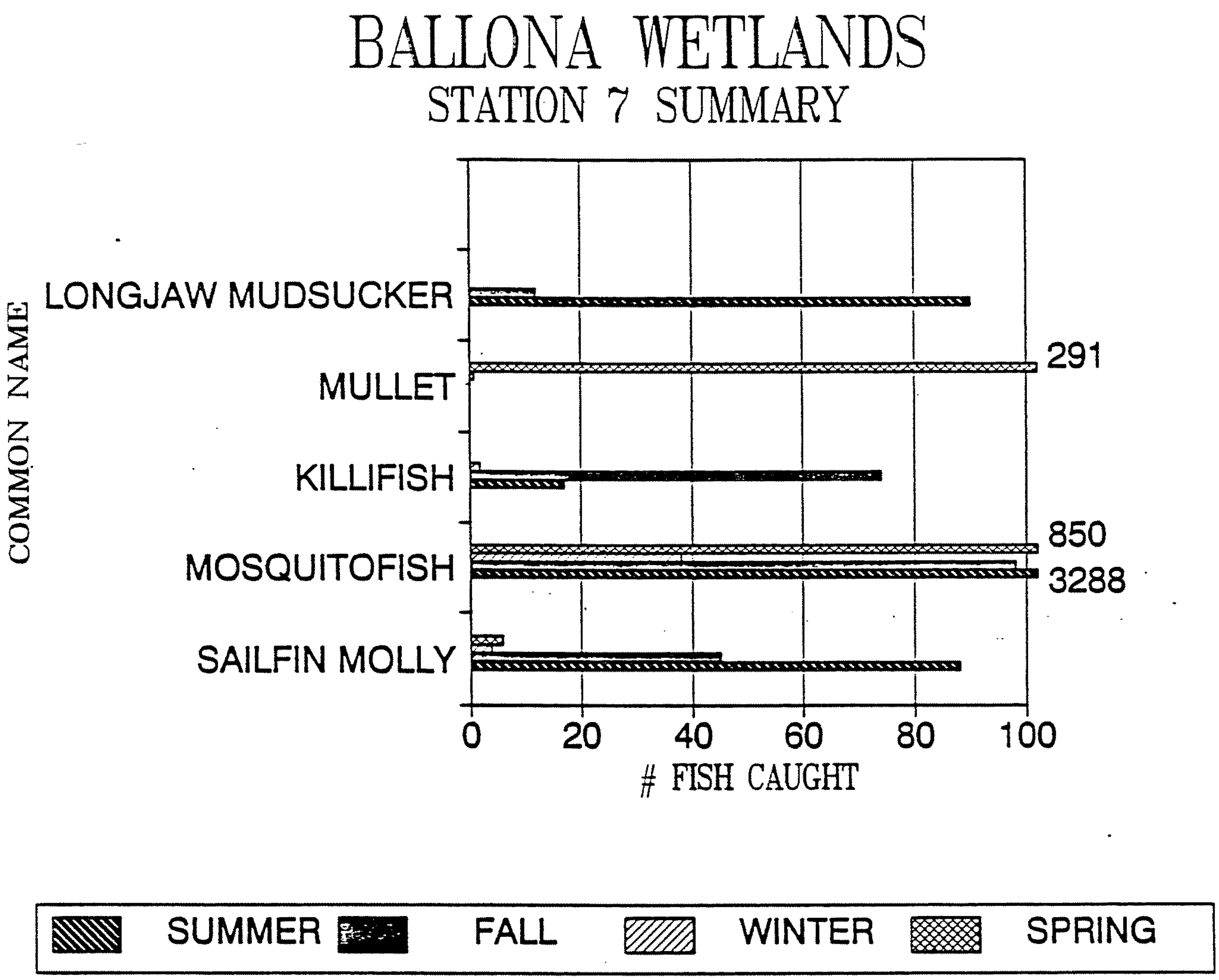

BALLONA WETLANDS
STATION 7 SUMMARY
COMMON NAME
LONGJAW MUDSUCKER
MULLET
KILLIFISH
MOSQUITOFISH
SAILFIN MOLLY
291
850
3288
0
20
40
60
80
100
FISH CAUGHT
SUMMER
FALL
WINTER
SPRING

FIGURE 3F.

TABLE 1.
BALLONA WETLANDS, FISH SURVEY
SEASONAL SUMMARY - RANKED BY TOTAL NUMBER OF INDIVIDUALS

SPECIES	SUMMER 1990 NO.	SUMMER 1990 %	SPECIES	FALL 1990 NO.	FALL 1990 %
Mosquitofish	4205	61.82	Mosquitofish	594	65.56
California killifish	2171	31.92	Longjaw mudsucker	141	15.56
Longjaw mudsucker	243	3.57	California killifish	88	9.71
Sailfin molly	88	1.29	Sailfin molly	57	6.29
Topsmelt	74	1.09	Topsmelt	24	2.65
Arrow goby	16	0.24	Yellowfin goby	1	0.11
Yellowfin goby	3	0.04	Staghorn scupin	1	0.11
Goby sp.	2	0.03			
TOTAL	6802		TOTAL	906	
NO. SPECIES	8		NO. SPECIES	7	

SPECIES	WINTER 1991 NO.	WINTER 1991 %	SPECIES	SPRING 1991 NO.	SPRING 1991 %
Mosquitofish	113	46.50	Mosquitofish	1009	56.84
Striped mullet	85	34.98	Striped mullet	411	23.15
California killifish	38	15.64	California killifish	140	7.89
Sailfin molly	4	1.65	Topsmelt	84	4.73
Arrow goby	2	0.82	Longjaw mudsucker	52	2.93
Longjaw mudsucker	1	0.41	Arrow goby	34	1.92
			Shadow goby	34	1.92
			Sailfin molly	6	0.34
			Yellowfin goby	3	0.17
			Staghorn sculpin	2	0.11
TOTAL	243		TOTAL	1775	
NO. SPECIES	6		NO.SPECIES	10	

TABLE 2.
BALLONA WETLANDS FISH SURVEY
4 SEASONS COMBINED
RANKED BY TOTAL NUMBER OF INDIVIDUALS

SPECIES	4 SEASON TOTAL NO.	%
Mosquitofish	5921	60.88
California killifish	2437	25.06
Striped mullet	496	5.10
Longjaw mudsucker	437	4.49
Topsmelt	182	1.87
Sailfin molly	155	1.59
Arrow goby	52	0.54
Shadow goby	34	0.35
Yellowfin goby	7	0.07
Staghorn sculpin	3	0.03
Goby sp.	2	0.02
TOTAL	9726	
NO. SPECIES	11	

TABLE 3.
BALLONA WETLANDS, FISH SURVEY
OVERALL SUMMARY - RANKED BY INCREASING TOTAL ABUNDANCE PER STATION
NUMBER GIVEN IS FOR THE NUMBER OF FISH PER 10 METERS

STATION 10

SPECIES	SUMMER	FALL	WINTER	SPRING	TOTAL
MOSQUITOFISH	150	65	22	4	241
KILLIFISH	0	1	<1	0	1
LONGJAW MUDSUCKER	<1	2	0	4	6
TOTAL PER SEASON	150	68	22	8	248

STATION 4

SPECIES	SUMMER	FALL	WINTER	SPRING	TOTAL
MOSQUITOFISH	0	<1	0	10	10
KILLIFISH	113	0	7	60	180
TOPSMELT	<1	10	0	0	10
STAGHORN SCULPIN	0	<1	0	0	<1
MULLET	0	0	28	0	28
LONGJAW MUDSUCKER	11	0	0	7	18
ARROW GOBY	0	0	0	3	3
TOTAL PER SEASON	124	11	35	80	249

STATION 1

SPECIES	SUMMER	FALL	WINTER	SPRING	TOTAL
MOSQUITOFISH	8	2	0	<1	10
KILLIFISH	286	3	1	0	290
MULLET	0	0	1	0	1
LONGJAW MUDSUCKER	4	0	0	2	6
GOBY SP.	1	0	0	0	1
TOTAL PER SEASON	298	6	2	2	308

STATION 6

SPECIES	SUMMER	FALL	WINTER	SPRING	TOTAL
SAILFIN MOLLY	0	5	0	0	5
MOSQUITOFISH	207	127	1	54	388
KILLIFISH	3	2	6	0	11
MULLET	0	0	1	0	1
LONGJAW MUDSUCKER	2	0	<1	5	7
TOTAL PER SEASON	212	134	8	59	412

STATION 3

SPECIES	SUMMER	FALL	WINTER	SPRING	TOTAL
MOSQUITOFISH	2	4	0	0	6
KILLIFISH	460	0	0	<1	460
TOPSMELT	29	0	0	37	66
MULLET	0	0	4	52	56
LONGJAW MUDSUCKER	43	49	0	4	96
YELLOWFIN GOBY	1	<1	0	1	2
ARROW GOBY	6	0	1	12	19
SHADOW GOBY	0	0	0	15	15
STAGHORN SCULPIN	0	0	0	<1	0
TOTAL PER SEASON	542	53	5	121	720

STATION 7

SPECIES	SUMMER	FALL	WINTER	SPRING	TOTAL
SAILFIN MOLLY	35	18	2	3	58
MOSQUITOFISH	1315	39	15	370	1740
KILLIFISH	7	30	1	0	37
MULLET	0	0	<1	127	127
LONGJAW MUDSUCKER	36	5	0	0	41
TOTAL PER SEASON	1393	92	18	500	2003

Appendix J-7: Population and Banding Study Belding's Savannah Sparrow

Kennon Corey, M.S. and Barbara W. Massey, M.S.

Appendix J-8: Bird Survey of Ballona Wetlands

Kennon A. Corey, M.S.

Bird Survey of Ballona Wetland, Playa del Rey, CA 1990-1991

April 30, 1992

Kennon A. Corey
Department of Biology
California State University at Long Beach
Long Beach, CA
90840

Introduction

From April 1990 to April 1991, bi-monthly bird surveys of the Playa Vista Project Area were conducted with a view to make comparisons to Ralph Schreiber's surveys from 1979-1981. Differences between the two surveys reveal changes in species richness over time at the wetland. My own survey results reveal bird species that may be impacted by the wetland restoration project and which may require special attention throughout the restoration process. Brief impact analyses are given for some of these species.

Project Area

The proposed Playa Vista project site is an asymmetrical area located south of Marina del Rey and the Marina Freeway, west of the San Diego Freeway, north of Los Angeles International Airport, and east of the community of Playa del Rey.

The site is along the southern margin of the historic Ballona Creek floodplain. The southern border of the floodplain is the Westchester/Playa del Rey bluff system. The system of bluffs are approximately 300 feet in height; Cabora Road is located along and about one-third up the bluffs' face. The road was used to establish approximately the irregular southern boundary of the project site.

For planning purposes, the site has been divided into four areas. These areas, labeled A, B, C, and D, are divided by the Ballona Flood Control Channel (Ballona Channel) on an easterly-westerly axis and by Lincoln Boulevard on a northerly-southerly axis. Area A is located immediately adjacent to Marina del Rey and is within the County of Los Angeles. Area B, C, and D are in the City of Los Angeles. Area B is immediately south of Area A; Area C is immediately east of Area A and Area D is southeast of Area A. Table 1 provides the acreage associated with each area.

Table 1. Acreage in each area

AREA	ACREAGE
Area A	138.6
Area B	337.9
Area C	66.3
Area D	462.0

Area A

Area A is bounded by Marina del Rey to the north and west, the Ballona Channel to the south, and Lincoln Boulevard to the east. The topography of the site is largely the result of anthropogenic activities. The naturally occurring topography of this site was altered by the disposal of dredge material during the construction of the Ballona Flood Control Channel in the 1930's and Marina del Rey in the 1960's (Schreiber, 1981). The area is now largely vacant. Oil wells are located in the southwest corner, a parking lot is located along the northwest margin and a drainage ditch is located along northeast margin. The drainage ditch is tidally influenced. The site is criss-crossed by off-road vehicle roads and pedestrian trails. A bike path/access road borders the southern margin of the site. This path is on the northern levee of the Ballona Channel. The Ballona Channel drains a total of approximately 76,700 acres of urban areas largely within the City of Los Angeles (Chambers Group, 1991). The channel is tidally influenced within the boundaries of the Playa Vista project area. Tidal margins within the channel approximate that found along the open coast (Lockhart, 1990).

Area B

Area B is bounded by the Ballona Channel to the north, the community of Playa del Rey to the west, the Playa del Rey Bluffs to the south and Lincoln Boulevard to the east. It is the least disturbed on the four areas. The natural topography of the site is largely intact. This area is also largely vacant.

Jefferson and Culver Boulevard cross the central portion of the area. A gas company staging area is located along the south central margin of the area at the base of the Playa del Rey Bluffs. Centinela Ditch is also located at the base of the Playa del Rey Bluffs. Jefferson Drain empties into the area southeast of the Jefferson/Culver Boulevards intersection. Oil production and gas storage facilities are scattered in the northwest portion of the site. The eastern portion of the site was farmed until the mid-1980's. An access road borders the northern margin of the site. This road is the southern levee of the Ballona Channel.

The area contains the largest contiguous wetland. The main tidal channels into the wetland have been cut-off from tidal flows by the installation of four tide-gated structures in the south levee of the Ballona Channel. A hydrologically insignificant amount of salt water does enter the northwest corner of the wetlands through these flap gates. Tidal amplitude has been reduced by approximately 63% (Bolland and Zedler, 1991). Salinity of the waters in the tidal channel near the tidegates, nevertheless, is approximately that of seawater (35ppt) (Boland and Zedler, 1991). Culverts under Culver Boulevard provide a hydrologic link between the wetlands to the north and south of this roadway. The channels south of Culver Boulevard contain freshwater (0 ppt) (Boland and Zedler, 1991).

Area C

Area C is bounded by commercial/residential development to the north, Lincoln Boulevard to the west, the Ballona Channel to the south and the Marina Freeway to the east. Like area A, this area is largely the result of anthropogenic activities. The naturally occurring topography of this site was also altered by the disposal of dredge material during the construction of the Ballona Flood Control Channel in the 1930's and Marina del Rey in the 1960's. The area is dissected by Culver Boulevard. The area north of Culver Boulevard is largely vacant. A small drainage ditch flows from the middle of the side to the norhtwest and into Area A. This ditch usually does not contain standing water. Baseball fields are located south of Culver Boulevard.

Area D

Area D is bounded by Lincoln Boulevard to the west, the Westchester Bluffs to the south, commercial/industrial parcels to the east and Jefferson Boulevard and the Ballona Channel to the north. It is the most developed of the four areas. It is the site of the offices and manufacturing facilities occupied by MacDonald Douglas and Hughes Aircraft Company. These facilities are located in the south eastern portion of the site. The south western portion of the site contains Centinela Ditch and a debris basin. Centinela Ditch is and intermittent freshwater stream carrying urban runoff. An abandoned airstrip is located in the central section of the site. Stockpiles of material are located along the northern margin. The Playa Vista site offices are located on the northwest portion of the parcel.

Methods

Surveys were conducted by myself on a bi-monthly basis, and were started within 1/2 hour after sunrise and curtailed by 1200-1400 hours. My survey routes through areas A, B, C, and D are more expansive and all encompassing than survey routes for the 1979-81 censuses. All birds seen or heard using the wetlands along the survey routes were recorded. Aerial birds ("flyovers") were noted but not officially counted unless they were observed using the wetland. At the beginning of each survey I started in a different area to equally distribute the "prime" early morning counts as the last area surveyed on a given day did not commence until 1000 to 1100 hours. Surveys were not scheduled for particular tide levels, but several different tide levels occurred when censusing Area B; the area most affected by tidal fluctuation.

Results

Below is a complete list of 80 species observed on the general surveys from April 1990 to April 1991. Under each species heading are comments on abundance and location of sightings. Birds are ordered as described in the A.O.U. Checklist of north American Species (1983). As shown in Table 1., Area B contained the greatest species diversity.

Table 1. Total number of species observed per area.

Area A	Area B
40	58
Area C	Area D
15	49

S = summer, W = winter, M = migrant, R = resident,
* = confirmed breeder

Ciconiiformes

Great Blue Heron (*Ardea herodias*) W/R
One or two birds regularly observed in the salt flats/pickleweed areas of Area A. In Area B, an average of 10 (n = 18) were seen residing on the northern saltflats and the southern Ballona Creek dike. Many (1-9) were often seen roosting in the largest cottonwood tree in the dune section of Area B.

Great Egret (*Casmerodius albus*) W/R
One to 10 individuals often observed roosting with the Great Blue Herons in the northern saltflats of Area B from October through April 1990/91.

Also observed hunting along the tidal channels here.

Snowy Egret (*Egretta thula*) W
Two individuals seen along the tidal channels in the northern section of Area B in February 1991.

Green-backed Heron (*Butorides striatus*) W/R
Regularly observed along the tidal channel (creek) in Area A. Occasionally seen in the *Eucalyptus* along Fiji Way bordering Area A.

Black-crowned Night Heron (*Nycticorax nycticorax*) W/R
One individual observed along Centinela Ditch in Area D. In Area B, one individual observed along the tidal channels north of Culver Blvd. and one south of Culver Blvd. One individual in Area A in October 1990.

Anseriformes

Mallard (*Anas platyrhynchos*) W
Observed occasionally in tidal channels and small puddles of Area B during winter 1990/91.

Cinnamon Teal (*Anas cyanoptera*) R/M
A group of eight individuals was observed in the tidal channel adjacent to the dunes of Area B in February 1991.

Falconiformes

Turkey Vulture (*Cathartes aura*) M
A single individual observed circling low over Area A in February 1991.

Osprey (*Pandion haliaetus*) R/M
One individual seen circling overhead in Area B in summer 1990.

Black-shouldered Kite (*Elanus leucurus*) W/R
Occasionally observed hunting and perching in Area B. Observed hunting once in Area D.

Cooper's Hawk (*Accipiter cooperii*) W/M
One individual observed hunting small birds in the willows in the southeastern section of Area B in February 1991.

Red-shouldered Hawk (*Buteo lineatus*) R
A single individual was observed perched in Area C overlooking the playing field while being mobbed by crows in October 1990.

Red-tailed Hawk (*Buteo jamaicensis*) W/R*
Observed in flight and perched in all areas. Often seen perching in pairs in Area D.

American Kestrel (*Falco sparverius*) R*
Often observed perched/hunting on the saltflats and coastal sage scrub of Area A, on the large dirt mound and bluff of Area D and in the northeastern section of Area B. As many as 6 seen hunting at one time over agricultural fields of Area B. One pair nested in a drain pipe in the largest building of Area D.

<u>Charadriiformes</u>

Black-bellied Plover (*Pluvialis squatarola*) W
Two individuals observed in May and June 1990 using the salt flats in Area B.

Killdeer (*Charadrius alexandrinus*) R*
Occasionally seen in saltflat/grassy areas of Area B and in open areas of Area D. One nest with 4 eggs was found in May 1990 on saltflat of Area B. Also observed once in Area A.

Willet (*Cataptrophorus semipalmatus*) W
One individual in May and 4 in February were observed in the pickleweed and along the tidal channels of Area B.

Spotted Sandpiper (*Actitis macularia*) W
One individual observed in April 1990 along the tidal channel in Area A. One also observed along a tidal channel in the northwestern section of Area B in February.

Whimbrel (*Numenius phaeopus*) W
Eleven birds observed in the pickleweed wetlands and the pickleweed transition areas in Area A in April 1990.

Least Sandpiper (*Calidris minutilla*) W/M
Seven individuals observed along a tidal channel in the northern section of Area B in October 1990.

Dowitcher (*Limnodromus sp.*) W
One individual in June and one individual in February was observed along the tidal channels of Area B.

Columbiformes

Rock Dove (*Columba livia*) R
Occasionally seen within Area D.

Spotted Dove (*Streptopelia chinensis*) R
Two individuals observed in the oleanders bordering Area A and another two observed in Area D during April 1990.

Mourning Dove (*Zenaida macroura*) R
Large numbers observed using areas A and D (20 - 50 per area per count). Fewer birds observed in Areas B and C.

Strigiformes

Burrowing Owl (*Athene cucicularia*) R
A single individual was observed on the Westchester Bluffs near the LMU sign in April 1990. Nesting was not confirmed.

Apodiformes

Vaux's Swift (*Chaetura vauxi*) M
A single individual observed in Area B in May 1990. Several observed in Area D in May and June 1990. All were feeding overhead.

White-throated Swift (*Aeronautes saxatalis*) R
Fifteen individuals observed in Area B in May 1990 and 140 in March 1991. Fewer birds also observed in area D. All were feeding overhead.

Anna's Hummingbird (*Calypte anna*) R*
Three or more individuals regularly observed using all the habitat types in Area A. Also seen along the gas company service roads in Area B and in

several habitats in Area D. One to three individuals were regularly seen in Area C. Nested in areas A and D.

Allen's Hummingbird (*Selasphorus sasin*) S
One to three individuals observed on the dunes in Area B in Spring 1990. An average of three individuals observed in the cattails, pampas grass and willows at the base of the Playa Del Rey Bluff in Area B in Spring/Summer 1990.

Coraciiformes

Belted Kingfisher (*Ceryle alcyon*) W
Occasionally seen on the fence (above the tide gates) overlooking the tidal channel in Area B. Seen once overlooking this same channel near Culver Blvd. in Area B. Occassionally observed on fence overlooking stream in Area A.

Piciformes

Northern Flicker (*Colaptes auratus*) R
One to 2 individuals regularly observed in the most woody sections of each area from late summer 1990 through winter 1990/91.

Passeriformes

Willow Flycatcher (*Empidonax traillii*) S/M
A single individual was observed in the willows surrounding the fresh water marsh in Area B in September 1990.

Western Flycatcher (*Empidonax difficilis*) S
One individual was observed in the willows along the Westchester Bluffs in Area D in April 1990. One individual was observed in the willows surrounding the fresh water marsh in Area B in September 1990.

Black Phoebe (*Sayornis nigricans*) R
A single individual was seen in the dune area of Area B in October 1990.

Say's Phoebe (*Sayornis saya*) W
Occasionally seen throughout Area B in the fall.

Ash-throated Flycatcher (*Myiarchus cinerascens*) S
In Area A, three individuals were observed in April, One individual in August, and one in September 1990. In Area D, Two individuals were observed along the Teale Rd. fence in April 1990. In Area B, one individual was observed near the fresh water marsh in September 1990.

Western Kingbird (*Tyrannus verticalis*) S
A single individual observed on fence along Teale Road in Area D in May, June, August, and September 1990.

Rough-winged Swallow (*Stelgidopteryx ruficollis*) S
Two individuals observed in flight over former agricultural fields in Area B in May 1990 and March 1991; two individuals observed in Area D in June 1990.

Cliff Swallow (*Hirundo pyrrhonota*) S
Irregularly observed in aerial displays over the salt flats in Areas A and B and in aerial displays over Area D.

Barn Swallow (*Hirundo rustica*) S
Irregularly observed in aerial displays over the salt flats in Areas A and B and in aerial displays over Area D.

Scrub Jay (*Aphelocoma coerulescens*) R*
Up to 5 Jays at one time occasionally seen in the dunes of Area B. One jay was occasionally seen in the *Eucalyptus* grove in Area B. The willow/freshwater marsh section of Area B occasionally had 1-3 jays. One to 6 jays were regularly observed in the southwestern section of Area D. One pair in Spring 1990 was a confirmed breeder here. One to 3 jays were regularly seen in Area C. Jays were rarely observed in Area A.

Common Raven (*Corvus corax*) R
Irregularly observed along the southern edge of Area D. Two individuals observed foraging on the southern Ballona Creek dike in Area B in February 1991.

Bushtit (*Psaltriparus minimus*) R
Common in Areas A, B and D in summer, fall and winter of 1990/1991 in coastal sage scrub and willow areas. Occasionally observed in Area C during this same time. Less common in spring 1990 : Five individuals

observed along the bluffs in the coastal sage scrub habitat in Area B in May; two individuals observed in Area D in April.

House Wren (*Troglodytes aedon*) S/R
One individual observed in the dunes of Area B in October 1990. Two individuals seen south of Teale Rd. in Area D in coastal sage scrub and piles of debris in February 1991.

Marsh Wren (*Cistothorus palustris*) W
One observed along the tidal creek in Area A in February 1991. One also regularly observed in the pickleweed section of north-central Area B in November and December of 1989 (before the general surveys began).

Ruby-crowned Kinglet (*Regulus calendula*) W
One individual observed in the willows at the base of the Playa del Rey Bluffs in Area B in December and February 1990/91. One individual observed south of Teale Rd. in willows along Centinela Ditch in February 1991 in Area D.

Blue-gray Gnatcatcher (*Polioptila caerulea*) W
One to 5 individuals regularly observed in Area D, particularly in coastal sage scrub south of Teale Rd. from October to February 1990/91. One to 2 individuals regularly observed in Areas A and C in the coastal sage scrub and mulefat habitats from October to February 1990/91. Never observed in Area B.

Northern Mockingbird (*Mimus polyglottos*) R*
Regularly observed in oleanders along Fiji Way throughout the surveys. Also observed in the vegetation on the dunes in Area B, along the bluffs and in the willows in Area B and in the willows near Teale Way in Area D. May be nesting in Area D. Nested in oleanders on Fiji Way bordering Area A and in the dune vegetation in Area B. Also regularly observed in Area C.

American Pipit (*Anthus spinoletta*) W
Five individuals observed in Area A in February 1991. Many other individuals observed flying over Area B in the winter of 1990/91.

Loggerhead Shrike (*Lanius ludovicianus*) R*
Single individual observed in Area A in June, July, Aug, and October 1990.

Observed throughout Areas B and D over entire survey period. One individual seen in Area C in Both December, 1990 and February, 1991. Nested in Area B.

European Starling (*Sturnus vulgaris*) R
Second most common bird using all habitats in Area
A. Over 120 individuals sighted during a single survey. Also common in all habitats in Areas B and D.

Warbling Vireo (*Vireo gilvus*) M
Two individuals observed in the coastal sage scrub and mulefat habitats in Area A in April 1990.

Orange-crowned Warbler (*Vermivora celata*) R/M
Three individuals observed in the mulefat habitats of Area A in September 1990. Two individuals seen in Area B in the Eucalyptus grove in September 1990.

Nashville Warbler (*Vermivora ruficapilla*) M
One individual observed in the willows at the base of the Playa Del Rey Bluffs in Area B in September 1990.

Yellow-rumped Warbler (*Dendroica coronata*) W
A single individual observed in the coastal sage scrub and eucalyptus trees in Area A in April 1990. Two individuals observed using the pampas grass at the base of the bluffs in Area B during this same period. During fall and winter of 1990, regularly observed in small numbers in Area A, B and D. A single individual observed once in Area C in December 1990.

MacGillivray's Warbler (*Oporornis tolmiei*) M
A single individual observed in the willows along the Westchester Bluffs in Area D in April 1990.

Common Yellowthroat (*Geothlypis trichas*) R*
A single individual observed in the mulefat habitat in Area A in April and October 1990. One individual observed along the dry tidal creekbed in Area C in October 1990. Also regularly observed in the freshwater marsh and willow communities in Areas B and D. Nesting confirmed in Area D and probable in Area B.

Wilson's Warbler (*Wilsonia pusilla*) M
Three individuals observed in the willows along the Westchester Bluffs in Area D in April 1990. One individual observed in willows at the base of the Playa Del Rey Bluffs in September 1990, and one individual in Area A in April, 1990.

Western Tanager (*Piranga ludoviciana*) M
One individual observed in Area D in April 1990.

Black-headed Grosbeak (*Pheucticus melanocephalus*) S/M
Two individuals observed in the mulefat habitat in Area A in April 1990. Also observed in the freshwater marsh and willow communities in Areas B and D.

Blue Grosbeak (*Guiraca caerulea*) S/M
A single individual observed in the willows at the base of the Playa del Rey Bluffs in Area B in July 1990.

Lazuli Bunting (*Passerina amoena*) S/M
A single individual observed in the willows at the base of the Westchester Bluffs in Area D in April 1990.

Rufous-sided Towhee (*Pipilo erythrophthalmus*) R
One individual observed in the dunes area in October 1990.

Brown Towhee (*Pipilo crisallis*) R
Up to five individuals observed in the coastal sage scrub habitat on the bluffs in Area B throughout the survey. Up to eight individuals seen regularly along the bluffs in Area D. May nest in both of these areas.

Lark Sparrow (*Chonsestes grammacus*) W
Two individuals were observed in scrub at the base of the Westchester Bluff in Area D in February 1991.

Savannah Sparrow (*Passerculus sandwichensis*)

P.s. beldingi R*: 1- 30 observed regularly in Area B throughout the year. From October to February 1990/91, up to 7 were observed occasionally in Area A. During fall and winter 1990, B.S.S. often occurred in mixed flocks with P. s. nevadensis in Areas A and B. Note: all non-Belding's Savannah Sparrows were lumped into nevadensis.

P.s. nevadensis W: This subspecies was most commonly observed in dry grassy areas in Area A through D from October, 1990 to March, 1991. Flocks up to 15 were observed in A and B.

Fox Sparrow (*Passerella iliaca*) W
Two individuals were observed in scrub at the base of the Westchester Bluff in Area D in February 1991.

Song Sparrow (*Passerella melodia*) R
One or two individuals regularly observed in the pickleweed transition and mulefat communities in Area A and in the dunes of Area B. Birds also observed in the freshwater marsh community in Area B and along the fence in Area D. This species is a probable breeder in Areas B and D.

Lincoln's Sparrow (*Passerella lincolnii*) W
A single individual observed in Area D in April 1990. One individual observed in coastal sage scrub habitat in Area A in October 1990. One to 2 individuals regularly observed in the brush at the base of the Playa del Rey bluffs in December 1990 and February 1991. One individual observed in a dry brush pile in the north-central section of Area B in October 1990.

Golden-crowned Sparrow (*Zonotrichia atricapilla*) W
Two individuals observed at the base of the bluffs in Area D in April 1990. Two to 7 regularly seen at the base of the Westchester Bluffs in November and December 1990. Up to 20 seen in the same location in February 1991. Four individuals observed in the willow/pampas grass habitat in Area B at the base of the Westchester Bluffs in February 1991.

White-crowned Sparrow (*Zonotrichia leucophrys*) W
Five individuals observed using several habitats in Areas A and D during April 1990. Regularly observed throughout Areas A, C and D in fall and winter of 1990/1991. Up to 110 observed in Area A and 120 observed in Area D south of Teale Rd. during this same time. Ten to 25 observed in the

former agricultural fields of Area B from October to march 1990/1991. occasionally seen in the dune area in small numbers in winter of 1990/1991.

Red-winged Blackbird (*Agelaius phoeniceus*) R*
One or two individuals regularly observed in the freshwater marsh habitat in Area B in Summer 1990; up to 25 individuals observed in the pocket wetlands of Area D where nesting was confirmed. One individual observed in the former agricultural fields of Area B in October 1990. Sixteen males observed in territorial behavior in the pocket wetland just south of the large dirt mound in Area D in February 1991. Three males observed along Centinela Ditch in February 1991.

Western Meadowlark (*Sturnella neglecta*) R*
Flocks up to 50 birds observed in Area A, B, and D throughout Fall, Winter and Spring. Confirmed nester in Area A in spring 1991. May have nested in Area B.

Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*) S
Two individuals observed in Area A using the mulefat habitat in April 1990. Six were observed in Area A in April 1990 while not conducting an official survey.

Brown-headed Cowbird (*Molothrus ater*) S
A single individual observed in flight over Area A in April 1990.

Hooded Oriole (*Icterus cucullatus*) S
A single individual observed in the mulefat habitat in Area A in June 1990.

Northern Oriole (*Icterus galbula*) S*
Two birds regularly observed in the Eucalyptus grove at the base of the bluffs in Area B during Summer 1990; nesting confirmed. One individual observed in Area D in April 1990.

House Finch (*Carpodacus mexicanus*) R
Common throughout the study area. Up to 300 individuals observed during one census in Area D (most likely an underestimation).

Lesser Goldfinch (*Carduelis psaltria*) R
Two individuals observed in the willows along Teale Way in Area D in April 1990. Up to 15 individuals observed at one time in the willow habitats of Areas B and D during December through February 1990/91. Two individuals observed in Area A in mulefat habitat in February 1991.

House Sparrow (*Passer domesticus*) R
Two individuals regularly observed along the fence on the north side of the helicopter plant. Two individuals observed in flight over Area A in April 1990. One individual observed on the fence along Fiji Way bordering Area A in September 1990. Five individuals were observed in Area C in October 1990.

Birds observed outside of survey time periods:

White-faced Ibis (*Plegadis chihi*) M
Two individuals were observed in March 1990 circling overhead many times before attempting to land in the northern section of Area B. The landing attempt was aborted as they regained altitude and continued to fly east up Ballona creek.

Canada Goose (*Branta canadensis*) W
A group of 30 was observed flying low overhead in Area B in the fall of 1990. The group of birds circled twice before continuing south.

American Avocet (*Recurvirostra americana*) S/R
Four individuals observed on the mudflats of Area B in October 1989.

Common Snipe (*Capella gallinago*) W
Observed occasionally in the pickleweed wetlands in Area B in Fall 1989 while conducting Belding's Savannah Sparrow field work.

California Least Tern (*Sterna antillarum browni*) S
Occasionally observed flying low over the tidal channels in Area B.in June and July 1989. They appeared to be hunting, but were never observed making a dive.

Legend For Species Analysis

A	Area A
B	Area B
C	Area C
D	Area D
ar	areal
pww	pickleweed wetlands
mf	mudflats, saltflats, tidal channels
ww	willow woodlands
fwm	freshwater marsh
d/aw	dune, alluvial wash, sandy habitats
css	coastal sage scrub
pw/t	pickleweed wetlands, transition habitats
c/pg	coyote bush/pampas grass
ag	former agricultural areas, disturbed areas, weedy fields
ips	ice plant stands
ls	landscaping

	A	B	C	D	ar	pww	mf	ww	fwm	d/aw	css	pw/t	c/pg	ag	ips	ls
BIRDS																
Ciconiiformes																
Great Blue Heron	X	X				x	x	x								
Great Egret		X					x									
Snowy Egret		X					x									
Green-backed Heron	X						x									
Black-crowned Night Heron	X	X		X			x		x							
Anseriformes																
Mallard		X					x									
Cinnamon Teal		X					x									
Falconiformes																
Turkey Vulture	X				x											
Osprey		X			x											
Black-shouldered Kite		X		X		x								x		
Cooper's Hawk		X						x								
Red-shouldered Hawk			X											x		
Red-tailed Hawk	X	X	X	X							x	x	x	x		x
American Kestrel	X	X		X			x				x	x	x	x		
Charadriiformes																
Black-bellied Plover		X					x									
Killdeer	X	X		X			x					x				
Willet		X				x										
Spotted Sandpiper	X	X					x									
Whimbrel	X											x				
Least Sandpiper		X					x									
Dowitcher		X					x									
Columbiformes																
Rock Dove				X										x		x
Spotted Dove	X			X										x		x
Mourning Dove	X	X	X	X						x	x	x		x		x
Strigiformes																
Burrowing Owl				X											x	
Apodiformes																
Vaux's Swift		X		X	x											
White-throated Swift		X		X	x											
Anna's Hummingbird	X	X	X	X				x			x	x	x	x		x
Allen's Hummingbird		X						x		x			x			

	A	B	C	D	ar	pww	mf	ww	fwm	d/aw	css	pw/t	c/pg	ag	ips	ls
Coraciiformes																
Belted Kingfisher	X	X					x									
Piciformes																
Northern Flicker	X	X	X	X				x								
Passeriformes																
Willow Flycatcher		X						x								
Western Flycatcher		X		X				x	x							
Black Phoebe		X								x						
Say's Phoebe		X				x				x		x				
Ash-throated flycatcher	X	X		X				x			x					x
Western Kingbird				X										x		
Rough-winged Swallow		X		X	x									x		
Cliff Swallow	X	X		X	x		x							x		
Barn Swallow	X	X		X	x		x							x		
Scrub Jay	X	X	X	X				x		x	x					
Common Raven				X										x		
Bushtit	X	X	X	X				x			x		x			
House Wren		X		X						x	x					
Marsh Wren	X	X					x					x				
Ruby-crowned Kinglet		X		X				x								
Blue-gray Gnatcatcher	X	X	X	X				x			x					
Northern Mockingbird	X	X	X	X				x		x						x
Water Pipit	X											x				
Loggerhead Shrike	X	X	X	X							x	x	x	x		
European Starling	X	X		X		x						x		x		x
Warbling Vireo	X										x					
Orange-crowned Warbler	X	X						x								x
Nashville Warbler		X						x								
Yellow-rumped Warbler	X	X	X	X				x			x		x			x
MacGillivray's Warbler				X				x								
Common Yellowthroat	X	X	X	X				x	x							
Wilson's Warbler	X	X		X				x								
Western Tanager				X				x								
Black-headed Grosbeak	X	X		X				x	x							
Blue Grosbeak		X						x								
Lazuli Bunting				X				x								
Rufous-sided Towhee		X								x	x					
Brown Towhee		X		X							x					
Lark Sparrow				X							x		x			

	A	B	C	D	ar	pww	mf	ww	fwm	d/aw	css	pw/t	c/pg	ag	ips	ls
Savannah Sparrow																
beldingi	X	X				x						x				
nevadensis	X	X	X	X		x					x	x		x		
Fox Sparrow				X							x		x			
Song Sparrow	X	X	X	X				x	x	x		x	x			
Lincoln's Sparrow	X	X		X							x		x			
Golden-crowned Sparrow		X		X				x			x		x			
White-crowned Sparrow	X	X	X	X						x	x	x	x	x		
Red-winged Blackbird		X		X					x					x		
Western Meadowlark	X	X		X		x					x	x		x		
Yellow-headed Blackbird	X								x		x					
Brown-headed Cowbird	X				x											
Hooded Oriole	X												x			
Northern Oriole		X		X				x								x
House Finch	X	X	X	X		x		x	x		x	x	x	x		x
Lesser Goldfinch	X	X		X				x								
House Sparrow	X		X	X										x		x

Table 1. Species observed during my 1990-91 survey that were not observed during the 1979-81 survey.

<u>Falconiformes</u>
Red-Shouldered Hawk
<u>Columbiformes</u>
Spotted Dove
<u>Apodiformes</u>
White-Throated Swift
Allen's Hummingbird
<u>Passeriformes</u>
Western Flycatcher
House Wren
Warbling Vireo
MacGillivray's Warbler
Black-Headed Grosbeak
Orange-Crowned Warbler
Nashville Warbler
Blue Grosbeak
Lazuli Bunting
Rufous-Sided Towhee
Golden-Crowned Sparrow
Northern Oriole
Hooded Oriole
Brown-Headed Cowbird
Fox Sparrow

Table 2. Species observed during the 1979-81 survey that were not observed during my 1990-91 survey.

Podicipediformes
Eared Grebe
Western Grebe
Pied Billed Grebe

Pelecaniformes
Brown Pelican
Double Crested Cormorant
Magnificent Frigatebird

Anseriformes
Brant
Gadwall
Pintail
Blue Winged Teal
(observed by PERL, 1990)
Green Winged Teal
American Widgeon
Bufflehead
White Winged Scoter
Ruddy Duck
Red Breasted Merganser
Shoveler

Falconiformes
Sharp-Shinned Hawk
Northern Harrier

Galliformes
California Quail

Gruiformes
Virginia Rail
American Coot

Charadriiformes
Semipalmated Plover
American Golden Plover
Snowy Plover
Ruddy Turnstone
Black Turnstone
Long Billed Curlew
Greater Yellowlegs
Lesser Yellowlegs
Red Knot
Baird's Sandpiper
Dunlin
Western Sandpiper
Marbled Godwit
Sanderling
Black-Necked Stilt
Red Phalarope
Wilson's Phalarope
Northern Phalarope
Pomarine Jaeger
Glaucous-Winged Gull
Western Gull
California Gull
Ring-Billed Gull
Bonapart's Gull
Heermann's Gull
Forster's Tern
Elegant Tern

Strigiformes
Short Eared Owl
Long Eared Owl

Passeriformes
Western Wood Pewee
Violet-Green Swallow
Bank Swallow

Table 3. Species observed on the 1990/91 surveys at Ballona Wetland included on "warning" lists indicating a low population level or a decline in population levels. The lists of state endangered and threatened birds, and bird species of special concern are both provided by the California Department of Fish and Game (1990). Candidate listings for threatened or endangered species are provided by the U.S. Fish and Wildlife Service (1989), and the Blue List (Tate, 1986) is provided by the National Audubon Society.

Species	State Endangered or Threatened	Candidates for Endangered or Threatened	Special Concern	Blue List
White Faced Ibis		X (category 2)		
California Least Tern	X			
Osprey				X
Cooper's hawk			X	X
Red Shouldered Hawk				X
Burrowing Owl			X	
Willow Flycatcher	X			
Loggerhead Shrike				X
Belding's Savannah Sparrow	X			

Discussion

The overall diversity of birds observed at Ballona Wetland in 1990/91 (80 species) is down from Schreiber's survey in 1979-81(129 species). This may be greatly attributed to a change in the condition of the wetland caused by the current 5 year drought. Virtually no open or free standing water occurred during my survey period, and the "mudflats" were extremely dry. These dry conditions limit the ability of many types of birds to utilize the area. In contrast, Schreiber (1981) describes the former agricultural fields as being covered, in part, by open water and muddy conditions attracting a greater number of birds including Anseriformes, Charadriiformes and three orders not observed on my surveys; Podicipediformes, Pelecaniformes, and Gruiformes.

IMPACT ANALYSIS

Species using habitats that will be removed by development and not replaced by the restoration project may incur the most detrimental impacts by facing possible extirpation from the area. Species typically found in the habitats being restored or created (wetland/riparian) may benefit from potential nesting, foraging and roosting sites. Below is a description by area, by selected orders and species, and by communities which may be negatively or positively impacted.

Direct and Indirect Impacts

Area A

Forty species, half of all species observed at Ballona, occurred here. The three confirmed nesting species were Western Meadowlark, Anna's Hummingbird and Northern Mockingbird. The primary concern is with the Belding's Savannah Sparrow as it previously nested here and currently uses pickleweed areas for foraging during winter months (Corey and Massey, 1991). Under the current plan, these foraging areas and the potential to rehabilitate Belding's Savannah Sparrow nesting sites in Area A will be lost. Altering this area into a boat harbor will remove most current bird species with the possible exception of; Great Blue Heron, Belted Kingfisher, Rock Dove and the areal foragers (swallows).

Area B

Of 80 bird species observed at Ballona Wetland, 58 (73%) occurred here. Confirmed nesters include; Killdeer, Northern Mockingbird, Loggerhead Shrike, Belding's Savannah Sparrow, and Northern Oriole. Primary concern is with the Belding's Savannah Sparrow being disrupted by the restoration project during the nesting season (see Corey and Massey, 1991). Other sensitive species affected by the restoration project include the Great Blue Heron, Killdeer, Allen's Hummingbird, and Loggerhead Shrike.

Great Blue Heron:

Presently, this species uses the Ballona Wetland primarily as a roosting/loafing area on the salt flats in Area B and in the large cottonwood tree on the dunes. The salt flats will be significantly altered under both mid and full-tidal plans. However, up to 24 Great Blue Herons have been observed along the rocks of Ballona Creek and on the adjacent dike opposite the planned bird island: It is possible that the Great Blue Herons will still use this area for roosting upon completion of the restoration project. The cottonwood tree roosting site will apparently be lost because of restoration of native dune habitat.

Killdeer:

The area of saltflats where Killdeer currently nest will be significantly reduced under the full tidal plan. Successful nesting of this species may be immediately lost, however, this species is highly adaptive in choosing nesting sites (Lennington and Mace, 1975).

Allen's Hummingbird:

This species was regularly seen during spring 1990 at the dunes and willow/pampas grass communities in Area B. Nesting was not confirmed but was possible because of observed male territorial disputes and courtship flights, and has been a confirmed breeder at Ballona in the past (Garrett and Dunn, 1981). The restoration project will significantly alter existing vegetation at the dunes and shift current willow areas to the fresh water marsh and riparian strip.

Loggerhead Shrike (on the Audubon Society's Blue List):

Currently, much of the Ballona Wetland is ideal for this bird which often breeds in open fields with scattered trees feeding primarily on large insects, and to a lesser degree birds, mice, and lizards (Bohall-Wood, 1987). The re-creation of a wetland and development of Areas A, C, and D may push the shrikes to perimeter areas including the bluffs and dunes or to a location away from the Ballona area.

Species using the former agricultural fields and other dry grassy portions of Area B will be negatively impacted primarily by losing a foraging area as these habitats are removed. These birds include the Western Meadowlark, Savannah Sparrow (nevadensis), Red-tailed Hawk (uses the area for hunting), American Kestrel (uses the area for hunting), Mourning Dove, and White-crowned Sparrow.

Area C

Fifteen out of 80 species (19%) occurred here. Anna's Hummingbird is a probable breeder. The most critical impacts here include a loss of foraging areas for the Red-tailed Hawk, Scrub Jay, Blue-gray Gnatcatcher, and Loggerhead Shrike as well as a possible breeding area for the Yellowthroat. Development here will also disrupt foraging patterns of the Mourning Dove, Anna's Hummingbird, Northern Flicker, and wintering species such as the White-crowned Sparrow.

Area D

Forty-nine out of 80 species (61%) occurred here. Confirmed breeders include the Red-tailed Hawk, American Kestrel, Anna's Hummingbird, Scrub Jay, Common Yellowthroat, and Red-winged Blackbird. Probable breeders include Northern Mockingbird and Brown Towhee.

Because of the complete restructuring of this area and loss of most current habitat, many species may be affected. Birds inhabiting pocket wetlands along Teal Rd. and just south of the large dirt mound (and north of the helicopter plant) will lose their nesting habitat. In spring 1990, up to 15 Red-winged Blackbird pairs and up to 5 Common Yellowthroat pairs nested here.

Other species using the open sections of Area D will primarily be impacted by losing valuable foraging areas. These species include the Red-tailed Hawk, American Kestrel, Killdeer, Scrub Jay, Mourning Dove, Ash Throated Flycatcher, Western Kingbird, Loggerhead Shrike, and various sparrows.

A primary concern in Area D is the Burrowing Owl (a species of special concern) of which one individual was observed below the LMU sign in April 1990 at the entrance to a burrow (no nesting confirmed). No direct impacts (destruction of the burrow) are foreseen in the restoration project, however, currently used or potential hunting/foraging sites in Area D will be lost. It is not known if Burrowing Owls forage along the bluffs, but traditionally Burrowing Owls hunt and nest in level, open, dry areas with low standing vegetation such as in open fields or desert areas (Grant, 1965). Their hunting range has been estimated at 4.8 to 6.5 hectares (Grant, 1965). A study on the population of Burrowing Owls at LAX may provide valuable information towards the possibility of establishing a stable population at Ballona.

Presently, this species may already be extirpated from Ballona, but

Burrowing Owls were described as a "fairly common resident" in the fields, dikes and bluff areas in 1979-81 (Schreiber, 1981). Possible reasons for its decline include:

1. Presence of the Red Fox as a potential predator.
2. A decline in prey base and foraging area
3. Increased human disturbance.
4. Lack of adequate or available burrows.

Estuarine habitats

The primary concern will be the affect of flooding current Belding's Savannah Sparrow nesting areas with increased tidal flow (Corey and Massey, 1991). The Belding's Savannah Sparrow must successfully transfer to newly created areas of pickleweed, and more pickleweed area appears to be created by the mid-tidal plan. However, the amount of pickleweed habitat created by the full-tidal plan still appears to exceed the current nesting area of Belding's Savannah Sparrows. In either plan, quality of pickleweed habitat may improve over current conditions primarily because of tidal flushing. In other saltmarshes receiving tidal flushing, Belding's Savannah Sparrow territories are reportedly smaller than the results I obtained at Ballona (Corey and Massey 1990, Massey 1976). Once the saltmarsh at Ballona is fully restored, territory sizes may decrease.

Podicipediformes:

No species from this group were found at the wetland. Both mid and full-tidal plans will probably attract Eared Grebes as this species primarily feeds on aquatic insects and larvae and can be found in shallow water (Cramp and Simmons, 1977; Jehl, 1988). However, the larger Clark's and Western Grebes are primarily fish and aquatic invertebrate feeders (Ehrlich et al, 1988), and may require deeper water to forage in, maximized by the full tidal plan (Nuechterlein, 1981).

Anseriformes and Gruiformes:

Ducks rarely used the wetland during the 1990/91 surveys. The current restoration plan, however, should greatly increase the potential for attracting waterfowl.

The salt marsh restoration plan under the full-tidal scheme should maximize potential use from duck species. The depth and width of the water will be greater under the full-tidal plan and will increase the chance of attracting diving ducks (Lesser Scaup, Greater Scaup, Ruddy Duck), and sea ducks (Bufflehead, Surf Scoter)(Bellrose, 1976). The shallow water areas under each plan may attract many types of dabbling ducks including Green-winged Teal (*Anas crecca*), Mallard, Northern Pintail (*Anas acuta*), Blue Winged Teal (*Anas discors*), Cinnamon Teal (*Anas cyanoptera*), Northern Shoveler (*Anas clypeata*), Gadwall (*Anas strepera*), and American Widgeon (*Anas americana*)(Corey, 1990).

The full-tidal plan also increases the remote possibility of introducing the Light Footed Clapper Rail (*Ralus longirostris levipes*) to the area (Massey, 1984).

Charadriiformes:

Absolute numbers of this group observed using Ballona Wetland were extremely low compared to other southern California salt marshes (Jurek, 1974). Mid and full-tidal restoration plans will greatly enhance the potential for attracting more shorebirds to forage, and "Bird Island" and the dikes connecting gas company structures should provide some area for roosting/loafing.

As mentioned earlier, however, birds presently or potentially nesting/foraging on the salt flats may be negatively affected. The western race of the Snowy Plover (*Charadrius alexandrius nivosus*) is under serious consideration for threatened or endangered status (currently category 2) which nests in open areas including beaches and salt flats (Page 1981, U.S. Fish and Wildlife Service 1989). This species has not been recorded at Ballona recently, and is doubtful whether it will return to nest. At Bolsa Chica wetland in Orange County, Snowy Plovers have consistently nested on the man made tern islands (Page 1981, Massey, pers. comm.) however, the proposed island at Ballona is smaller and not adjacent to open salt flats.

The endangered California Least Tern has a realistic possibility of nesting on "bird island" as a large colony of Least Terns currently nests on nearby Venice Beach. The Elegant Tern (*Sterna elegans*) (a category 2 species) and the Black Skimmer (*Rhynchops niger*) currently nest together with Least Terns on man-made islands at Bolsa Chica and are potential but improbable nesters on "bird Island".

Falconiformes:

A species not observed during my surveys but which may be attracted to the restored wetland is the Northern Harrier (on the Audubon Society's Blue List). The Northern Harrier is basically an open country species and is highly adapted to hunt in dense vegetation such as tall grass prairies and marsh lands (Johnsgard, 1990). Perhaps the Northern Harrier is currently unable to compete with the Kestrel and Red-tailed Hawk in the bare fields at Ballona, and may return only when its specialty of locating prey by sound can be used to outcompete other diurnal birds of prey once the wetland is restored.

Willow community

More species (mostly migrants) were observed in this community than any other. The replacement of willows along the new riparian strip and fresh water marsh should compensate for any loss incurred to present willow stands. However, to greatly improve upon existing riparian habitat, willow stands should be allowed to mature and undergrowth should not be "manicured".

Freshwater marsh

The freshwater marsh located on the south-central edge of Area B was mostly lacking in free-standing water throughout the survey period. However, Common Yellowthroats and Song Sparrows are probable nesters here. The pocket wetlands in Area D are even less moist and have many weeds growing throughout, however, common Yellowthroats and Red-winged Blackbirds are confirmed nesters while Song Sparrows are probable nesters. The proposed freshwater marsh in Area B should compensate for loss of these areas by providing new nesting habitat. However, removal of the existing freshwater marshes before the new one is "functional" may cause temporary extirpation of the Common Yellowthroat and Red-winged Blackbirds as nesting species.

Terrestrial habitats

Birds dependent on terrestrial areas at Ballona will be the most negatively impacted as Areas A, C, and D are developed and Area B is restored into a healthy wetland. Selected species using virtually all available terrestrial habitat at Ballona are discussed below.

Falconiformes:

This group of birds is particularly important and have been described as indicator species because of their top rank in the food chain. The most common species are the Red-tailed Hawk and American Kestrel which both have wide tolerances for habitat variation (Johnsgard, 1990). However, the Kestrel mostly prefers open, dry areas, and the Red-tailed Hawk depending on the season and sex, prefers open pasture, grassland, marsh-shrub, fields and open hardwood forests (Johnsgard, 1990). The loss of open areas will likely decrease the absolute numbers of these species, although the bluffs and perimeter areas may sustain stable populations.

Loggerhead Shrike (see Area B)

Savannah Sparrow (*nevadensis*):

This species is a common winter migrant along the coast of southern California in most open grassy fields (Garrett and Dunn, 1981). Remnants of the current population may still occur along the dikes and dryer portions of the saltmarsh after development and restoration are completed.

Coastal sage scrub

This habitat produced the second largest species diversity. The California Gnatcatcher (*Polioptila melanura californica*), a species representative of this community was not observed on my surveys. Currently this species can be found nearby at various coastal sage scrub locations on the Palos Verdes Peninsula.

Phase 1

Phase 1 of the development will contribute mostly to the loss of foraging areas for species found in open fields and disturbed areas (see Direct Impacts). Species forced out of the phase 1 development area may move to other parts of Ballona where similar habitats occur and temporarily increase competition for space. This may disrupt nesting of some species in Areas A, B, and C during the spring.

No immediate extirpation of any bird should occur assuming the Burrowing Owl is already absent from the area.

CUMULATIVE IMPACTS

Undeveloped open fields within urban Los Angeles do provide habitat for many bird species as indicated above. Although most birds inhabiting these areas are considered common, continuous net loss of open fields will have a diminishing effect on local bird populations, cumulatively decreasing overall populations of "open field birds".

The restored Ballona saltmarsh, however, will possibly contribute to an increase in the local Belding's Savannah Sparrow population. Healthy saltmarsh habitat in L.A. County is extremely rare and the restoration of Ballona will be a valuable addition to the Pacific Flyway where shorebirds and ducks can stop to forage and loaf. Similarly, the freshwater marsh and riparian zones will be a stopover for many terrestrial migrants, and will provide nesting habitat rarely occurring in the urbanized areas of Los Angeles.

References

American Ornithologists Union, 1983. *Checklist of North American Birds*, 6th Edition.

Bednarz, J.C., and J.J. Dinsmore 1981. Status, habitat use, and management of Red Shouldered Hawks in Iowa. J. Wildl. Manage. 45 : 236-241.

Bellrose, F.C.. 1976. Ducks, Geese and Swans of North America, second edition. Stackpole Books, Harrisburg, PA.

Bohall-Wood, P. 1987. Abundance, habitat use, and perch use of Loggerhead Shrikes in north-central Florida. Wilson Bull. 99:82-86.

California Department of Fish and Game. 1990. 1990 List of birds and mammal species of special concern.

California Department of Fish and Game. 1990. State and federal endangered and threatened animals of California.

Chambers Group, Inc., preliminary draft "Environmental assessment for construction of the freshwater wetland system and filling of isolated wetlands for the proposed playa vista project", January 1991. Prepared for Maguire Thomas Partners for submittal to the U.S. Army Corps of Engineers.

Corey, Kennon A.. 1990. Effects of tidal fluctuation on shorebird movement at Bolsa Chica. Unpublished report. Calif Dept. of Fish and Game.

Corey, Kennon A. and B. Massey. 1990. A Population and banding study on the Belding's Savannah Sparrow at Ballona Wetland, 1989-1990. Unpublished Report.

Cramp, S., and K.E.L. Simmons. 1977. Handbook of the birds of the Middle East and North Africa, Vol 1. Oxford Univ. Press Oxford.

Ehrlich, Paul R., D.S. Dobkin, and Darryl Wayne. 1988. The birder's handbook. Simon and Schuster Inc.

Garrett, K., and J. Dunn. 1981. Birds of Southern California. Los Angeles Audubon Society.

Grant, R.A. 1965. The burrowing owl in Minnesota. Loon 37:2-17.

Jehl, Joseph R. 1988. Biology of the eared grebe and wilson's phalarope in the nonbreeding season: a study of adaptations to saline lakes. Studies in Avian Biology No. 12. Cooper Ornithological Society.

Johnsgard, Paul A. 1990. Hawks, Eagles and Falcons of North America. Smithsonian Institution Press.

Jurek, R.M. 1974. California shorebird study. Cal-Nevada Wildlife. p49-57.

Lockhart, S.H., J. Lipa, G. Vasarhelyi, and V. Tsihrintzis, preliminary draft "Application for a permit pursuant to section 10 ofc the river restore a 230.4-acre salt marsh system within the Ballona Estuary, County of Los Angeles", December 1990. Prepared for Maguire Thomas Partners-Playa Vista.

Lenington, S., and T. Mace. 1975. Mate fidelity and nesting site tenacity in the Killdeer. Auk 92:149-151.

Massey, B.W., R. Zembal, and P.D. Jorgenson. 1984. Nesting habitat of the Light-footed Clapper Rail in southern California. J. Field Ornithol. 55:67-80.

Nuechterlein, G.L.. 1981. Courtship behavior and reproductive isolation between Western Grebe color morphs. Auk 98:335-349.

Page, Gary W. and Lynne E. Stenzel. 1981. The breeding status of the Snowy Plover in California. Western Birds. v.12-13:1-30.

PERL. 1991. The functioning of Ballona Wetland in relation to tidal flushing, Part 1-- Before tidal flushing. Pacific Estuarine Research Laboratory, San Diego State Univ., San Diego.

Schreiber, R.W., editor. 1981. Biota of the Ballona Region, Los Angeles County. Los Angeles Natural History Museum, Los Angeles.

Tate, James. 1986. The Blue List for 1986. American Birds. Vol. 40, No. 2.

U.S. Fish and Wildlife Service, Department of the Interior. 1989. Federal Register. Endangered and Threatened Wildlife and Plants; Animal Notice of Review. Vol. 54, No. 4.

Appendix One

This section contains the raw data collected in the survey. Each number represents the mean number of birds seen per month.

APPENDIX ONE

SPECIES	Apr, '90 A	B	C	D	May, '90 A	B	C	D	Jun, '90 A	B	C	D	Jul, '90 A	B	C	D	Aug, '90 A	B	C	D	Sep, '90 A	B	C	D	Oct, '90 A	B	C	D
Ciconiiformes																												
Great Blue Heron	2			1		2				6				8				9			1	12				16		
Great Egret		1																								1		
Snowy Egret																												
Green-backed Heron	1				1				1				1								1							
Black-crowned Night Heron										1				1		1									1			
Anseriformes																												
Mallard																												
Cinnamon Teal																												
Falconiformes																												
Turkey Vulture																												
Osprey																		1										
Black-shouldered Kite																1												
Cooper's Hawk																												
Red-shouldered Hawk																											1	
Red-tailed Hawk	1	1				2		1				2		1		1		1		2		2	1	1			1	
American Kestrel		1			1			1	1			3	1	1		3	1			2		2		2	1			
Charadriiformes																												
Black-bellied Plover						1				1																		
Killdeer		1		6		1												1								1		
Willet						1																						
Spotted Sandpiper	1																											
Whimbrel	11																											
Least Sandpiper																										4		
Dowitcher										1																		

SPECIES	Nov, '90 A	B	C	D	Dec, '90 A	B	C	D	Jan, '91 A	B	C	D	Feb, '91 A	B	C	D	Mar, '91 A	B	C	D	Apr, '91 A	B	C	D
Ciconiiformes																								
Great Blue Heron		18				14			5	17								1				7		
Great Egret		1								9								3						
Snowy Egret														2										
Green-backed Heron					1																			
Black-crowned Night Heron																								
Anseriformes																								
Mallard						2				2								2						
Cinnamon Teal														4										
Falconiformes																								
Turkey Vulture													1											
Osprey																								
Black-shouldered Kite		1				1								1										
Cooper's Hawk														1										
Red-shouldered Hawk																								
Red-tailed Hawk			1			2		1		2		3				2		1				1		1
American Kestrel	1	4						1	1	1		1				2						2		1
Charadriiformes																								
Black-bellied Plover																								
Killdeer													4			1		1						
Willet										1														
Spotted Sandpiper										1														
Whimbrel																								
Least Sandpiper																								
Dowitcher																								

010862

APPENDIX ONE.

	Apr, '90				May, '90				Jun, '90				Jul, '90				Aug, '90			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Columbiformes																				
Rock Dove								3												3
Spotted Dove	2			2																
Mourning Dove	10	2		10	40	17		11	10	5		15	20	4		12	25			18
Strigiformes																				
Burrowing Owl				1																
Apodiformes																				
Vaux's Swift						1		5				1								
White-throated Swift						15		5				6				4				
Anna's hummingbird	3			4		5		1	3	3		3	4	2		2	3	2	2	4
Allen's hummingbird						5				4				7				4		
Coraciiformes																				
Belted kingfisher																		1		
Piciformes																				
Northern Flicker																				
Passeriformes																				
Willow Flycatcher																				
Western Flycatcher				1																
Black Phoebe																				
Say's Phoebe																				
Ash-throated Flycatcher	3			2													1			
Western Kingbird								1				1								1
Rough-winged Swallow						2						2								
Cliff Swallow	7					40		10	1			4				3		4		
Barn Swallow	15	8			7	8		10		7			10	4			13	7		4
Scrub Jay				1		2		1		1		1						2		1
Common Raven								1				3								2

	Sep, '90				Oct, '90				Nov, '90				Dec, '90				Jan, '91			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Columbiformes																				
Rock Dove																				
Spotted Dove																				
Mourning Dove	12	8		2	11	7	16	12	30	3	11	16	15		3	16			11	8
Strigiformes																				
Burrowing Owl																				
Apodiformes																				
Vaux's Swift																				
White-throated Swift																				
Anna's hummingbird	6	4			4	2	3	3	1	1	2	4	3		2	2	2	5	1	7
Allen's hummingbird																				
Coraciiformes																				
Belted kingfisher		1			1	1				1							1	1		
Piciformes																				
Northern Flicker						2	1	1			2		1	1	2		1		1	
Passeriformes																				
Willow Flycatcher		.5																		
Western Flycatcher		.5																		
Black Phoebe						.5														
Say's Phoebe										1				2				1		
Ash-throated Flycatcher	1	1																		
Western Kingbird				1																
Rough-winged Swallow																				
Cliff Swallow																				
Barn Swallow		6																		
Scrub Jay	1					5	2	2		2	1	1			2			4	2	1
Common Raven																				

	Feb, '91				Mar, '91				Apr, '91			
	A	B	C	D	A	B	C	D	A	B	C	D
Columbiformes												
Rock Dove				5								
Spotted Dove								1				
Mourning Dove				9	5	21	6		11	7	5	13
Strigiformes												
Burrowing Owl												
Apodiformes												
Vaux's Swift												
White-throated Swift						70						
Anna's hummingbird				6	4	3	3		4	3	2	1
Allen's hummingbird						3				4		
Coraciiformes												
Belted kingfisher					1							
Piciformes												
Northern Flicker				1			1					
Passeriformes												
Willow Flycatcher												
Western Flycatcher												
Black Phoebe												
Say's Phoebe												
Ash-throated Flycatcher									1			1
Western Kingbird												
Rough-winged Swallow						2						
Cliff Swallow										5		
Barn Swallow						2			3	5		
Scrub Jay				5		2	1			2	1	3
Common Raven		1		1								1

APPENDIX ONE

	Apr, '90				May,'90				Jun, '90				Jul, '90			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Bushtit				2		5										
House Wren																
Marsh Wren																
Ruby-crowned kinglet																
Blue-gray Gnatcatcher																
Northern Mockingbird	6	1		3	10	7		4	9	8		2	10	10		2
American Pipit																
Loggerhead Shrike		2		1		2		2	1	4		1	1	5		1
European Starling	20			1	120	220		8	65			1	15			15
Warbling Vireo	2															
Orange-crowned Warbler																
Nashville Warbler																
Yellow-rumped Warbler	1	2														
MacGillivray's Warbler				1												
Common Yellowthroat	1			2		5		1		5		2		6		2
Wilson's Warbler	1			3												
Western Tanager				1												
Black-headed Grosbeak	2			2						1						
Blue Grosbeak														1		
Lazuli Bunting				1												
Rufous-sided Towhee																
Brown Towhee		1		2		5		2		2		4		1		4
Lark Sparrow																
Savannah Sparrow						12										
P.s. beldingi		1				12				12				12		
P.s. nevadensis	4	1		8												
Fox Sparrow																
Song Sparrow	2	3		4	2	5		1	1	3		4		2		1
Lincoln's Sparrow				1												
Golden-crowned Sparrow				2												
White-crowned Sparrow	3			2												
Red-winged Blackbird	1			10		2		25				20				2

	Aug, '90				Sep, '90				Oct, '90				Nov, '90			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Bushtit		7				9				10						
House Wren									.5							
Marsh Wren																
Ruby-crowned kinglet																
Blue-gray Gnatcatcher									1		2				1	3
Northern Mockingbird	5	3	2	4	5	9	3	2	7	3	4	5	8	2	2	1
American Pipit									4							
Loggerhead Shrike	1	4		1		3			1	2		1		2		1
European Starling	5	10	33		25					5				75		2
Warbling Vireo																
Orange-crowned Warbler					2	1			1							
Nashville Warbler						1										
Yellow-rumped Warbler									3	3			4	2		1
MacGillivray's Warbler																
Common Yellowthroat		5				6			1		1	1		2		1
Wilson's Warbler					1											
Western Tanager																
Black-headed Grosbeak																
Blue Grosbeak																
Lazuli Bunting																
Rufous-sided Towhee										.5						
Brown Towhee						2						3				
Lark Sparrow																
Savannah Sparrow																
P.s. beldingi						4				11			4			
P.s. nevadensis									9	1	1		7			
Fox Sparrow																
Song Sparrow				2	1	2			1	1	1	1	1	1		
Lincoln's Sparrow									1	.5						
Golden-crowned Sparrow														5		
White-crowned Sparrow									53	27	45	80	75	2	30	15
Red-winged Blackbird		1								1				1		

	Dec, '90				Jan, '91				Feb, '91				Mar, '91				Apr, '91			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Bushtit					5	16	6	6					2	9			1			
House Wren												.5								
Marsh Wren									.5											
Ruby-crowned kinglet		1								1		.5								
Blue-gray Gnatcatcher	1		2	4				3				2								
Northern Mockingbird	7	1		1	3	1	2	2	2				5	3	4	1	3	5	1	1
American Pipit									3											
Loggerhead Shrike		1	1			3		1		2	1	1	1	2				1		
European Starling				20	13		20		26	40	11	4	6					4		60
Warbling Vireo																				
Orange-crowned Warbler																				
Nashville Warbler																				
Yellow-rumped Warbler	3	1		4				5	3				5	15			2			2
MacGillivray's Warbler																				
Common Yellowthroat		3		1		1								3				2		1
Wilson's Warbler																				
Western Tanager																				
Black-headed Grosbeak																				
Blue Grosbeak																				
Lazuli Bunting																				
Rufous-sided Towhee																				
Brown Towhee								2				5		3						
Lark Sparrow												1								
Savannah Sparrow																				
P.s. beldingi	2					1			6					5						
P.s. nevadensis	6					8			9				7	4						
Fox Sparrow												1								
Song Sparrow		3		1		2		2				6	3	4			1			1
Lincoln's Sparrow				1								2	1	1						
Golden-crowned Sparrow		3						7		16										
White-crowned Sparrow	35	14	10	67		9	20	62				97	22		14			4		
Red-winged Blackbird		2												2		13				16

APPENDIX ONE

	Apr, '90				May, '90				Jun, '90				Jul, '90				Aug, '90			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Western Meadowlark	10				10	11			5	6			4	5			10			
Yellow-headed Blackbird	2																			
Brown-headed Cowbird	1																			
Hooded Oriole									1											
Northern Oriole		2		1		2				2										
House Finch	50	4		6	150	44		15	70	4		80	100	13		25	90	2	11	170
Lesser Goldfinch				2																
House Sparrow	2			2				2				2								1

	Sep, '90				Oct, '90				Nov, '90				Dec, '90			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Western Meadowlark		5			9	11										
Yellow-headed Blackbird																
Brown-headed Cowbird																
Hooded Oriole																
Northern Oriole																
House Finch	30	90		9		89	15	20	11	6		35	40	12	8	15
Lesser Goldfinch																
House Sparrow	1						3					1				3

	Jan, '91				Feb, '91				Mar, '91				Apr, '91			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Western Meadowlark		37		2				19	13	2						
Yellow-headed Blackbird																
Brown-headed Cowbird																
Hooded Oriole																
Northern Oriole														1		
House Finch	30		18	80	120	2	60	161	8	7	5		19	1	21	3
Lesser Goldfinch					2											
House Sparrow									1			2				2

A population and banding study on the Belding's Savannah Sparrow at Ballona Wetland, 1989-1990.

By Kennon Corey and Barbara W. Massey

Department of Biology
California State University, Long Beach

November 1990

ABSTRACT

A population and banding study on the Belding's Savannah Sparrow (*Passerculus sandwichensis beldingi*) was conducted at Ballona wetland from June 1989 through July 1990. There were 9 breeding pairs in 1989, 11-12 in 1990. These figures represent a considerable decline from the 29 pairs counted in 1987. Probable reasons for the decline are discussed.

Territory shapes and sizes changed markedly from 1989-1990 and varied in size from 856 m to .

Thirty-two sparrows were trapped and individually color banded after the 1989 breeding season. Some were apparently winter visitors, as only 10 were seen on territories in 1990.

Foraging patterns were observed on 4 study plots during the winter to determine differential use of micro-habitats.

INTRODUCTION

The state endangered Belding's Savannah Sparrow *Passercccululus sandwichensis beldingi* is holding on in the last few coastal salt-marshes in southern California in alarmingly low numbers. The latest California census in 1986 (Zembal & Kramer 1986) produced a total of 2,274 pairs. The importance of saving the remaining salt-marsh areas in California and Mexico has become a matter of life or extinction for the Belding's Savannah Sparrow (BSS) and other salt-marsh dependent species.

At the degraded Ballona Wetland in Playa Del Rey, Los Angeles, California, a planned salt-marsh habitat restoration project has been underway for many years, and the local BSS population has been a major consideration in this plan. In order to better understand the utilization of Ballona Wetland by the BSS, a study was conducted for 13 months from June, 1989 - July, 1990 to determine the number of breeding pairs, the size of each territory, preferred feeding areas, and to document the breeding and feeding changes within the yearly cycle.

STUDY AREA

Ballona Wetland is criss-crossed with streets, powerlines, and the concrete Ballona Creek channel. The study area was located in area B (Fig. 1) between Ballona Creek and Culver Blvd. where minimal tidal flushing still occurs. Pickleweed (*Salicornia virginica*) surrounds the tidal channels, eventually giving way to open dirt/salt flats. Throughout the Salicornia there are scattered shrubs and upland weeds. Only the vegetation near the tidal streams receive any tidal flushing; the salt flats and outer Salicornia receive none. A detailed vegetational analysis of area B has been done by Pacific Estuarine Research Laboratory (1989).

METHODS

Census

A census of the breeding population was conducted by KC throughout Ballona Wetland in *Salicornia*-dominant areas by counting the number of singing males. The survey was done on 10 separate days in June and July of 1989, and on 7 separate days in March-May in 1990. All censusing began within a half hour after sunrise and ended by 9 or 10 AM.

Each territory (T) was located by sitting and observing one singing male at a time. A territory was defined as the area within a circle of perches where the same BSS male sang. A few extra feet beyond these perches were included as part of the territory as described by Massey (1979). Territorial boundary lines were double-checked by observing how far the male would chase other BSS intruders; when the resident male reached his territory boundary, the chase was usually discontinued. Occasionally, two neighboring males would sing 3-5 m apart from each other with the territorial boundary line in between the two birds. Steel "bamboo" garden stakes were then used to outline the territories.

BSS nest sites were not searched for fear of leading predators to them; e.g. Red Foxes (*Vulpes fulva*) were regularly seen in the breeding area.

Banding

Banding was begun on 27 July 1989, after there were no further indications of nesting activity. BSS were all caught with mist-nets; net placement and the procedure for herding birds into the nets was refined by trial and error. On the first attempt, with the nets set up at dawn and two people in the field, we caught only 3 sparrows. Three more sessions (including an unsuccessful one at night) during which we revised the technique, resulted in a method that worked well. In the early morning on 2 October we placed 5 mist nets across the breeding area, with one stretched across a tidal channel. With 6 people to herd the birds, we walked quietly towards the nets. Sparrows would start up from the pickleweed and fly short distances ahead of us. When we were close to the nets we clapped and called and rushed toward the nets. The birds were by then too close to the net to avoid it. We trapped 13 sparrows at this session, as many as on the 4 previous attempts.

After trapping 26 BSS, we deferred further banding until the breeding season, when a selective banding technique was then employed to capture individual territorial males. A single mist-net and a tape recorder, placed directly under the net and playing a BSS song (endless loop cassette), were set up on the edge of an observed territory. The male on territory would fly into the net in an attempt to chase the "intruder". This technique netted 3 territorial males.

Each Savannah Sparrow was banded with three color bands and a U.S. Fish and Wildlife service band: two color bands on one leg and one color band and one service band on the other leg. The colors used were:

1. Mauve (M)	5. Red (R)
2. Dark Blue (B)	6. White (W)
3. Light Blue (b)	7. Light Green (G)
4. Black (K)	8. Service band (S)

Habitat Use

In order to evaluate the use by BSS of micro-habitats in the wetland an index survey was conducted. Three 60 x 60 m plots were set up in the study area (Fig. 1). Plot 1 was placed over pickleweed/saltflat edge, Plot 2 over pickleweed/tidal channel, and Plot 3 cover a continuous section of pickleweed (Fig. 1). A 4th plot was established on the southern bank (rip rap) of Ballona Creek. Using 10 x 50 binoculars or a 20-60x scope, each plot was surveyed for a duration of 60 seconds every 5 minutes, 3 times in a row. All plots were surveyed twice in a row on 6 different days in both the breeding and nonbreeding seasons at various times of the day.

Vegetational sampling

A 75 m line transect was laid through Plot 3 along the long axis (Fig. 1) and the amount of vegetational cover calculated along its entire length. Categories of cover included plant species, bare ground and litter. A 1 m^2 circular quadrat was placed around every 5 m mark on the line transect and percent cover determined within the circle. The vegetation in Plots 1 & 2 were not analyzed as they were not different from Plot 3; all were monotypic stands of *S. virginica*.

The territories were each outlined with stakes. Compass readings and distances were measured between each stake and plotted on a map. A computerized planimeter was then used to find the area of each territory.

RESULTS

Breeding and Wintering Chronology

The breeding season of 1989 ended by August when singing stopped and territories broke down as the BSS began to flock together in feeding groups of up to 25 birds. The non-breeding season extended from August 1989 through January 1990. The first BSS song of the 1990 breeding season was heard on 8 Feb. However, feeding flocks of up to 20 BSS were seen until the end of February. The first copulation was seen on 1 March. Establishment and fierce defense of territorial boundaries was first observed on 5 March. This timetable is similar to that reported by Massey (1987).

Territories and Breeding Population

In both the 1989 and 1990 breeding seasons, breeding territories were found in the area surrounding tidal channel Y in area B (Fig. 2 & 3). No other areas of Ballona Wetland contained any breeding BSS. In 1989, 9 pairs maintained territories, and in 1990 there were 12 pairs. The size of each territory (Table 1) varied considerably from 856 m^2 to 19,081 m^2. In 1990,
4 territories included portions of the salt flats between clumps of pickleweed with MK-SK's territory being the largest at 19,081 m^2 (12,201 m^2 saltflat and 6,880 m^2 pickleweed).

Territorial boundaries apparently remained constant throughout the breeding season with one exception. In late May of 1990 SR-RR, the male on T3, disappeared and was not seen again during the study, presumably having died. On 6/12/90, the males on T2 and T4 on either side of T3 expanded their territories into the newly vacant territory of SR-RR.

Between seasons, territory shapes and sizes changed rather markedly (Figs. 2 & 3).

Feeding Areas and Utilization of Ballona Wetland

Fig. 4 shows photographs of the feeding plots in October 1990. Plot 1 (Fig. 1), consisting of 95% *S. virginica*, contained the most BSS in both the winter and summer indexes (Table 2). Plot 2, consisting of 60% *S. virginica* and 40% tidal channel had the second highest index in both winter and summer while Plot 3, away from any tidal flushing, containing 60% *S.virginica* and 40% salt flat had the lowest indexes for both winter and summer. The Ballona Creek edge (Plot 4) remained an important feeding area throughout the year.

The vegetational transect for Plot 3 is shown in Table 3. The only plant was *S. virginica*, the other categories were 'bare ground' and 'litter'.

The general feeding pattern of the BSS at Ballona in the breeding season was very difficult to observe, as any BSS other than a singing male was extremely hard to see. However, no exodus from the nesting area in the late morning occurred as it did at Anaheim Bay (Massey, 1979). It appeared that most of the feeding activity took place in the nesting area throughout the day. One to two BSS were observed flying from the nesting area or Ballona Creek to another part of the wetland (mostly to the western pickleweed fields of area B) only 5 times during the breeding seasons of 1989 and 1990. Almost all activities in the breeding season (courting, nesting, feeding, preening) took place within the general breeding area shown on Fig. 2. Within this area, feeding was more easily observed in the open areas along tidal channel/pickleweed edges, pickleweed/salt-flat edges, and along the rocks of Ballona Creek. Feeding was also observed rarely within the pickleweed, but it is apparent from the index numbers of Plot 3 (95% pickleweed) that the BSS spent most of its time there.

The onset of fall and winter brought about drastic changes in feeding and social patterns. The BSS began flocking in August and fed together in virtually every part of the nesting area, but apparently still preferred the continuous pickleweed sections. However, flocks of up to 20 BSS were repeatedly seen (on 7 different days) feeding in a small pickleweed/grass clump 25 square M in size adjacent to Plot 3.

More areas of Ballona Wetland were used in the winter for feeding than during the breeding season; on 5 different days in the fall and winter of 1989/90, 3-8 BSS feeding were observed in area A; in area B south of Culver Blvd., 3 BSS were observed in November 1989. (These areas are not shown on any of our figures.)

Banded Population

Thirty two BSS were banded, 26 in the summer and fall of 1989 (Table 4), the rest during the 1990 breeding season. Only 10 of these banded birds were seen in 1990 at Ballona (Table 5), all in the breeding area (Fig. 3). SM-MM and WR-SG were confirmed as a pair on T5, and SM-WK, KR-WS, GK-RS, SR-RR, and MK-SK were confirmed as males on T1,8,6,3, and 11 respectively. The other 3 banded birds seen were probably females; they were secretive, rarely seen and not observed singing. Determination of territory size was much clearer in 1990 when 6 were occupied by banded males; T11, a very large territory, would have been considered two were the territorial male not banded. Banding also enabled us to document the demise of SR-RR on T3, impossible without indivudually color-marked birds.

DISCUSSION

Previous population censuses of the Ballona wetlands showed 37 pairs in area B in 1977 (Massey 1977); 21, 18, and 13 in 1979-80-81 (Schreiber 1981); 32 pairs in 1986 (Zembal et al 1986); and 29 pairs in 1987 (Massey 1987). There were breeding birds on both sides of the main channel (X in Fig. 5) on all censuses. Locations of territorial males in 1987 are shown in Fig. 5. Thirteen territories were concentrated in the northeastern part of area B east of the channel Y (Fig. 5), closely comparable to the 1989-90 pattern of nesting. But there was an equal number of pairs nesting on the west side of channel X where only one pair nested in 1989.

The dredge spoil north of Ballona Creek (Area A) had 18 breeding pairs in 1979, 10 in 1980, 10-13 in 1981 (Schreiber 1981), and 5 in 1987 (Massey 1987). In the present study, no BSS were found nesting in area A. The saltmarsh vegetation has been invaded by upland weeds, apparently a result of the prolonged drought.

The breeding population in area B has shown considerable variation over the last 20 years, with the largest population in 1977 and very small numbers in 1981 and 1989-90. In 1981, standing water from heavy winter rains covered much of the salt flat, and may have impaired feeding (Schreiber 1981), thus limiting the nesting capacity.

The greatest change occurred between 1987 (29 pairs) and 1989 (9 pairs) and is thought to be the end result of lack of tidal flow and the long drought that southern California has been experiencing over the past 4 years. Much of the

Salicornia is in a dessicated state. Fig. 6 shows the contrast in October 1990 between vegetation adjacent to a channel edge (T3) where some tidal flow currently occurs and the pickleweed appears healthiest, and an area of high ground (T7) where the vegetation is struggling to survive. Fig. 6 also shows a completely exposed BSS nest in dry pickleweed as it was found in October 1990. Earlier in the breeding season this was a healthier stand of pickleweed and was part of T7 (Fig. 3). While there is nothing that can be done about rainfall, opening the tide gates on a regular basis during the winter would be salutory for the vegetation, and thus for the BSS. During the nesting season, however, tidal inundation would have to be carefully controlled so as not to impact nests.

Territory size has been documented in several other BSS studies. In Anaheim Bay, Massey (1979) documented 14 pairs in a 1-acre study plot where the habitat was considered to be optimum. The range of territory sizes was 250-375 m^2. At Camp Pendleton, Zembal (1986) found BSS densities ranging from 2.5-42 territorial males per hectare (238-4000 m^2/territory). Study plots were located in saltmarsh of variable plant composition, ranging from monotypic stands of *S. virginica* to upland edge marsh containing 9 plant species. In what was considered 'prime habitat', territory size was 540 m^2. At Ballona, we found that the smallest territory size (856 m^2) was larger than at either Anaheim Bay or Camp Pendleton. There is nothing that could be considered 'prime habitat' in the Ballona wetland.

The size, shape, and immediate location of BSS territories changed from 1989 to 1990 contrary to what Massey reported in 1979. In 1990, T1, T11, and T12 were located in areas not used in 1989 while T8 of 1989 was not used again in 1990. There was almost a complete redistribution of territorial boundaries (Figs. 2 & 3). One breeding pair was in marginal habitat which contained only isolated patches of pickleweed surrounded by saltflat (T11).

The increase in the number of BSS in the fall after the breeding season is not easy to explain, although there is documentation in other marshes of influxes of sparrows in winter (Massey, field notes). We banded 26 BSS between July and October 1989, and did not catch all birds that were present; the wintering population was estimated at 40-50. Yet with the onset of the 1990 breeding season, a maximum of 24 sparrows remained in the wetland, and only 10 individuals on 11 territories were banded. Molt patterns on 7 of the sparrows we banded indicated that they were adults; some of the others could have been first-year birds that hatched at Ballona in 1989. There were, however more wintering sparrows than can be accounted for in this way, and an influx from other marshes is the only explanation.

Red foxes are in residence at Ballona, and a den with 5 kits was located adjacent to the BSS breeding site. No interactions were observed between foxes and sparrows. However this study was not directed at examining such interactions and it is possible that foxes preyed on eggs or chicks, particularly at night when no one was watching. The role of the Red Fox as predator on the sparrows is unclear, and a study to answer this question would have to be designed with care. Location and monitoring of nests could attract foxes to them. Radiotelemetry would be the best means of determining the hunting practices of the fox. Red foxes are of such concern in California's saltmarshes that a separate study should be done on this subject.

RECOMMENDATIONS

Tidal flow should be reintroduced as soon as possible, preferably before the 1991 BSS nesting season. When the culverts have been opened, the breeding area should be monitored to determine the reach of the tide. During the nesting season the culverts should be closed during high tides to prevent flooding of nests.

A census of the BSS breeding population should be done each spring to monitor any changes that may occur.

LITERATURE CITED

Massey, B.W. 1977. A census of the breeding population of the Belding's Savannah Sparrow in California, 1977. State of CA. The Resources Agency, Dept. of Fish & Game.

Massey, B.W. 1979. Belding's Savannah Sparrow. U.jS. Army Corps of Engineers, Los Angeles District.

Massey, B.W. 1987. Census of Belding's Savannah Sparrow in the Ballona Wetlands - 1987. Report to National Audubon Society

Pacific Estuarine Research Laboratory. 1989. Research for adaptive management of Ballona Wetland. Technical Report 89-02, for National Audubon Society.

Schreiber, R. W. 1981. The biota of the Ballona region, Los Angeles County. Supplement 1, Marina del Rey/Ballona Local Coastal Plan. California Coastal Commission.

Zembal, R. 1986. A survey of Belding's Savannah Sparrows on the Marine Corps Base, Camp Pendleton, CA, 1984-85. Report to U.S. Navy, Natural Resources Mgt. Branch, San Bruno CA.

Zembal, R. & K.J. Kramer. 1986. A survey of Belding's Savannah Sparrows in California, 1986. Report to U.S. Navy, Natural Resources Mgt. Branch, San Bruno CA.

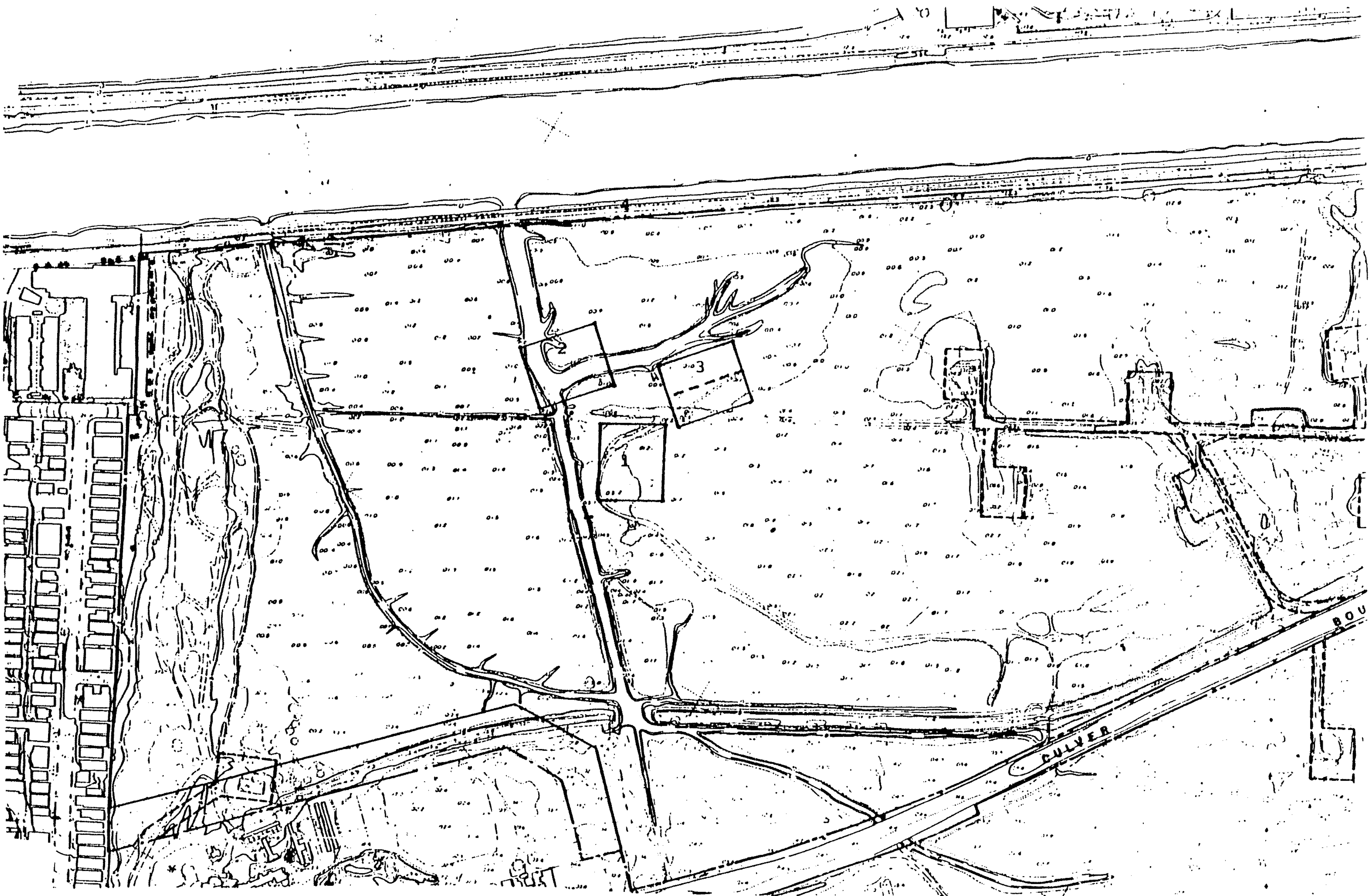


Figure 1. Area B showing feeding Plots 1-4. Vegetational transect is shown in Plot 3 as hatched line.

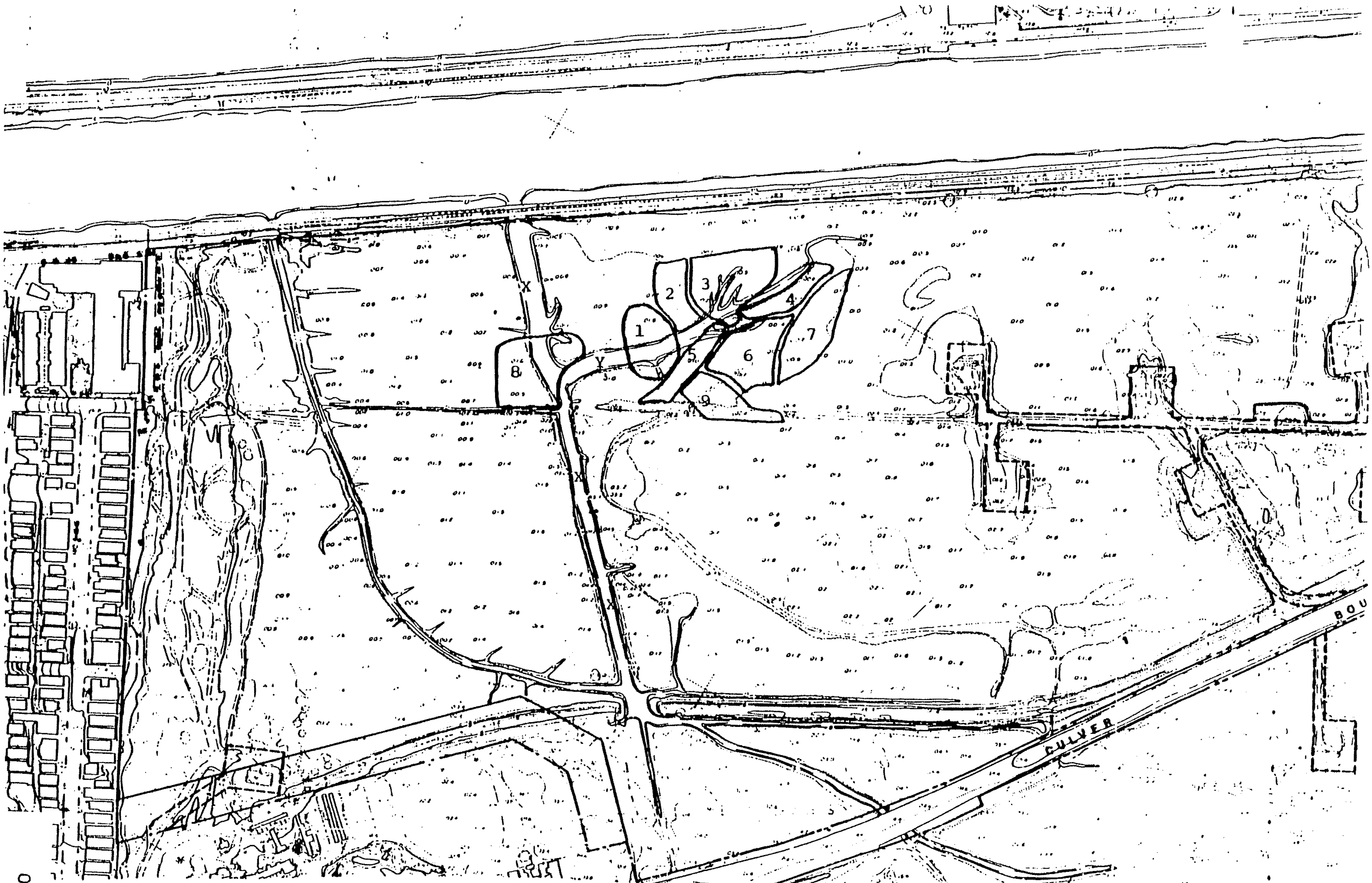


Fig. 2. Territory sizes in 1989, in square meters. T1 - 1411, T2 - 1439, T3 - 2040, T4 - 984, T5 - 1247, T6 - 2178, T7 - 1573, T8 - 2540, T9 - 1522.

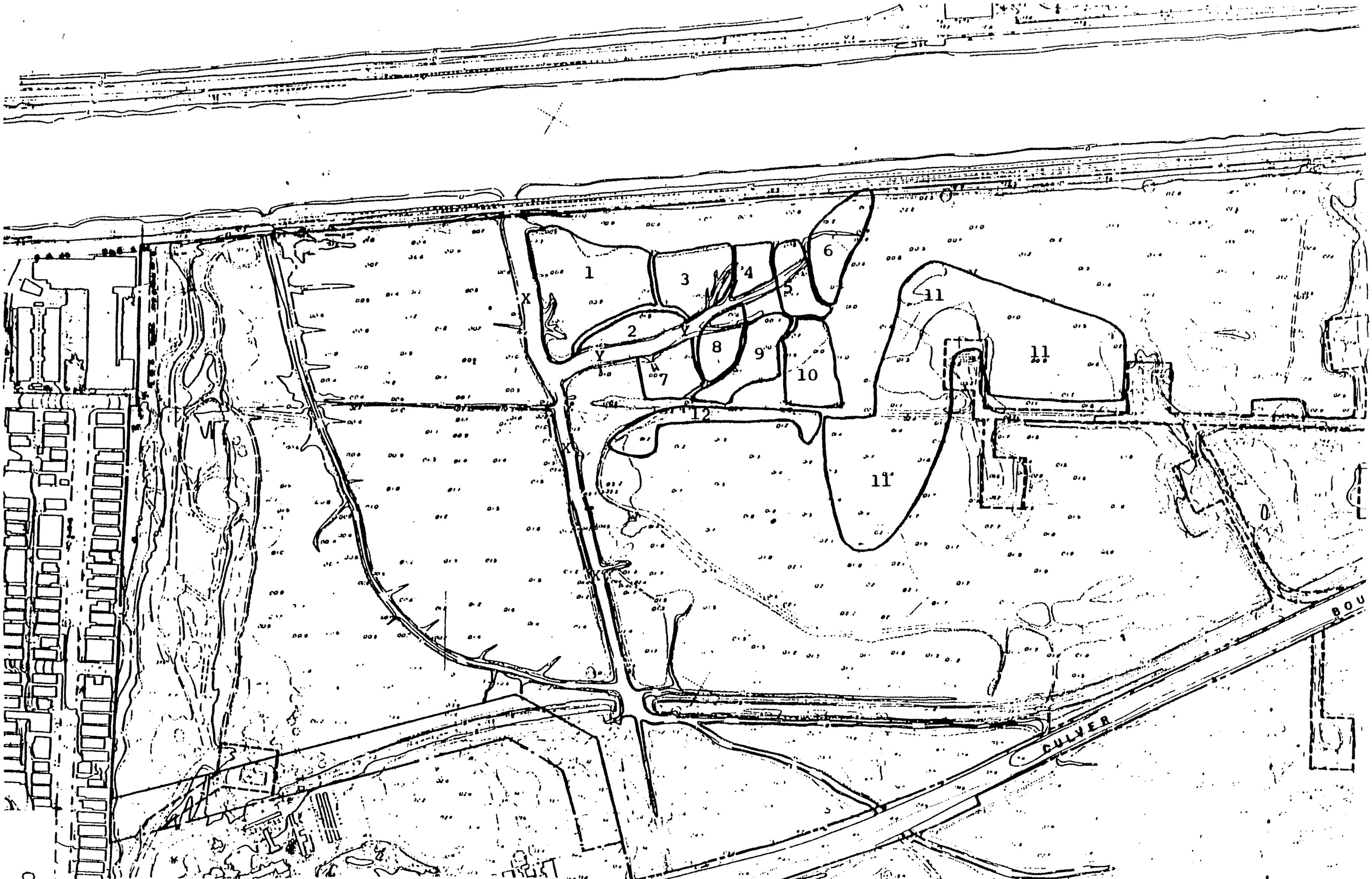
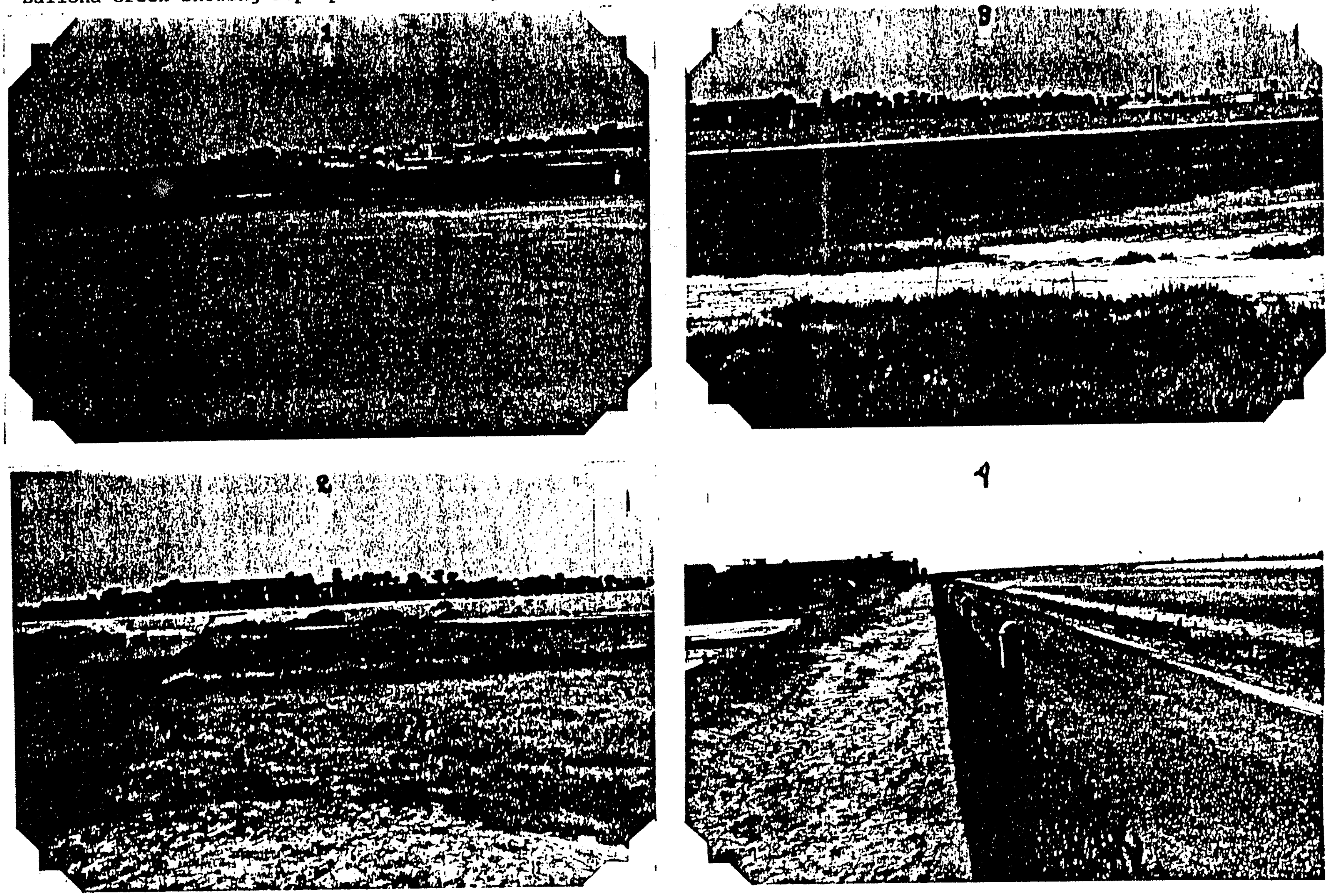
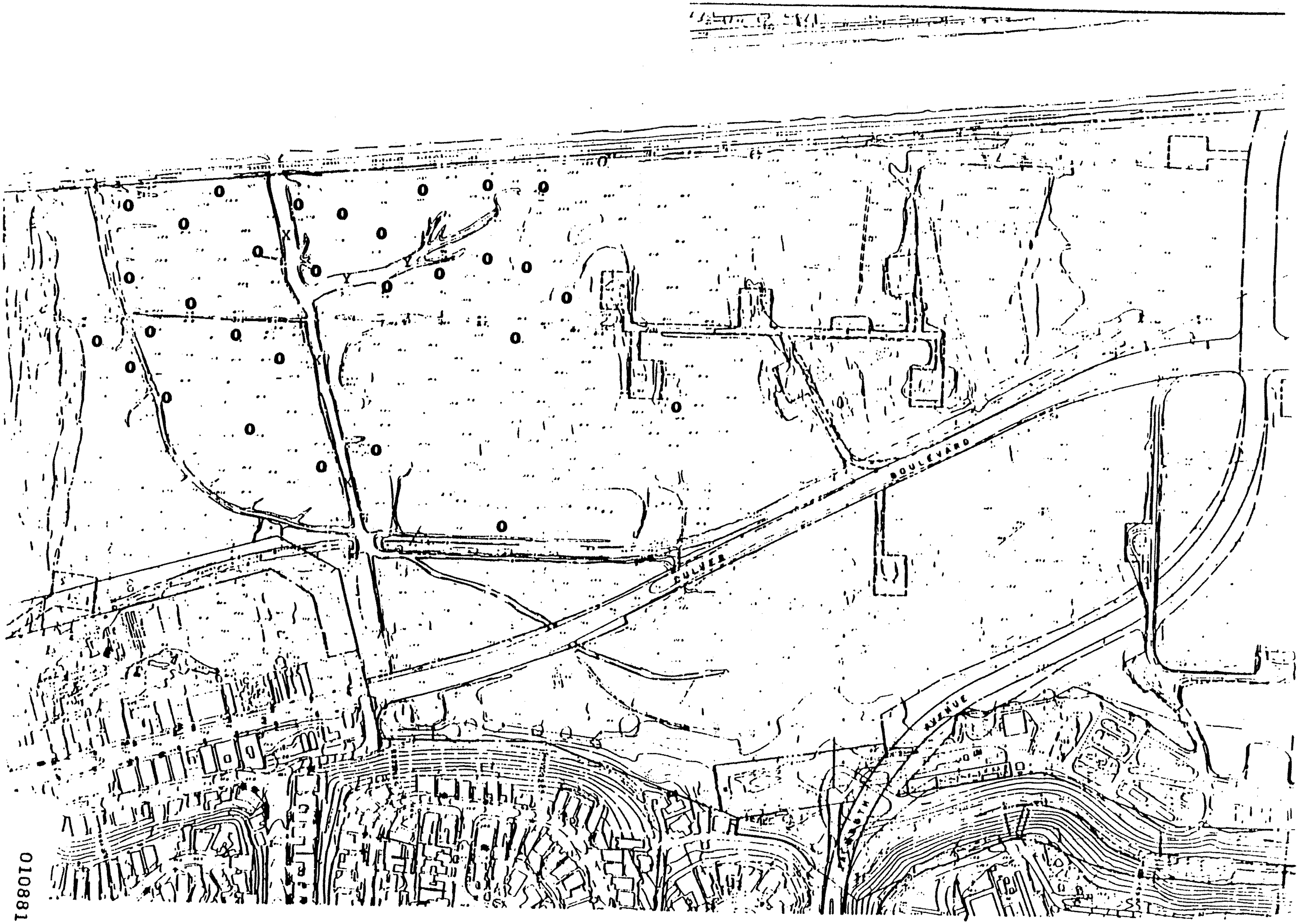


Fig. 3. Territory sizes in 1990, in square meters. T1 - 5468, T2 - 1220, T3 - 2122, T4 - 856, T5 - 1049, T6 -1682, T7 - 1583, T8 - 1779, T9 - 1654, T10 - 1994, T11 - 19081, T12 - 1506.

010879

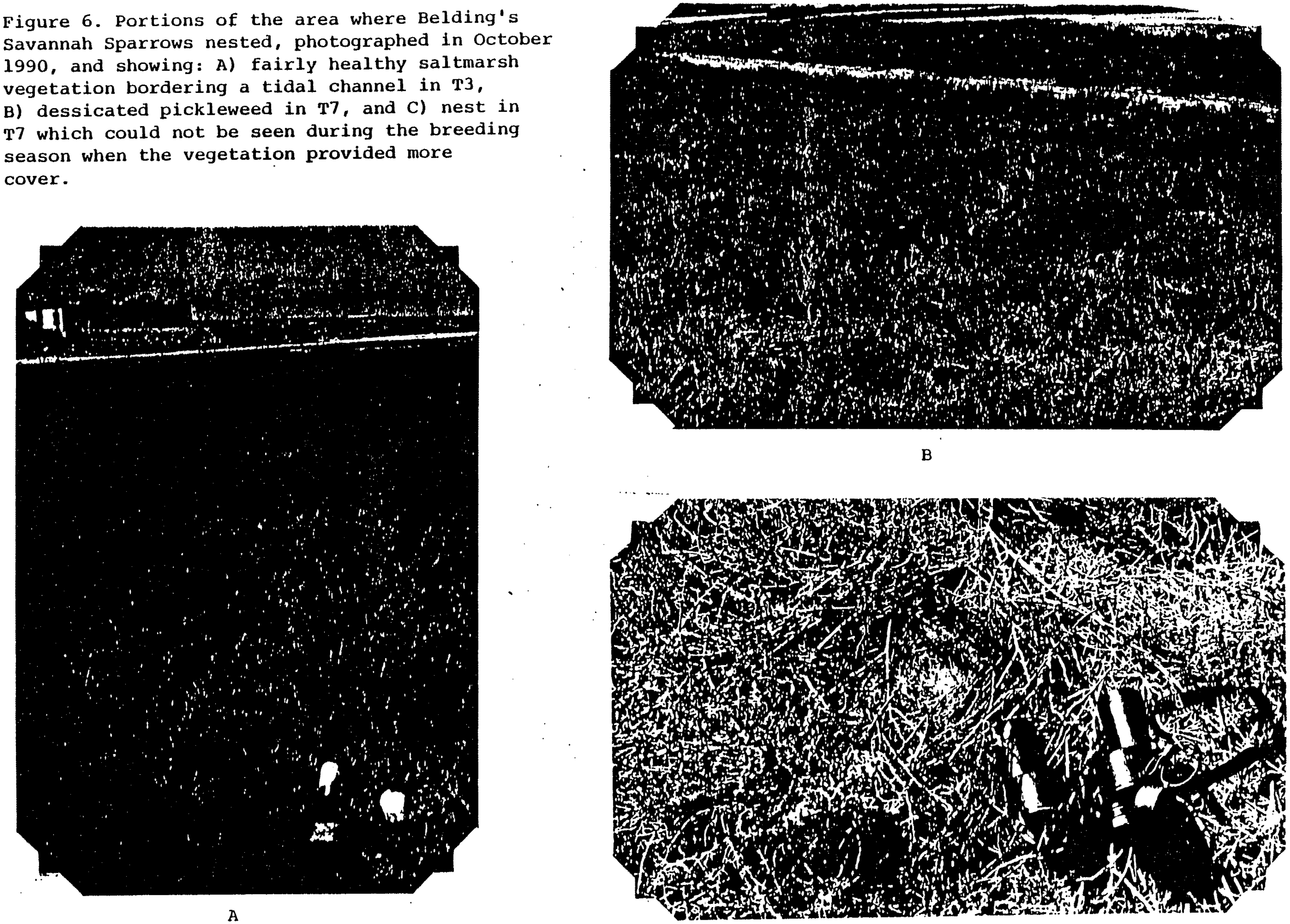
Figure 4. Photographs of the four feeding plots taken in October 1990. Plot 1) 60% pickleweed, 40% saltflat; Plot 2) 60% pickleweed, 40% tidal channels; Plot 3) 95% pickleweed, 5% saltflat; Plot 4) south edge of Ballona Creek showing riprap where Belding's Savannah Sparrows fed.





Figur BSS census of Ballona wetlands, April 1987, showing locations of 30 territorial males.

Figure 6. Portions of the area where Belding's Savannah Sparrows nested, photographed in October 1990, and showing: A) fairly healthy saltmarsh vegetation bordering a tidal channel in T3, B) dessicated pickleweed in T7, and C) nest in T7 which could not be seen during the breeding season when the vegetation provided more cover.



A

B

C

Table 1. Territory sizes for 1989 and 1990 in square meters.

T	1989	T	1990
1	1411	1	5468
2	1439	2	1220
3	2040	3	2122
4	984	4	856
5	1247	5	1049
6	2178	6	1682
7	1522	7	1583
8	2540	8	1779
9	1573	9	1654
-		10	1994
-		11	19081
-		12	1506

Table 2. 1990 summaries of winter and summer index counts for BSS in Plots 1, 2, 3, and 4. Thirty six one minute surveys were conducted for each plot and Ballona Creek in each season.

	NUMBER OF SIGHTINGS	
Plot	Winter	Summer
1	19	12
2	37	48
3	49	71
4	26	28

Table 3. Data from vegetation transect in Plot 3.

	LINE TRANSECT			CIRCLE
	live *Salicornia* (cm)	bare ground (cm)	litter (cm)	% cover
0- 5M	0	75	425	70%L, 30%B
5-10M	0	10	490	85%L, 15%B
10-15M	0	0	500	95%L, 5%B
15-20M	0	120	380	100%L, 0%B
20-25M	0	310	190	60&L, 40%B
25-30M	0	420	80	5%L, 95%B
30-35M	0	100	400	70%L, 30%B
35-40M	62	40	392	95%L, 5%B
40-45M	150	40	310	35%L, 65%S
45-50M	180	0	320	75%L, 25%B
50-55M	160	20	320	45%L, 15%B, 40%S
55-60M	200	0	300	5%L, 20%B, 75%S
60-65M	60	60	380	60%L, 20%L, 20%S
65-70M	150	30	320	90%L, 10%B
70-75M	250	0	250	100%L, 0%B
75M				25%L, 75%S

TABLE 4. BANDING DATA

BAND NUMBER	COLOR CODE	1ST BANDED	# RECAPS	MOLT	SEX
970 67001	RW-GS	7/27/89	1		
67002	KS-GW	7/27/89			
67003	WK-SG	8/03/89			
67004	WR-GS	8/03/89			
67005	RW-KS	8/03/89			
67006	WR-SG	8/05/89	1		
67007	KG-SR	8/05/89			
67008	KR-WS	8/05/89	1	+	M
67009	SK-GW	8/05/89			
67010	WK-KS	8/05/89			
67011	WR-RS	8/05/89			
67012	MB-KS	9/02/89			
67013	SM-WK	9/02/89		+	M
67014	bK-SG	9/02/89		+	
67015	RB-SB	9/02/89			
67016	KM-BS	9/02/89		+	
67017	GS-MB	9/02/89			
67018	BS-RG	9/02/89			
67019	bG-MS	9/02/89		+	
67020	MR-SB	9/02/89			
67021	Wb-SR	9/02/89			
67022	Sb-MB	9/02/89		+	
67023	Sb-RB	9/02/89			
67024	GB-WS	9/02/89		+	
67099	GK-RS	8/05/89	1		M
67100	KG-RS	7/27/89			
67025	NONE	2/27/90			
67026	MR-SG	2/27/90			
67027	SR-GK	2/27/90			
67028	SM-MM	3/03/90			M
67029	SR-RR	4/15/90			M
67030	MK-SK	5/28/90			M

Table 5. Banded B.S.S. observed in the field. Color combination, date of banding (in bold type), and dates the bird was observed in the field are given.

RW-GS	SM-WK	KR-WS	SK-GW	WR-SG	GK-RS	MB-KS	SM-MM	SR-RR	MK-SK
7/28/89	**8/05/89**	**8/05/89**	**8/05/89**	**8/05/89**	**9/02/89**	**9/02/89**	**3/03/90**	**4/15/90**	**5/28/90**
11/13/89	03/09/90	03/09/90	03/05/90	03/09/90	03/03/90	11/13/89	03/05/90	04/28/90	06/02/90
05/01/90	04/28/90			03/30/90	03/05/90		03/30/90	05/16/90	06/19/90
	07/02/90			04/15/90	03/09/90		06/12/90		06/20/90
	07/10/90			04/28/90	04/28/90		07/02/90		07/02/90
				06/07/90	05/01/90				07/10/90
				06/12/90	05/16/90				
				06/19/90	06/12/90				
				07/02/90	06/19/90				
				07/24/90	06/26/90				
					07/02/90				
					07/10/90				
					07/24/90				

Table 1. Territory sizes for 1989 and 1990 in square meters.

T	1989	T	1990
1	1411	1	5468
2	1439	2	1220
3	2040	3	2122
4	984	4	856
5	1247	5	1049
6	2178	6	1682
7	1522	7	1583
8	2540	8	1779
9	1573	9	1654
-		10	1994
-		11	19081
-		12	1506

Table 2. 1990 summaries of winter and summer index counts for BSS in Plots 1, 2, 3, and 4. Thirty six one minute surveys were conducted for each plot and Ballona Creek in each season.

	NUMBER OF SIGHTINGS	
Plot	Winter	Summer
1	19	12
2	37	48
3	49	71
4	26	28

Table 3. Data from vegetation transect in Plot 3.

	LINE TRANSECT			CIRCLE
	live *Salicornia* (cm)	bare ground (cm)	litter (cm)	% cover
0- 5M	0	75	425	70%L, 30%B
5-10M	0	10	490	85%L, 15%B
10-15M	0	0	500	95%L, 5%B
15-20M	0	120	380	100%L, 0%B
20-25M	0	310	190	60&L, 40%B
25-30M	0	420	80	5%L, 95%B
30-35M	0	100	400	70%L, 30%B
35-40M	62	40	392	95%L, 5%B
40-45M	150	40	310	35%L, 65%S
45-50M	180	0	320	75%L, 25%B
50-55M	160	20	320	45%L, 15%B, 40%S
55-60M	200	0	300	5%L, 20%B, 75%S
60-65M	60	60	380	60%L, 20%L, 20%S
65-70M	150	30	320	90%L, 10%B
70-75M	250	0	250	100%L, 0%B
75M				25%L, 75%S

TABLE 4. BANDING DATA

BAND NUMBER	COLOR CODE	1ST BANDED	# RECAPS	MOLT	SEX
970 67001	RW-GS	7/27/89	1		
67002	KS-GW	7/27/89			
67003	WK-SG	8/03/89			
67004	WR-GS	8/03/89			
67005	RW-KS	8/03/89			
67006	WR-SG	8/05/89	1		
67007	KG-SR	8/05/89			
67008	KR-WS	8/05/89	1	+	M
67009	SK-GW	8/05/89			
67010	WK-KS	8/05/89			
67011	WR-RS	8/05/89			
67012	MB-KS	9/02/89			
67013	SM-WK	9/02/89		+	M
67014	bK-SG	9/02/89		+	
67015	RB-SB	9/02/89			
67016	KM-BS	9/02/89		+	
67017	GS-MB	9/02/89			
67018	BS-RG	9/02/89			
67019	bG-MS	9/02/89		+	
67020	MR-SB	9/02/89			
67021	Wb-SR	9/02/89			
67022	Sb-MB	9/02/89		+	
67023	Sb-RB	9/02/89			
67024	GB-WS	9/02/89		+	
67099	GK-RS	8/05/89	1		M
67100	KG-RS	7/27/89			
67025	NONE	2/27/90			
67026	MR-SG	2/27/90			
67027	SR-GK	2/27/90			
67028	SM-MM	3/03/90			M
67029	SR-RR	4/15/90			M
67030	MK-SK	5/28/90			M

Table 5. Banded B.S.S. observed in the field. Color combination, date of banding (in bold type), and dates the bird was observed in the field are given.

RW-GS	SM-WK	KR-WS	SK-GW	WR-SG	GK-RS	MB-KS	SM-MM	SR-RR	MK-SK
7/28/89	**8/05/89**	**8/05/89**	**8/05/89**	**8/05/89**	**9/02/89**	**9/02/89**	**3/03/90**	**4/15/90**	**5/28/90**
11/13/89	03/09/90	03/09/90	03/05/90	03/09/90	03/03/90	11/13/89	03/05/90	04/28/90	06/02/90
05/01/90	04/28/90			03/30/90	03/05/90		03/30/90	05/16/90	06/19/90
	07/02/90			04/15/90	03/09/90		06/12/90		06/20/90
	07/10/90			04/28/90	04/28/90		07/02/90		07/02/90
				06/07/90	05/01/90				07/10/90
				06/12/90	05/16/90				
				06/19/90	06/12/90				
				07/02/90	06/19/90				
				07/24/90	06/26/90				
					07/02/90				
					07/10/90				
					07/24/90				

Appendix J-9: Ballona Wetlands/Playa Vista Biota • Amphibians, Reptiles and Mammals

---

Frank Hovore and Associates

BALLONA WETLANDS/PLAYA VISTA DEVELOPMENT
DRAFT ENVIRONMENTAL IMPACT REPORT
BIOTA • AMPHIBIANS, REPTILES AND MAMMALS

INTRODUCTION

This report summarizes approximately one year of field studies of the amphibian, reptile and mammal populations of the Ballona wetlands system, Playa del Rey, Los Angeles County, California. The primary purposes for these studies was to provide updated information concerning the existing conditions of these organisms in the wetlands and adjacent habitats, and to summarize these conditions within the Playa Vista project environmental documents. The information given regarding the current status of small vertebrate populations in the system is supplemental to that contained in *The Biota of the Ballona Region, Los Angeles County* (1981, Schreiber et al) report on the system. It should be noted, however, that the present report differs in its overall scope, encompassing areas within the Playa Vista project which were not investigated by earlier teams, but not reiterating historical and general information contained therein.

In total, the Playa Vista project calls for the removal of native and disturbed ecosystems over all of the 1004.8 acreas within sections labelled Areas A, B, C, and D, except for ± 180 acres of pickleweed-dominated wetlands in area B. Area A would be developed into a marina complex, while other sections would become residential and commercial complexes of varying densities.

Based upon requests for information from biota team coordinators, major emphasis in field studies and preliminary reports was given to Phase One of the Playa Vista project. This phase would remove all existing terrestrial habitats outside the ± 180 acre saltmarsh wetlands, including open fields dominated by ruderal ("weedy, largely non-native") growth and scattered elements of coastal sage scrub. A few small areas of saltmarsh wetland vegetation (not part of any tidally-flushed wetlands) and degraded riparian habitat (freshwater-supported) would also be eliminated by the project. Proposed mitigations for these losses include the creation of a narrow revegetated riparian corridor along a realignment of Centinela Creek (intended to function as a flood control channel) and a small freshwater marsh habitat (within and surrounding the catchbasin at the west end of the channel).

A significant corollary of the development project is the protection of the tidally-flushed saltmarsh wetland in Area B, restoration of which is part of the agreed-upon mitigations. The differing values and potential of partial and full tidal flushing of these habitats are discussed from the perspective of the herpetofauna and mammals on the site.

Numerous preliminary reports were submitted to the team coordinators during the field study period (March 1990 to March 1991). These reports discussed and summarized findings, and are reiterated herein as appropriate.

PROJECT AREA

The proposed Maguire Thomas Partners Playa Vista residential project encompasses the remaining undeveloped natural and disturbed vacant areas collectively known as "Ballona Wetlands." Overall, the project area includes tidally-flushed (historically) saltmarsh, relictual coastal dune remnants, Centinela Creek freshwater channel, former agricultural fields, and disturbed uplands with existing manufacturing complexes, ruderal graded areas, recreational facilities, and naturalized habitats on dredging spoils.

If fully-developed, the Playa Vista project will alter the natural and invasive habitat formations and resources on all lands east of Lincoln Boulevard (areas "C" and "D"), and all lands north of Ballona Channel (including area "A," west of Lincoln). A narrow corridor of re-created riparian vegetation will line the runoff channel to be constructed along the base of the Westchester bluffs below Loyola Marymount University. Area B (west of Lincoln, between the bluffs and Ballona Channel), consisting of fallow agricultural fields, dune and wetland habitats, transected by Culver Boulevard, will be protected by a separate saltmarsh mitigation/restoration program, with the extreme eastern portion (adjacent to Lincoln) used to create a freshwater mitigation system.

Project impacts will be discussed as follows: effects of residential development on areas A, C, and D; effects of mitigation programs on areas B and C; effects of tidal flushing programs on saltmarsh habitats in Area B; cumulative impacts. Where mitigations involve habitat restoration, re-creation or enhancement, impacts will be assessed as regards biotic differences between existing natural systems (to be lost or altered) and the proposed new systems. Sensitive species impacts and changes in, or loss of, habitat will be particularly important. Also, the type and quality of habitat lost is of importance in assessing project impacts and net benefits of mitigations.

PREVIOUS STUDIES

The last comprehensive survey of the flora and fauna of the Ballona system was*The Biota of the Ballona Region, Los Angeles County*, which provided a compilation of field studies on component groups within the biota, with each section authored independently by one or more specialists. Although most of these studies were conducted through all seasons over one or more years, the sections vary in levels of detail, methodologies and objectives. Overall, this report comprised an adequate understanding and analysis of the flora and fauna of the site at that time, and is the data baseline against which new information is assessed.

Reptiles and amphibians were investigated by M. P. Hayes and C. Guyer, who summarized existing literature on the Ballona herpetofauna, and provided maps and narratives for all species found. Their methodologies consisted primarily of direct field observations and collections. Their data adequately documented the nature and diversity of the fauna, as well as behavior, diet, phenology, reproductive cycles and relative abundance of each species found. At that time, species diversity of both amphibian and reptiles was relatively high, but with certain organisms restricted to narrow ecological zones, or existing only in low population densities. No further studies specifically of the Ballona system herpetofauna have been published, although several local schools apparently continue to collect or search for amphibians and reptiles in the area (C. R. Carter, pers. comm., 1990).

Mammals were studied by R. D. Friesen, W. K. Thomas and D. R. Patten, who completed a total of 2,005 trapnights on the property, surveying in all major ecological subdivisions south of Ballona channel. Trap results were supplemented by field observations, compilations from existing literature, and specimen records from institutional collections. Their work contrasted in part with that performed one year earlier by Envicom (in *Environmental Profile of the Playa Vista Master Plan Area*, report by Jones and Stokes), in reporting slightly different trapping results, species identifications and/or distributions. Overall, they listed 19 species of mammals residing or foraging within the wetlands habitats, of which 6 were introduced (=non-native). As many as 20 other species were known or suspected to have at one time utilized the area, but no longer could be shown to persist on site. The decline or elimination of some species was historical, having occurred as a consequence of initial developments in the area, or as a consequence of the channelization of the water systems. Other species may have been extirpated more recently, either directly (by hunting or competition by non-native species), or from habitat degradation, reduction or loss.

Studies or reviews produced for the Ballona habitat restoration program since the 1981 Schreiber report include the *Ballona Wetland Habitat Management Plan* (National Audubon Society, by Shapiro & Associates, 1986), which discussed the herpetofauna or mammals only as part of larger ecosystem concerns; and several documents produced by the Pacific Estuarine Research Laboratory [PERL], including: *Research for Adaptive Management of Ballona Wetland*, Tech. Rpt. 89-02, 1989; a Spring 1990 Progress Report; and *The Functioning of Ballona Wetland in Relation to Tidal Flushing; Part I -- Before Tidal Restoration*, 1991. These reports focused on ecosystems, marine and terrestrial invertebrates, and birds, but did not specifically discuss amphibians, reptiles or mammals (except red foxes, in the 1991 report).

During the past 10 years, the State of California, Department of Fish and Game (CDFG), and U.S. Fish and Wildlife Service (USFWS) have enacted statutes or adopted resolutions changing the legal or protected status of some Ballona wetlands organisms. Of the amphibians, reptiles and mammals known to occur, or believed to have occurred historically on site, 4 mammals, one lizard, and one turtle are listed by the state of California, as Species of Special Concern (CDFG), "Special Animals" (Natural Diversity Data Base, 1990), or candidate species for federal listing as threatened or endangered. Of these, only two (Southern California salt marsh shrew and southern marsh harvest mouse) are known to persist today in the Ballona system (*sensu latu*), and one of these (the mouse) was recently synonymized within a more widespread taxon (George, 1991). This synonymy effectively removes the subspecies from all listings (state and federal) by virtue of its no longer being recognized as a distinctive or isolated population.

No other reptile or mammal taxa listed in the 1981 Schreiber report have been synonymized or otherwise reduced in status. Four of the six protected-status organisms are so listed as subspecies, occurring at the species level over broader ranges or in other, separate populations. Williams (1986, *Mammalian Species of Special Concern in California*) discusses the taxonomic status and ecological requirements of sensitive mammals in southern California estuarine habitats.

METHODS AND RESULTS

Since the March, 1990, FH&A biologists have conducted numerous separate surveys of the wetlands and surrounding coastal sage scrub habitats, with emphasis given to sensitive species, and to locating and censusing all naturally-occurring reptile and mammal populations. All portions of Areas A, B, C, and D were investigated, and trap placements were situatied to cover all potential natural habitats. Literature reviews and searches of computerized and handwritten field notes from other local researchers and institutions were conducted. Agency contacts (ie. Calif. Fish and Game, U.S. Fish and Wildlife Service) were established to obtain information concerning the status of selected species on and off the property, and to assist in analyzing the effects of red fox predation on the Ballona ecosystem.

Mammal trapping utilized Sherman extra-long aluminum box-style live traps, subjectively placed in potential small mammal habitats along linear transects or on measured intervals along conventional traplines. Nearly 1,000 trapnights were accumulated, and all areas were also surveyed visually during the day. Techniques employed followed standards developed over many years of censusing rodents and other small vertebrates in wetlands and other habitats.

Reptiles and amphibians were surveyed opportunistically by turning sheltered microsites (beneath debris), placing "trap boards" in specific habitats, sifting dune sand, listening for nocturnal calling (frogs), flashlight searching, can seining, and visually searching suitable habitats. Methodologies also incorporated those recommended by Corn, P.S. and R.B. Bury (1990, *Sampling Methods for Terrestrial Amphibians and Reptiles*, USDA Forest Service PNW-GTR-256, 34 pp.). Pitfall trap records were supplied by R. Mattoni, from a system of shallow bowl traps set for arthropods.

Field investigators included FH&A biologists F.T. Hovore, M.C. Long, and M. Kouba; additional field information was supplied by C. R. Carter and D. Soltz of the biota team. Capture and release of reptiles and mammal trapping was conducted under California State Department of Fish and Game permits #0073 (Hovore, exp. 1991), #1312 (Kouba, exp.1991) (both renewed through 1993).

Report of Surveys: Reptiles and Amphibians

Extensive ground surveys for amphibians and reptiles were made over the entire project site and into adjacent coastal sage habitats. Reptile populations, while limited in species diversity, are relatively high in individual numbers, in part due to their adventitious use of unnatural non-saline habitats such as exist in Areas A and D. Amphibians populations appear to be extremely low, and only one treefrog and three slender salamanders were found in normal habitats. Western toad tadpoles were seen or reported in seasonal accumulations of fresh water in Area D. While, comparisons of present amphibian and reptile abundances with those reported in the Schreiber report must be cautiously drawn (due to subjective differences in survey methodologies, and changing environmental and non-natural factors), some obvious inferences may be made.

Ballona's original tidally-inundated saltmarsh habitats probably did not support many-- if any-- of the species which now occur over the area, as most of the fauna presently consists of typically terrestrial or freshwater-dependent organisms. Species distributions and habitat preferences therefore correspond to existing unnaturally-created (but naturalized in surface character) habitats, and are arrayed rather incongruously over the property. For example, highest reptile numbers occur along gas line service levees and in the attendant debris piles, while lowest use areas are the relatively undisturbed pickleweed (*Salicornia*) stands and saltflat hardpan. Amphibians would not normally occur in saline or even brackish water systems, and so the increased amounts of surface freshwater habitats following the exclusion of tidal flushing have favored their spread and permitted elevated population densities. During the study period, however, the quality and salinity of surface water flows has been rapidly changed by environmental and disturbance factors, with a resulting decline in amphibians. During the drought conditions which prevailed through the winter of 1990/1991, the "freshwater" channels in Area B were hypersaline, a condition which may have been caused by low inflow rates and dissolved soil salts. In fall, 1990, a massive discharge of street runoff was directed into Centinela channel, flushing much of Area B with freshwater of unknown chemistry. The net effects of these hydrölogical changes has not yet been determined, but in all probably the alternation of saline and fresh waters in such a short time span probably served to eliminate most amphibians in the affected areas.

Hayes and Guyer (in Schreiber, 1981) found two snake species, the common kingsnake, *Lampropeltis getulus californiae*, and San Diego gopher snake, *Pituophis melanoleucus annectens*, to be relatively abundant in the Ballona wetlands. We encountered these same two species in roughly similar numbers to their findings, and over a similar range of habitats (in comparable areas). Gopher snakes were equally abundant in Area A, and the two species (which typically inhabit a broad range of communities, feeding on a spectrum of smaller vertebrates) appear to be reproducing successfully in the larger tracts of land, whatever their surface character. It must be pointed out, however, that abundance estimates for many reptiles and amphibians are directly related to the amount of human debris under which to search (this was particularly true in the spring months), and it is therefore also probable that population densities are in part positively correlated to human disturbance in the area.

Most snake specimens found were subadult or adults, of potential breeding size. All individuals were scarred, and the largest kingsnakes (> 120 cm overall length) and gopher snake (±150 cm) all had broken tails, or had the terminal few cm missing. This scarring may have been caused by human attempts to injure or kill these reptiles, but appeared consistent with wounds inflicted by predators, possibly birds, but probably red foxes. No other species of snakes were found or reported.

Alligator lizards (*Elgaria* [=*Gerrhonotus* auct.] *multicarinatus webbi*) were encountered in relative abundance in the same areas and under the same circumstances as reported by Hayes and Guyer, but most specimens found were juveniles or small adults, and nearly all (about 90% where positive identification of individuals assured no duplication of records) were missing portions of their tails. This, combined with the scarring noted above on the snakes, suggests active predation by foxes or other species; when disturbed, alligator lizards characteristically seek cover under low vegetation or debris, often thrashing their tails behind them in a distraction display. Alligator lizard belly scales were found in a fox scat on the Hastings Canyon terrace.

Fence lizards (*Sceloporus occidentalis biseriatus*) remain the most abundant reptile species in all sites surveyed, but their densities and distribution are clearly related to the presence of debris or elevated habitats within wetlands formations. The areas of greatest abundance are along the margins of the elevated service levees for the gas lines on the northwest side of Culver Blvd. Terrestrial invertebrates in these areas are primarily non-native or disturbed habitat taxa such as isopods, snails and black widow spiders, and abundances beneath debris are extreme. The high number of alligator and fence lizards in these disturbed habitats is probably directly correlated to the elevated densities of these few prey items.

Side-blotched lizards (*Uta stansburiana*) are found in much lower frequencies in the project area, and occur regularly only in drier habitats away from the wetlands. They have not proliferated along the disturbed levee habitats, probably due in part to competition and/or predation by *Elgaria* and *Sceloporus*, but in general due to their preference for open, sandy substrates. This observation corresponds with the findings of Hayes and Guyer, although no census of individual numbers was undertaken by us. The greatest numbers of *Uta* occur on the Hastings Canyon alluvial fan, on the bluff faces, and in Area A.

The silvery legless lizard (*Anniella p. pulchra*), a City of Los Angeles sensitive species, occurs sporadically over the area, wherever fine-grained sandy substrates permit its burrowing habits. Numerous individuals of all sizes were encountered beneath debris in the relict dunes, and one individual was found high on the bluff face just west of Lincoln. Hayes and Guyer recorded it from a small alluvial fan at the base of the bluffs in the western portion of Area B. Excavations for this species beneath iceplant and other non-native vegetation along the dune margins were unsuccessful (FH&A, report to Ballona team, 1990).

Only one adult treefrog was seen along the riparian corridor in area D, and none were located in the marshes in area B, and no evidence of larval forms was found by can seining the canal south of the McDonell-Douglas gate. Channels in Area B which Hayes and Guyer noted as containing treefrogs (*Hyla regilla*) in abundance were hypersaline in July, 1990, and no evidence of amphibians was found in this area. Tadpoles (probably western toad, [*Bufo boreas halophilus*]) were reported from seasonal freshwater accumulations in area D in June, but this habitat was entirely dry by month's end, and no verification of species was obtained. Nocturnal surveys encountered no frogs or toads, and none were heard calling either diurnally or nocturnally, in conditions ranging from relatively warm and breezy to cool with misting rain.

Although crayfish are relatively common in Centinela channel through area D, few aquatic invertebrates occur in the waters (other than mosquito larvae). Full channel seine net surveys were conducted in conjunction with fish and invertebrate sampling (by D. Soltz and C. Carter), and in all of Area B, where water systems have high salinity, neither amphibians or freshwater aquatic invertebrates were found. Further, according to information given in the PERL report (1991, p. 15), Mosquito Abatement District workers sprayed oil into some of the water systems in area B, and dug ditches to eliminate standing freshwater; if this occurs regularly, it would further lower or eliminate reproductive success by amphibians in open water systems. In all probability, the extremely low amphibian populations in the Ballona wetlands area are directly attributable to a combination of drought effects, human disturbances, and irregularly changing water quality and salinity of the freshwater channel systems.

The garden slender salamander (*Batrachoseps pacificus major*) was encountered in low numbers in Area A (where it was also found by Hayes and Guyer), where it occurs under debris and in natural litter accumulations beneath laurel sumac and other large shrubs. This species has an unusually long adult life (J. Wright, LACM, pers. comm.), and may persist in an area beyond the point at which habitat changes induce general reproductive failure. Size ranges in the individuals found in Area A appeared to represent both juvenile and adult stages, and it is presumed that the species is successfully breeding on site.

Of the 9 amphibian and reptile species recorded by Hayes and Guyer in 1981, all are still in existence in the Ballona system, although the relative abundance of frogs and toads appears to be greatly reduced. Distributions of snakes and lizards correspond to those given in their report for areas A and B, and we found the same species to occur in Area D as well. No snakes or amphibians were found in Area C, and lowered densities in this area would be a reflection, no doubt, of its more heavily-disturbed nature and relative isolation. At least western toads would be expected to occur in this habitat given sufficient standing water systems for breeding.

Mammals

A total of nearly 1,000 trapnights were run in a series of transects covering all habitats and areas of the property. Trapping was hindered somewhat by the presence of large numbers of transients living in Areas A and B during spring, 1990, and on several occasions traps were disturbed or stolen. Argentine ants fouled entire traplines in sections of Area C, and red foxes (*Vulpes vulpes*) (or domestic pets) chewed on or otherwise disturbed or relocated several traps. The intent of the surveys were to establish presence or absence of species in an area or habitat, rather than to repeatedly census populations. This is because no sensitive small mammal species readily censused in standard traps occur on the project site; and population activity of selected species (such as voles) can be assessed visually once presence has been determined. The Southern California salt marsh shrew (*Sorex ornatus salicornicus*), a California Species of Special Concern is best censused by pitfall trapping, a method which often results in the death of the specimen, and which requires a Memorandum of Understanding from the Department of Fish and Game. R. Mattoni used a systematic pitfall trap array over all of Area B, sampling invertebrates, and did capture a single specimen of the shrew.

Very few rodents were taken during the year of trapping conducted, with most captures being western harvest mice (*Reithrodontomys megalotis longicauda*) and house mice (*Mus musculus*), the latter being relatively widely-distributed in and around disturbed areas or unnatural habitats (ie. gas levees). Less-common species such as the California vole (*Microtus californicus stephensi*) and dusky-footed woodrat (*Neotoma fuscipes macrotis*) may have been more abundant or widespread over the site at one time, but both now appear restricted to specific isolated habitat types. The vole in particular would be susceptible to red fox predation, and only two specimens were recorded during 1990/1991, one from Area A and one a pitfall trap in an isolated willow-wetland along the bluff base in Area B (R. Mattoni, pers. comm.). Rabbit and squirrel populations were very low in the area during survey dates, despite abundant fecal and burrow evidence of past occurrence. Overall, the ratio of trapping success was well below that of all earlier surveys, and almost all small mammal populations appear to be declining.

Pocket gophers (*Thomomys bottae* ssp) remain abundant in all elevated or dry habitats, and are the only rodents identified from over 150 fox scats. Raccoon (*Procyon lotor psora*) tracks were seen on both sides of Culver in area B, and opossum (*Didelphis v. virginiana*) tracks were found on the south side of Culver. Both opossum and striped skunk (*Mephitis mephitis holzneri*) carcasses were seen on Lincoln and Culver boulevards during spring, 1990. Raccoon, opossum and striped skunk have all become "urban animals" in southern California, successfully reproducing in attics, crawl spaces, street drains and other similar sites. Thus they would be expected to persist in or reinvade Ballona over time, regardless of negative changes in habitat quality. The longtailed weasel (*Mustela frenata latirostra*) was reported from a skull fragment by Friesen et al., and it may yet persist in low numbers, feeding and hiding in gopher burrows.

Eastern red foxes are abundant over all areas, especially Areas A, B and D. Their point of introduction is speculative, but the single individual gray foxes reported in 1981 by M. Hayes and by Envicom (both records are listed in the Schreiber report, p. M28-29) may actually have been for red foxes. No other holocene records of gray foxes for this area have been seen by us, and none were found by Friesen et al., although it is reasonable to assume that the native fox species once occurred in this area.

The PERL group surveyors reported seeing foxes in all of their sites (1991, p. 53) during nearly all months of the year; their numbers probably reflect at most a small sampling of the actual fox population density. Active fox burrows were found in several sections in the northwestern portion of Area B, on the bluffs east of Hastings Canyon, and on Westchester bluffs below Loyola-Marymount University. In Area B, red fox pathways form extensive networks through the *Salicornia*, the intersections clearly marked with scats, fur and musk. Surface digging (for rodents and crabs) is evident everywhere, and the dismembered carcasses of dozens of shorebirds and seabirds were found in Area B. Fox scats (± 100) examined in spring months contained bird feathers (from gulls, terns, egrets, several duck species, undetermined songbirds, and great blue heron), crab parts, gopher bones, small amounts of fur (including domestic cat), vegetable matter, and rubber bands, apparently from golf ball centers. Examination of over 150 scats in summer and fall, however, had reduced rodent materials (all gopher), and bird feathers increased in frequency of appearance, along with crustacean exoskeletons (mostly crabs), vegetable matter and inorganic debris (including more golf balls). Raccoon scats examined (± 20) consistently contained only crab or crayfish exoskeletons.

As noted above, small mammal population densities appear to be much lower than during the 1981 Friesen et al. surveys, and our trapping results are also below the rates of return experienced in the same habitats by Los Angeles County mammalogists in 1988 (Dr. S. George, LACM, pers. comm. to FTH, 29 May 1990). Species diversity has decreased, with species most sensitive to fox predation (ie. voles and lagomorphs), significantly reduced or absent from habitats wherein they were formerly trapped or observed. Many habitats capable of supporting numerous herbivorous or granivorous rodents (such as the Hastings Canyon scrub habitats) presently appear to possess virtually no rodent fauna except gophers. Trapping in desert and chaparral ecosystems during this same time period yielded normal results, ranging from ± 20 - 45% rate of return (FH&A, misc. studies), so the decline in trapping rates cannot be entirely attributed to drought or other external conditions. The slow degradation of Ballona wetland habitats has no doubt contributed to the loss of mammal diversity and numbers, but it appears that many, if not all, of the specific declines by taxon may be a direct result of depredation by red foxes.

The US Fish and Wildlife Service (1990, DEIR, Seal Beach Naval Weapons Station, Endangered Species Management and Protection Plan) has documented the direct decline or extirpation of smaller vertebrates and birds in relation to rising fox populations on site. Richard Zemball (USFWS, pers. comm., July 1990) stated that "he would not be surprised" to learn that red foxes at Ballona had virtually eliminated surface-dwelling rodents. Sarah George, LACM (pers. comm., August 1990) also felt that the apparent decline in rodents, including harvest mice, could be a consequence of fox predation rather than any other single environmental factor. While it might be premature to draw absolute conclusions from recent trapping efforts, it appears clear that fox predation is an immediate threat to the continued viability of the Ballona ecosystem, and eventually may be the primary constraint upon vertebrate species persistence or restoration.

SENSITIVE SPECIES

The only listed sensitive species taxa on the site it the southern California saltmarsh shrew, a federal candidate, category 2, for threatened or endangered status, a California "Mammal Species of Special Concern (CSC)" (CDFG, 1990), and a California "Special Animal." The state designations are administrative, comprising a "watch" alert for taxa which are declining in the state, and while they carry no formal legal status, the CSC list cover letter suggests that researchers, "consider these species and subspecies as 'sensitive' during preparation and review of environmental documents." The only other recently-listed special status species, the southern marsh harvest mouse, was placed into synonymy with the widespread western harvest mouse, and therefore is no longer listed by state or federal agencies (Caryla Larsen, CDFG, and Dick Zimball, USFWS, pers. comm., March 1991).

One specimen of the shrew has been seen from the Ballona system, taken in a pitfall trap set in the willow-wetland portion of Area B along the western base of the bluffs. It has been given to the Los Angeles County Natural History Museum Dept. of Mammalogy for further study. Friesen et al. also saw one specimen, collected by M. Hayes in a pitfall set for amphibians and reptiles. The destructive nature of pitfall traps makes their use difficult and potentially destructive as an informational survey method for this apparently rare species, and so we have no real knowledge of its population density or distribution in the Ballona system. Given its food habits and preference for *Salicornia* habitats, it is probable that it yet persists in low numbers over much of the area.

DISCUSSION

Existing Conditions

All existing habitats in the Ballona wetlands system are clearly under environmental stress and in varying states of transition from natural organization to increasingly invaded, exotic compositions. Human disturbances have for many years degraded the quality and species diversity of the plant communities, replacing much of the original biota with cultivated fields (now ruderal systems) or grading deposits. Invasive alien plants such as iceplant, myoporum and pampas grass dominate many substrates, and the hydrologic systems on site change from freshwater to hypersaline seasonally and by controlled flooding.

Biotic diversity has been further reduced by elimination of sensitive (in the biological sense of the term) species and replacement by ecological generalists, either native or introduced. Population densities of many vertebrate organisms are extremely low, and the on-site ranges of certain species have been greatly reduced or confined from historic parameters. Small mammal populations in particular are under constant predation pressure from red foxes, which appear to be increasing exponentially in numbers (this is termed a "mesopredator release" by USFWS, indicating an unrestricted upsurge in population numbers of a smaller, lower-trophic level predator species when it has few or no natural biological controls). Species such as voles and harvest mice, active above ground during all seasons, may eventually be extirpated by these predators.

Reptiles are more dependent upon food resources and substrate consistencies than on vegetation or macrohabitat types for long-term population maintenance, and the high numbers of black widow spiders and non-native isopods appear sufficient to support present lizard densities. In the absence of red fox depredation, existing lizard populations and pocket gopher colonies appear adequate to support viable numbers of gopher snakes and kingsnakes. Elimination of food sources and reductions in population numbers of individuals by fox predation could ultimately extirpate snakes and large lizards from the system.

Amphibian populations at present appear to be virtually non-existent, except for the western toad, which can persist in strictly terrestrial habitats, where it breeds in seasonal surface accumulations of freshwater; and slender salamanders, which have long lifetimes which permit them to "ride out" temporary declines in habitat quality. They also do not depend upon open water system for reproduction. The treefrog populations at Ballona may yet persist in inundated rodent burrows and other protected habitats, but the current irregular hydrology in the channels precludes active population maintenance and reproductive survival.

Restoration Proposals

One of the proposed corollaries of project implementation would be the restoration of saltmarsh habitats by returning tidal flows to the system. While this proposal is an impact of the project, it is apart from other impacts in that it will be created with the intent that it benefit the system. Therefore, it is considered herein as part of the discussion of wildlife on the site, as it may in fact represent a return to some levels of historical habitat value. The effects of the differing levels of tidal flushing on small vertebrates in Area B may be considered in the context of the existing communities, some of which would not normally be part of a tidally-flushed saltmarsh. Freshwater riparian systems on site may be relatively recent in their colonization of lowland habitats, particularly along the eastern portion of the dune sand sheet. Vertebrate species inhabiting these areas have either entered the system following the advent of the communities (if they are riparian-obligate organisms), or have shifted into the riparian habitats as part of their broader preferences for habitat types. Many terrestrial organisms now inhabiting pickleweed subcommunities are widespread generalists (such as the kingsnake, gopher snake, alligator and fence lizards), and are neither restricted to nor dependent upon any particular habitat type on site. These species may be equally or more abundant in adjacent upland coastal sage scrub and chaparral habitats.

Species with restricted on-site distributions, either to particular soil types or to vegetation/communities, are generally more typical of the original Ballona wetlands biota. Species such as the harvest mouse and shrew characteristically inhabit saltmarshes, maintaining populations at the margin of the high-tide zone, or nesting above tidal inundation lines and foraging into the system during intertidal retreat. Depending upon their need for specific resources in any given community, these species may or may not occur in adjacent upland habitats. The fossorial (burrowing) legless lizard appears to be restricted to certain edaphic (soil) sites in the Ballona system, primarily fine-grained alluvium or dune sands, although it also occurs in loamy soils or beneath layers of leaf duff in oak woodland and chaparral habitats. One specimen was taken beneath debris near the top of the bluffs east of Hastings Canyon, in a coastal sage scrub and ruderal grassland habitat. Its restriction to particular microhabitats in Ballona would be more a result of unsuitable conditions such as soil inundation or salinity than plant community type.

A return to partial tidal flushing would bring salt water into now terrestrial "upland" portions of the habitat, removing existing vegetation formations, and eliminating or periodically inundating refugial areas such as road margins and debris piles. If incurred gradually, these impacts could permit a retreat to more easterly habitats by more mobile vertebrates, including lizards, snakes, and most mammal species. Organisms which are capable of tolerating or surviving temporary saline flooding (such as voles, shrews and the harvest mouse) might maintain or establish populations within halophytic vegetation systems remaining intact or which replace present habitats. Shrews may benefit populationally from a return to mid-tidal flushing, as such a system could provide for wider zones of foraging habitat while retaining marginal and upland habitats for nesting and retreat from high tides. A diversity of shrew food sources might likewise be promoted by a mid-tidal system. The few amphibians currently persisting in non-saline habitats or seasonal freshwater pools would be extirpated, unless they are relocated, or are able to migrate up channels into the proposed riparian and pond systems.

Few, if any, terrestrial vertebrate species would be expected to flourish or even persist within the broad saline environments provided by full-tidal flushing, except as they are able to move in and out of the system during intertidal episodes.

Marginal habitats may provide refugia for rodents and reptiles, provided such habitat values as cover, forage, food and movement corridors are retained. Also, an unnaturally abrupt environmental transition to the proposed freshwater systems would be less species-supportive than would a gradual zone of transition through a brackish water interface. The small and homogeneous nature of the full-tidal system might greatly restrict or remove existing terrestrial vertebrates from the flooded zones, except on a transitory basis during low tides. Properly established, managed and protected, the freshwater systems and surrounding coastal sage scrub habitats could continue to support a number of the species now found on site, particularly reptiles.

Project impacts are discussed separately, in the sections that follow.

PROJECT IMPACTS

The following terminology has been taken from R. Gustafson, *The Vegetation of Ballona*, in Schreiber (1981), modified parenthetically to correspond with more current usages and definitions per R. Holland (1986, *Preliminary Descriptions of the Terrestrial Natural Communities of California*, CDFG document, 156 pp.). The effects of project implementation on the Ballona wetlands habitats may be summarized either by natural community changes, or by area description using the letter designations of the Playa Vista project and its predecessors ("Area A, B," etc.). In terms of assessing losses or gains in species diversity, the community analysis may be more effective, while the area system may be somewhat easier to comprehend geographically. For the community approach, impacts only will be discussed; mitigations for impacts will be given in the discussions of impacts by area, and will consider both community and area aspects equally.

General impacts by area are given cumulatively, with impacts for Areas A, B, C and D differing from those to Areas B, C and D only by the elimination of the impacts to Area A. Development of Areas B to D but not A would retain the habitat values of A, but removes all other support habitats on site. These impacts are discussed by area and habitat type below, and so do not require identification as separate impacts. Phase 1 impacts to small vertebrate faunas by area are identical to general impacts, again absent the Area A impacts. Species names already given in the first part of this report will be cited herein as common names only.

BIOTIC COMMUNITIES

Pickleweed saltmarsh, saltflats and mudflats, transitional pickleweed and salt pan (southern coastal salt marsh)

These subcommunities occur sporadically to broadly over much of what is called Area B, in the central portion of Area A, and with small stands of pickleweed also occurring in the other areas. Aside from the naturally-occurring, if severely degraded, habitats in Area B, all the other pickleweed formations exist atop grading or dredge spoils, and are not remnants of historical saltmarshes, but rather are attributable to recent colonization of salty topsoils. Amphibian species use of saline environments is negligible, and reptile use is adventitious, reflecting the lack of tidal flushing and saline hydrology which has permitted colonization by typically terrestrial species. Mammal use of the sites includes the saltmarsh endemic southern saltmarsh shrew, and facultative saltmarsh species, the western harvest mouse, and California vole. Other mammals in the system occur as transients, or are species (such as raccoon, opossum, red fox) which forage widely over all habitats on the property.

Impacts to the small vertebrates of this habitat would be from two phases of the project: community elimination for development, and saltmarsh and freshwater habitat restoration. Areas A, C, and D would be lost altogether as habitat, and so would their small vertebrate faunas. All species presently existing on these sites would be extirpated from each area, with the possible exception of house mouse and other feral non-natives. No shrews have been found in these areas, although the slight possibility exists that the species could occur in association with saltmarsh vegetation systems in Area A. Voles have been confirmed in Area A, and the harvest mouse occurs in Area C. Loss of these areas would reduce the overall genetic diversity of these species on site, and would incrementally lower population densities, as well as remove dispersal areas from the system. All species inhabiting these subcommunities at present would be expected to persist on site in Area B, depending upon conditions during and following habitat restoration.

The establishment of either mid or full tidal flushing regimes over the remaining saltmarsh habitats in Area B would benefit the endemic and facultative species presently extant, although full tidal flows could reduce refugial areas for species not capable of living in the flooded zones. Whichever level of tidal flushing is chosen, the design must include adequate zones of habitat above the high tide line. Preservation of adequate stands of pickleweed along with marginal upland habitats surrounding inundation areas should assure continued use of the site by the existing saltmarsh species.

Willow and freshwater marsh (southern willow scrub, coastal freshwater marsh)

These habitats occur primarily along the course of Centinela Creek, and tributary drainages in the system, and in low spots or areas of seasonal rainfall accumulation. The largest stands of willow occur along the portion of Centinela Creek passing through Area D, and in two sites in Area B, with the densest grove being adjacent to the Playa del Rey dune remnant. These latter systems appear to be of recent origination, and probably began as a result of runoff accumulating in the topsoils and channels following the cessation of tidal flows into the wetlands. The vole and shrew were found in the willow-dominated systems along the southern margin of the bluffs in Area B, and these areas support the California kingsnake and gopher snake as well. During the Schreiber report field investigations these areas were found to support healthy populations of treefrogs, and in general, riparian habitats have high faunistic diversity. At Ballona, this holds true more for birds than for other vertebrate species.

Project implementation would eliminate the existing riparian and freshwater marsh habitats in all areas except B, incrementally reducing the number of individuals of all organisms occurring therein. Restoration to mid or full tidal flushing may eliminate willow habitats along the dunes and bluff bases through inundation or elevated groundwater salinity. Creation of a freshwater riparian corridor and marsh as part of the drainage course and catch-basin system for the project along the southern portions of Area D and into the extreme eastern portion of Area B could provide replacement ecosystems for these losses, provided that they are established and functioning prior to the elimination of existing sites.

Coastal dunes (southern dune scrub)

The remnant dune habitats at Ballona possess a severely limited and highly degraded fauna. Only the lower strip of the inland face of the dune exists, and in this the natural sand is mixed with construction debris; the entire system is overshadowed by towering residences built atop the original dune. Much of the present vegetation is non-native, and the lower portion of the sand sheet is densely clothed with iceplant, pampas grass and myoporum. Easy access to the remaining area by humans, pets and vehicle traffic has further eliminated natural habitat values, and increased the amount of debris accumulated on the substrate. No amphibians have been found in this area, and the only reptiles seen were legless lizards, and a few side-blotched and fence lizards. Kingsnakes and gophersnakes no doubt occasionally stray into the area, but it is isolated from most other natural systems by the residences and commercial development, Culver Boulevard, and the large inflow channel just east of the willow thickets. Red foxes appear to forage through the dunes regularly, and there is no sign of rodent or other small mammal activity (other than gophers).

The proposed development of areas other than this portion of Area B would not have a direct impact upon the dune system, except as it incrementally lowers population densities of terrestrial vertebrates in general. The relatively low-mobility legless lizards probably do not now have any genetic exchange with individuals in the coastal sage scrub areas of the project zone, and the project would not alter this situation negatively or positively. Project implementation includes a restoration of the native dune vegetation, and this could in turn enhance the values of the system for small mammals and reptiles.

Coastal scrub (Diegan coastal sage scrub)

This community, which is nowhere represented in a typical condition, occurs along the margins of the site on the bluff faces, and in a successional growth on the dredge spoils in Area A. It is a terrestrial community, possessing primarily generalist faunal elements in its present state, but with sensitive reptile or mammal species listed as having occurred historically (San Diego horned lizard, *Phyrnosoma coronatum blainvillei*, Pacific pocket mouse, *Perognathus longimembris pacificus*). No evidence of these or other sensitive taxa has been found during any of the surveys conducted in the past 10 years (including the Schreiber reports), and it is probable that they no longer exist locally in viable populations.

The fauna of the various forms of coastal sage scrubs on site is not particularly rich nor abundant. Species such as the dusky-footed woodrat, gopher snake, kingsnake, fence and alligator lizards are generally distributed in scrub and chaparral habitats in southern California, and are not endemic to the specific sage scrub types of Ballona. Only one species, the slender salamander, is confined in the project property to coastal sage scrub habitat, entirely within Area A. Most of the species observed or suspected to occur do not have high population densities, due in large measure to the reduced and isolated size of the habitat patches. The low numbers may also reflect recent entry into these habitats, low founder numbers, reduced genetic vigor, and depredation by humans and introduced predators.

Project implementation would eliminate altogether the fauna of the coastal sage scrub successional community in Area A. This would reduce diversity by the loss of the slender salamander, with little probability of recolonization of the system from adjacent suitable habitats (as none exist). Although the woodrat has not been found elsewhere within Ballona, it is common in similar habitats and chaparral locally, and no doubt persists outside the zone of impacts. No other species will be lost outright from the area by the development of this scrub system. The loss of individuals of other species will create an incremental impact upon overall population vigor and numbers, and will reduce genetic diversity proportionally.

The coastal sage scrub habitats on the bluffs are in a degraded condition due to dessication (from the recent drought), saltspray, and invasion by exotic ornamental plant species. Small vertebrate diversity is relatively low, and the system overall is under predation stress from red foxes. No development is planned on the bluffs themselves, but the realignment of Centinela Creek would create a riparian zone at the base of the habitat. This would benefit the coastal sage system if it increases protection of the area, and if vegetation restoration is extended onto the bluffs (including removal of iceplant and other exotics). There should be no net loss of species diversity on the bluffs due to project implementation, except as secondary impacts from the introduction of additional human and pet disturbances.

Coyote brush and pampas grass, agricultural fields (ruderal and disturbed habitats)

These habitats occur in scattered patches over much of Area D and B, and are most prevalent on elevated grading spoils or on non-wetland soils. They support little in the way of native wildlife, except those species which occur as transients over all of the property. Kingsnakes, gopher snakes, alligator and fence lizards, house mouse, and cottontail rabbits occur in these habitats, but no sensitive species would be expected to utilize them. The loss of virtually all such subcommunities on site would result in an incremental loss of overall numbers of some species, but would not significantly alter populations, gene flow, or dispersal opportunities.

PROJECT AREAS

Area A

Area A, the "marina site" consists of channel dredging spoils deposited over 50 years ago when Ballona channel was dug to its present extent. The land surface is several meters higher than surrounding or original natural terrain, and the habitat as it exists has never been part of a tidally-flushed wetland. Numerous wetland indicator species and halophytic plants exist in the area, apparently supported or permitted by the presence of salts in the dredged soils (either residual or drawn from lower sediments). Overall, the area is characterized by highly-disturbed coastal sage scrub and chaparral, with large areas of invasive non-native plants; faunal elements present are typical of such degraded communities, but the area does support low numbers of facultative wetland species (such as voles). Red foxes are common throughout area A, and their depredation appears to be reducing diversity and overall abundance of smaller vertebrates. Transient humans living in the scrub area have created further disturbances, and have even preyed upon selected species. Illegal vehicle use and dumping have introduced volumes of debris.

Low numbers of rodents, including California voles, a facultative wetland species, dusky-footed woodrat, a chaparral species, and the non-native house mouse occur in this area, and population densities of all smaller mammals (including Audubon cottontail (*Sylvilagus audubonii*) were well below typical norms for coastal scrub habitats. No typical saltmarsh mammal species (such as saltmarsh shrew or western harvest mice) were taken in this area. Because house mice tended to occur in and around disturbed areas, utilizing debris and urban improvements for shelter, their numbers are higher than those of other rodents on site, and it is probable that they are expanding their on-site distribution to occupy habitat niches vacated by other species. The pocket gopher, a primarily subterranean species, appears to be maintaining normal population densities despite red fox predation. Although Area A is generally disturbed and degraded, fox predation is the probable immediate cause for low numbers of most species censused.

Several amphibian species, including garden slender salamander and western toad occur in portions of the habitat, associated with moisture-retentive debris, leaf duff, and seasonal freshwater accumulation. Great Basin fence lizards are abundant in the heavily-vegetated portions of the property, particularly around the laurel sumac (*Malosma laurina*), and in areas of accumulated debris. Side-blotched lizards are less common, and are primarily confined to more open, sandy substrates. California kingsnakes and San Diego gopher snakes are still relatively common in area A, but most larger specimens exhibited scars on the body and tail, probably indicative of attempts at predation or injury by foxes or humans.

Construction of a marina in this site will eliminate all terrestrial flora and fauna, with no avenues for relocation or escape. Because no sensitive or endangered species of reptiles, amphibians or mammals are known to occur on area A, this impact would be considered locally important, consisting of an incremental loss of successional coast sage scrub habitat and its associated fauna. Construction of Phase One of the Playa Vista project would occur off-site and beyond Ballona channel, and does not directly affect area A.

Area B (southern section, below Culver Boulevard)

This portion of the property consists of a relatively large, primarily wetland system, with ruderal non-halophytic vegetation on the eastern portion in an area of fallow, regenerating agricultural land. Also found within Area B are a small alluvial fan/dune system, degraded saltmarsh with dense accumulations of invasive non-native flora, open saltflats, elevated soil and concrete debris berms (service roads and facilities for natural gas wells), and *Salicornia*-dominated saltmarsh. The bluffs surrounding Hastings Canyon (just west of Lincoln Boulevard) contain degraded and drought-stressed coastal sage scrub and chaparral, intermixed with invasive non-native herbs and grasses. The present fauna of Area B is predominantly upland terrestrial, reflective of the fact that this area no longer receives tidal flushing and has been colonized by species favoring habitats supported by fresh or brackish water systems. Low rainfall in recent years has resulted in high salinity in normally fresh or brackish runoff water channels, a condition which appears to have reduced or eliminated most amphibians.

Fox population density is very high in Area B, and predation pressure on smaller vertebrates is severe; fox dens with pups were noted in spring, 1990, in the saltmarsh near the main inflow channel, and on the bluffs near Hastings Canyon. Three nests of the western harvest mouse were found in *Salicornia* habitats in Area B, but all appeared to have been abandoned or were disturbed by predators. Species diversity is relatively lower in this area, despite its ecotonal nature and relatively large acreage. No voles were trapped in the area, but one juvenile individual was taken in a pitfall in 1990 in the riparian area at the bluff base. House mice occurred in higher numbers than did native rodents, and were always in association with disturbed areas or debris. Rodent and lagomorph (rabbits and hares) activity was most prevalent along the base of the bluffs, in more sheltered habitats or around areas of human disturbance. Pocket gophers are abundant throughout non-inundated areas. Predation on native species by domestic animals was noted in Area B, and there was also fecal evidence of fox predation upon domestic cats.

Amphibian activity was virtually undetectable in Area B during 1990, at times and localities wherein Hayes and Guyer (1981) recorded abundant treefrog activity. Water quality tests conducted by other researchers (D. Soltz and C. R. Carter, pers. comm., July 1990) indicated hypersalinity in the runoff channels west of Lincoln Boulevard. This condition alone could account for lowered adult population densities of amphibians, and water quality problems would negatively affect amphibian reproduction. Subsequent flushing by sewer discharge during late summer and fall may have returned these systems from saline to freshwater, but until a stable source of freshwater is present in the system, the fluctuations in salinity and chemical quality will likely restrict amphibian population dynamics.

California kingsnakes and gopher snakes were found along the bluffs and in the lowlands of area B, usually hiding or hibernating under trash and debris. A few southern alligator lizards were found beneath debris or in open habitats, and both fence and side-blotched lizards were present, although the latter is not common away from open, sandy substrates. All of these species (except the side-blotched lizard) are more abundant in the portion of area B north of Culver Boulevard. The silvery legless lizard, a Los Angeles City-listed sensitive species, occurs in the Hastings Canyon alluvial fan, in the relictual Ballona Dunes habitats, and on the face of the bluffs above Lincoln Boulevard.

Both phase one and the general buildout plan for Playa Vista would directly affect only the southeastern portion of Area B, with the proposed construction of a freshwater catchbasin structure adjacent to the west margin of Lincoln Boulevard. The catchbasin would be surrounded by an earthen berm, and its construction would require deposition of fill into delineated wetlands. This area is presently dominated by ruderal herbaceous non-wetland vegetation, and supports the lowest density of native faunal elements of any portion of the area. Loss of this habitat would have no significant affect on the native herpetofauna or mammals.

Once developed, the residential and commercial structures on the east side of Lincoln, and to a lesser extent on Area C, will have some long-term impacts to the saltmarsh and freshwater systems in Area B. Existing open space provides foraging and refuge values to wildlife, particularly birds and medium-sized mammals (ie. raccoons, skunks). Relatively abundant populations of kingsnakes and lizards occur in Area D, and these no doubt interact genetically with those in Area B via channel openings under the roads. The removal of these other areas as open space, even though they possess relatively low habitat values, will result in an incremental loss of population density and genetic vigor. The nature and timing of these effects upon the remaining populations cannot be assessed *a priori*, but could, in a worst case scenario, lead to inbreeding depression or inability to successfully find mates or defend territory, and eventually to the loss of one or more species.

Interruption of "normal" (=existing) freshwater flooding and nutrient deposition into Area B's lower wetlands from Centinela Creek could significantly reduce overall, long-term habitat values and restrict species diversity. The absence of a brackish water transition zone between the Centinela drainage and the tidally-flushed saltmarsh could reduce species diversity by those elements which are resource-dependent upon such ecotonal systems. Subsquently, the loss of transition zone species might directly or indirectly affect movement or population dynamics of saltmarsh species within interrelationship groups. None of the existing or historically-known amphibian, reptile or mammal species of Ballona would be directly affected by the absence of brackish systems, but a reduction of other resources could cause some species, such as western harvest mouse, to lose a portion of their food base should selected plant species be eliminated or reproductively inhibited. The saltmarsh shrew has a relatively diversified diet of invertebrates, requires moist habitats and dense cover (Williams, 1986), but is not known to be dependent upon particular water salinity levels, and so may be expected to persist in the absence of a brackish water interface.

Area C

Most of this area is highly disturbed, and the land exhibits overall habitat values which are a decrement of those in Areas A and B. Much of the substrate is heavily altered and developed, and natural resources are confined to small areas along the margins of the site, adjacent to existing residential development. A small area of delineated, adventitious wetland has been identified, and mammal use of this subcommunity is surprisingly high in terms of numbers of individuals trapped; most, however, were house mice, probably reflective of the volume of suitable habitat created by debris, adjacent residential areas, and fewer foxes. The western harvest mouse also occurs here, and appears to maintain a small population in association with ruderal habitats and isolated wetland patches. Very few reptiles (lizards only), and no amphibians were found in this area.

Development of any phase of the project as proposed would result in the elimination of this site , but no sensitive or site-restricted resources would be lost. There would be an incremental loss of open space adjacent to the wetlands, general habitat diversity, and individual numbers of those species occurring on the site.

Area D

Most of Area D is severely degraded, and a significant proportion of the area is under older fill and graded materials, existing factories, storage facilities, access roads and parking lots, evaporation ponds, and other remnants of former factory operations. Centinela Creek is confined to a narrow, steep-sided runoff channel, carrying flows from street drainage, adjacent plant operations, and wastewater dumping. Some natural runoff discharge occurs during rainfall, but generally comprises only a small portion of the flow. Opportunistic riparian elements, primarily willows (*Salix* spp.) and cattails (*Typha* sp.) have colonized channel margins and bottom, but overall the area is dominated by ruderal herbaceous vegetation. Maintenance of the channel during spring, 1990, including clearing marginal vegetation and cutting cattails and other aquatic plants. Additional riparian, coastal sage scrub and chaparral elements are mixed with invasive non-native species on the bluff faces above the area (below Loyola Marymount). In its densest growth, this scrub vegetation possesses relatively high habitat values for reptiles, small mammals, and birds. Trapping in this area, however, yielded only house mice, and red fox activity was noted during every site visit.

As noted, house mice were the only rodents trapped in Area D, and these were commonest in association with debris and construction materials along the bluff base; none were found in open areas away from the bluffs, or in the small adventitious patches of wetland vegetation. Although still extant in 1990, cottontail and jackrabbit populations appear greatly reduced, and sightings of either species were rare. Fox predation pressure is very great in area D, and adult foxes were commonly seen hunting in and around the lawn areas of the Playa Vista building. A fox "den," lined with fur, heavily musked, and containing the remains of numerous shorebirds was uncovered in a debris pile in the southwest corner of the building fenceline. Pocket gophers were the only rodents (other than house mice) maintaining normal population levels in Area D. In general, mammal diversity and individual numbers appear to be very low.

Kingsnakes, gopher snakes, fence and side-blotched lizards occur in varying densities in Area D, with the greatest numbers of snakes occurring along the bluff base in association with disturbed habitats and debris. Trash and debris provide shelter from weather and predators, and several kingsnakes were found wintering beneath larger pieces of wood or metal (pallettes, refrigerator doors, etc.). Two juvenile kingsnakes were observed in the northern portion of the site and in the lawn area of the Playa Vista building during late summer, 1990. Overall, the reptile fauna of Area D appears to have remained moderately high, but consists entirely of species characteristic of coastal sage scrub and chaparral habitats.

A single male Pacific treefrog (*Hyla regilla*) was sweep-net collected in spring, 1990, from cattails along the upper end of Centinela Creek (adjacent to Teale Road); this area may have remained sufficiently non-saline to permit breeding early in 1990, but was dry by June. Seine-netting yielded large numbers of crayfish and mosquitofish (*Gambusia affinis*), but no treefrog tadpoles were found. Western toad tadpoles were reported in seasonal pools in the grading fill portions of the site, where small, adventitious wetlands are supported by rainwater accumulation. The entire channel and all seasonal pools were completely dry by early summer, 1990.

All of Area D will be developed with residential and support facilities as part of phase one and subsequent phases of the Playa Vista plan. The present channel of Centinela Creek will be realigned into a runoff channel along the bluff base, on the south margin of the site. Existing vegetation will be removed, and faunal elements not able to escape into bluff habitats will be eliminated. Development of this site must be preceded by establishment of riparian mitigation habitats to permit native species to escape or be relocated prior to grading or construction.

CONSTRUCTION IMPACTS

Direct impacts of implementation of the current plan for Phase One of the Playa Vista project to the herpetofauna and mammals of the Ballona system will be the outright elimination of most species from the developed properties. Larger, more mobile and disturbance-sensitive organisms (ie. raccoons, foxes) may be able to flee as grading approaches, but for the most part, smaller, less-aware species will be killed during the leveling of the land. Conversion of the all (or nearly all) existing natural habitat, combined with the fact that no refugial habitats exist within easy access, assures that few, if any, organisms will escape destruction. Those not eliminated outright during construction will not be able to re-establish populations, and will eventually die or be killed.

The net impacts regionally of this loss of species and individuals will be moderately significant, but no sensitive or agency-listed species will be eliminated or directly affected by habitat losses in areas A, C and D. The only sensitive mammal species (the shrew) yet extant in the Ballona system appears to be confined to saltmarsh wetland habitats, and will be more broadly affected by those phases of the Playa Vista project which involve freshwater and saltmarsh restorations.

Native species to be lost do include rodents and reptiles, all of which function within the overall Ballona wetlands food web, interacting directly through various trophic levels by feeding upon smaller invertebrates, gathering and dispersing seeds, and providing a food source for larger predators. Loss of rodent and lizard habitats in areas A and C would be locally significant, as both areas appear to be important foraging and hunting grounds for predatory birds (including loggerhead shrike, American kestrel, red-tailed and red-shouldered hawks, barn and great-horned owls, northern harrier and great blue heron). Kestrels and shrikes were observed feeding upon lizards and snakes; red-shouldered hawks frequently prey upon snakes and alligator lizards; owls, northern harriers and black-shouldered kites actively hunt voles and other small diurnal vertebrates; great blue herons feed upon a wide variety of smaller vertebrates, including amphibians, reptiles and rodents. Remains of alligator lizards were found in raccoon and fox scats.

Retention of Area A would preserve the foraging areas discussed above, and would provide a large area of suitable habitat for most species occurring in Areas C and D. It could serve as a refugium for most species, provided they are able to reach it safely. A relocation program for terrestrial species from C and D into A would greatly benefit the populations of most species, and would mitigate the impacts of development in these other areas.

FRESHWATER DRAINAGE CHANNEL AND CATCH BASIN IMPACTS

As part of the proposed restoration/mitigation for lost wetlands as proposed within the Playa Vista project, Centinela Creek will be relocated along the base of the Westchester bluffs (in the southern portion of Area D), and the existing channel and resources will be eliminated. The new alignment of the drainage channel and catch basin will be planted with native riparian vegetation, to approximate and enhance existing freshwater ecosystem values. The runoff channel will cover approximately 25 acres, extending from the eastern margin of Area D (near the 405 Freeway) to Lincoln Boulevard; at this point the flow will be carried under the roadway, through debris filters, and into a 27-acre settling basin. This basin will be maintained as a flood control structure, and its freshwater contents will be kept separate from the proposed saltmarsh restoration area by a high earthen berm. The berm will be planted with native vegetation, and will have a service roadway along its crest.

Sluicegates and spillways will permit flood overflows to enter the saltmarsh, and will allow for managed amounts of freshwater to be released. Maintenance proposed for this channel and basin system includes clearance of flow-restricting vegetation and periodic removal of accumulated sediments. Both channel and catch basin are mandated flood control systems, and may carry water from a variety of sources, including groundwater, surface flows from local drainages, discharge from groundwater remediation and tertiary treatment facilities. Preliminary studies of water quality indicate that pollutant loading should not be a biological problem in the channel or basin riparian habitats (hydrological information *fide* the project Public Notice of Permit Application, U.S. Army Corps of Engineers, 02 Jan 1991).

Entrapment of nutrient-bearing sediment within the catchbasin may create an ecological problem: organic materials normally are carried into the saltmarsh with freshwater during flooding and residual surface flows, creating a brackish water interface and depositing nutrients within the estuarine system. This nutrient flow is essential to the energy and food chain dynamics of the saltmarsh, and is a prerequisite to seed germination of many halophytic plants (some of which are basic food resources for mammal species). In the absence of this flow, there could be a net loss of plant species diversity, which in turn could affect other trophic levels.

Channel construction impacts include removal and alteration of existing habitats along the lower margin of the bluffs east of Lincoln Boulevard. Although the areas to be lost currently fosterthe spread and proliferation of invasive non-natives such as house mouse and red fox, the debris provides shelter and breeding sites for lizards and snakes. In 1990, fence lizard and kingsnake populations in degraded habitats and dumping areas along the bluff base were the highest censused for the entire Ballona system. Mammal trapping, however, was very poor in this area, and the catch consisted solely of house mice. The loss of existing habitat along Centinela channel and the bluff base would have no significant direct impacts to native mammal populations, but would remove numbers of upland, non-riparian reptile species.

The only amphibians found in the southern portion of the Ballona system in 1990 occurred in upper Centinela Creek and in temporary freshwater pools in graded sections of area D. Population levels appear to be extremely low at present, and the loss of existing riparian habitat would not constitute a significant impact at present species densities and composition. Habitat values might be reestablished over time, particularly after the prolonged drought breaks, and the existing conditions should be regarded as a "low cycle" phenomenon, and not as an indicator of long-term community conditions. The realigned corridor could serve as a replacement habitat for the creek, with similar herpetofaunal and mammal resource values, provided that a suitable riparian ecosystem is established within the mitigations, prior to the onset of construction.

LONG-TERM AND CUMULATIVE IMPACTS

Post Completion Impacts

The primary potential long-term impacts of project build-out, aside from the direct effects of habitat and organism destruction, would result from several elements within communities and industries developed. The most significant potential impacts to the riparian habitats created to mitigate lost ecosystems would result from pollution of groundwater and surface freshwater by infiltrative chemicals, direct spills, surface flushing, and illegal dumping. Commonly-available commercial solvents, herbicides and pesticides may, in sufficient concentration, render freshwater habitat toxic to wildlife, inhibit or eliminate amphibian reproduction, accumulate in animal tissues, or poison streambed and riparian vegetation. Source points for potentially toxic chemicals commonly occur in residential and light industrial developments, and runoff filtration systems must be carefully planned against as a condition of project approval.

Human intrusion, even in controlled recreational activities, within riparian corridors can lower or eliminate sensitive species use of the habitat. Youths frequently hunt and capture small vertebrates, virtually all of which are either killed for sport or taken indoors to become short-lived pets. Dogs and cats may severely reduce local populations of native rodents, lizards, snakes, and birds, and can introduce domestic pet diseases and parasites to native species. Foot traffic within the riparian understory creates ever-widening denuded areas, loosens topsoil (accelerating direct erosion and siltation), compacts subsoil (restricting gaseous exchanges to plant root systems and inhibiting seedling growth), and generally disturbs and reduces sensitive species use of the system. Open access to restoration habitats would invite illegal trash dumping (which often results in fire) and other intrusive disturbances (partying, transient residence, etc.). Degeneration of habitat quality and accumulation of trash and debris often result in establishment of non-native, disturbance-favoring species such as house mouse, brown and/or black rats (*Rattus norvegicus*, *R. rattus*), and eastern fox squirrel (*Sciurus niger*).

Adjacent placement of roadways, tennis courts, baseball fields and other similar facilities requiring outdoor night lighting can also create long-term disturbances to riparian areas. Many of the species for which this mitigation is intended are nocturnal, and may be highly sensitive to adjacent night-lighting. Further, continuous illumination of habitat may contribute to breeding depression in sensitive species, and favors less-sensitive non-native predators such as domestic pets and red foxes. It also would encourage human entry.

Alternatives for waste disposal and other effluent treatments proposed as part of the project design are divided into "Conventional vs Ecological Infrastructure Options." Issues of relevance to habitat and biota protection include materials recycling, water reclamation, and organic recycling of wastewater sludge. The "Ecological" alternative would develop reclamation and recycling facilities within the development to deal with locally-generated waste, while the "Conventional" alternative would utilize existing off-site facilities. Clearly, the "Ecological' alternative is superior to the other in terms of eliminating off-site impacts and accumulation of excessive amounts of trash. Recycling encourages proper trash disposal, and can result in slightly lower rates of illegal dumping. Organic composting systems support water reclamation efforts, and do not appear to directly affect mitigations. According to project description, the conventional option does not call for discharge or deposition of effluent into the riparian corridor; to achieve habitat protection within the mitigation, no such degradation may be permitted. Under the ecological option; Class 1 quality reclaimed water may be discharged into the system. If suitable in quality for wildlife consumption, this source of water could permit year-round habitat maintenance within the riparian corridor (approximating historic conditions), which would be beneficial if permitted to enter the wetlands. In general, waste reduction and recycling should be a mandatory condition of all such projects.

Cumulative Impacts

This term is generally applied to impacts of the project as they relate to similar projects nearby, or to the general effects of reductions of similar resources on a local or regional basis. Numerous other developments are underway or planned within reasonable distance, but only those within the bluffs drainage appear to bear directly upon this project. Virtually no other similar habitats exist locally, and so the cumulative impacts of this project do not increase or decrease with respect to other similar developments outside the Centinela Creek drainage. Residential developments on the bluffs continue to spread the erosional effects already visible above the wetlands in Area B, and expand the post-completion impacts (discussed earlier) following development occupation. Development of Hastings Canyon would remove a source point for alluvial soils into the wetlands, eliminate the sand sheet habitat currently supported by these soils, and reduce somewhat the diversity of vegetation and wildlife species along the bluff margin. Residences placed atop Hastings Canyon would have direct intrusive impacts upon freshwater mitigation habitats and wetlands below.

Reductions of coastal sage scrub, coastal freshwater riparian scrub, and coastal saltwater marsh incurred as a result of project implementation may be factored against similar losses elsewhere along the California coast. In this relation, the projected cumulative impacts of habitat loss in areas A, B, C and D each would be to further reduce the overall areas available for species dispersal, incrementally reduce the gene pools of virtually all reptile and mammal species in the system, lower the overall number of individuals for virtually all native species, and reduce resource values for prey species. The latter loss of values would be most severely incurred by destruction of open and disturbed habitats on site, all which are utilized as hunting and foraging areas by predatory species, most notably birds of prey.

The general value of the Ballona habitats to migratory species would be of greatest concern as regards the bird fauna, while the same habitat losses represent a lesser impact to reptiles and mammals. The system is isolated from similar resources by many miles of impassable non-habitat. Terrestrial movement into and out of the Ballona wetland system is limited to species capable of ranging widely and rapidly along beach strand, or through urban environments. Habitat-sensitive or narrowly resource-dependent species (such as amphibians and certain small mammals) would not be expected to naturally enter or recolonize this system from other similar habitats along the coast due to intervening ecological barriers.

UNMITIGATIBLE IMPACTS

No proposal has been made to mitigate the loss of terrestrial habitat (coastal sage scrub) or faunal elements from areas A, C and D. Although coastal sage scrub habitats are generally rated "highest inventory priority" by the California Department of Fish and Game, Natural Diversity Data Base, the vegetation formations to be lost do not conform to agency definitions of sensitive habitats. The loss of terrestrial habitats cannot be mitigated within the remaining acreage of Playa Vista or the Ballona wetlands area, except by retention of Area A. The loss of open ruderal fields and adventitious *Salicornia* wetlands will not be mitigated within remaining habitats, nor by the creation of freshwater riparian and marsh areas.

Habitat loss without replacement will result in significant incremental decreases in the present numbers of lizards, snakes, voles, gophers, rabbits and hares, woodrats, and smaller predators (such as raccoons, skunks and opossum). The possibility exists for the the complete extirpation of the slender salamander, found in Ballona only in area A.

Small, fragmented habitat patches, particularly of specific resources such as wetlands may lose biotic diversity through a loss of genetic diversity and other reductive processes. Research by the PERL group (1991) has discussed some nutrient cycling processes which are not at normal rates or levels within Ballona, and it may be assumed that further removal of resources may generate additional systemic imbalances or a similar nature. Surrounding fragmentary habitats with highly-disturbed or developed areas further reduces diversity by eliminating site use by sensitive species, and human intrusion eventually degrades all natural resource values. Should the project be redesigned to encompass, rather than remove, existing wetland patches, the resulting isolation of habitat and restriction of animal movement would be functionally equivalent to the removal of resources, and must require the same basic mitigation measures as would outright loss of habitat.

MITIGATION MEASURES and MONITORING

The following are mitigation measures to be taken to: (1. mitigate to the extent possible the direct impacts of Phase One of the Playa Vista master plan; (2. mitigate all phases of the project as currently proposed; (3. ensure and increase the probability of continued amphibian, reptile and mammal use of the Ballona system at present species diversity levels; (4. augment the existing fauna within the proposed created riparian habitat system; and (5. mitigate impacts to sensitive species. Some of the mitigations proposed actually constitute enhancements of existing habitat, in association with the restoration plans. These are discussed separately, following the specific mitigations. Ordering is not according to priority; all mitigations should be fully implemented as a condition of project approval.

- The proposed riparian corridor and freshwater marsh amenities to the flood control system must be established to the full extent described within the permit application. This must be done as the first phase of the project, to allow the system to mature and provide habitat values for wildlife displaced from other project areas. A monitoring program, utilizing professional botanists and ecologists, should be established and maintained for at least five years to assure that the habitats restored achieve the desired biotic and physical goals.

- Water quality entering the freshwater riparian corridor must be sufficiently high to assure healthy, reproducing populations of amphibians, fish, plants and other wildlife. No polluted water should be permitted to enter the system, but tertiary treatment water may be allowed. Water quality in the corridor and catchbasin habitats should be monitored by testing on a regular basis, and as needed following seasonal flooding.

- The riparian corridor should function as a wildlife sanctuary, and be protected from all human intrusion by perimeter fencing. No recreational facilities or "improvements" should be placed within or immediately adjacent to the corridor, and "screening" vegetation should separate it visually from housing, industry, roads, or other developments. Law enforcement agencies must vigorously enforce trespass ordinances.

- Maintenance of the riparian corridor should be performed by hand, not by machine, and should never include herbicide or pesticide application. Trash and debris must not be allowed to accumulate in or near the habitat. If necessary a special homeowners association or similar internal benefit assessment should be created to assure proper maintenance of the habitat.

- Eastern red foxes must be completely eradicated from the Ballona ecosystem prior to establishment of new habitat opportunities. At present these predators are decimating small vertebrate populations throughout the system, in all areas, and their continued presence could severely devalue restored mitigation habitat. Invasive non-native species, such as largemouth bass (*Micropterus salmoides*) and African clawed frogs (*Xenopus* spp.) must be kept out of the freshwater habitat. All other non-native species (ie. muskrat, brown rat, etc.) should also be removed whenever they are found to occur. California Fish and Game should oversee all such programs.

- Native amphibians, reptiles and small mammals should be trapped from areas to be developed and relocated into protected mitigation habitats, after habitat values have become established for cover, forage and reproduction. Populations of rodents in Areas A and C should be trapped and relocated into suitable habitats in area B prior to project initiation.

- Only low-level, non-intrusive lighting shall be permitted adjacent to natural areas, and this shall be shielded and directed away from habitats. This would be maintained within zoning codes, or by CC&Rs.

- Informational materials should be developed for distribution to residents, noting the sensitivity of the mitigation habitats and notifying them of the need for compliance with protection measures for same. It would be the responsibility of the developer to provide and distribute information.

Once established, riparian habitats along the channel and around the catchbasin/freshwater pond could support denser and more diverse amphibian populations than currently exist in the area. If the riparian corridor aspects of the channel approximate natural conditions, stable populations of more mobile amphibian species (ie. western toad, pacific treefrog) might become established. The garden slender salamander could be introduced from Area A into suitable microsites within the created riparian channel margins.

The channel and basin, once vegetated, should support low densities of the same reptile species as presently occupy the Centinela drainage. Shaded, moist riparian understory habitat is generally not as favorable microclimatically to lizards and snakes as are more open scrub areas, but should support viable populations of species currently known to occur on site. Further, the California red-sided garter snake (*Thamnophis sirtalis parietalis*, reported as occurring in the area prior to habitat degradation and channelization), or Hammond's two-striped garter snake (*Thamnophis h. hammondi*), could be reintroduced to the system as frog and toad population densities permit. Southwestern pond turtle (*Clemmys marmorata* *pallida*), recorded historically from Centinela Creek, is now listed as a California Species of Special Concern. It also be reintroduced once riparian habitats mature, provided that protections against human and domestic animal depredation are established and enforced.

Mammal use of the riparian corridor will depend largely upon the amount and type of understory vegetation, in combination with riparian overstory density. Many mammal species found in this area move or forage nocturnally through open habitats, and would not be particularly abundant within mature riparian habitats. Notable exceptions would be native species such as deer mice (*Peromyscus* sp., reported from the region in earlier accounts, but not found in recent studies), raccoon, and opossum. Wide-ranging predators such as coyote (*Canis latrans*), long-ago extirpated from the region, might return to such habitat on a transient hunting/foraging basis, but the areal extent of the habitat is too small to support populations of such "upper-end" predators.

Open, grassy habitats along the riparian corridor margin would permit reintroduction and/or population expansion of the California vole, as well as provide grazing areas for other rodents and lagomorphs. This, in combination with maturing riparian forest, might in turn encourage residence establishment of rarer wetland and riparian-associated raptorial birds such as black-shouldered kite and long-eared owl.

Overall, the potential mitigative benefits of the proposed riparian corridor and freshwater pond could outweigh the direct impacts of their construction, provided that they are established at least a year in advance of destruction of their ecological analogues. Further, the full spectrum of positive environmental benefits may only be accrued through careful maintenance and monitoring of the habitats created. Human intrusion into the riparian corridor should not be permitted, even under controlled conditions (such as jogging paths, etc.), and the system must be fenced against casual entry by people and domestic animals. Understory habitats are easily eroded and trampled, processes which quickly eliminate microsite values and increase sedimentation. Impacts of human and domestic animal predation and harrassment of sensitive wildlife in restricted or degraded ecosystems can be very significant; the absence of several species (ie. garter snakes, pond turtles) from the existing Ballona wetland system may be due in large measure--if not entirely--to human collection and other depredation activities.

Water quality must be maintained at unpolluted levels; episodic flooding with clean freshwater would pose no significant threat to the system unless the flow is of sufficient strength to scour the channel (an unlikely occurrence given the extent of the drainage). Tertiary treated water may be satisfactory, but direct discharge from residential and light industrial streets and gutters should not be permitted to enter the channel untreated (standard debris collectors and oil traps do not constitute water treatment facilities for urban runoff flowing into riparian systems). No recreational facilities requiring night-lighting, watering, fertilization, herbicide, pesticide or other chemical maintenance should be permitted on porous substrates adjacent to the corridor. Waste disposal systems must be kept at a safe distance, and raw sewage must never be permitted to enter the system.

Appendix J-10: City of Los Angeles Consultant Review Letter and Consultant Response

Planning Consultants Research

REVIEW

of

BIOLOGICAL SURVEYS AND DRAFT EIR FOR BIOLOGICAL RESOURCES PLAYA VISTA PROJECT

by

Michael H. Horn
Department of Biological Science
California State University, Fullerton
Fullerton, CA 92634-9480

31 December 1991

QUESTIONS AND ANSWERS ABOUT THE BIOLOGICAL SURVEYS AND DRAFT EIR

I. The Functioning of Ballona Wetland in Relation to Tidal Flushing, Part I -- Before Tidal Restoration. Prepared by John M. Boland, Ph.D. and Joy B. Zedler, Ph.D. January 1991.

1. Has the study been comprehensive and objective?

This is a thorough, well-documented, hypothesis-driven study that is objective and sufficiently comprehensive given the caveats noted below. Its shortcomnings are the lack of a winter study season, no CHN analyses and no primary productivity measurements. The reasons for all of these omissions are adequately explained. The authors describe additional research projects that they would like to undertake before restoration. These projects would remove the mentioned shortcomings and provide additional important information. They should be carried out.

2. Does the study's methodology meet current scientific standards?

The authors have used methods that meet current scientific standards in this field.

3. Are the study's conclusions consistent with the findings?

The authors have drawn conclusions consistent with the results of their research.

4. Are the study's conclusions scientifically supportable?

The authors reach conclusions that are scientifically supportable based on studies at Ballona and at wetland sites elsewhere. They correctly cite the importance of tidal flushing for improving conditions for native species, for reducing the populations of exotic species and for enhancing the general functioning of the wetland.

5. Does the pertinent portion of the draft EIR accurately present the study's findings and conclusions?

The findings and conclusions of the study are accurately presented in the draft EIR.

6. If an answer to any of the preceding questions is "no", what can be done to remedy the weakness(es) perceived?

(#1 above) The weaknesses perceived can be remedied by the actions proposed by the authors.

II. Botanical Resources of Playa Vista (draft). Prepared by James Henrickson, Ph.D. May 1991.

1. Has the study been comprehensive and objective?

This is an exhaustive, descriptive study of the flora of the Playa Vista area. It is both comprehensive in scope and objective in approach.

2. Does the study's methodology meet current scientific standards?

The methods used by the author satisfactorily meet current scientific standards.

3. Are the study's conclusions consistent with the findings?

The author has drawn conclusions consistent with the results of his research.

4. Are the study's conclusions scientifically supportable?

The author reaches conclusions that are scientifically supportable based on studies at Ballona and at wetland sites elsewhere. The Ballona wetland represents a small remnant of former Los Angeles County wetlands and Ballona itself has undergone a drastic reduction in wetland habitats. The severely disturbed nature of the site is reflected in the relatively low proportion of native species in the flora. His statements that pickleweed habitat is essential for Belding's savannah sparrow, that a muted tidal flow (vs. full tidal flow) is preferable for terrestrial biota and that a broad interface of freshwater and salt marsh enhances biological diversity are all supportable conclusions.

5. Does the pertinent portion of the draft EIR text accurately present the study's findings and conclusions?

The findings and conclusions of the study are accurately presented in the draft EIR.

6. If an answer to any of the preceding questions is "no", what can be done to remedy the weakness(es) perceived?

None of the answers is considered to be "no".

III. Biological Assessment of the Greater Ballona Wetlands Region: Terrestrial Arthropod Species. Prepared by Rudi Mattoni, Ph.D. April 1991.

1. Has the study been comprehensive and objective?

This is an objective study and a comprehensive one given the still poor state of knowledge of terrestrial arthropod communities.

2. Does the study's methodology meet current scientific standards?

The methods used by the author satisfactorily meet current scientific standards.

3. Are the study's conclusions consistent with the findings?

The author has drawn conclusions consistent with the results of his research.

4. Are the study's conclusions scientifically supportable?

The author reaches conclusions that are scientifically supportable based on studies at Ballona and at similar sites elsehwere. These conclusions include: a) There is a need to save not only large habitat areas but also smaller specialized habitats when the emphasis is on insects. b) A mid-tidal plan is preferable to a full-tidal plan because it would provide more habitat for terrestrial species. c) All arthropod populations at Playa Vista are depauperate compared with those of communities of nearby similar habitats. d) An exotic species (the Argentine ant), which is dominant at all sites, is uneradicable. e) The richest habitats are in the ecotone between pickleweed stands and freshwater marsh. f) The major negative cumulative impact of the Playa Vista project will be reduction of potential habitat size.

5. Does the pertinent portion of the draft EIR text accurately present the study's findings and conclusions?

The findings and conclusions of the study are accurately presented in the draft EIR.

6. If an answer to any of the preceding questions is "no", what can be done to remedy the weakness(es) perceived?

(#1 above) The lack of full identifications for a number of arthropod taxa reflects the limited systematic information for many groups. As the author states, this situation is inevitable because too few taxonomic specialists are available to make identifications and provide other biological information.

IV. Ballona Wetlands/Playa Vista Development: Non-Insect Invertebrate Survey. Prepared by Cassie R. Carter, M.S. April 1991.

1. Has the study been comprehensive and objective?

This quarterly sampling study of terrestrial, freshwater, brackish and marine habitats is satisfactorily comprehensive in scope and objective in approach. Given the sampling program, however, some quantitative data on species abundance should be included.

2. Does the study's methodology meet current scientific standards?

The author used methods that adequately meet current scientific standards and should have generated quantitative information.

3. Are the study's conclusions consistent with the findings?

The author has drawn conclusions consistent with the results of her research, which are qualitative in nature.

4. Are the study's conclusions scientifically supportable?

The author reaches conclusions that appear to be scientifically supportable based on the 1981 study of the Ballona region and her current study. However, the lack of any quantitative data weakens her conclusions. Without information on abundance of this fauna, which is reasonably well known taxonomically, no meaningful comparisons can be made with data obtained in any future monitoring studies. Nevertheless, her general conclusions seem to have validity. These include: a) Area B and the Ballona Channel are the only areas with any real invertebrate diversity. b) The main terrestrial species are an introduced land snail and hardy species capable of persisting in degraded habitats. c) General habitat quality has declined since the 1981 study. and d) Restoration of any tidal flow to the wetlands would increase habitat health and stability.

5. Does the pertinent portion of the draft EIR text accurately present the study's findings and conclusions?

The findings and conclusions of the study are accurately presented in the draft EIR.

6. If an answer to any of the preceding questions is "no", what can be done to remedy the weakness(es) perceived?

(#1 and #4 above) Some quantitative data on abundances of non-insect invertebrates should be obtained before the restoration and development processes begin.

V. The Fish Populations Inhabiting Low Marina del Ray Harbor and Ballona Channel from July 1990 to April 1991. Prepared by Larry G. Allen, Ph.D. April 1991.

1. Has the study been comprehensive and objective?

This quarterly study provides objective, quantitative data on the bottom-associated fishes occupying lower Marina del Ray Harbor and Ballona Channel. The study could be made more comprehensive by including information on sizes (and overall biomass) of fish caught and on which fishes were captured in each of the two trawl nets, which differed in overall dimension and mesh size. The scheduled April 1991 sample in Ballona Channel was missed because of an oil spill. This omission could be considered minor except that the results of this and other studies consistently show high seasonal variability in abundance and diversity of fish assemblages in temperate bays and estuaries.

2. Does the study's methodology meet current scientific standards?

The methods used by the author meet the current scientific standards for sampling bottom-associated fishes in harbors, bays and estuaries.

3. Are the study's conclusions consistent with the findings?

The author has drawn conclusions consistent with the results of his research.

4. Are the study's conclusions scientifically supportable?

The author reaches conclusions that are scientifically supportable based on this study and others in similar habitats in southern California. He appropriately concluded that the Harbor fish assemblage was typical of southern California harbors and that the Channel fauna was depauperate but similar to those of shallow marina habitats adjacent to estuaries and marshes in southern California. The author also logically concluded that conversion of Area A into a marina would provide currently non-existent habitat for marine fishes. His estimate of annual production of fish biomass in a new marina and restored Channel underscore the value of including biomass data in the report.

5. Does the pertinent portion of the draft EIR text accurately present the study's findings and conclusions?

The findings and conclusions of the study are accurately presented in the draft EIR.

6. If an answer to any of the preceding questions is "no", what can be done to remedy the weakness(es) perceived?

(#1 above) The report should include overall biomass data, size (length and/or biomass) information on individual species and the catch statistics of each type of trawl. The author most likely has these data available and can readily include the information in an expanded report. The missed sampling period in the Channel is probably not important enough to warrant further sampling.

VI. Fish Survey of Ballona Wetlands: Areas B and D of the Playa Vista Project. Prepared by David L. Soltz, Ph.D. June 1991.

1. Has the study been comprehensive and objective?

This quarterly study provides objective, quantitative data on the fish assemblages in the Ballona wetlands. The study could be made more comprehensive by including information on individual fish size (length and/or biomass) and on which species were captured with each of the two types of seine, which differed in overall dimension and mesh size.

2. Does the study's methodology meet current scientific standards?

The methods used by the author meet the current scientific standards for sampling fishes in tidal sloughs and channels.

3. Are the study's conclusions consistent with the findings?

The author has drawn conclusions consistent with the results of his research.

4. Are the study's conclusions scientifically supportable?

The author reaches conclusions that are scientifically supportable based on this and an earlier study at Ballona and on other studies in similar habitats in southern California. His main conclusions are: a) The fish community has declined in abundance and diversity since 1980-81, and the mosquitofish has increased to become the numerically dominant species. b) The Ballona fish community contains fewer species and less abundant native species than other similar habitats in southern California. The author cites several plausible reasons for the decline and generally depauperate condition of the fish community and expects any increase in tidal flushing to lead to increased abundance and diversity of the fish community.

5. Does the pertinent portion of the draft EIR text accurately present the study's findings and conclusions?

The findings and conclusions of the study are accurately presented in the draft EIR.

6. If an answer to any of the preceding questions is "no", what can be done to remedy the weakness(es) perceived?

(#1 above) The report should include data on fish sizes and on the catch statistics of each type of seine. The author most likely has these data readily available and can include them in an expanded report.

VII. A Population and Banding Study on the Belding's Savannah Sparrow at Ballona Wetland, 1989-1990. Prepared by Kennon Corey, M.S. and Barbara W. Massey, M.S. November 1990.

1. Has the study been comprehensive and objective?

This year-long quantitative study is comprehensive in scope and objective in approach.

2. Does the study's methodology meet current scientific standards?

The methods used by the authors meet current scientific standards.

3. Are the studies conclusions consistent with the findings?

The authors have drawn conclusions consistent with the results of their research.

4. Are the study's conclusions scientifically supportable?

The authors reach scientifically supportable conclusions based on this and previous studies of Belding's savannah sparrow in the Ballona wetlands and in similar habitats in southern California. Their main conclusions are: a) The number of breeding pairs has declined considerably in the past few years. b) The reasons are thought to be the four-year drought and the lack of tidal flow, both detrimental to pickleweed vegetation. c) Tidal flow should be reintroduced as a soon as possible. and d) The breeding population should be monitored each spring.

5. Does the pertinent portion of the draft EIR text accurately present the study's findings and conclusions?

The findings and conclusions of the study are accurately presented in the draft EIR.

6. If an answer to any of the preceding questions is "no", what can be done to remedy the weakness(es) perceived?

None of the answers to the preceding questions is "no".

VIII. Bird Survey of Ballona Wetlands, Playa del Ray, California, 1990-1991. Prepared by Kennon A. Corey, M.S. April 1990.

1. Has the study been comprehensive and objective?

This year-long, bimonthly study provides quantitative information and is comprehensive in scope and objective in approach. The data on abundance of individual species should be expressed in tabular or graphic form for greater appreciation. If all birds were counted, then these data are useful and important for comparative purposes.

2. Does the study's methodology meet current scientific standards?

The methods used in the study meet current scientific standards.

3. Are the study's conclusions consistent with the findings?

The conclusions reached by the author are consistent with the results of his research.

4. Are the study's conclusions scientifically supportable?

The conclusions reached by the author are scientifically supportable based on this and a previous study of the birds of the Ballona wetlands. His main conclusions are: a) Overall bird diversity has declined from the 1979-81 survey, probably as a result of the condition of the wetland caused by the five-year drought. b) Continuous net loss of open fields will lead to reduced populations of local, "open field" birds. and c) The increased size and productivity of the saltwater/freshwater marsh and riparian areas will, however, increase the habitat for Belding's savannah sparrow, shorebirds and ducks, and terrestrial migrants.

5. Does the pertinent portion of the draft EIR text accurately present the study's findings and conclusions?

The findings and conclusions of the study are accurately presented in the draft EIR.

6. If an answer to any of the preceding questions is "no", what can be done to remedy the weakness(es) perceived?

(#1 above) The abundance data on individual species should be given greater prominence through presentation in tabular or graphical form.

IX. Ballona Wetlands/Playa Vista Development, Draft Environmental Impact Report, Biota - Amphibians, Reptiles and Mammals. Prepared by Frank Hovore and Associates. April 1991.

1. Has the study been comprehensive and objective?

This year-long study provides quantitative information and is comprehensive in scope and objective in approach. The data apparently collected on abundance of individual species should be presented, in tabular or graphical form, to substantiate the conclusions and to provide information for comparative purposes.

2. Does the study's methodology meet current scientific standards?

The methods used by the authors meet current scientific standards.

3. Are the study's conclusions consistent with the findings?

The conclusions reached by the authors are apparently consistent with the results of the study, but the results need to be substantiated with data on abundances of individual species.

4. Are the study's conclusions scientifically supportable?

The conclusions reached by the authors are apparently scientifically supportable based on this and previous studies at Ballona but confirmation awaits inclusion in their report of quantitative information on species abundances. Among their conclusions are: a) Reptile populations, while low in diversity, are relatively high in abundance, in part a result of their use of marginal non-saline habitats. b) Amphibian populations appear to be virtually non-existent, except for those of the western toad and slender salamander. c) Small mammal densities appear to be much lower than during the 1981 surveys. d) The slow degradation of Ballona wetland habitats has contributed to the decline in mammal abundance and diversity, but many if not all declines may be a direct result of red fox predation. e) Partial tidal flushing might benefit shrews but amphibians in non-saline habitats and seasonal freshwater pools would be extirpated. f) Full tidal flushing would benefit few if any terrestrial vertebrates. and g) Retention of Area A as a terrestrial habitat would provide habitat for most species using Areas C and D, and relocation of species from C and D into A would benefit most species and would mitigate the impacts of development in these two areas.

5. Does the pertinent portion of the draft EIR text accurately present the study's findings and conclusions?

The findings and conclusions of the study are accurately presented in the draft EIR.

6. If an answer to any of the preceding questions is "no", what can be done to remedy the weakness(es) perceived?

(#1 above) The report should be expanded to include abundance data on the amphibian, reptile and mammal populations sampled. Apparently these data are available and can be readily incorporated into an expanded report.

GENERAL COMMENTS

These biological surveys vary in quality and quantity of information, largely because of differences in the organisms and systems being studied and, in turn, the different methodologies required. These studies, however, are vital to the Playa Vista Project if an apparent goal is to maintain viable populations of native species and functioning ecosystems both natural and restored. This goal presents a formidable challenge for several reasons. First of all, the habitats represent "remnants of remnants" of formerly much larger habitats and ecosystems. Moreover, these habitats are now more isolated from one another in southern California than formerly. As such, these fragmented systems contain species that are subject to the risks of small population size. These risks include random variation in population variables such as sex ratio, age class distribution and the like, genetic deterioration through genetic drift and inbreeding, social dysfunction as in mating requirements, and density-independent mortality induced by random catastrophic events such as storms and disease outbreaks. Secondly, the biotas are still incompletely known as indicated explicitly or implicitly by the surveys, and all are now existing in degraded habitats. Thirdly, the natural and restored ecosystems face and will continue to face severe impacts from inflows of potentially toxic chemicals, from exotic species such as the mosquitofish, red fox and Argentine ant, all of which are known to have or appear to have the capacity to extirpate native species and drastically alter community structure, and from excessive use and disturbance by humans and their pets. Whether to have full or partial tidal flushing remains a pivotal biological question because it will significantly affect the proportions of terrestrial and aquatic habitats eventually realized at the site. It is not enough merely to wish for little patches of habitat and diminutive ecosystems to sustain themselves healthily and conveniently while embedded in a vast matrix of altered landscape just because they are interesting and enhance the surrounding development. To achieve the above stated goal, sustained management of these systems will require continued study and monitoring into the foreseeable future and vigorous and dedicated efforts to minimize the many sources of negative impacts existing in the project area. All the biological knowledge and managerial wisdom that can be mustered will be required to make the plan a reality.

Michael H. Horn

Michael H. Horn
Professor of Biology
California State University, Fullerton
31 December 1991

Sharon H. Lockhart
ENVIRONMENTAL COUNSELOR
7943 East Santa Cruz Avenue
Orange, California 92669
Telephone: (714) 289-1817
Fax: (714) 289-1907

August 17, 1992

Mr. Dick Takase
Planning Department
City of Los Angeles
200 N. Spring Street, Room 505
Los Angeles, California 90012

Re: Comments of Technical Reports - Biotic Section

Dear Mr. Takase:

The technical reports for the Biotics Section of the draft Environmental Impact Report (EIR) for the Playa Vista Project were prepared by Drs. John M. Boland and Joy B. Zedler, James Henrickson, Rudi Mattoni, Larry G. Allen, David L. Soltz; Ms. Barbara W. Massey and Ms. Cassie Carter; Mr. Kennon Corey; and Frank Hovore and Associates. These technical reports evaluated components of the biological community at Playa Vista between 1989-1991. Dr. Horn, an independent consultant to the City of Los Angeles, reviewed the technical reports and the draft EIR.

In all cases, Dr. Horn found that:

(1) the methods used by the author satisfactorily met current scientific standards,

(2) the author drew scientifically supportable conclusions consistent with the results of the research, and

(3) the findings and conclusions of the technical studies were accurately presented in the draft EIR.

Dr. Horn, nevertheless, suggested the following editing of the technical reports:

(1) quantitative data on the abundance of non-insect invertebrates in the wetlands;

(2) overall biomass data, size (length and/or biomass) information on the individual species and the catch statistics of each type of trawl for the marina and Ballona Channel fish study;

(3) fish sizes and catch statistics of each type of seine for the wetlands fish study;

(4) abundance data presented in tabular form for the general bird study; and

(5) abundance data (trapping results) presented in tabular form for the reptile, amphibian, and mammal studies.

Dr. Noel Davis of the Chamber Group and I wrote the biotics section of the draft Environmental Impact Report. I prepared the summary of the technical information and Dr. Davis prepared the impact analysis. Dr. Davis and I agree with Dr. Horn findings on the adequacy of the technical studies. We believe that the studies, as written, are adequate to support the environmental baseline evaluation and the impact analysis. The following specifically responds to Dr. Horn's comments.

Ballona Wetlands/Playa Vista Development: Non-Insect Invertebrate Survey. Prepared by Cassie R. Carter, M.S., April 1991.

Invertebrate abundance data is detailed in the report by Drs. Boland and Zedler. The report by Ms. Carter confirms the species distribution findings of Drs. Boland and Zedler. Therefore, additional information on the abundance of invertebrates is unnecessary in this study to support the findings in the draft EIR, Biotic Section.

The Fish Population Inhabitating Low Marina del Ray Harbor and Ballona Channel from July 1990 to April 1991. Prepared by Larry G. Allen, Ph.D., April 1991.

We believe that the requested information on overall biomass data, size information on individual species and the catch statistics of each type of trawl is unnecessary to support the findings in the draft EIR, Biotic Section. This information would not change either the baseline or the impact analysis. Such information would be valuable to have compiled prior to the habitat restoration efforts. This information would aid in the scientific documentation of pre- and post-project conditions.

Fish Survey of Ballona Wetlands: Areas B and D of the Playa Vista Project. Prepared by David L. Soltz, Ph.D., June 1991.

We believe that the requested information on fish size and catch statistics of each type of seine is unnecessary to support the findings in the draft EIR, Biotic Section. This information would not change the description of the environmental baseline or the impact analysis. Such information would be valuable to have compiled prior to the habitat restoration efforts. It would aid in the scientifically documenting pre- and post-project conditions.

Bird Survey of Ballona Wetlands, Playa del Rey, California 1990-1991. Prepared by Kennon A. Corey, M.S., April 1990.

The requested editorial changes have been made. See Enclosure.

Ballona Wetlands/Playa Vista Development, draft Environmental Impact Report, Biota - Amphibians, Reptiles, and Mammals. Prepared by Frank Hovore and Associates. April 1991.

Information on the abundance of amphibians, reptiles and mammals, while not in tabular form, is contained within the technical report. While it would be helpful to have the information in tabular form, it is unnecessary to support the findings in the draft EIR, Biotic Section. This information would not change the environmental baseline or the impact analysis.

We hope that this information addresses your concerns. Should you have any questions, please contact me at your convenience.

Sincerely,

Sharon H. Lockhart

Sharon H. Lockhart

Enclosure