3.4.5 Regulatory Considerations

Many types of industrial and commercial facilities require air quality permits for their equipment and operations. Local air pollution control districts are responsible for air quality permit programs in California. Permit authority is derived from a combination of state and federal legislation. In general, federally required air quality permit programs have been integrated into the pre-existing state and local permit program. This results in a two-step permit process for new stationary emission sources: an initial authority to construct (ATC) permit and a subsequent permit to operate (PTO).

Air quality permits would be needed for the enhanced evaporation system associated with some project alternatives. Air quality permits also may be needed for other fixed facilities (such as diesel engines used for pumping plants and electrical generators) that would be associated with some alternatives. The Imperial County APCD has permit authority within the Imperial County portion of the Salton Sea Air Basin. The South Coast AQMD has permit authority within the Riverside County portion of the Salton Sea Air Basin.

3.4.6 Meteorological Conditions

Temperature and Precipitation Patterns

Average temperature and precipitation conditions for the Salton Sea Air Basin are summarized in Appendix C. Temperature patterns are very similar throughout the air basin. Average daily high temperatures vary from about 71 degrees F during winter to about 105 degrees F during summer. Average daily low temperatures vary from about 40 to 45 degrees F during winter to about 70 to 75 degrees F during summer.

Annual precipitation quantities are greatest in the northern part of the Coachella Valley, and are relatively uniform and low throughout the Imperial Valley. Annual precipitation is less than 5.5 inches per year in the Palm Springs area, slightly above 3 inches per year in the Indio area, and about 2.5 inches per year throughout the Imperial Valley.

Regional Wind Patterns

An air basin perspective on wind direction patterns is provided by data summarized in California Air Resources Board (1984). Seasonal and annual average data for five locations in the Salton Sea Air Basin (Palm Springs, Indio, Thermal, El Centro, and Holtville) are presented in Appendix C.

Wind patterns in the Coachella Valley are influenced rather strongly by topographic features. Winds in the Coachella Valley generally are oriented in a northwest-southeast alignment. The predominant winds are from the northwest at all season for Palm Springs, Indio, and Thermal. Palm Springs experiences a secondary wind component from the east-southeast during all seasons. Thermal experiences seasonably variable secondary wind components from the south-southeast and north-northeast.

Topographic influences on wind patterns are less obvious in the Imperial Valley. Predominant wind patterns at the El Centro Naval Air Facility are from the west during most of the year. During the summer, southeast winds are predominant, together with a strong secondary component from the west. Wind patterns at Holtville in the eastern part of the Imperial Valley show both southeasterly and northwesterly or westerly components at all seasons. The northwest component dominates during winter, a westerly component dominates during spring, and the southeast component dominates during the summer. Southeasterly and northwesterly components are of similar magnitudes during the fall.

Local Wind Patterns

In the absence of strong frontal systems or strong gradients between high and low pressure areas which would generate a regionally dominant wind direction, winds from the Coachella Valley and Imperial Valley are likely to converge in the vicinity of the Salton Sea, creating complex airflow patterns. As a consequence of such factors, wind patterns over the southeastern part of the Salton Sea tend to differ from those over the northern part of the Sea (Cook et al., 1998).

The California Irrigation Management Information System (CIMIS) operates several meteorological monitorning stations in the Imperial and Coachella Valleys. Some of the monitoring stations are close to the Salton Sea and relatively close to facility sites associated with various alternatives. Recent data from some of these stations have been analyzed to determine wind direction and wind speed patterns. Detailed summaries of the data are presented in Appendix C. CIMIS station #154 is the monitoring site closest to the Bombay Beach EES site considered in Alternative 2. CIMIS station #127 is the monitoring site closest to the Salton Sea Test Base EES site considered in Alternatives 3, 4, and 5.

CIMIS station #154 is located near the northeast corner of the Salton Sea at the headquarters of the Salton Sea State Recreation Area. Only one year of complete data is available for this location. Wind direction patterns at the State Recreation Area site for 1997 are illustrated in Figure 3.1-3. Northwest and northeast winds were dominant during winter months. Southeast winds were dominant during spring and summer months. Fall months showed a transition from summer to winter directional patterns, with northwest, northeast, and southeast winds all making important contributions to directional patterns.

CIMIS station #127 is located near the boat ramp on the north side of Salton City (the boat ramp location is shown in Figures 2.5-2 and 3.12-6). Wind direction patterns for 1997 are illustrated in Figure 3.1-3. Northwest winds were dominant during all seasons. During winter months, there was a secondary component from the west and west-southwest. During spring and summer months, winds from the east-southeast became important secondary components. Fall months showed a return to the winter directional pattern, with winds predominantly from the north-northwest through west-southwest.

Comparison of 1997 wind patterns for Salton City and the State Recreation Area shows that predominant wind directions are roughly aligned with the long axis of the Salton Sea. Northwest winds are dominant at Salton City, while southeast winds are dominant on the opposite shore at the State Recreation Area. Off-shore winds make a secondary contribution during fall and winter months at both locations. Somewhat surprisingly, direct on-shore winds were infrequent at both locations. The basic wind pattern at both sites seems to be daytime valley axis winds and nighttime off-shore winds.

The low frequency of direct on-shore winds may be a consequence of converging winds from the Coachella Valley and Imperial Valley. The low frequency of direct on-shore winds also might be a consequence of water temperatures in the Salton Sea being too warm to generate a typical lake effect pattern of daytime on-shore winds and nighttime off-shore winds.

Local Wind Speed Frequencies

Direct comparison of wind speed data from the CIMIS stations with wind speed data from other monitoring sites is complicated somewhat by differences in instrument height. Wind speeds generally increase with height above the ground due to reduced friction effects of ground surfaces, vegetation, buildings, and other obstructions. The standard instrument height preferred by the National Weather Service is 10 meters (about 33 feet). Most CIMIS stations monitor wind conditions at a height of 2 meters (about 6.6 feet), which is more useful for assessing evaporation rates. The CIMIS station at the Salton Sea State Recreation Area (State Park site) monitors wind conditions at a height of about 5 meters (about 16 feet). To facilitate comparisons to other wind data, wind speed measurements from the CIMIS monitoring sites have been extrapolated to wind speeds at the standard 10-meter height.

Table 3.4-4 summarizes wind speed frequencies for the CIMIS State Recreation Area monitoring site (site #154) during 1997 (the only year of data available for that site). Wind speeds were highest during the winter, and lowest during the fall. As an annual average during 1997, wind speeds exceeded 15 mph only 4.8 percent of the time. Wind speeds exceeded 15 mph 9.3 percent of the time during winter months, 4.4 percent of the time during spring months, 2.3 percent of the time during summer months, and 3.3 percent of the time during fall months.

Table 3.4-5 summarizes wind speed frequencies for the CIMIS Salton City monitoring site (site #127) during 1997. Average wind speeds at the Salton City site were about 2 mph higher than those at the State Recreation Area site. Average

Table 3.4-4
1997 Seasonal and Annual Wind Speed Frequencies at the State Park Monitoring Site

WINTER 1997, STATE PARK SITE
Total Hours: 2,160
MEAN = 6.94 mph
MAXIMUM = 31.03 mph

FREQUENCY DISTRIBUTION BY MPH RANGE:

Lo End	Hi End	Hours	Percent	% Higher
0	3	444	20.56%	79.40%
3	6	831	38.47%	40.93%
6	9	322	14.91%	26.02%
9	12	205	9.49%	16.53%
12	15	156	7.22%	9.31%
15	18	96	4.44%	4.86%
18	21	66	3.06%	1.81%
21	24	28	1.30%	0.51%
24	27	11	0.51%	0.00%
27	30	0	0.00%	0.00%
30	33	1	0.05%	0.00%

SPRING 1997, STATE PARK SITE
Total Hours: 2,208
MEAN = 6.35 mph
MAXIMUM = 27.18 mph

FREQUENCY DISTRIBUTION BY MPH RANGE:

Lo End	Hi End	Hours	Percent	% Higher
0	3	421	19.07%	80.93%
3	6	831	37.64%	43.30%
6	9	553	25.05%	18.25%
9	12	178	8.06%	10.19%
12	15	128	5.80%	4.39%
15	18	59	2.67%	1.72%
18	21	19	0.86%	0.86%
21	24	10	0.45%	0.41%
24	27	8	0.36%	0.05%
27	30	1	0.05%	0.00%
30	33	0	0.00%	0.00%

SUMMER 1997, STATE PARK SITE
Total Hours: 2,208
MEAN = 6.09 mph
MAXIMUM = 21.69 mph

FREQUENCY DISTRIBUTION BY MPH RANGE:

Lo End	Hi End	Hours	Percent	% Higher
0	3	336	15.22%	84.78%
3	6	941	42.62%	42.16%
6	9	611	27.67%	14.49%
9	12	157	7.11%	7.38%
12	15	113	5.12%	2.26%
15	18	34	1.54%	0.72%
18	21	13	0.59%	0.14%
21	24	3	0.14%	0.00%
24	27	0	0.00%	0.00%
27	30	0	0.00%	0.00%
30	33	0	0.00%	0.00%

FALL 1997, STATE PARK SITE
Total Hours: 2,138
MEAN = 5.37 mph
MAXIMUM = 25.24 mph

FREQUENCY DISTRIBUTION BY MPH RANGE:

Lo End	Hi End	Hours	Percent	% Higher
0	3	542	25.35%	74.65%
3	6	1,001	46.82%	27.83%
6	9	340	15.90%	11.93%
9	12	108	5.05%	6.88%
12	15	76	3.55%	3.32%
15	18	47	2.20%	1.12%
18	21	15	0.70%	0.42%
21	24	6	0.28%	0.14%
24	27	3	0.14%	0.00%
27	30	0	0.00%	0.00%
30	33	0	0.00%	0.00%

Table 3.4-4
1997 Seasonal and Annual Wind Speed Frequencies at the State Park Monitoring Site *(continued)*

ANNUAL 1997, STATE PARK SITE

Total Hours:		8,714	
	MEAN =	6.19	mph
	MAXIMUM =	31.03	mph

FREQUENCY DISTRIBUTION BY MPH RANGE:

Lo End	Hi End	Hours	Percent	% Higher
-	-	-	-	-
0	3	1,743	20.00%	79.99%
3	6	3,604	41.36%	38.63%
6	9	1,826	20.95%	17.67%
9	12	648	7.44%	10.24%
12	15	473	5.43%	4.81%
15	18	236	2.71%	2.10%
18	21	113	1.30%	0.80%
21	24	47	0.54%	0.26%
24	27	22	0.25%	0.01%
27	30	1	0.01%	0.00%
30	33	1	0.01%	0.00%

Note: The anemometer height at the State Park site is about 5 meters. Measured wind speed values have been extrapolated to a standard10-meter height.

Table 3.4-5
1997 Seasonal and Annual Wind Speed Frequencies at the Salton City Monitoring Site

WINTER 1997, SALTON CITY SITE
Total Hours: 2,160
MEAN = 8.31 mph
MAXIMUM = 35.77 mph

FREQUENCY DISTRIBUTION BY MPH RANGE:

Lo End	Hi End	Hours	Percent	% Higher
-	-	-	-	-
0	3	250	11.57%	87.59%
3	6	834	38.61%	48.98%
6	9	382	17.69%	31.30%
9	12	230	10.65%	20.65%
12	15	135	6.25%	14.40%
15	18	108	5.00%	9.40%
18	21	112	5.19%	4.21%
21	24	49	2.27%	1.94%
24	27	26	1.20%	0.74%
27	30	16	0.74%	0.00%
30	33	11	0.51%	0.00%
33	36	7	0.32%	0.00%
36	39	0	0.00%	0.00%

SPRING 1997, SALTON CITY SITE
Total Hours: 2,207
MEAN = 8.33 mph
MAXIMUM = 29.72 mph

FREQUENCY DISTRIBUTION BY MPH RANGE:

Lo End	Hi End	Hours	Percent	% Higher
-	-	-	-	-
0	3	111	5.03%	94.97%
3	6	597	27.05%	67.92%
6	9	631	28.59%	39.33%
9	12	509	23.06%	16.27%
12	15	203	9.20%	7.07%
15	18	96	4.35%	2.72%
18	21	50	2.27%	0.45%
21	24	7	0.32%	0.14%
24	27	1	0.05%	0.09%
27	30	2	0.09%	0.00%
30	33	0	0.00%	0.00%
33	36	0	0.00%	0.00%
36	39	0	0.00%	0.00%

SUMMER 1997, SALTON CITY SITE
Total Hours: 2,207
MEAN = 9.29 mph
MAXIMUM = 29.22 mph

FREQUENCY DISTRIBUTION BY MPH RANGE:

Lo End	Hi End	Hours	Percent	% Higher
-	-	-	-	-
0	3	70	3.17%	96.83%
3	6	433	19.62%	77.21%
6	9	612	27.73%	49.48%
9	12	603	27.32%	22.16%
12	15	297	13.46%	8.70%
15	18	111	5.03%	3.67%
18	21	63	2.85%	0.82%
21	24	12	0.54%	0.27%
24	27	4	0.18%	0.09%
27	30	2	0.09%	0.00%
30	33	0	0.00%	0.00%
33	36	0	0.00%	0.00%
36	39	0	0.00%	0.00%

FALL 1997, SALTON CITY SITE
Total Hours: 2,184
MEAN = 7.51 mph
MAXIMUM = 26.28 mph

FREQUENCY DISTRIBUTION BY MPH RANGE:

Lo End	Hi End	Hours	Percent	% Higher
-	-	-	-	-
0	3	229	10.49%	89.51%
3	6	771	35.30%	54.21%
6	9	502	22.99%	31.23%
9	12	365	16.71%	14.51%
12	15	160	7.33%	7.19%
15	18	82	3.75%	3.43%
18	21	44	2.01%	1.42%
21	24	27	1.24%	0.18%
24	27	4	0.18%	0.00%
27	30	0	0.00%	0.00%
30	33	0	0.00%	0.00%
33	36	0	0.00%	0.00%
36	39	0	0.00%	0.00%

Table 3.4-5
1997 Seasonal and Annual Wind Speed Frequencies at the Salton City Monitoring Site *(continued)*

ANNUAL 1997, SALTON CITY SITE
Total Hours: 8,758
MEAN = 8.37 mph
MAXIMUM = 35.77 mph

FREQUENCY DISTRIBUTION BY MPH RANGE:

Lo End	Hi End	Hours	Percent	% Higher
0	3	660	7.54%	92.26%
3	6	2,635	30.09%	62.17%
6	9	2,127	24.29%	37.89%
9	12	1,707	19.49%	18.39%
12	15	795	9.08%	9.32%
15	18	397	4.53%	4.78%
18	21	269	3.07%	1.71%
21	24	95	1.08%	0.63%
24	27	35	0.40%	0.23%
27	30	20	0.23%	0.00%
30	33	11	0.13%	0.00%
33	36	7	0.08%	0.00%
36	39	0	0.00%	0.00%

Note: The anemometer height at the Salton City site (CIMIS station #127) is 2 meters. Measured wind speed values have been extrapolated to a standard 10-meter height.

wind speeds were highest during the winter, and lowest during the fall. As an annual average during 1997, wind speeds exceeded 15 mph 9.3 percent of the time. Wind speeds exceeded 15 mph 14.4 percent of the time during winter months, 7.1 percent of the time during spring months, 8.7 percent of the time during summer months, and 7.2 percent of the time during fall months.

3.5 NOISE

3.5.1 Introduction

The attenuation of noise levels with increasing distance from the noise source results in a fairly limited Phase I study area for noise issues. For this phase, the study area is within five miles of the Salton Sea. A more localized study area is appropriate for some discrete noise sources; such localized areas of influence are generally within half a mile of the noise source.

3.5.2 Noise Environment

Existing Noise Conditions

The primary sources of noise in the Salton Sea area include recreational activities, vehicle traffic, rail traffic, and agricultural equipment. Existing noise along the north shore of the Sea is dominated by vehicle traffic on State Route 86 and State Route 111 and agricultural equipment along the northeast shoreline. The Riverside County Comprehensive General Plan does not identify the Salton Sea as falling within 60 dB or higher noise contours from aircraft or roadway sources in Riverside County. The only activity proposed in this area is a potential fish processing plant on Torres Martinez Reservation lands and a shorebird and pupfish protection dike.

Existing noise sources along the east shore of the Sea include State Route 111 and the Southern Pacific Railway rail line. The Imperial County General Plan (1997) noise element identifies these areas as primary sources of noise along the Salton Sea. Other noise sources along the east shore include a fairly high level of recreational use associated with developed areas within the Salton Sea State Recreation Area; recreational noise sources including tent and RV camping, boating (powerboating and fishing), and other active recreational use of this area. The only activity proposed in this area is a potential EES east of the recreation area and State Route 111.

Existing noises sources along the south shore of the Salton Sea include State Route 86 and State Route 111, which are located further from the shoreline than along the rest of the Sea's perimeter, agricultural operations, and geothermal hydroelectric facilities on the southwest shore. The Imperial County General Plan (1997) noise element identifies State Route 86 and State Route 111 and a geothermal plant in the area southeast of the Salton Sea as primary sources of noise around the Salton Sea. Much of the south shore is made up of public lands, including the Sonny Bono National Wildlife Refuge, the Imperial County Wildlife Area-Wister Unit, and the inactive Salton Sea Test Base. The greatest area of wildlife sensitivity occurs along this part of the Sea and therefore may be more sensitive to noise. Recreational sources of noise include hunting and boating, though more passive forms of recreational activities result in lower levels of noise than recreational activities along the east shore. Potential activities proposed in this area include shorebird and pupfish protection ponds, concentration ponds, displacement dike, EES, and fish harvest pier.

The primary noise source along the west shore of the Salton Sea is State Route 86, which provides access to the greatest number of communities found around the Sea. Noise also stems from sport fishing, which occurs via some dirt roads but mainly via four boat ramps located in the communities within this area. The main activity proposed in this area is the northern reaches of a concentration pond.

3.6 FISHERIES AND AQUATIC RESOURCES

3.6.1 Introduction

The affected environment discussion for fish and aquatic resources is based on the food web established in the Sea. Because its inflow is largely agricultural drainage, the Sea receives large amounts of nitrogen and phosphorous. These nutrients create a rich environment for lower trophic levels, such as bacteria, phytoplankton, and phytobenthos. This productivity supports the higher trophic level represented by numerous fish species introduced to the Salton Sea. The aquatic food web of the Salton Sea is unique because it lacks an adult exclusively planktivorous (plankton-eating) fish. This puts added importance on bottom-dwelling organisms and limits success of some fish to forage from benthic substrate (Thiery 1999). A discussion of sport fishery in the Salton Sea, largely centered on orange-mouth corvina, also is included.

Aquatic habitats include freshwater marsh, cismontane alkali marsh, and open water and mudflats; the habitats are discussed in Section 3.8 of this report. The discussion of special status aquatic species is focused on fish and includes a discussion of the desert pupfish, the only fish species native to the Salton Basin (Thiery 1999). A discussion of the existing sport fishery also is provided.

The Phase I study area for fish and aquatic resources includes the Salton Sea, its tributaries, and adjacent shoreline and riverbanks. The ecosystem of the Salton Sea is composed of several components, which are discussed below.

The aquatic ecosystem in the Salton Sea has low diversity but high productivity, resulting from high nutrient loading from irrigation drain water. This eutrophic condition stimulates high primary productivity of phytoplankton and benthic (bottom-dwelling) algae, thus sustaining high secondary productivity of zooplankton and benthic worms, which create an extremely important decomposition energy pathway. This high productivity creates favorable conditions for fish that tolerate high temperatures, high salinity, and low concentrations of dissolved oxygen. However, at times, the decomposition of algal blooms resulting from excess nutrients diminishes the dissolved oxygen to levels that threaten the survival of aquatic resources. Conditions during algal blooms have been implicated in fish die-offs.

The low diversity in the Salton Sea ecosystem makes each link in the food web vital to the survival of species in the higher trophic levels. For example, the piscivorous (fish-eating) birds rely directly on the fish in the Salton Sea. Should the fish populations decline significantly, the piscivorous birds would decline as well. For this reason, there is great concern about adverse impacts from environmental pollutants and pathogens on the biota of the Salton Sea and its environs. Proper functioning of agricultural drainages is a vital part of the Salton Sea ecosystem operation. It is also a source of complex challenges to the ecosystem's viability. The water is vital but the excess nutrients and other environmental contaminants that it delivers to the Salton Sea are detrimental, particularly in combination with the avian and fish pathogens present there. Some studies examining contaminant (i.e. selenium) levels in fish and invertebrate tissue have been conducted in the Salton Sea. The results of these studies are discussed in Section 3.14, Public Health and Environmental Hazards.

3.6.2 Lower Trophic Levels

Bacteria

The abundance and significance of bacteria in alkaline saline lakes are not well understood or studied in general. Bacteria probably have a dual functional role, acting as both primary producers and decomposers. As with most saline lakes, the Salton Sea bacterial assemblage is virtually unstudied. There are purple and green sulfur bacteria present, but there have been no real attempts to study the open water or bottom-dwelling bacteria qualitatively or quantitatively. Levels of bacteria periodically are elevated at the south end of the Salton Sea as a result of elevated coliform bacterial levels in river discharge (RWQCB 1996).

Phytoplankton and Phytobenthos

Studies initiated in January 1998 in support of the CEQA/NEPA process included a focus on phytoplankton. The Sea is considered eutrophic, and phytoplankton is plentiful. This results in frequent algal blooms, often creating color changes and increased chlorophyll content in the Sea (Hurlbert 1999b). The dominant primary producers in the lake are phytoplankton and phytobenthos, microscopic plants that are found in the water column and benthic (bottom) habitats, respectively. The plant life in the Salton Sea is predominantly single-celled algae. Carpelan (1961) studied the Sea between 1954 and 1956 and found the major groups of algae to be diatoms (Chrysophyta), dinoflagellates (Pyrrophyta), and green algae (Chlorophyta). At that time, blue-green algae (Cyanophyta) also was found on the bottom of the Sea in shallow water and on buoys and pilings in the Sea.

In 1970, the USDI reported that the major species in the Salton Sea included diatoms (*Cyclotella caspia*, *Nitzchia longissima*, *Nitzschia* sp., *Pleurosigma* sp., *Thalassionema nitzschoides*), dinoflagellates (*Gyrodinium resplendens*, *Peridinium sp.*, *Cachonina niei*, *Exuviella* sp.), Euglenophyta (*Eutreptia* sp.), (*Westella botryoides*), and blue-green algae (*Oscillatoria* sp., *Phomidium* sp.).

During recent phytoplankton sampling efforts flourishing populations of three new sigmoid diatom species were observed (Hurlbert 1999c). These are *Gyrosigma balticum* (Ehrenberg) Rabenhorst, *Gyrosigma wormleyi* (Sullivant) Boyer, and *Pleurosigma ambrosianum*. The occurrence of *Gyrosigma balticum* (Ehrenberg) Rabenhorst so far inland is at least unusual if not unique. *Gyrosigma wormleyi* (Sullivant) Boyer is conventionally typified as a freshwater species; therefore, this finding is significant, and the ecology of this diatom must be extended to include saline habitats (Hurlbert 1999c). *Pleurosigma ambrosianum* is the dominant member of the plankton diatom assemblage during the winter. Samples collected prior to this most recent study indicated that many of the previously documented species are still present in the Sea. Hurlbert hypothesized (1999c) that the phytoplankton composition changes may be due both to an increase in salinity of the Sea, as well as from the introduction of tilapia, which includes plankton in its diet.

Invertebrates

There are five phyla of invertebrates represented within the Salton Sea: Protozoa, Rotifera, Nematoda, Annelida (segmented worms), and Arthropoda (crustaceans and insects). Some of the common invertebrates found in the Sea include ciliate protozoans, foraminifera (over two dozen species have been recorded in the Sea), *Brachionus plicatilis* (rotifer), *Apocyclops dengizicus* and *Cletocamptus dietersi* (copepods), *Balanus amphitrite saltonensis* (barnacle), *Neanthes succinea* (pileworm), *Gammarus mucronatus* (amphipod), and *Trichocorixa reticulata* (corixid, or water boatman). The rotifer *Brachionus plicatilis* is the dominant rotifer species in the Sea. It is completely planktonic and has great value as food for fish larvae. The pileworm *Neanthes* is considered a major food source for fish and some birds and thus is a significant species in the Sea benthos.

The major zooplanktonic organisms (microscopic animals) in the Salton Sea include *Brachionus*, the two copepods, the egg and larval stages of the pileworm, and the nauplia and cypris of the barnacle. Brine shrimp (*Artemia franciscana)*, brinefly larvae (*Ephydra riparia*), and some surface-dwelling insects (*Trichocorixa reticulata*) occur in Salton Sea. The remaining organisms and life history stages are considered to be primarily benthic. Most habitats in the lake are soft-bottomed sand or silt, with only a few rocky areas. This means all organisms that need to attach permanently to a hard surface are limited to rocky areas, docks, discarded debris, or inundated brush along the shore.

3.6.3 Fishery Resources

Fishery resources in the Salton Sea area are present in canals, irrigation ditches, rivers, and the Sea itself. Fish make up the entire submerged Salton Sea megafauna. The impact fish have on the Salton Sea benthic community is unknown, although the fish feed on all adult macroinvertebrates, except the acorn barnacle *Balanus amphitrite* and its planktonic larvae. Most of the fish in the Sea have been introduced from the Gulf of California by the CDFG and have supported a highly productive sport fishery.

The fish community experiences periodic large-scale die-offs. The reason for these events is not entirely clear, but is likely the result of rapid declines in dissolved oxygen levels (Salton Sea Science Subcommittee Meeting 12/8/99). These declines in dissolved oxygen are due in part to seasonal algal blooms. Due to the large algal blooms, high temperatures and shallow depth of the Sea, these die-offs are likely to continue as long as the Sea supports large numbers of fish.

Introductions to the Sea

Since fish were first introduced in the early 1900s, the Sea has been characterized by changing fish communities. Initially freshwater species were introduced to the Salton Sea from the Colorado River during the Sea's initial formation. Though no published records exist, the fish were noted to be abundant in both numbers and species (Evermann 1916). As both the salinity and water level increased over time, the original freshwater fish species disappeared.

In 1929, a biological survey conducted by Coleman (1929) recommended the introduction of sport fish into the Salton Sea. Between 1929 and 1956, the CDFG made numerous transplants of both fish and invertebrates to develop a sport fishery in the Sea. Of the numerous species intentionally transplanted by CDFG, only the pileworm (*Neanthes*, introduced as fish forage), mudsucker, and three sport fish (orange-mouth corvina, sargo, and bairdiella,) survived.

The threadfin shad (*Dorosoma petenense*) was introduced accidentally to the Salton Sea via an irrigation canal in 1955 (Walker et al. 1961). This fish cannot reproduce in the Sea (Meyer Resources, Inc. 1988) and is probably present only in the tributaries. Two species of tilapia, Mozambique tilapia (*Oreochromis mossambicus*) and Zill's tilapia (*Tilapia zillii*) were recorded in tributaries near the Sea in 1964 and have contributed to the sport fish industry. The accounts vary as to which species exists in the Sea, but it is most likely a hybrid of Mozambique tilapia (Meyer Resources Inc. 1988; Black 1981). Further research on the tilapia resources of the Salton Sea are currently being conducted by Barry Costa-Pierce.

Today, the Salton Sea supports numerous species of fish, including sailfin molly (*Poecilia latipinna)*, porthole livebearer (*Poeciliopsis gracilis)*, longjaw mudsucker (*Gillichthys mirabilis)*, mosquitofish (*Gambusia affinis affinis*), tilapia (*Oreochromis mossambicus* and *Tilapia zillii*), bairdiella (*Bairdiella icistia)*, sargo (*Anisotremus davidsoni)*, and orange-mouth corvina (*Cynoscion xanthulus)*. Each of these species is briefly described below.

Desert pupfish (*Cyprinodon macularius)* is currently the only known special status speices occurring in the Sea. This species is discussed in Section 3.6.4. Bairdiella, sargo, and corvina are marine species, while the remaining species are estuarine or freshwater fish with extreme salinity tolerances.

Tilapia

The most abundant species present in the Salton Sea, tilapia, is an introduced warm-water cichlid from Africa used in mosquito and weed control, commercial fish farming, and as an aquarium fish. Tilapia is a robust fish weighing up to 3.53 pounds and growing to 15.8 inches. Tilapia are mouth brooders (females carry the eggs and young fry in their mouths) and may spawn five to eight times per year. Tilapia are omnivorous, feeding on plankton, insects, larvae, crustaceans, and plant material. They are the major food source for corvina (a sport fish), pelicans, and other fish-eating birds; tilapia itself is an important sport fish (Black 1981; Meyer Resources Inc. 1988).

Tilapia migrate long distances and disperse their progeny widely beyond the area of initial introduction. As a result, tilapia can quickly overpopulate suitable environments and affect native fish and habitats. Tilapia have been blamed for the decline of the endangered desert pupfish in the Salton Sea.

Three species of tilapia may inhabit the Sea and associated tributaries/canals. Each of these species that inhabit the Sea is discussed below.

Zill's Tilapia (Tilapia zillii). *Tilapia zillii* is native to Africa. *T. zillii* is noted for its hardiness and can tolerate wide temperature ranges (7-42°C). *T. zillii* was imported to southern California for its ability to feed on nuisance aquatic weeds and other macrophytes, which were clogging irrigation canals.

T. zillii has high fecundity and frequent spawning periodicity, a slow overall growth rate to a small maximum size, and a narrow temperature optimum for good growth.

Mozambique Tilapia (Oreochromis mossambicus). Mozambique tilapia, or mouthbrooder, is one of the most widely spread exotic animals in the world. By 1968, this species of tilapia had been found in some 15 miles of irrigation canals (the Araz Drain and Reservation Main Drain) near Bard in Imperial County, California (Costa-Pierce 1999). The Salton Sea Science Subcommittee is investigating this species via the ongoing reconnaissance studies (Costa-Pierce 1999). Since it was not legally stocked into southern California waters until 1971 (Costa-Pierce 1999), tilapia likely represent rapid colonization from irrigation canals connected to California water.

Wami River Tilapia (Oreochromis urolepis hornorum). The Wami River tilapia originates from the Wami River in eastern Tanzania. The Wami River tilapia is famous for its role as the male parental stock used with female *Oreochromis mossambicus* to produce "all male" hybrid progeny (Costa-Pierce 1999). An all- male hybrid tilapia that could not reproduce excited worldwide interest. As a result, the Wami River tilapia was exported worldwide for aquaculture development and environmental control. The Salton Sea Science Subcommittee is investigating this tilapia species via the ongoing reconnaissance studies (Costa-Pierce 1999).

Anywhere in the tropical and subtropical aquatic environment where tilapia is introduced, there is a risk of interbreeding and hybridization among populations that may be distinct in the wild but reproductively compatible. Where a mixture of tilapia species has been stocked, reproductively viable hybrids have resulted (Costa-Pierce 1999). Hybrids of *Oreochromis mossambicus* x *Oreochromis urolepis hornorum* were stocked extensively into the Salton Basin to the point that it is unlikely that pure species lines of Wami River tilapia or Mozambique tilapia exist.

The salinity and temperature thresholds for the hybrid tilapia are not well understood; it is known, however, that the Mozambique tilapia has a wide salinity tolerance but a low tolerance for large fluctuations in water temperature (Costa-Pierce 1999). This likely holds true for the hybrid, which experiences large die-offs at the Salton Sea during periods of high water temperatures in the spring and summer and low water temperatures in the winter (Meyer Resources Inc. 1988; USFWS 1996). Further studies on tilapia ecology at the Salton Sea are being conducted (Costa-Pierce in prep.).

Bairdiella

Bairdiella, or gulf croaker, is native to the Gulf of California. It is common in shallow and moderate depths. The Salton Sea population stems from 67 fish introduced in 1950 to 1951 by CDFG (Walker et al. 1961). By 1952, sampling in the Sea indicated a sizable population (Walker et al. 1961). Bairdiella are small silvery fish and weigh on average about 5.6 ounces and grow to about 9.8 inches.

The diet of the young of the year consists of copepods and their larvae, barnacle larvae, fish eggs, and smaller larvae of their own. The adults feed primarily on pileworms (Quast 1961) and probably other invertebrates. Bairdiella are an important source of food for corvina however, little is known about the current population status of Bairdiella in the Salton Sea.

Sargo

Sargo have a native range from Point Conception, California, to southern Baja California and the upper Gulf of California. The population in the Salton Sea stems from the 65 fish introduced in 1951. Initially, they did not show an explosive increase. Evidence of spawning occurred in 1957, and by 1960 there was a large enough population to support a sport fishery (Walker et al. 1961).

Sargo has been reported to exceed a length of 17 inches. In the Salton Sea it has been reported to reach 2.2 pounds in weight and 13.8 inches in length. It has a deep body, a strong spinous first dorsal fin, and three strong spines in the anal fin. A black bar extends below the fifth and seventh dorsal spine. With its increase in numbers, the sargo became an important gamefish and forage fish in the Sea (Walker et al. 1961; Meyer Resources Inc. 1988). Its numbers, however, have greatly declined, and its present population status in the Sea is unknown.

Orange-mouth Corvina

Orange-mouth corvina has a native range within the Gulf of California. It was planted in the Salton Sea at various times between 1950 and 1955. It increased substantially to form the sport fishery in the Salton Sea (Walker et al. 1961), where it is considered the chief game fish. It is a long fish, with a tan back and silvery sides and can weigh over 30 pounds and grow to 42.5 inches. It has two almost separated dorsal fins and two anal spines. It was introduced at the same time as short-fin corvina, which showed initial signs of acclimation but was not able to spawn in the Sea.

The diet of young of the year corvina consists of barnacle nauplii and other plankters. When they are 1.2 to 2.4 inches, the young feed primarily on pileworms or other invertebrates. The adults feed on the fry and young of the year of tilapia, bairdiella, and other fish of appropriate size. Field data collected between 1987 and 1989 with salinities of 38,000 and 44,000 mg/L, respectively, showed a decrease in number of ichthyoplankton (larval fish) as a result of significant decline in both the late egg and early larval stages for corvina (Matsui et al. 1991b). However, a sport fishery still exists in the Sea.

Sailfin Molly

Sailfin molly has a native range along the east coast of North America, from North Carolina to the Yucatan Peninsula. The population in the Salton Sea is believed to have stemmed from escapes/releases from tropical fish farms in the 1960s (St. Amant 1966). Sailfin mollies inhabit freshwater and saltwater marshes, ponds, and ditches (Herbert et al. 1987). It is an oblong fish, reaching over 4.7 inches in length. It differs from most other freshwater species in that the females carry the developing eggs until they hatch internally, and the young emerge from the female alive (Eddy and Underhill 1978). Sailfin molly feeds on plants and small organisms associated with detritus and opportunistically on insects and their larvae (Eddy and Underhill 1978; Herbert et al. 1987). The species is tolerant of wide ranges of salinity (Herbert et al. 1987), and adults are reported to withstand salinities greater than 80,000 mg/L (Nordlie et al. 1992; Herre 1929).

Porthole Livebearer

Porthole livebearer native range includes Central America and southern Mexico (Lee et al. 1980). It probably was introduced through escapes/releases from tropical fish farms in the 1960s (Mearns 1975).

Longjaw Mudsucker

Longjaw mudsucker has a native range from central California to the Gulf of California. The Salton Sea population stems from 500 fish introduced in 1930 by CDFG (Walker et al. 1961). It is found mostly inshore around cover and quiet water (Walker et al. 1961). The longjaw mudsucker reaches a length of 5.5 inches. It has a long upper jaw reaching to the posterior part of the head. It is able to withstand high salinities and has been collected in the field with salinities of 83,000 mg/L (Barlow 1963).

The longjaw mudsucker diet consists of harpacticoid copepods, larvae, and nematodes for the juveniles and *Neanthes*, barnacles, juvenile pupfish, mudsuckers, and tilapia for the adults. It has value as a baitfish for corvina and historically was numerous enough at the Sea to support a small bait fishery. During certain seasons, longjaw mudsucker may be an important food item for corvina (Walker et al. 1961).

Mosquitofish

Mosquitofish has been introduced around the world for mosquito control, hence the common name, which it shares with at least five other fish species, including the guppy. Unfortunately, *G. affinis* is not as good at eating mosquitoes as the fishes it tends to replace in those new locations. Mosquitofish tend to replace native fishes where it is introduced, probably through competition for food and aggressive interactions. Mosquitofish is an aggressive fry eater and may feed on the fry of its neighbors, as well as on mosquito larvae or eggs.

3.6.4 Special Status Species

One of the 41 species of fish known to occur or that may occur in the Sea is considered sensitive by state or federal resource agencies. This species is the desert pupfish (*Cyprinodon macularius*).

Desert Pupfish

Desert pupfish is the only native species in the Salton Sea. It is both a California endangered species and a federally endangered species (Federal Register 51(61):10842-51). This is the largest of the North American pupfish. Although it may reach three inches in length, it is seldom more than half that size. Desert pupfish is a chubby, thick-bodied and slab-sided (Schoenherr 1990) fish. The females are pale with brownish blotches, and the males are brightly colored during the spring and summer with blue backs and golden bellies. Desert pupfish is an opportunistic feeder whose diet varies seasonally with food availability (Naiman 1979). Its diet consists of algae, minute organisms associated with detritus, insects, fish eggs, and small crustaceans (Cox 1972; Naiman 1979). It is not considered an important food for wading birds and other fish because of its low numbers (Walker et al. 1961; Barlow 1961).

Desert pupfish has a high tolerance for extreme environmental conditions, including ranges of temperature, dissolved oxygen, and salinity (Barlow 1958). Barlow (1958) reported that the adult desert pupfish survived salinity as high as 98,100 mg/L in the laboratory.

Although desert pupfish is extremely hardy in many respects, it prefers quiet water with aquatic vegetation (Schoenherr 1990), and it cannot tolerate competition or predation and thus is readily displaced by exotic fishes (USFWS 1986). It prefers backwater areas, springs, streams, and pools along the shoreline of the Salton Sea. Distribution of the desert pupfish and its designated critical habitat (after Sutton 1999) is shown in Figure 3.6-1.

Historically, desert pupfish were abundant along the shore of the Salton Sea through the 1950s (Barlow 1961). During the 1960s, the numbers declined, and by 1978, they were noted as scarce and sporadic (Black 1980). Declines are thought to have resulted from the introduction of tilapias into the Salton Sea (Bolster 1990).

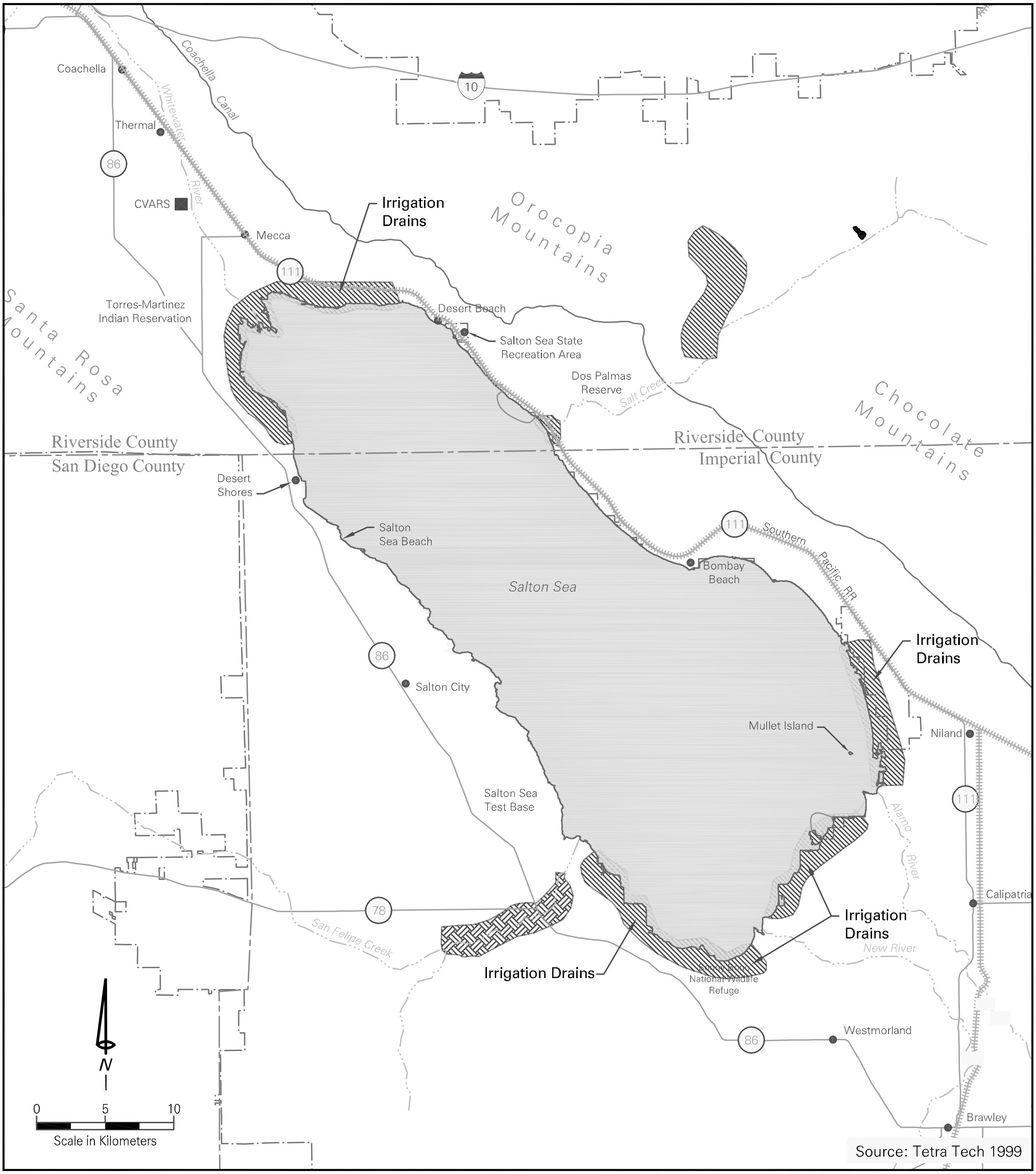
Surveys conducted by the US Fish and Wildlife Service (USFWS) to determine their distribution around the Salton Sea indicated that desert pupfish were present in more than fifty localities in canals and shoreline pools on the southern and eastern margins of the Salton Sea (Lau and Boehm 1991), and in small pools in Felipe Creek, Carrizo Wash, and Fish Creek Wash near the Salton Sea. Localities also include agricultural drains in the Imperial and Coachella valleys, shoreline pools around the Salton Sea, the mouth of Salt Creek in Riverside County, lower San Felipe Creek and its associated wetlands in Imperial County, and eight artificial refuge ponds (Bolster 1990; USFWS 1999).

Sutton (1999) observed desert pupfish movement between the Sea and nearby drains. Pupfish were observed moving from both irrigation drains and Salt Creek downstream into shoreline pools. The reverse movement from shoreline pools upstream into both drains and Salt Creek was also observed. The best evidence of movements were observed in the southwestern area between Trifolium 20A and a connected shoreline pool. These observations indicate the importance of agricultural drains as pupfish habitat and the potential for pupfish to use shoreline aquatic habitats as corridors. This potential movement may be important in providing genetic mixing between various populations.

3.6.5 Sport Fishery

The Salton Sea sport fishery consists sargo, bairdiella, orange-mouth corvina, and tilapia. The tilapia catch represents the first reported California sport fishery for this genus.

All of the sport fishes but tilapia are serial spawners, producing pelagic externally fertilized eggs during May, June, and July. Sargo generally spawns from February through July, peaking in March, biardiella from April to August, peaking in May, and corvina from May until July, peaking in June. Little information is available on the early development of the orange-mouth corvina.



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Pupfish Critical Habitat

Other Known Pupfish Areas from 1983 Survey

Distribution of Desert Pupfish and Designated Critical Habitat

Salton Sea, California

Figure 3.6-1

The lack of an effective planktivorous fish means that the productivity of the Sea has to travel through the benthos before reaching the fishery. There is, however, a question about the effectiveness of bairdiella, historically the most important forage fish, in benthic feeding. Whitney (1961) reported that the plumpness of bairdiella correlated closely with the occurrence of pileworm swarming. This implies that bairdiella could not reliably feed on pileworms directly from the bottom of the Sea. If pileworm swarming were as highly seasonal in the Salton Sea as it is in other habitats, it is possible that bairdiella would not survive in the Sea. This apparent benthic feeding limitation of bairdiella may also explain their partial replacement by *Tilapia mossambica*, which has a well-developed ability to forage food directly from benthic substrate (Costa-Pierce 1999).

Whether via bairdiella or tilapia, the Salton Sea food chain leading to corvina, the primary sport fish, consists of the following five or six steps: phytoplankton to zooplankton to bacteria/foraminifera to pileworm to bairdiella/tilapia to corvina. In most lakes, the chain to reach a similar-sized sport fish would be only the four steps of phytoplankton to zooplankton to planktivorous fish to piscivorous fish (sport fish).

The successful and adaptive nature of the Salton Sea's invertebrate fauna seems to indicate continued resilience for the Sea's community as a whole, but the pattern and length of the food chain places the sport fishery at considerable risk.

3.7 BIRD RESOURCES

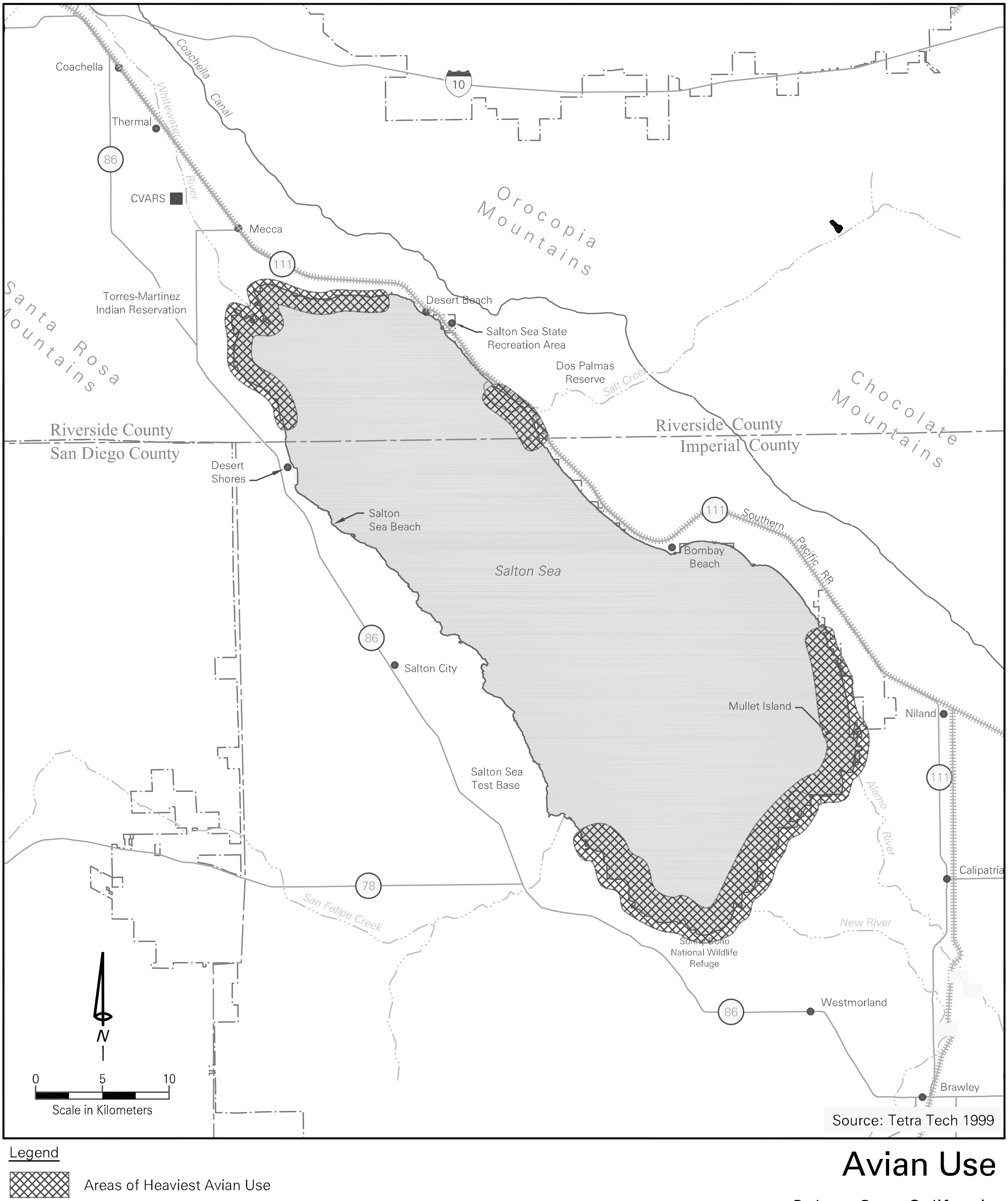
3.7.1 Introduction

The affected environment discussion for avian resources includes resident species, migratory species, and special status species. The discussion of resident and migratory species is broken down by foraging guilds, with an emphasis placed on waterbirds. The special status species presented are bird species that are listed as endangered, threatened, or of special concern by the US Fish and Wildlife Service or the California Department of Fish and Game. The Phase I study area for avian resources is defined as Imperial and Riverside counties. Data from studies on the Salton Sea being conducted through the Salton Sea Science Subcommittee has been incorporated into this section and into Section 4.7, as appropriate. When these studies are completed, the additional data will be used to analyze impacts of future actions.

The Salton Sea has become the center of avian biodiversity in the American Southwest, supporting over 400 species and averaging over 1.5 million birds annually. For example numbers of eared grebes alone have reached as many as 3.5 million birds at the Sea (Point Reyes Bird Observatory 1999). The Sea is an integral part of the Pacific Flyway, providing essential habitat for both resident and migrant species. The breeding bird communities on the Salton Sea represent a significant proportion of the breeding populations of many of these species. In addition, numerous species of migratory waterfowl depend on Salton Sea habitats. From 1978 to 1987 mid-winter waterfowl numbers averaged over 75,000 and 60,000 were counted in January 1999 alone (Point Reyes Bird Observatory 1999). The Sea and adjacent wetlands, river systems, natural habitats, and agricultural fields provide foraging and roosting opportunities for large numbers of birds. An estimated 97 percent of California's wetlands have already been converted to other uses (US Fish and Wildlife Service 1999), including the loss of suitable habitat in the Rio Colorado Delta area, causing the Salton Sea to become increasingly important for birds. In general, the highest avian use occurs in the southern and northern portions of the Sea (see Figure 3.7-1) (Point Reyes Bird Observatory 1999). Observed nesting colonies in use during 1999 include; cormorants on Mullet Island, islands near Wister Unit, and near the Whitewater River; herons and egrets along the southeast and southwest shoreline, and in snags near the Whitewater River; and terns and skimmers near the Alamo and Whitewater Rivers (Point Reyes Bird Observatory 1999).

Since the early 1990s, there has been an unprecedented series of fish and bird die-offs at the Salton Sea (Kuperman and Matey 1999). A variety of diseases have been diagnosed and some mortality remains undiagnosed despite extensive efforts. Studies seem to indicate that bacterial and viral pathogens are involved but that they are not necessarily the only cause of this mortality. The diseases include avian botulism associated with bacterial toxin (US Fish and Wildlife Service / National Wildlife Refuge 1996), Newcastle disease associated with a virus, and avian cholera and Newcastle disease both from bacterial sources. Recent events include a die-off of 4,515 cattle egrets in 1989 from salmonellosis (US Fish and Wildlife Service / National Wildlife Refuge 1996-1997), a die-off of an estimated 145,000 eared grebes in 1992 (Rocke 1999), loss of 15,000 pelicans and other fish-eating birds in 1996 from avian botulism (which killed over 10 percent of the western white pelican population) (Rocke 1999), a die-off of 6,845 birds in 1997 (Rocke 1999), and loss of 18,410 birds in 1998 from a variety of agents, including avian cholera, Newcastle disease, avian botulism, and salmonella (US Fish and Wildlife Service / National Wildlife Refuge 1998-1999). Avian disease has been present at the Sea for many years. The recent increase in disease occurrence, magnitude of losses, and variety of disease is indicative of an ecosystem under severe stress (Friend 1999). The varieties of diseases present have individual ecological relationships that must be determined to provide a sound foundation for addressing disease prevention and control. These relationships may include interactions between different types of disease agents (i.e., chemicals and microbes) in addition to abiotic aspects of the environment.

Preliminary studies have also shown increased selinium levels in white and brown pelicans (Burehler and de Peyster 1999). Comparison of samples from 19 birds from the Salton Sea and 4 birds from Sea World of California showed that the mean concentrations of selenium in liver tissue were significantly higher in both brown and white pelicans from the Salton Sea compared with pelicans from Sea World. There is also some indications that selinium my play a role in supression



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Areas of Heaviest Avian Use

Avian Use

Salton Sea, California

Figure 3.7-1

of the immune system of some birds (Fairbrother and Fowles 1990) and that the increased selinum levels in the pelicans may make them susceptible to botilism and other diseases. However, Burehler and de Peyster caution about making a direct correlation between selenium levels and increased bird dieoffs as many other factors may be contributing to this phenomenon.

3.7.2 Bird Species

Waterbirds represent the higher trophic levels of the food web of the Salton Sea and surrounding areas. The primary food resources in the Salton Sea are fish and aquatic invertebrates; but aquatic plants, terrestrial invertebrates, amphibians, and reptiles found along shorelines and in adjacent fresh/brackish water wetlands and agricultural drainage systems also provide food. Some species roost on the Sea but forage for grains, plants, terrestrial invertebrates, amphibians, reptiles, birds, and small mammals in surrounding agricultural fields and natural habitats. Certain species of raptors hunt for avian prey at the Sea or in neighboring habitats.

Waterbirds can be categorized into guilds based on their primary methods of foraging. Over 50 percent of waterbird species at the Salton Sea belong to guilds that forage in shallow water of the Sea and adjacent wetlands or that probe and glean for food along shorelines, mudflats, and in agricultural fields. About 20 percent of species feed on fish in deeper waters. The wader/shallow water foraging guild has the highest number of species occurring at the Salton Sea and in adjacent wetlands, followed by the ground gleaners, the probers, the generalists, bottom feeders, water column divers, plunge divers, predators, surface feeders, and hawkers. A number of these species, such as cattle egrets, geese, white-faced ibis (*Plegadis chihi*), long-billed curlews (*Numenius americanus*), and blackbirds, roost on the Salton Sea but forage primarily in adjacent agricultural lands.

The most numerous waterbird species at the Salton Sea is the eared grebe (*Podiceps nigricollis*), with 65,000 to 700,000 individuals annually (US Fish and Wildlife Service 1996). This is followed by black-necked stilt (*Himantopus mexicanus*), American avocet (*Recurvirostra americana*), and ring-billed gull (*Larus delawarensis*), each with an estimated 100,000 individuals. Northern shoveler (*Anas clypeata*) is fifth in abundance (60,000 individuals), followed by long-billed dowitcher (*Limnodromus scolopaceus*), with a population of 50,000, and ruddy duck (*Oxyura jamaicensis*), with 42,000 individuals.

The Salton Sea provides important food sources, especially fish and invertebrates, for many foraging waterbirds. Other birds rest on the Sea and along shorelines, foraging on plants and invertebrates in agricultural fields, and in natural habitats in the Imperial and Coachella valleys. Of those species typically occurring at the Salton Sea and in adjacent wetlands, primary food sources were categorized and ranked for each species using dietary information from Ehrlich et al. (1988), Bellrose (1980), and IID (1994). Aquatic invertebrates are the highest ranked food sources used by the 101 waterbird species. The second highest ranked food resource is terrestrial invertebrates, followed by fish, vegetative material (includes aquatic and terrestrial plant parts except for seeds), and seeds. Other food sources include small vertebrates (amphibians, reptiles, and small mammals), scavenged foods (garbage, carrion), avian prey, and plankton.

Most of the 101 species that depend on the Salton Sea and adjacent wetlands are winter visitors or migrants, and about 27 percent of waterbird species regularly breed at the Salton Sea. Over 80 percent of the breeding species occur as year-round residents, while the remainder are summer visitors. A small proportion of winter or spring visitors that sporadically breed at the Salton Sea augments the breeding population. Four percent of species are post-breeding visitors, and only one species occurs year-round as a nonbreeder.

Following is a description of waterbird foraging guilds found in the waters and along the shorelines of the Salton Sea and in adjacent fresh/brackish water ponds, marshes, agricultural drainage ditches, and riparian habitats, along with a description of some representative species found at the Salton Sea.

The ***wader/shallow foraging guild*** includes birds that use shallow waters, often along the edge of the Sea or in adjacent wetlands to forage for invertebrates, fish, other small vertebrates, or submerged aquatic vegetation. This guild is largely made up of herons, egrets, geese, and dabbling ducks.

Great blue heron (*Ardea herodias*) is the most widespread of all North American herons and is found throughout most of California (Zeiner et al. 1990a). At the Salton Sea, this species is a common year-round resident, with a population of 500 individuals (IID 1994). In 1992, great blue heron were reported nesting at Finney Lake near the south end of the Salton Sea. Great blue heron typically nests in colonies using large trees to support their substantial platform nests. Great blue heron forage in shallow water for fish, aquatic invertebrates, and small vertebrates. This species has declined in California in part because of a loss of wetland habitats and is considered sensitive at nesting colonies because human disturbance and activity at a colony may cause nest desertion (Zeiner et al. 1990a).

In California, great egret (*Casmerodius albus*) is distributed throughout the coastal lowlands and the Central Valley as a winter visitor or year-round resident (Zeiner et al. 1990a). Great egret is a common year-round resident at the Salton Sea, with an annual population of about 300 individuals (US Fish and Wildlife Service 1993; IID 1994). Small numbers nest at Finney Lake near the south end of the Salton Sea. This species is similar to the great blue heron in foraging habits and nesting requirements.

Snowy egret (*Egretta thula*) is distributed throughout much of California as a winter visitor and nesting resident (Zeiner et al. 1990a). It is a common year-round resident at the Salton Sea, with a population of 500 to 1,000 individuals (US Fish and Wildlife Service 1993; IID 1994). This species nests at the Salton Sea at such locations as Finney Lake and Sonny Bono Salton Sea National Wildlife Refuge. It has been displaced by the cattle egret at several nesting colonies in the Salton Sea area (Garrett and Dunn 1981; Rosenberg et al. 1991). Snowy egret forages for a variety of foods in shallow water and nests in dense emergent wetland vegetation and in trees. Reasons for the decline of snowy egret in California include competition for nest sites with cattle egret, abandonment of nesting colonies because of human intrusion, and a susceptibility to pesticides and herbicides in foraging and nesting habitats (Zeiner et al. 1990a).

The ***prober foraging guild*** is characterized by birds (includes many shorebirds) that probe with their bills for invertebrates on or along exposed sandy beaches, mudflats, and submerged shoreline.

Long-billed curlew (*Numenius americanus*) is a common winter visitor and a spring and fall migrant to the Salton Sea, with a peak population of up to 20,000 individuals (US Fish and Wildlife Service 1993; IID 1994). It probes for terrestrial and aquatic invertebrates in wetlands and agricultural fields. Long-billed curlew has declined, largely as a result of loss of prairie nesting habitat.

Bottom feeders dive underwater and forage on the bottom of the Sea and in neighboring freshwater ponds for invertebrates and submerged vegetation. Typically, this guild forages in deeper waters than the wader/shallow water guild. The bottom feeding guild includes diving duck species, such as canvasback (*Aythya valisineria*), scaup species, goldeneye, bufflehead (*Bucephala albeola*), and ruddy duck (*Oxyura jamaicensis*).

The ***water column diver*** guild is composed of cormorants, grebes, and mergansers that dive under the surface of the water to various depths and forage for fish.

An estimated 5,000 year-round resident and migrating western grebes (*Aechmophorus occidentalis*) occur at the Salton Sea (IID 1994). This species dives through the water column, primarily foraging for fish. Western grebes breed at the Salton Sea, using the open waters for courtship, foraging, and flocking and using the adjacent wetlands for nesting. This species typically nests in colonies using emergent vegetation (e.g., tules and cattails) to anchor nests. Western grebe is declining throughout their range because of loss of wetland habitats and the introduction of pesticides into watersheds (Zeiner et al. 1990a). Grebes also are vulnerable to human encroachment and disturbance at nesting colonies, and injury or death from human trash (e.g., fishing line and plastic six-pack holders).

Clark's grebe (*Aechmophorus clarkii*) has been distinguished as a separate species from western grebe (American Ornithologist's Union 1999). It is less common in southern California, although its numbers are uncertain, because this species formerly was included in counts of western grebes. Approximately 500 Clark's grebes occur as migrants and year-round residents at the Salton Sea (IID 1994). Clark's grebe uses the same foraging and nesting habitats as western grebe and faces the same threats.

Members of the ***plunge diver guild*** search for fish while flying, then dive to just below the surface to capture their prey. The plunge diving guild includes California brown pelican (*Pelecanus occidentalis californicus*), osprey (*Pandion haliaetus*), and tern species. The brown pelican is described as a special status species in Section 3.7.3.

Caspian tern (*Sterna caspia*) is a common summer resident and migrant at the Salton Sea, nesting sporadically (US Fish and Wildlife Service 1993). A population of about 500 individuals has been recorded at the Salton Sea (IID 1994). Caspian terns nest in dense colonies on undisturbed islands or shorelines.

Forster's tern (*Sterna forsteri*) is a common summer visitor and migrant and is an uncommon winter visitor at the Salton Sea (US Fish and Wildlife Service 1993). This species' population at the Salton Sea is estimated at 5,000 individuals, although nesting birds are far fewer (about 200 pairs) (IID 1994; Zeiner et al. 1990a). Forster's terns primarily plunge dive for small fish in the sea but also forage for aquatic and terrestrial invertebrates in adjacent habitats.

The ***surface feeder guild*** includes such birds as the American white pelican (*Pelecanus erythrorhynchos*) that swim or float on the surface of the water and submerge their heads to catch fish near the surface. This guild also includes the black skimmer (*Rhynops niger*), which flies low over the water scooping up aquatic invertebrates and small fish from the surface. These species are described in Section 3.7.3.

The ***predator guild*** is represented by raptors that hunt over the waters of the Sea, such as American peregrine falcon (*Falco peregrinus anatum*), or along shorelines and adjacent wetlands, such as northern harrier (*Circus cyaneus*), sharp-shinned hawk (*Accipiter striatus*), and Cooper's hawk (*A. cooperii*). These species are described in Section 3.7.3.

Ground gleaners pick up mostly invertebrates and some seeds from the sand and other shoreline substrates along the Sea. This guild also scavenges for dead aquatic organisms along the shoreline. Typical ground gleaners are cattle egrets (*Bubulcus ibis*), plovers, black-crowned heron, and horned lark.

Black-crowned night heron (*Nycticorax nycticorax*) is a common year-round breeding resident and migrant at the Salton Sea with an estimated population of 4,000 individuals (US Fish and Wildlife Service 1993; IID 1994). It feeds at night in shallow water along the edges of fresh and saline emergent wetlands, searching for fish, invertebrates, and small vertebrates. Black-crowned night heron nest and roost in trees with thick concealing foliage or in dense emergent wetlands. Although still fairly common, black-crowned night heron is considered sensitive because its known breeding colonies are vulnerable to human disturbance (Zeiner et al. 1990a). Loss of riparian and wetland habitats, environmental contaminants, and introduced predators pose additional threats to this species.

The California horned lark (*Eremophila alpestris actia*) is a resident of grasslands, deserts, and other open habitats, such as agricultural fields, beaches, and disturbed areas. At the Salton Sea, the lark is an uncommon year-round breeding resident whose population is substantially augmented during winter and fall by winter visitors (US Fish and Wildlife

Service 1993; Zeiner et al. 1990a). Horned lark forages for insects and other invertebrates on the ground, where it also nests. This species forms large flocks during the nonbreeding season.

Hawkers capture insects while in flight, often taking short flights from a perch or hovering. Examples in this foraging guild include gull-billed tern (*Sterna nilotica*), swifts, and common tern (*S. hirundo*).

Vaux's swift (*Chaetura vauxi*) is a summer resident of northern California and breeds fairly commonly in the Coast Ranges, the Sierra Nevada, and possibly the Cascade Range (Zeiner et al. 1990a). This species is a common spring migrant at the Salton Sea, where thousands of migrating birds have been documented at the north end; but the species is relatively uncommon elsewhere in the Salton Basin (Garrett and Dunn 1981). Vaux's swifts nest in tall snags or fire-charred trees (especially conifers) and often prefer to forage over water (Zeiner et al. 1990a). This species winters in Mexico and Central America, with small numbers of birds irregularly wintering in the coastal lowlands of southern California.

The ***generalist*** foraging guild includes gull species, American coots (*Fulica americana*), common moorhen (*Gallinula chloropus*), and other species that use a wide variety of food sources and employ various foraging techniques on shore and in the water.

California gull (*Larus californicus*) is a common visitor to the Salton Sea most of the year, except for the winter when it is uncommon (US Fish and Wildlife Service 1993). It scavenges for dead fish and debris along shorelines and hunts for terrestrial invertebrates, fish, and small vertebrates at the sea and in adjacent aquatic and agricultural habitats. This species is considered sensitive in California at its nesting colonies at Mono Lake and across the northeastern plateau region (Zeiner et al. 1990a; CDFG 1992).

3.7.3 Special Status Species

Table 3.7-1 lists special status species that have been identified in the Salton Sea study area. A description of most of the species listed and their distribution at the Salton Sea Basin is given below. Table 3.7-2 describes the occurrence by season in the Salton Sea Basin and whether or not they are breeding in the basin.

California brown pelican (*Pelecanus occidentalis californicus*) is found primarily in estuarine, marine subtidal, and open waters. Nesting colonies are found on the Channel Islands, the Coronado Islands, and on islands in the Gulf of California (Garrett and Dunn 1981). The brown pelican nesting colony closest to the Salton

Table 3.7-1
Special Status Bird Species

Scientific Name	Common Name	Federal*	State*	Other*

Accipiter cooperii	Cooper's hawk			CDFG: SC
A. striatus	Sharp-shinned hawk			CDFG: SC
A. gentilis	Northern goshawk	Species of Concern		
Agelaius tricolor	Tri-colored blackbird	Species of Concern		CDFG: SC
Aquila chrysaetos	Golden eagle			CDFG: SC
Asio flammeus	Short-eared owl			CDFG: SC
A. otus	Long-eared owl			CDFG: SC
Athene cunicularia	Burrowing owl	Species of Concern		CDFG: SC
Branta canadensis leucopareia	Aleutian Canada goose	Threatened		
Buteo regalis	Ferruginous hawk	Species of Concern		CDFG: SC
B. swainsoni	Swainson's hawk		Threatened	
Charadrius alexandrinus nivosus	Western snowy plover	Threatened		CDFG: SC
C. montanus	Mountain plover	Potentially Threatened		CDFG: SC
Childonias niger	Black tern	Species of Concern		
Circus cyaneus	Northern harrier			CDFG: SC
Coccyzus americanus occidentalis	Western yellow-billed cuckoo		Endangered	
Colaptes chrysoides	Gilded flicker		Endangered	
Contopus cooperi	Olive-sided flycatcher	Species of Concern		
Dendrocygna bicolor	Fulvous whistling-duck	Species of Concern		CDFG: SC
Dendroica petechia	Yellow warbler			CDFG: SC
D. petechia brewsteri	California yellow warbler			CDFG: SC
Egretta rufescens	Reddish egret	Species of Concern		
Empidonax traillii brewsteri	Little willow flycatcher	Species of Concern	Endangered	
E. traillii extimus	Southwest willow flycatcher	Endangered	Endangered	
Falco columbarius	Merlin			CDFG: SC
F. mexicanus	Prairie falcon			CDFG: SC
Grus canadensis tabida	Greater sandhill crane		Threatened	
Haliaeetus leucocephalus	Bald eagle	Threatened	Endangered	
Icteria virens	Yellow-breasted chat			CDFG: SC
Ixobrychus exilis	Least bittern	Species of Concern		CDFG: SC
Lanius ludovicianus	Loggerhead Shrike	Species of Concern		
Larus atricilla	Laughing gull			CDFG: SC
Laterallus jamaicensis coturniculus	California black rail	Species of Concern	Threatened	
Melanerpes uropygialis	Gila woodpecker		Endangered	
Micrathene whitneyi	Elf owl		Endangered	
Mycteria americana	Wood stork			CDFG: SC
Myiarchus tyrannulus	Brown-crested flycatcher			CDFG: SC

Table 3.7-1
Special Status Bird Species *(continued)*

Scientific Name	Common Name	Federal*	State*	Other*
Pandion haliaetus	Osprey			CDFG: SC
Parabuteo unicinctus	Harris' hawk			CDFG: SC
Passerculus sandwichensis rostratus	Large-billed savannah sparrow	Species of Concern		
Pelicanus erythrorhynchos	American white pelican			CDFG: SC
P. occidentalis	Brown pelican	Endangered	Endangered	
Phalacrocorax auritus	Double-crested cormorant			CDFG: SC
Plegadis chihi	White-faced ibis	Species of Concern		CDFG: SC
Piranga flava	Hepatic tanager			CDFG: SC
P. rubra	Summer tanager			CDFG: SC
Progne subis	Purple martin			CDFG: SC
Pyrocephalus rubinus	Vermilion flycatcher			CDFG: SC
Rallus longirostris yumanensis	Yuma clapper rail	Endangered	Threatened	
Riparia riparia	Bank swallow		Threatened	
Rynchops niger	Black skimmer			CDFG: SC
Sterna antillarum browni	California least tern	Endangered	Endangered	
S. elegans	Elegant tern	Species of Concern		
S. nilotica vanrossemi	Van Rossem's gull-billed tern	Species of Concern		CDFG: SC
Toxostoma bendirei	Bendire's thrasher			CDFG: SC
T. lecontei	Leconte's thrasher			CDFG: SC
Vireo bellii pusillus	Least Bell's vireo	Endangered	Endangered	
V. vicinior	Gray vireo			CDFG: SC

Sources: California Department of Fish and Game 1999. US Fish and Wildlife Service 1999.

* Federal and State Status have legal consequence. CDFG:SC (California Department of Fish and Game, Species of Concern) are assigned for information only.

Table 3.7-2
Occurrence of Special Status Birds Within the Salton Sea Basin

Species	Season of Occurrence				
Common Name	**Spring**	**Summer**	**Fall**	**Winter**	**Nesting**
Cooper's hawk	X	X	X	X	X
Sharp-shinned hawk			X	X	
Northern goshawk				X	
Tricolored blackbird	X	X	X	X	X
Golden eagle	X	X	X	X	X
Short-eared owl				X	
Long-eared owl	X	X	X	X	X
Burrowing owl	X	X	X	X	X
Aleutian Canada goose				X	
Ferruginous hawk				X	
Swainson's hawk	X				
Western snowy plover	X	X	X		X
Mountain plover				X	
Black tern	X	X	X	X	X
Northern harrier	X	X	X	X	X
Western yellow-billed cuckoo	X				
Gilded flicker	X	X	X	X	X
Olive-sided flycatcher	X	X	X		
Fulvous whistling-duck	X				
Yellow warbler	X	X	X		
California yellow warbler	X	X	X		
Reddish egret		X	X		
Little willow flycatcher	X	X	X		X
Southwest willow flycatcher	X	X	X		
Merlin			X	X	
Prairie falcon	X	X	X	X	X
Greater sandhill crane				X	
Bald eagle				X	
Yellow-breasted chat	X	X	X		X
Least bittern	X	X	X	X	X
Loggerhead Shrike	X	X	X	X	X
Laughing gull		X			
California black rail	X	X	X	X	X
Gila woodpecker	X	X	X	X	X
Elf owl	X	X			X

Table 3.7-2
Occurrence of Special Status Birds Within the Salton Sea Basin *(continued)*

Species	Season of Occurrence				
Common Name	**Spring**	**Summer**	**Fall**	**Winter**	**Nesting**
Wood stork				X	
Brown-crested flycatcher	X	X			X
Osprey	X		X		
Harris' hawk			X	X	
Large-billed savannah sparrow	X	X	X	X	X
American white pelican	X		X	X	X
Brown pelican	X	X	X	X	X
Double-crested cormorant	X	X	X	X	X
White-faced ibis	X	X	X	X	X
Hepatic tanager	X	X			
Summer tanager	X	X			
Purple martin	X	X	X	X	X
Vermilion flycatcher	X				
Yuma clapper rail	X	X	X	X	X
Bank swallow	X	X	X		X
Black skimmer	X	X	X		X
California least tern	X	X	X	X	X
Elegant tern	X	X	X	X	X
Van Rossem's gull-billed tern	X	X	X		X
Bendire's thrasher		X			
LeConte's thrasher	X	X	X	X	X
Least Bell's vireo	X	X	X		X
Gray vireo	X	X			

Sea is about 220 miles away, on San Luis Island in the Gulf of California (IID 1994). Historically, there was little use of the Salton Sea by brown pelicans, which were first confirmed overwintering at the Sea in 1987, with some visiting postbreeding pelicans documented in the late 1970s. The Salton Sea currently supports a year-round population of California brown Pelicans, sometimes reaching 5,000 birds. The brown pelican nested successfully at the Sea in 1996 and has attempted to nest since then (US Fish and Wildlife Service 1999). Brown pelicans are plunge divers, often locating fish from the air and diving into the water to catch them. They typically congregate at selected roosting locations that are isolated from human activity. The brown pelican population declined sharply in California in the 1960s due to the introduction of pesticides, such as 1,1,1-trichloro-2,2-bis(p-chlorophenyl)-ethane (DDE), into the food chain (Zeiner et al. 1990a). The Salton Sea area has shown significant levels of DDE contamination, which can affect the brown pelican's reproductive success when they