Appendix A

Cabrillo Power I LLC, Encina Power Station

316(b) Cooling Water Intake Effects Entrainment and Impingement Sampling Plan

Cabrillo Power I LLC, Encina Power Station

316(b) Cooling Water Intake Effects Entrainment and Impingement Sampling Plan

Submitted to the California Regional Water Quality Control Board – San Diego Region for Compliance with Section 316(b) of the Clean Water Act

August 27, 2004

Prepared by:
Tenera Environmental
971 Dewing Ave. Suite 101
Lafayette, CA 94549

141 Suburban Rd., Suite A2
San Luis Obispo, CA 93401

TABLE OF CONTENTS

1.0 INTRODUCTION 1

1.1 Development of the 316(b) Sampling Plan 1

1.2 Overview of the 316(b) Program 1

1.2.1 Target Organisms Selected for Study 1

1.3 Sampling Plan Organization 2

2.0 DESCRIPTION OF THE ENCINA POWER STATION AND CHARACTERISTICS OF THE SOURCE WATER BODY 3

2.1 Background 3

2.1.1 Plant Cooling Water System Description and Operation 3

2.2 Aquatic Biological Resources in the Vicinity of EPS 7

2.2.1 Agua Hedionda Lagoon 7

2.2.2 Pacific Ocean 8

3.0 ENTRAINMENT STUDY AND ASSESSMENT METHODS 10

3.1 Entrainment Study 10

3.1.1 Entrainment Sampling Methods 11

3.2 Source Water Study 12

3.2.1 Source Water Sampling Methods 13

3.3 Laboratory Processing and Data Management 13

3.4 Assessment Methods 14

3.4.1 Demographic Approaches (FH and AEL) 15

3.4.2 Empirical Transport Model (ETM) 16

4.0 IMPINGEMENT EFFECTS 18

4.1 Review of 1980 Impingement Study 18

4.2 Impingement Study Methods 19

4.2.1 Sampling Frequency 21

5.0 COOLING WATER SYSTEM IMPACT ASSESSMENT 23

5.1 Entrainment Effects Assessment 23
5.2 Summary of Entrainment Effects 24
5.3 Summary of Impingement Effects 24

6.0 LITERATURE CITED 25

LIST OF TABLES

Table 1. Encina Power Station generation capacity and cooling water flow volume. 3
Table 2. Cooling water approach velocities at EPS intake screens... 4

LIST OF FIGURES

Figure 1. Location of 2004 Encina Power Station 5
Figure 2. Schematic of Encina Power Station cooling water intake system................................ 6
Figure 3. Location of 2004 Encina Power Station entrainment and source water stations 12

1.0 INTRODUCTION

1.1 Development of the 316(b) Sampling Plan

This document presents a sampling plan for conducting the entrainment and impingement sampling necessary for a cooling water intake assessment required under Section 316(b) of the Federal Clean Water Act (CWA). Our sampling plan is based on a survey and compilation of available background literature, results of completed Encina Power Station (EPS) intake studies, and cooling water system studies at other power plants. The data from this study will form the basis of demonstrating compliance with the new Phase II regulations recently developed by the U.S. Environmental Protection Agency (USEPA).

1.2 Overview of the 316(b) Program

Section 316(b) of the Clean Water Act requires that "the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact" (USEPA 1977). Because no single intake design can be considered to be the best technology available at all sites, compliance with the Act requires a site-specific analysis of intake-related organism losses and a site-specific determination of the best technology available for minimizing those losses. Intake-related losses include losses resulting from entrainment (the drawing of organisms into the cooling water system) and impingement (the retention of organisms on the intake screens).

1.2.1 Target Organisms Selected for Study

The USEPA in its original 316(b) lists several criteria for selecting appropriate target organisms for assessment including the following:

1. representative, in terms of their biological requirements, of a balanced, indigenous community of fish, shellfish, and wildlife;
2. commercially or recreationally valuable (e.g., among the top ten species landed—by dollar value);
3. threatened or endangered;
4. critical to the structure and function of the ecological system (i.e., habitat formers);
5. potentially capable of becoming localized nuisance species;
6. necessary, in the food chain, for the well-being of species determined in 1–4; and
7. meeting criteria 1–6 with potential susceptibility to entrapment/impingement and/or entrainment.

In addition to these USEPA criteria there are certain practical considerations that limit the selection of target organisms such as the following:

- identifiable to the species level;
- collected in sufficient abundance to allow for impact assessment, i.e., allowing the model(s) constraints to be met and confidence intervals to be calculated; and
- having local adult and larval populations (i.e., source not sink species). For example, certain species that may be relatively abundant as entrained larvae may actually occur offshore or in deep water as adults.

These criteria, results from the previous 316(b) studies at EPS completed in 1980, results from a supplemental 316(b) study completed in 1997 (EA Engineering 1997), results from more recent studies on the ecological resources of Aqua Hedionda Lagoon (MEC Analytical Systems 1995), and data collected from studies described in this document will be used to determine the appropriate target organisms that will be evaluated in detail. The final target taxa will include the fishes that are found to be most abundant in the entrainment and impingement samples. In addition to large invertebrates that may be abundant in impingement, megalopal (final) larval stage of all species of cancer crabs (*Cancer* spp., which includes the edible species of rock crabs) and the larval stages of California spiny lobster will be identified and enumerated from all processed entrainment and source water plankton samples.

1.3 Sampling Plan Organization

This sampling plan first describes the EPS environment, design, and operating characteristics. The methods for obtaining updated information on the types and concentrations of planktonic marine organisms entrained by the power plant's CWIS are then discussed. A discussion of the theoretical considerations behind the assessment methods for the entrainment and impingement data is then presented. The final 316(b) report will also include an overview of alternative intake technologies and an analysis of feasible alternatives and their cost-effectiveness to minimize adverse entrainment and impingement effects of the EPS CWIS.

2.0 DESCRIPTION OF THE ENCINA POWER STATION AND CHARACTERISTICS OF THE SOURCE WATER BODY

2.1 Background

The Encina Power Station (EPS) is situated on the southern shore of the outer segment of the Agua Hedionda Lagoon in the city of Carlsbad, California, approximately 193 km (85 miles) south of Los Angeles and 16 km (35 miles) north of San Diego. EPS is a gas- and oil-fueled generating plant with five steam turbine generators (Units 1 through 5), which all use the marine waters of Agua Hedionda Lagoon for once-through cooling, and a small gas turbine generator. EPS began withdrawing cooling water from Agua Hedionda Lagoon in 1954 with the startup of commercial operation of Unit 1. Unit 2 began operation in 1956, Unit 3 in 1958, Unit 4 in 1973, and Unit 5 in 1978. The gas turbine was installed in 1968, which does not use cooling water in its operation. The combined net generation capacity of EPS is 966 megawatts electric (Mwe) (**Table 1**).

2.1.1 Plant Cooling Water System Description and Operation

Cooling water for the five steam electric generating units are supplied by two circulating and one or two service water pumps for each unit. The quantity of cooling water circulated through the plant is dependent upon the number of units in operation. With all units in full operation, the cooling water flow through the plant is 2,253 m^3/min (595,200 gallons per minutes [gpm]) or 3,244,430 m^3/day (857 million gallons per day [mgd]) based on the manufacturer ratings for the cooling water pumps (**Table 1**).

Table 1. Encina Power Station generation capacity and cooling water flow volume.

Unit	Gross Generation (MWe)	Cooling Water Flow m^3/min (gpm)	Daily Flow m^3/day (mgd)
1	107	193 (51,000)	278,000 (73)
2	104	193 (51,000)	278,000 (73)
3	110	204 (54,000)	294,350 (78)
4	300	806 (213,000)	1,161,060 (307)
5	325	856 (226,200)	1,233,010 (326)
Gas Turbine	20		
Total	**966**	**2,252 (595,200)**	**3,244,430 (857)**

Cooling water for all five steam-generating units is supplied through a common intake structure located at the southern end of the outer segment of Aqua Hedionda Lagoon, approximately 854 m (2,800 ft) from the opening of the lagoon to the ocean (**Figure 1**). Cooling water from the system is discharged into a small discharge pond that is located to the west of the intake structure. Water from the discharge pond flows through a culvert under Carlsbad Blvd and through a discharge canal across the beach and out to the ocean.

Seawater entering the cooling water system passes through metal trash racks on the intake structure that are spaced 8.9 cm (3½ in) apart and keep any large debris from entering the system. The trash racks are cleaned periodically. Behind the trash racks the intake tapers into two 3.7 m (12 ft) wide tunnels that further splits into four 1.8 m (6 ft) wide conveyance tunnels (**Figure 2**). Conveyance tunnels 1 and 2 provide cooling water for Units 1, 2 and 3, while conveyance tunnels 3 and 4 supply cooling water to Units 4 and 5, respectively. Vertical traveling screens prevent fish and debris from entering the cooling water system and potentially clogging the condensers. There are two traveling screens for Units 1, 2 and 3, two screens for Unit 4, and three screens for Unit 5. The mesh size on the screens for Units 1 through 4 is 0.95 cm (3/8 in), while the mesh size for Unit 5 is 1.6 cm (5/8 in).

The traveling screens can be operated either manually or automatically when a specified pressure differential is detected across the screens due to the accumulation of debris. When the specified pressure is detected the screens rotate and the material on the screen is lifted out of the cooling water intake. A screen wash system (70-100 psi), located at the head of the screen, washes the debris from each panel into a trough, which empties into collection baskets where it is accumulated until disposal.

The velocity of the water as it approaches the traveling screens has a large effect on impingement and entrainment and varies depending on the number of pumps operating, tidal level, and cleanliness of the screen faces. Approach velocities at high and low tide with all pumps operating were presented in the previous 316(b) study conducted in 1979 and 1980 (**Table 2**).

Table 2. Approach velocities at traveling screens for Encina Power Station with all circulating water and service water pumps in operation.

	Estimated Mean Approach Velocity (fps)	
Unit	**High Tide**	**Low Tide**
1	0.7	1.2
2	0.7	1.2
3	0.7	1.2
4	1.0	1.6
5	0.7	1.1

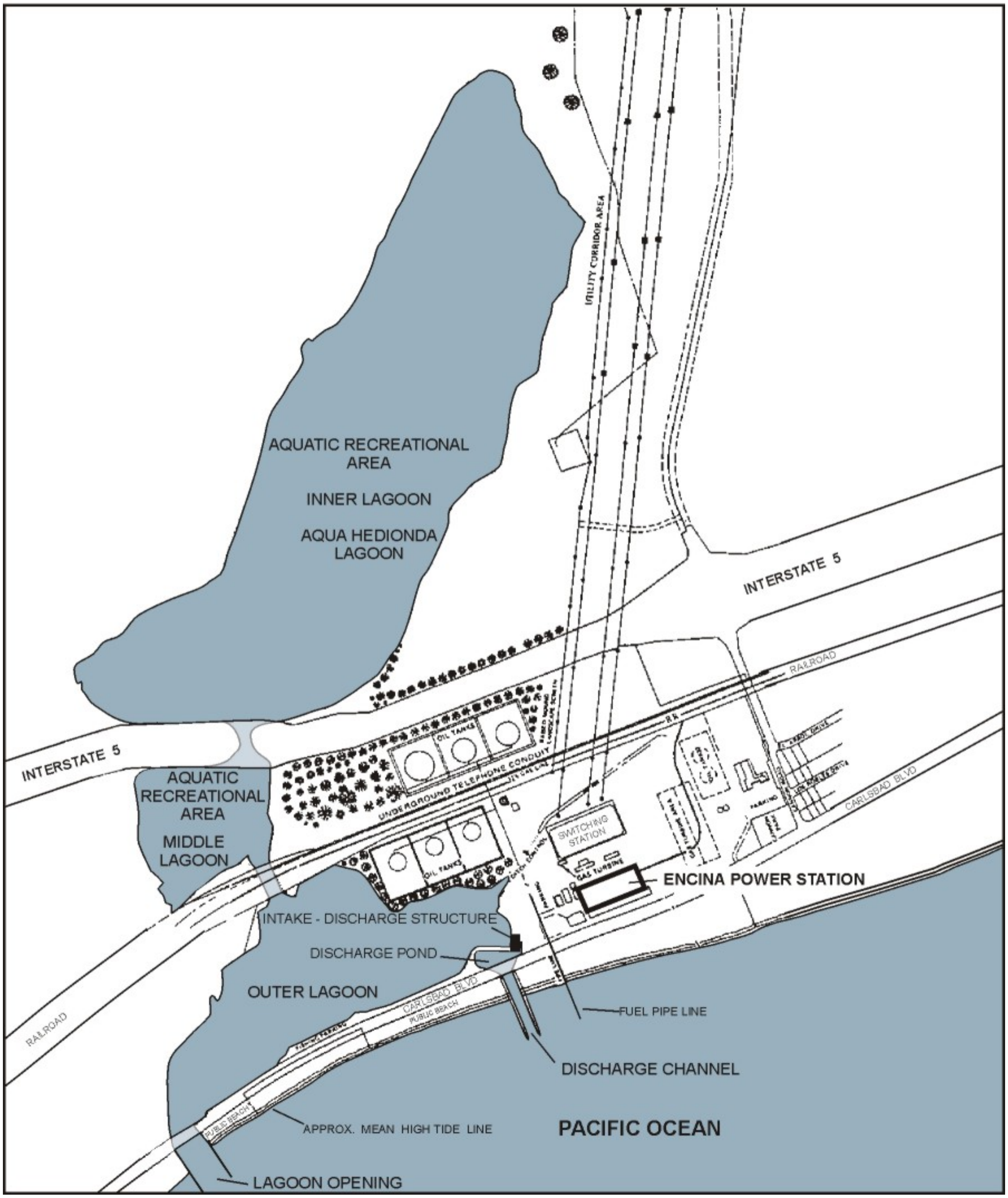


Figure 1. Location of Encina Power Station in Carlsbad, California

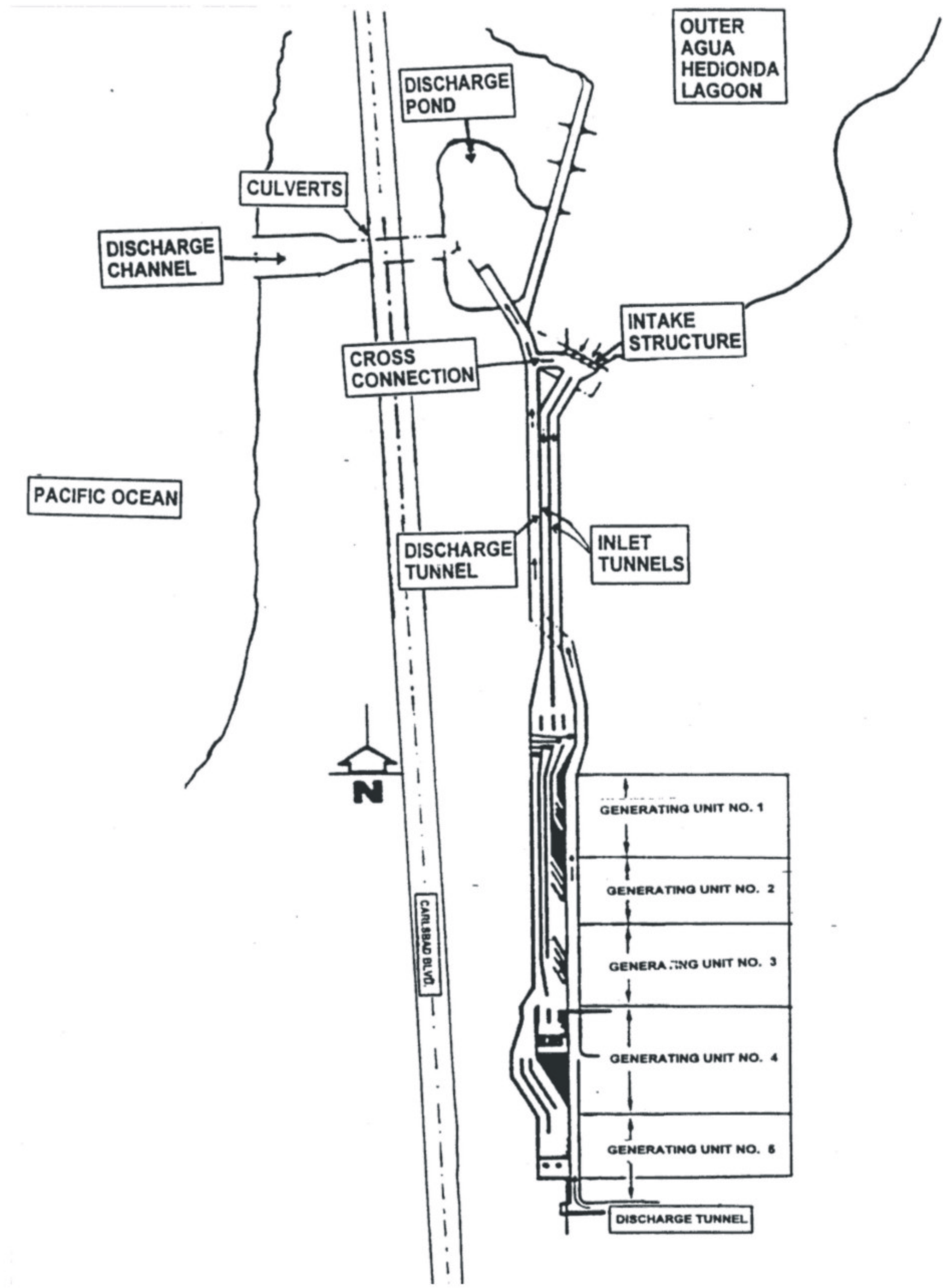


Figure 2. Schematic of Encina Power Station cooling water intake system.

2.2 Aquatic Biological Resources in the Vicinity of EPS

2.2.1 Agua Hedionda Lagoon

The Encina Power Station (EPS) is located on Agua Hedionda Lagoon, which is a man-made coastal lagoon that extends 2.7 km (1.7 miles) inland and is up to 0.8 km (0.5 mi) wide. The lagoon was constructed in 1954 to provide cooling water for the power plant. A railroad trestle and the Interstate Highway 5 bridge separate Agua Hedionda Lagoon into three interconnected segments: an Outer, Middle, and Inner lagoon. The surface areas of the Outer, Middle, and Inner lagoons are 26.7 (66 acres), 9.3 (23 acres), and 79.7 (197 acres) hectares, respectively. The lagoon is separated from the ocean by Carlsbad Boulevard and a narrow inlet 46 m [151 ft] wide and 2.7 m [9 ft] deep at the northwest end of the Outer Lagoon that passes under the highway and allows tidal exchange of water with the ocean.

Circulation and input into Aqua Hedionda Lagoon is dominated by semi-diurnal tides that bring approximately 2.0 million m^3 of seawater through the entrance to the Outer Lagoon on flood tides. Approximately half of this tidal volume flows into the Middle and Inner lagoons. On ebb tides this same tidal volume flows out through the entrance to the ocean. As a result of this tidal flushing the lagoon is largely a marine environment. Although freshwater can enter the lagoon through Buena Creek, which drains a 7,500 hectare (18,500 acres) watershed, for most of the year freshwater flow is minimal. Heavy rainfall in the winter can increase freshwater flows, reducing salinity, especially in the Inner Lagoon.

A study on the ecological resources of Agua Hedionda showed that it has good water quality and supports diverse infaunal, bird, and fish communities (MEC Analytical 1995). Eelgrass was found in all three lagoon segments, but was limited to shallower depths in the Inner Lagoon because water turbidity reduces photosynthetic light penetration in deeper areas. The eelgrass beds provide a valuable habitat for benthic organisms that are fed upon by birds and fishes. Although eelgrass beds were less well developed in areas of the Inner Lagoon, it also provides a wider range of habitats, including mud flats, salt marsh, and seasonal ponds that are not found elsewhere in Aqua Hedionda. As a result bird and fish diversity was highest in the Inner Lagoon.

A total of 35 species of fishes was found during the 1994 and 1995 sampling conducted by MEC (MEC Analytical 1995). The Middle and Inner lagoons had more species and higher abundances than the Outer Lagoon. During the 1995 survey only four species were collected in the Outer Lagoon, compared to 14 to 18 species in the Middle and Inner lagoons. The sampling did not include any surveys of the rocky revetment lining the Outer Lagoon that would increase the abundance and number of species collected. Silversides (Atherinopsidae) and gobies (Gobiidae) were the most abundant fishes collected. Silversides, including jacksmelt and topsmelt, that occur in large schools in shallow waters where water temperatures are warmest were most abundant in the shallower Middle and Inner lagoons. Gobies were most abundant in the Inner Lagoon which has large shallow mudflat areas that are their preferred habitat.

Special Status Species

The recent assessment of the ecological resources of Agua Hedionda did not collect any federally endangered tidewater goby (*Eucyclogobius newberryi*) that was once recorded from the lagoon (MEC Analytical 1995). The record of the occurrence may not be accurate or may predate the construction of the Outer Lagoon that provided a direct connection with the ocean. The current marine environment in the lagoon would not generally support tidewater gobies because they prefer brackish water habitats. No other listed fish species were collected in the study.

2.2.2 Pacific Ocean

Agua Hedionda Lagoon is tidally flushed through the small inlet in the Outer Lagoon by waters from the Pacific Ocean. The physical oceanographic processes of the southern California Bight that influence the lagoon include tides, currents, winds, swell, temperature, dissolved oxygen, salinity and nutrients through the daily tidal exchange of coastal seawater. Near the mouth of the lagoon the mean tide range is 3.7 ft (1.1 m) with a diurnal range of 5.3 ft (1.6 m). Waves breaking on the shore generally range in height from 2 to 4 ft (0.6 to 1.2 m), although larger waves (6 to 10 ft [1.8 to 3.0 m]) are not uncommon. Larger waves exceeding 15 ft (4.6 m) occur infrequently, usually associated with winter storms. Surface water in the local area ranges from a minimum of 57ºF (13.9ºC) to a maximum 72ºF (22.2ºC) with an average annual temperature between 63ºF (17.2ºC) and 66ºF (18.9ºC).

The outer coast has a diversity of marine habitats and includes zones of intertidal sandy beach, subtidal sandy bottom, rocky shore, subtidal cobblestone, subtidal mudstone and water column. Organisms typical of sandy beaches include polychaetes, sand crabs, isopods, amphipods, and clams. Grunion utilize the beaches around EPS during spawning season from March through August. Numerous infaunal species have been observed in subtidal sandy bottoms. Mollusks, polychaetes, arthropods, and echinoderms comprise the dominant invertebrate fauna. Sand dollars can reach densities of 1,200 per square meter. Typical fishes in the sandy subtidal include queenfish, white croaker, several surfperch species, speckled sanddab, and California halibut. Also, California spiny lobster and *Cancer* spp. crabs forage over the sand. Many of the typically outer coast species can occasionally occur within Agua Hedionda Lagoon, carried by incoming tidal currents.

The rocky habitat at the discharge canal and on offshore reefs supports various kelps and invertebrates including barnacles, snails, sea stars, limpets, sea urchins, sea anemones, and mussels. Giant kelp (*Macrocystis*) forests are an important habitat-forming community in the area offshore from Agua Hedionda. Kelp beds provide habitat for a wide variety of invertebrates and fishes. The water column and kelp beds are known to support many fish species, including northern anchovy, jack smelt, queenfish, white croaker, garibaldi, rockfishes, surfperches, and halibut.

Marine-associated wildlife that occur in the Pacific waters off Agua Hedionda Lagoon are numerous and include brown pelican, surf scoter, cormorants, western grebe, gulls, terns and loons. Marine mammals, including porpoise, sea lions, and migratory gray whales, also frequent the adjacent coastal area.

3.0 ENTRAINMENT STUDY AND ASSESSMENT METHODS

Entrainment studies were previously conducted in 1979 and 1980 at the EPS as part of the plant's initial Section 316(b) Demonstration requirement. The original study was conducted using pump sampling for plankton at the intake structure and net sampling of plankton at three source water stations in the Outer Lagoon (SDG&E 1980). For this study, plankton net sampling at the intake station and at an array of source water stations will be used to collect data for impact models that will be used to update the previous 316(b) Demonstration study. The following questions will be addressed by the entrainment and source water studies:

- What is the baseline entrainment mortality?
- What are the species composition and abundance of larval fishes, cancer crabs, and lobsters entrained by the EPS?
- What are the estimates of local species composition, abundance and distribution of source water stocks of entrainable larval fishes, cancer crabs, and spiny lobsters in Agua Hedionda Lagoon and the nearshore oceanic source waters?

The basis for estimation of entrainment effects is accurate knowledge of the composition and densities of planktonic organisms that are at risk of entrainment through the power plant cooling water system. Recent studies addressing 316(b) issues have focused on larval fishes and commercially important crustacean species (Tenera 2001, 2004). The basic study design involves the collection of plankton samples directly from the intake cooling water flow (entrainment sampling) and comparing the densities of various target species from plankton samples taken concurrently from the source water body (source water sampling). In the case of Encina Power Station (EPS), two areas contribute to the source water body; the lagoon sub-area and the nearshore sub-area, each having a unique contribution to the cooling water flows in terms of species composition and probability of entrainment.

3.1 Entrainment Study

Field data on the composition and abundance of potentially entrained larval fishes, *Cancer* spp. megalopae, and larval spiny lobster *Panulirus interruptus* will provide a basis to estimate the total number and types of these organisms passing through the power plant's cooling water intake system. For the purposes of modeling and calculations, through-plant mortality will be assumed to be 100 percent. Monthly entrainment and source water surveys started in June 2004 will be continued on a monthly basis through May 2005.

3.1.1 Entrainment Sampling Methods

This study was designed to quantify the composition and abundance of entrained larval fishes, *Cancer* spp. megalopae, and spiny lobster larvae. A map of the station locations that were sampled starting in June 2004 is shown in **Figure 3**. These stations will continued to be sampled through May 2005 on a monthly basis.

Sample collection methods are similar to those developed and used by the California Cooperative Oceanic and Fisheries Investigation (CalCOFI) in their larval fish studies (Smith and Richardson 1977) but modified for sampling in the shallow areas of Agua Hedionda Lagoon. Two replicate entrainment samples are collected from a single station (E1) located in front of the EPP intakes by towing plankton nets from a small boat. A net frame is equipped with two 0.71 m (2.33 ft) diameter openings each with a 335 µm (0.013 in) mesh plankton net and codend. The start of each tow begins close to the intake structure, proceeds in a northerly direction against the prevailing intake current, and ends approximately 100 m from the structure. It is assumed that all of the water sampled at the entrainment station would have been drawn through the EPS cooling water system.

The tows are done by first lowering the nets as close to the bottom as practical without contacting the substrate. Once the nets are near the bottom, the boat is moved forward and the nets retrieved at an oblique angle (winch cable at approximately 45° angle) to sample the widest strata of water depths possible. Total time of each tow is approximately two minutes at a speed of 1 kt during which a combined volume of at least $60 m^3$ ($2,119 ft^3$) of water is filtered through both nets. In similar studies conducted by Tenera, this volume has been shown to typically provide a reasonable number and diversity of larvae for data modeling. The water volume filtered is measured by calibrated flowmeters (General Oceanics Model 2030R) mounted in the openings of the nets. Accuracy of individual instruments differed by less than 5% between calibrations. The sample volume is checked when the nets reach the surface. If the target volume is not collected, the tow was repeated until the targeted volume is reached. The nets are then retrieved from the water, and all of the collected material rinsed into the codend. The contents of both nets are combined into one sample immediately after collection. The sample is placed into a labeled jar and preserved in 10 percent formalin. Each sample is given a serial number based on the location, date, time, and depth of collection. In addition, the information is logged onto a sequentially numbered data sheet. The sample's serial number is used to track it through laboratory processing, data analyses, and reporting.

Entrainment samples are collected over a 24-hour period, with each period divided into four 6-hour sampling cycles. Larval fishes show day-night differences in abundances related to their vertical migratory behavior and spawning periodicity, and the 24-hr sampling regime allows these differences to be averaged for assessing entrainment abundances. Concurrent surface water temperatures and salinities are measured with a digital probe (YSI Model 30).

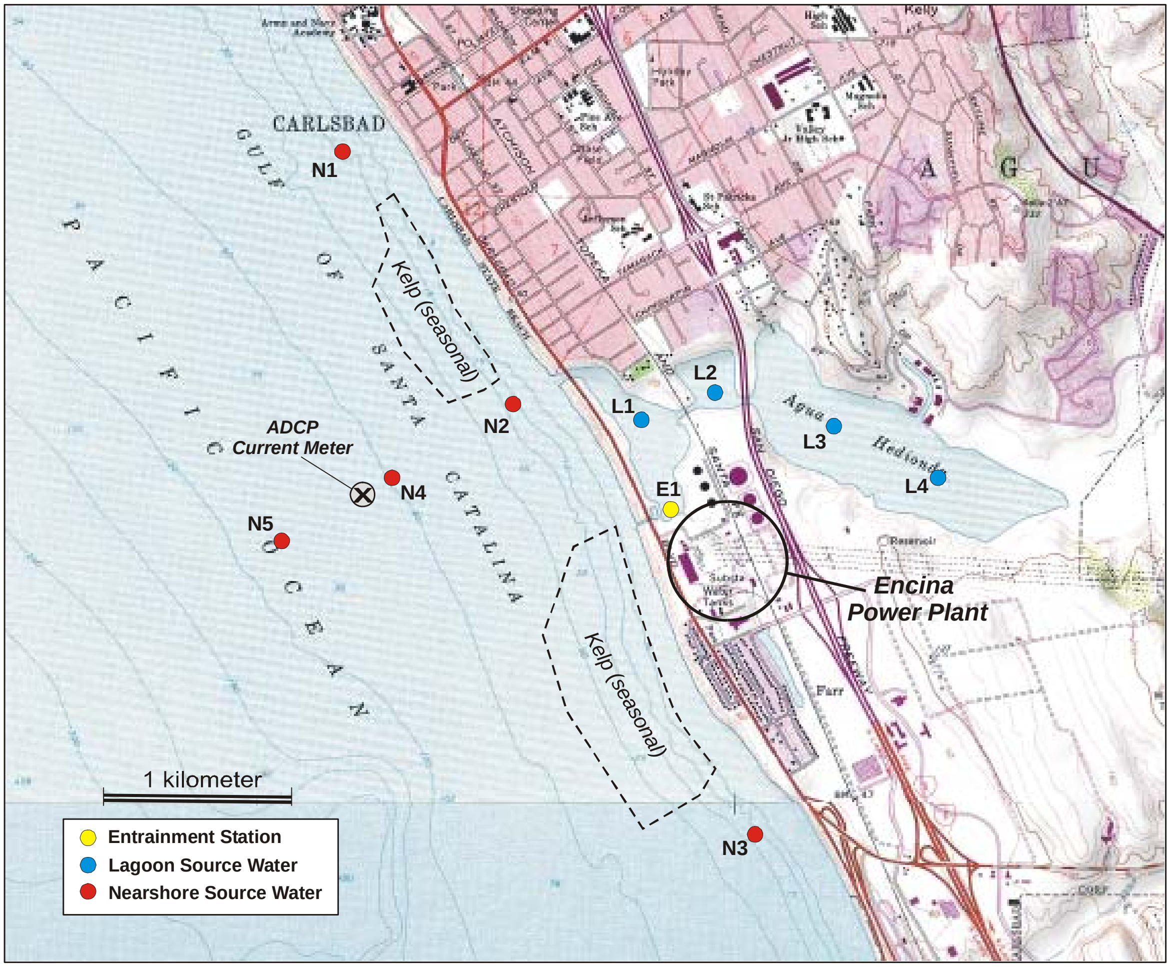


Figure 3. Location of Encina Power Station entrainment (E1) and source water stations (L1 through L4, and N1 through N5).

3.2 Source Water Study

This study was designed to quantify the local source water composition and abundance of larval fishes, *Cancer* spp. megalopae, and larval *Panulirus interruptus* in Agua Hedionda Lagoon and the nearshore source waters. The source water is partitioned into lagoon and nearshore sub-areas for modeling cooling water withdrawal effects (**Figure 3**). Collection methods are identical to the entrainment sample collection, with the exception that a single paired-net sample is collected at each station and the nearshore samples are be collected from a larger vessel capable of navigating open coastal waters in all weather conditions, day or night. The shallow waters in the Middle and Inner lagoons required a different sampling protocol than the oblique tows used at the Outer Lagoon and nearshore stations. The Inner Lagoon is sampled using a single frame plankton net mounted on the bow of a small boat which pushes the net through the water thereby eliminating any obstructions in front of the net during sampling. The net is raised and lowered during sampling to sample the range of depths available in the shallow Inner Lagoon.

The stations are stratified to include four lagoon stations within the inner (2), middle (1), and outer lagoons (1), and five nearshore stations that cover a depth range of 5–30 m (16–98 ft). The array of locations and depths was chosen to assure that all potential source water community types are represented. For example, stations in the inner lagoon will have a greater proportion of larvae from species with demersal eggs, such as gobies, that spawn in quiet water environments, while nearshore stations will have more larvae of species that spawn in open water such as California halibut and white seabass. The study will allow comparison to earlier larval fish studies done for the original EPS 316(b) in 1979-80 (SDG&E 1980).

A current meter is placed in the nearshore between Stations N4 and N5. The data from the meter will be used to characterize currents in the nearshore area that would directly affect the dispersal of planktonic organisms that could be entrained by the power plant. The data will be used to define the size of the nearshore component of the source water by using the current speed and the estimated larval durations of the entrained organisms.

The number of source water stations will be evaluated as data become available to determine if fewer stations can be sampled. For example, a reduction in the number of stations may be recommended if analysis indicates that only one station is necessary to characterize the Inner Lagoon, or the Middle Lagoon is sufficiently similar to the Inner Lagoon that it does not need to be sampled separately. Analysis of current meter data may also indicate that Station N5 does not need to be sampled because the current is predominantly alongshore and can be adequately characterized using the other stations closer to shore.

3.2.1 Source Water Sampling Methods

Sampling is conducted using the same methods and during the same time period described earlier for the entrainment collections (Section 3.1.1) with target volumes for the oblique tows of approximately 60 m^3 (2–3 minute tow at approximately 1 knot).

3.3 Laboratory Processing and Data Management

Laboratory processing will remove all larval fishes, megalopal stages of *Cancer* spp., and larvae of spiny lobster from the samples. Fish eggs will not be sorted from the samples. Although many marine fish eggs are described in the scientific literature, most identifications are difficult and very time consuming, and impact models can be adequately parameterized without egg density data. Larval fishes and all species of cancer crab megalopae will be identified to the lowest taxonomic level possible by Tenera's taxonomists. In addition, the developmental stage of fish larvae (yolk-sac, preflexion, flexion, postflexion, transformation) will be recorded on the data sheet. A laboratory quality control (QC) program for all levels of laboratory sorting and taxonomic identification will be applied to all samples. The QC program will also incorporate the use of outside taxonomic experts to provide taxonomic QC and resolve identification uncertainties.

Many larval fish cannot be identified to the species level; these fish will be identified to the lowest taxonomic classification possible (e.g., genus and species are lower orders of classification than order or family). Myomere and pigmentation patterns are used to identify many species; however, this can be problematic for some species. For example, sympatric members of the family Gobiidae share similar characteristics during early life stages (Moser 1996), making identifications to the species level uncertain. Those gobiids that we are unable to identify to species will be grouped into an “unidentified goby” category.

Laboratory data sheets will be coded with species or taxon codes. These codes will be verified with species/taxon lists and signed off by the data manager. The data will be entered into a computer database for analysis.

Length measurements will be taken on a representative sample of the target larval fish taxa. Approximately 100 fish from each taxon will be measured using a video capture system and Optimus™ image analysis software. The 100 fish from each taxon will be selected from the entrainment station based on the percentage frequency of occurrence of a taxon in each survey. For example, if 20 percent of the California halibut larvae for the entire year-long study were collected from during the June survey then 20 fish will be measured from that survey.

3.4 Assessment Methods

Potential cooling water intake system (CWIS) entrainment effects will be evaluated using a suite of methods, with no single method being superior to any others. The potential entrainment effects of the EPS CWIS, assuming 100 percent through-plant mortality, will be estimated using the site-specific field data collected in this proposed study. The potential for any such CWIS effects to cause long-term population level impacts will be evaluated through the use of three analytical techniques: proportional entrainment (*PE*), adult equivalent loss (*AEL*), and fecundity hindcasting (*FH*). The results of these analytical steps will support assessments with respect to species population demographics (e.g., standing stock, age structure stability, fishery trends, and sustainable harvest management plans).

*3.4.1 Demographic Approaches (*FH *and* AEL*)*

The fecundity hindcasting or *FH* analysis approach (Horst 1975) compares larval entrainment losses with adult fecundity to estimate the amount of adult female reproductive output eliminated by entrainment. It thereby hindcasts the numbers of adult females effectively removed from the reproductively active population. The accuracy of these estimates of effects is dependent upon such factors as accurate estimates of age-specific mortality from the egg and early larval stages to entrainment, and also on age-specific estimates of adult fecundity, spawning periodicity, and reproductive lifespan. If it is assumed that the adult population has been stable at some current level of exploitation and that the male:female ratio is known and constant, then fecundity and mortality are integrated into an estimate of loss by converting entrained larvae back into females (i.e., hindcasting). In making this conversion, the number of eggs, derived from the number of larvae adjusted for egg to larvae mortality, are divided by the average number of eggs produced by each age class (size) of reproductive females in the stable population’s ideal age structure. However this degree of information is rarely available for a population. In most cases, a simple range of eggs per females is reported without age-specificity.

An advantage of *FH* is that survivorship need only be estimated for a relatively short period of the larval stage (i.e., egg to larva). This method does not require source water sampling in addition to estimates of larval entrainment concentrations. This method assumes that the loss of a single female's reproductive potential is equivalent to the loss of adults. For the purpose of the resource assessment, if EPS-induced entrainment losses are to be equated to population level units in terms of fractional losses, it is still necessary to estimate the size of the population of interest. To this end, our assessment will employ any available, scientifically acceptable sources of information on fisheries stock or population estimates of unexploited species entrained by the EPS.

The adult equivalent loss or *AEL* approach (Goodyear 1978) uses age-specific estimates of the abundance of entrained or impinged organisms to project the loss of equivalent numbers of adults based on mortality schedules and age at recruitment. The primary advantage of this approach is that it translates power plant-induced, early life-stage mortality into equivalent numbers of adult fishes, the units used by resource managers. Adult equivalent loss does not necessarily require source water estimates of larval abundance in addition to entrainment estimates, as required in *PE*. This latter advantage may be offset by the need to gather age-specific mortality rates to predict adult losses and the need for information on the adult population of interest for estimating population-level effects (i.e., fractional losses). However, the need for age-specific mortality estimates can be reduced by various approximations as shown by Saila et al. (1987), who used six years of entrainment and two years of impingement data for winter flounder *Pleuronectes americanus*, red hake *Urophycis chuss*, and pollock *Pollachius virens* at the Seabrook Station in New Hampshire. Their model assumed an adult population at equilibrium, a stable age distribution, a constant male:female ratio, and an absence of density-dependent (i.e., compensatory) mortality between entrainment and recruitment to the adult or fished stocks. Input data to their model parameters were gathered in field surveys of spawning populations, egg and larval production, and local hydrology.

Declining populations can be accounted for in both the *AEL* and *FH* approaches by using age-specific adult mortality estimates from fishery catch data and by assuming no compensatory mortality. However, we know that this is not an assumption that fits the reality of population dynamics. The removal (mortality) of any life stage will have an effect if it exceeds the number of reproductive adults required to produce that number of larvae. That is, the adult population will decline one for one with every larva lost. This is clearly not the case, nor does every larva survive to become an adult. Although we have essentially no way of estimating the degree to which a population can sustain losses and remain stable, it is an important issue when estimating long-range effects. The effect, known as density-dependence (sometimes called compensation), can affect the vital rates of impacted organisms. Density-dependence is not confined to acting through mortality; growth and fecundity may also be density-dependent. In fisheries management models, which we will take as our working models in forecasting long-term population trends, the level of compensation possible in species can be examined empirically by the response of its population to harvest rates.

Some entrainment studies have assumed that compensation is not acting between entrainment and the time when adult recruitment would have taken place, and further, that this specific assumption resulted in conservative estimates of projected adult losses (Saila et al. 1987). Others, such as Parker and DeMartini (1989), did not include compensatory mortality in estimates of equivalent adult losses because of a lack of consensus on how to include it in the models and, more importantly, uncertainty about how compensation would operate on the populations under study. The uncertainty arises because the effect of compensation on the ultimate number of adults is directly related to which of the vital processes (fecundity, somatic growth, mortality) and which life stages are being affected. In particular, Nisbet et al. (1996) showed that neglecting compensation does not always lead to conservative long-term estimates of equivalent adult losses.

*3.4.2 Empirical Transport Model (*ETM*)*

The *PE* approach (Boreman et al. 1978, Boreman et al. 1981) will provide an estimate of incremental (conditional, Ricker 1975) mortality imposed by EPS on local source water larval populations by using empirical data (plankton samples) rather than relying solely on hydrodynamic and demographic calculations. Consequently, *PE* requires an additional level of field sampling to characterize abundance and composition of larvae using results from the larval fish surveys defined in this document (Section 3.2.1). These estimates of species-specific fractional losses (entrainment losses relative to source water abundance) can then be expanded to predict regional effects on appropriate adult populations using an empirical transport model (*ETM*), as described below. Required parameters for the *PE* approach include the rate of cooling water withdrawal, estimates of entrained larval fish concentrations, and estimates of the larval fish concentrations in the source waters.

The use of *PE* as an input to the empirical transport model (*ETM*) has been proposed by the U.S. Fish and Wildlife Service to estimate mortality rates resulting from cooling water withdrawals by power plants (Boreman et al. 1978, and subsequently in Boreman et al. 1981). Variations of this model have been discussed in MacCall et al. (1983) and have been used to assess impacts at a southern California power plant (Parker and DeMartini 1989). The *ETM* has also been used to assess impacts at the Salem Nuclear Generating Station in Delaware Bay, New Jersey (PSE&G 1993) as well as other power stations along the East Coast. Empirical transport modeling permits the estimation of annual conditional mortality due to entrainment while accounting for the spatial and temporal variability in distribution and vulnerability of each life stage to power plant withdrawals. The generalized form of the *ETM* incorporates many time-, space-, and age-specific estimates of mortality as well as information regarding spawning periodicity and duration, many of which are limited or unknown for the marine taxa being investigated at EPS. The applicability of the *ETM* to the present study at EPS will be limited by a lack of either empirically derived or reported demographic parameters needed as input to the model. However, the concept of summarizing *PE* over time that originated with the *ETM* can be used to estimate entrainment effects over appropriate temporal scales either through modeling or by making assumptions about species-specific life histories. We will employ a *PE* approach that is similar to the method described by MacCall et al. (1983) and used by Parker and DeMartini (1989) in their final report to the California Coastal Commission (Murdoch et al. 1989), as an example for the San Onofre Nuclear Generating Station (SONGS). This estimate can then be summarized over appropriate blocks of time in a manner similar to that of the *ETM*.

4.0 IMPINGEMENT EFFECTS

The two primary ways cooling water withdrawal can affect aquatic organisms are through impingement and entrainment. Larger organisms are subjected to impingement on the screening system on the power plant's cooling water intake system (CWIS) that excludes debris from the circulating water pumps. EPS presently has seven sets of vertical traveling screens in three separate areas. Approach velocities vary from approximately 0.7 fps at high tide to 1.6 fps at low tide. Impingement occurs when an organism larger than the traveling screen mesh size is trapped against the screens. These impinged organisms are assumed to undergo 100 percent mortality for the purposes of this study. The following questions will be addressed by the impingement study:

- What is the baseline impingement mortality?
- What are the species composition and abundance of fishes and macroinvertebrates impinged by EPS?

4.1 Review of 1980 Impingement Study

In earlier impingement studies at EPS, fish samples were collected from screen washes during high and low impingement periods for one year (SDG&E 1980). Samples were collected over two-12 hour periods during each day to represent daytime and nighttime impingement. Since samples were collected every day the study provides a direct measure of EPS impingement. During the one-year period during normal plant operations 76 species of fishes and 45 species of macro-invertebrates totaling 85,943 individuals and weighing 1,548 kg (3,414 lb) were impinged. During the seven heat treatments conducted during the sampling period 108,102 fishes weighing 2422 kg (5,341 lb) were collected. The most abundant fishes collected in impingement samples were actively swimming, open-water schooling species such as deepbody and northern anchovy, topsmelt, and California grunion. Other abundant species included queenfish and shiner surfperch. During heat treatments larger fishes were collected that were less common during normal impingement. These larger fishes probably live in the CWIS and are able to avoid impingement during normal plant operation, but succumb to the warmer temperatures during heat treatment. Marine plants, largely eelgrass and giant kelp, made up the largest component of material in impingement samples.

Impingement losses at EPS were much less when compared with impingement at other coastal plant in southern California. Impingement was much greater at the Redondo Beach Generating Station and San Onofre Nuclear Generating Station Unit 1, even though the cooling water flows at those two facilities are less than the flow at EPS (673 and 500 MGD, respectively compared with 828 mgd at EPS). The intake approach velocities at the screenwells at EPS are lower than the velocities at these other facilities allowing most fishes to avoid impingement by continuous or burst swimming. The SDG&E report (SDG&E 1980) and a later evaluation (EA 1997) both concluded that the biological impact of EPS was insignificant in terms of impingement losses.

4.2 Impingement Study Methods

The purpose of the proposed 316(b) impingement study will be to characterize the juvenile and adult fishes and selected macroinvertebrates (e.g., shrimps, crabs, lobsters, squid, and octopus) impinged by the power plant's CWIS. The sampling program is designed to provide current estimates of the abundance, taxonomic composition, diel periodicity, and seasonality of organisms impinged at EPS. In particular, the study will focus on the rates (i.e., number or biomass of organisms per m^3 water flowing per time into the plant) at which various species of fishes and macroinvertebrates are impinged. The impingement rate is subject to tidal and seasonal influences that vary on several temporal scales (e.g., hourly, daily, and monthly) while the rate of cooling water flow varies with power plant operations and can change at any time. A review of the previous impingement study at EPS will provide context for interpreting changes in the magnitude and characteristics of the present day impingement effects. Studies of the Agua Hedionda fish assemblages independent of EPS (e.g., MEC Analytical 1995) will also provide information regarding the marine environment in southern and central Agua Hedionda Lagoon.

In accordance with procedures employed in similar studies, impingement sampling will occur over a 24-hour period one day per week. Before each sampling effort, the trash racks will be cleaned and the traveling screens will be rotated and washed clean of all impinged debris and organisms. The sluiceways and collection baskets will also be cleaned before the start of each sampling effort. The operating status of the circulating water pumps on an hourly basis will be recorded during the collection period. Each 24-hour sampling period at the traveling screens will be divided into six 4-hour cycles. The traveling screens will remain stationary for a period of 3.5 hours then they will be rotated and washed for 30 minutes. The trash racks will be cleaned once every 24 hours. The impinged material from the traveling screens will be rinsed into the collection baskets associated with each set of screens and the impinged material from the trash racks will be collected in the bin on the rake apparatus. The debris and organisms rinsed from each set of traveling screens and the trash racks will be kept separate and processed according to the procedures presented in the following section.

If the traveling screens are operating in the continuous mode, then sampling will be coordinated with the intake crew so samples can be collected safely. A log containing hourly observations of the operating status (on or off) of the circulating water pumps for the entire study period will be obtained from the power plant operation staff. This will provide a record of the amount of cooling water pumped by the plant, which will then be used to calculate impingement rates. The same procedure will be used to coordinate additional sampling efforts at the trash racks in case they need to be cleaned more frequently than once every 24 hours. The sampling at each of the three sets of traveling screens will be offset by one hour to allow screen wash and collection to occur at each set of screens separately.

Impingement sampling will also be conducted during heat treatment “tunnel shock” operations. Procedures for heat treatment will involve clearing and rinsing the traveling screens prior to the start of the heat treatment procedure. At the end of the heat treatment procedure normal pump operation is resumed and the traveling screens rinsed until no more fish are collected on the screens. Processing of the samples will occur using the same procedures used for normal impingement sampling. We anticipate that up to eight heat treatments will occur during the one-year study period.

A quality control (QC) program will be implemented to ensure the correct identification, enumeration, length and weight measurements of the organisms recorded on the data sheet. Random cycles will be chosen for QC re-sorting to verify that all the collected organisms were removed from the impinged material.

Depending on the number of individuals of a given target species present in the sample, one of two specific procedures is used, as described below. Each of these procedures involves the following measurements and observations:

1. The appropriate linear measurement for individual fishes and motile invertebrates is determined and recorded. These measurements are made in millimeters to the nearest 1 mm. The following standard linear measurements are used for the animal groups indicated:

Fishes	Total body length for sharks and rays and standard lengths (fork length) for bony fishes.
Crabs	Maximum carapace width.
Shrimps & Lobsters	Carapace length, measured from the anterior margin of carapace between the eyes to the posterior margin of the carapace.
Gastropod & Pelecypod Molluscs	Maximum shell length or maximum body length.
Octopus	Maximum “arm” spread, measured from the tip of one tentacle to the tip of the opposite tentacle.
Squid	Maximum body length, measured from the tip of one tentacle to the posterior end of the body.

2. The wet body weight of individual animals is determined after shaking loose water from the body. Total weight of all individuals combined is determined in the same manner. All weights are recorded to the nearest 1 g.

3. The qualitative body condition of individual fishes and macroinvertebrates is determined and recorded, using codes for decomposition and physical damage. These codes are shown on the attached form.

4. Other non-target, sessile macroinvertebrates are identified to species and their presence recorded, but they are not measured or weighed. Rare occurrences of other impinged animals, such as dead marine birds, are recorded and their individual weights determined and recorded.

5. The amount and type of debris (e.g., *Mytilus* shell fragments, wood fragments, etc.) and any unusual operating conditions in the screen well system are noted by writing specific comments in the "Notes" section of the data sheet.

The following specific procedures are used for processing fishes and motile invertebrates when the number of individuals per species in the sample or subsample is $\leq$ 29 :

1. For each individual of a given species the linear measurement, weight, and body condition codes are determined and recorded on separate lines.

The following specific subsampling procedures are used for fishes and motile invertebrates when the number of individuals per species is > 29:

1. The linear measurement, individual weight, and body condition codes for a subsample of 30 individuals are recorded on individual lines of the data sheet. The individuals selected for measurement should selected after spreading out all of the individuals in a sorting container, making sure that they are well mixed and not segregated into size groups. Individuals with missing heads or other major body parts are eliminated from consideration, since linear measurements of them are not representative.

2. The total number and total weight of all the remaining individuals combined are determined and recorded on a separate line.

4.2.1 Sampling Frequency

Results from the previous impingement study indicated that the impingement is much greater during the heat treatment "tunnel shock" events. Almost 60 percent of the total impinged fishes (over 60 percent by weight) were collected during the seven tunnel shock events. Impingement rates during normal operations were much less. Although we have proposed to sample normal impingement weekly, we will evaluate the potential to reduce the sampling frequency to once every two weeks. The analysis will be done using the weekly data collected at EPS during this study and data from other southern California power plants with shoreline intake structures. The reduced sampling frequency may provide an adequate estimate of impingement especially since we will continue to sample impingement during each of the tunnel shock events when impingement is highest.

5.0 COOLING WATER SYSTEM IMPACT ASSESSMENT

The entrainment and impingement effects of the cooling water intake system for the EPS project will be assessed on the basis of historical studies and 12 months of recent plankton and 12 months of impingement survey information. The assessment will consider the effects of entraining larval fishes, crabs and lobsters, and impinging larger fishes and invertebrates in the CWIS. The three methods for assessing CWIS effects are fecundity hindcasting (*FH*), adult equivalent loss (*AEL*) and empirical transport modeling (*ETM*). These methods were explained in Section 3.5—Assessment Methods. The report will contain estimates of *AEL* and *FH* where data are available to parameterize these demographic approaches.

The impacts of impingement and entrainment on source water populations can be evaluated by estimating the fractional losses to the population attributable to the CWIS. Impingement rates and biomass estimates from the study will provide estimates of impingement losses that can then be translated directly to estimate potential impingement effects on local fisheries. Estimated entrainment losses are extrapolated to fishery losses using *FH* and *AEL* estimates. One constraint in the modeling approach is that life history data are available for only a portion of the entrained taxa and commercial fishery statistics will also only be available for a few of the entrained species (e.g., California halibut, northern anchovy, white croaker). Many of the fishes that have historically been entrained in highest numbers are small fishes that are not the focus of any recreational or commercial fishery.

Present-day findings on the EPS CWIS entrainment effects will be reviewed and assessed for the most abundant larval fish taxa, megalopal cancer crabs, and larval spiny lobster. By comparing the number of larvae and megalopae withdrawn by the power plant to the number available (i.e., at risk to entrainment), an estimate of the conditional mortality due to entrainment (*PE*) can be generated for each taxon or species. These estimates of conditional mortality will be combined in the *ETM* model to provide an estimate of the annual probability of mortality due to entrainment (P_m) that can be used for determining CWIS effects and the potential for long-term population declines. Fishery management practices and other forms of stock assessments will provide the context required to interpret P_m. In the case of a harvested species, P_m must be considered in addition to these harvest losses when assessing impacts and any potential for population decline.

5.1 Entrainment Effects Assessment

The assessment will focus on entrainment effects to the most abundant and to commercially or recreationally important fish taxa, cancer crab megalops and lobster larvae. Larval fishes analyzed will tentatively be the Goby complex, three Engraulid species, three Atherinopsid species, California halibut, white croaker, black croaker, spotted sand bass, and barred sand bass. These taxa likely comprise over 90 percent of all the entrained larval fishes based on earlier studies. Other species, which may occur in lower abundances, may also be included in the assessment because they represent species of commercial or recreational importance

5.2 Summary of Entrainment Effects

The length of time that a larval fish is in the plankton and subject to entrainment is a key parameter in *ETM* calculations. Length measurements taken from representative samples of the larval fish taxa presented in Section 4.0 will be used to estimate the number of days that larvae (for a specific taxon) are at risk to entrainment. Reports on larval duration from the scientific literature are likely to overestimate the period of time that larvae are exposed to entrainment. This is because ontogenetic changes during larval development result in increased swimming ability or behavioral changes, such as association with the bottom or other pre-settlement microhabitats. Possible outliers are eliminated by basing the minimum and maximum lengths on the central 98 percent of the length distribution for a taxon and excluding the lengths of the top and bottom percentiles. Estimates of larval growth rates (mm/day) are then used on this range to estimate the number of days the larvae are exposed to entrainment. The estimates of growth rates and their source from the literature will be presented in the impact assessment section for the different taxa. The average duration of entrainment risk for a taxon is calculated from the bottom percentile value to the mean value, while the maximum duration is calculated from the bottom percentile value to the 99 percentile value. Our estimates of the period of entrainment risk for cancer crabs and spiny lobster will be derived from literature values on the average age of the stages for each crustacean species.

5.3 Summary of Impingement Effects

Impingement effects in relation to source water fishery resources and potential ecological effects will be summarized based on data summarized from the earlier impingement study (SDG&E 1980), data on fish populations in Agua Hedionda Lagoon (MEC 1995), and CDF&G catch records for sport and commercial fishery resources.

6.0 LITERATURE CITED

Boreman, J., C. P. Goodyear, and S. W. Christensen. 1978. An empirical transport model for evaluating entrainment of aquatic organism by power plants. United States Fish and Wildlife Service. FWS/OBS-78/90, Ann Arbor, MI.

Boreman, J., C. P. Goodyear, and S. W. Christensen. 1981. An empirical methodology for estimating entrainment losses at power plants sited on estuaries. Transactions of the American Fishery Society 110:253-260.

EA Engineering, Science, and Technology. 1997. Encina Power Plant supplemental 316(b) assessment report. Prepared for San Diego Gas and Electric Company.

Goodyear, C. P. 1978. Entrainment impact estimates using the equivalent adult approach. USFWS Biological Services Program. FWS/OBS – 78/65. 14 pp.

Horst, T. J. 1975. The assessment of impact due to entrainment of ichthyoplankton. Pp. 107-118 *In* S. B. Saila (ed.) Fisheries and Energy Production: A Symposium. Lexington Books, D. C. Health and Company, Lexington, MA.

MacCall, A. D., K. R. Parker, R. Leithiser, and B. Jessee. 1983. Power plant impact assessment: A simple fishery production model approach. Fishery Bulletin 81(3):613-619.

MEC Analytical Systems. 1995. 1994 and 1995 field survey report of the ecological resources of Agua Hedionda Lagoon. Submitted to San Diego Gas and Electric Company. 47 pp. + Appendices.

Moser, H. G. 1996. The Early Stages of Fishes in the California Current Region. California Cooperative Oceanic Fisheries Investigations, Atlas No. 33. Allen Press Inc., Lawrence, Kansas.

Murdoch, W. W., R. C. Fay, and B. J. Mechalas. 1989. Final Report of the Marine Review Committee to the California Coastal Commission, Marine Review Committee Doc. No. 89-02, 346 pp.

Nisbet, R. M., W. Murdoch and A. Stewart-Oaten. 1996. Consequences for adult fish stocks of human-induced mortality on immatures. Pages 257-277 *In*: Schmitt, R.J and C.W. Osenberg (eds.). Detecting ecological impacts: Concepts and applications in coastal habitats. Academic Press.

Parker, K. R. and E. E. DeMartini. 1989. Chapter D: Adult-equivalent loss. Technical Report to the California Coastal Commission. Prepared by Marine Review Committee, Inc. 56 pp.

Public Service Electric and Gas Company (PSE&G). 1993. Appendix I—Modeling. Permit No. NJ0005622. Prepared by Lawler, Matusky, and Skelly Engineers, Pearl River, NY. Comments on NJPDES Draft. 82 pp.

Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Fishery Research Board of Canada Bulletin 91. 382 pp.

Saila, S. B., X. Chen, K. Erzini, and B. Martin. 1987. Compensatory mechanisms in fish populations: Literature reviews. Volume 1: Critical evaluation of case histories of fish populations experiencing chronic exploitation or impact. EA-5200. Report prepared for the Electric Power Research Institute.

San Diego Gas and Electric (SDG&E). 1980. Encina Power Plant cooling water intake system demonstration. Prepared for California Regional Water Quality Control Board, San Diego Region.

Smith, P. E. and S. L. Richardson. 1977. Standard Techniques for Pelagic Fish Egg and Larva Surveys. FAO Fisheries Technical Paper 175:1-100.

Tenera Environmental. 2001. Morro Bay Power Plant Modernization Project 316(b) Resource Assessment. Doc. E2000-107.8. Prepared for Duke Energy Morro Bay, LLC.

Tenera Environmental. 2004. SBPP Cooling Water System Effects on San Diego Bay, Vol. II: Compliance with Section 316(b) of the Clean Water Act for the South Bay Power Plant. Doc. No. ESLO2003-037.6. Prepared for Duke Energy. August 2004.

U. S. Environmental Protection Agency (USEPA). 1977. Guidance for evaluating the adverse impact of cooling water intake structures on the aquatic environment: Section 316(b) P.L. 92-500. 58 pp.

Appendix B

Agua Hedionda Lagoon Hydrodynamics Studies

AGUA HEDIONDA LAGOON HYDRODYNAMIC STUDIES

by

Hany Elwany, Ph.D.
Reinhard Flick, Ph.D.
Martha White, M.S.
Kevin Goodell

Prepared for

Tenera Environmental
141 Suburban Road, Suite A-2
San Luis Obispo, California 93401

Prepared by

Coastal Environments
2166 Avenida de la Playa, Suite E
La Jolla, CA 92037

25 October 2005
CE Reference No. 05-10

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 DESCRIPTION OF AGUA HEDIONDA LAGOON 6
- 2.1 OCEAN TIDES 13
- 2.2 POWER PLANT INTAKE FLOW RATES 13

3.0 WATER LEVEL, VELOCITY, SALINITY, AND TEMPERATURE MEASUREMENTS 16
- 3.1 WATER LEVEL 16
- 3.2 WATER VELOCITY 16
- 3.3 SALINITY AND TEMPERATURE 26

4.0 RESIDENCE TIME OF WATER IN THE LAGOON 27

5.0 SUMMARY AND CONCLUSIONS 36
- 5.1 LAGOON DESCRIPTION 36
- 5.2 FIELD MEASUREMENTS 36
- 5.3 RESIDENCE TIME 37

6.0 REFERENCES 38

LIST OF APPENDICES

Appendix A Water Level Measurements at Outer, Inner, and Middle Basins
Appendix B Water Velocity Measurements at Outer and Inner Basins
Appendix C Lagoon Tidal Prism with Contributions of Outer, Inner, and Middle Basins to Tidal Prism
Appendix D Temperature and Salinity Measurements at Outer and Inner Basins

LIST OF FIGURES

Figure 1-1 Map showing the location of Agua Hedionda Lagoon 2
Figure 1-2 Map of Agua Hedionda Lagoon showing the locations of its three basins, the Outer, Inner, and Middle Basins 3
Figure 1-3 Configurations of intake and discharge channels of Agua Hedionda Lagoon 4
Figure 2-1 Bathymetry map of Agua Hedionda Lagoon 7
Figure 2-2 Bathymetry map of Outer Basin 8
Figure 2-3 Bathymetry map of Middle Basin 9
Figure 2-4 Bathymetry map of Inner Basin 10
Figure 2-5 Agua Hedionda Lagoon surface area and water volume 11
Figure 2-6 Potential tidal prism for the Outer, Middle, and Inner Basins and the lagoon (total) 12
Figure 2-7 Hourly Encina Power Station intake flow 15

Figure 3-1 Measurement locations for stations S0 (water level, water velocity, temperature, salinity), S2A (water level, water velocity, temperature, salinity), S2B (water level), and S2C (water level) 17
Figure 3-2 Locations of benchmarks used in this study 18
Figure 3-3 Comparison of water level at sites S0, S2A, S2B, and S3 during neap tide . 19
Figure 3-4 Comparison of water level at sites S0, S2A, S2B, and S3 during spring tide 20
Figure 3-5 Comparison of water level at sites S0, S2A, S2B, and S3 during mean tide . 21
Figure 3-6 Water level and velocity measurements during neap tide 22
Figure 3-7 Water level and velocity measurements during spring tide 23
Figure 3-8 Water level and velocity measurements during mean tide 24
Figure 3-9 Tidal prism of the lagoon between June 1, 2005 and July 6, 2005 25
Figure 4-1 Percentage of old water in the lagoon vs. tidal cycle 28
Figure 4-2 Percentage of old water in the lagoon vs. day, with solid line showing best-fit curve 29
Figure 4-3 Lagoon inflow and outflow through the inlet per tidal cycle during 1 June 05 through 7 July 05 32
Figure 4-4 Lagoon inflow and outflow through the inlet per day during 1 June 05 through 7 July 05 33
Figure 4-5 Ratio between inflowing water and water taken in by power plant cooling system by tidal cycle. The solid line represents the mean ratio measurement time period 34
Figure 4-6 Ratio between inflowing water and water taken in by power plant cooling system by day. The solid line represents the mean ratio over the measurement time period 35

APPENDIX FIGURES

Figure A-1 Comparison between water level measurements at Station S0 and ocean tide A-1
Figure A-2 Comparison between water level measurements at Station S2A & ocean tide A-2
Figure A-3 Comparison between water level measurements at Station S2B & ocean tide A-3
Figure A-4 Comparison between water level measurements at Station S3 and ocean tide A-4
Figure B-1 East component of water velocity at Station S0 . . . . B-1
Figure B-2 North component of water velocity at Station S0 . . . . B-2
Figure B-3 East component of water velocity at Station S2B B-3
Figure B-4 North component of water velocity at Station S2B B-4
Figure C-1 Tidal prism of Outer Basin as computed from water level measurements at Station S0 . . . . C-1
Figure C-2 Tidal prism of Middle Basin as computed from water level measurements at Station S2A C-2
Figure C-3 Tidal prism of Middle Basin as computed from water level measurements at Station S2B C-3
Figure C-4 Tidal prism of Inner Basin as computed from water level measurements at Station S3 . . . . C-4
Figure C-5 Agua Hedionda Lagoon tidal prism C-5
Figure D-1 Water temperature measurements at Station S0 . . . . D-1
Figure D-2 Water temperature measurements at Station S2B D-2
Figure D-3 Water salinity measurements at Station S2B D-3

LIST OF TABLES

Table 2-1 Tidal levels with respect to MLLW and NGVD (1960-1978) 14
Table 4-1 Curve-fitting parameters for "old water" percentage per tidal cycle 31
Table 4-2 Curve-fitting parameters for "old water" percentage per day 31
Table 4-3 Residence time of water in Agua Hedionda Lagoon 31

AGUA HEDIONDA LAGOON
HYDRODYNAMIC STUDIES

1.0 INTRODUCTION

The purpose of this report is to evaluate the hydrodynamics of Agua Hedionda Lagoon, which is located in Carlsbad, California (Figure 1-1). The lagoon consists of three basins, the Outer, Middle, and Inner Basins (Figure 1-2). The lagoon is connected to the Pacific Ocean through an inlet channel protected by two jetties.

The results of this study will be used to estimate entrainment mortality on a bay or lagoon population caused by the operation of the Encina Power Station (EPS). The EPS is located adjacent to Agua Hedionda Lagoon. The five power-generating units withdraw about 635 to 670 million gallons of water per day (mgd) from the lagoon to the power plant condenser systems for cooling purposes. The heated water is discharged through a channel across the beach. Figure 1-3 shows the configurations of the inlet and discharge channels.

The main questions for this study are:

1. What are the general hydrodynamics of Agua Hedionda Lagoon?
2. What are the volumes of the three lagoon basins at various elevations?
3. What is the tidal prism, defined in this study as the volume of water in the lagoon between maximum and minimum water level per tidal cycle?
4. What is the residence time of water in the lagoon and its basins?

Chapter 1 describes the purpose of the study and outlines the required tasks. Chapter 2 describes the lagoon and the tidal cycles that control the water level in the lagoon. Chapter 3 provides information about the water level, velocity, salinity, and temperature measurements in the lagoon that were conducted between 1 June 2005 and 7 July 2005. Chapter 4 describes the method used to estimate the residence time of water in the lagoon and provides the results. Chapter 5 gives a brief summary of the results; a list of the references used in this study is given in Chapter 6. The appendices provide a summary of the results obtained from the fieldwork conducted during the study.

Our efforts during this study included:

1. Site visits to Agua Hedionda Lagoon;
2. A review of the existing oceanographic data and literature;
3. Installation of instruments at four temporary data collection stations;
4. Collection of data for a one-month period, including water level, water velocity, salinity, and temperature measurements;
5. Computation of the tidal prism; and
6. Presentation of our findings in this report.

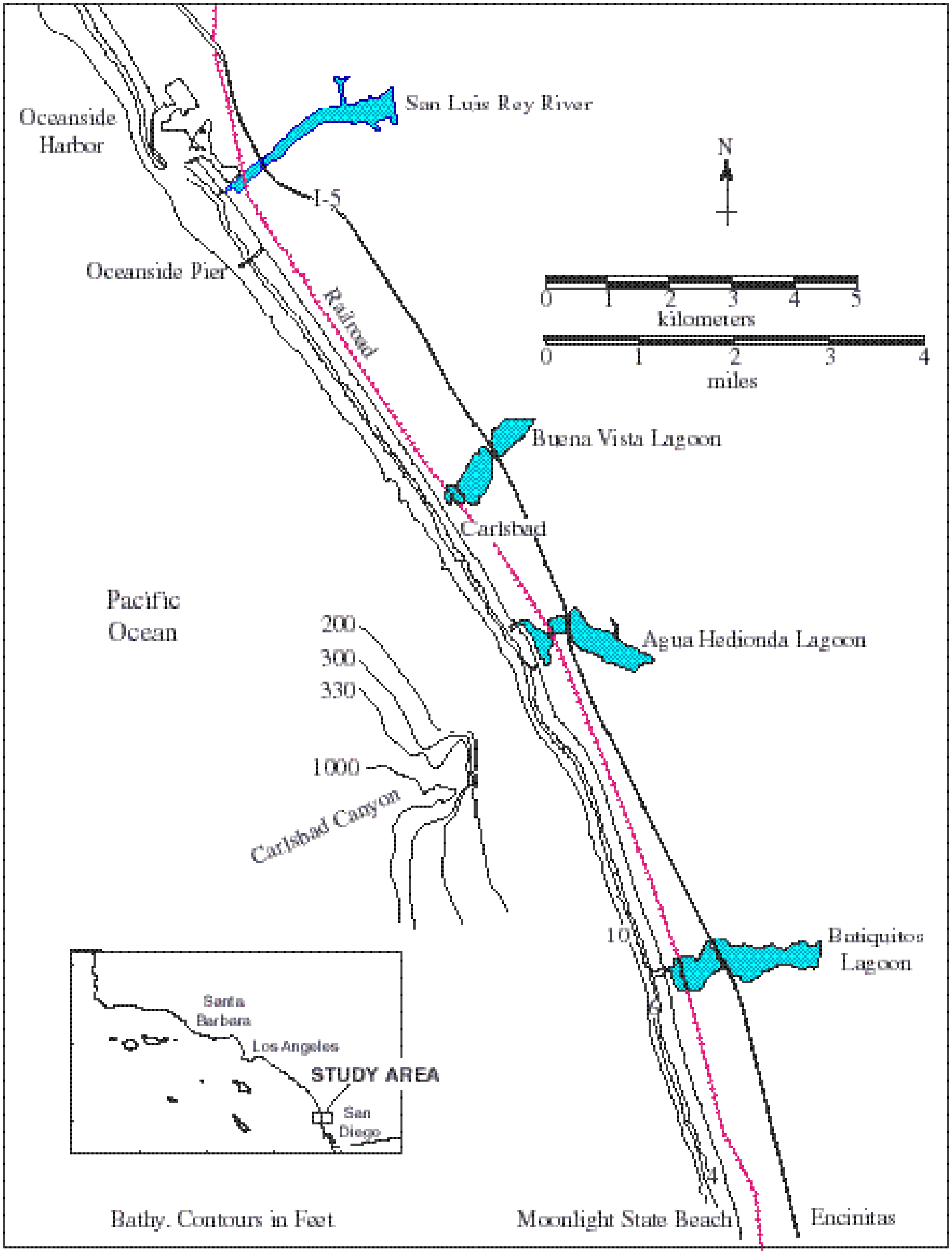


Figure 1-1. Map showing the location of Agua Hedionda Lagoon

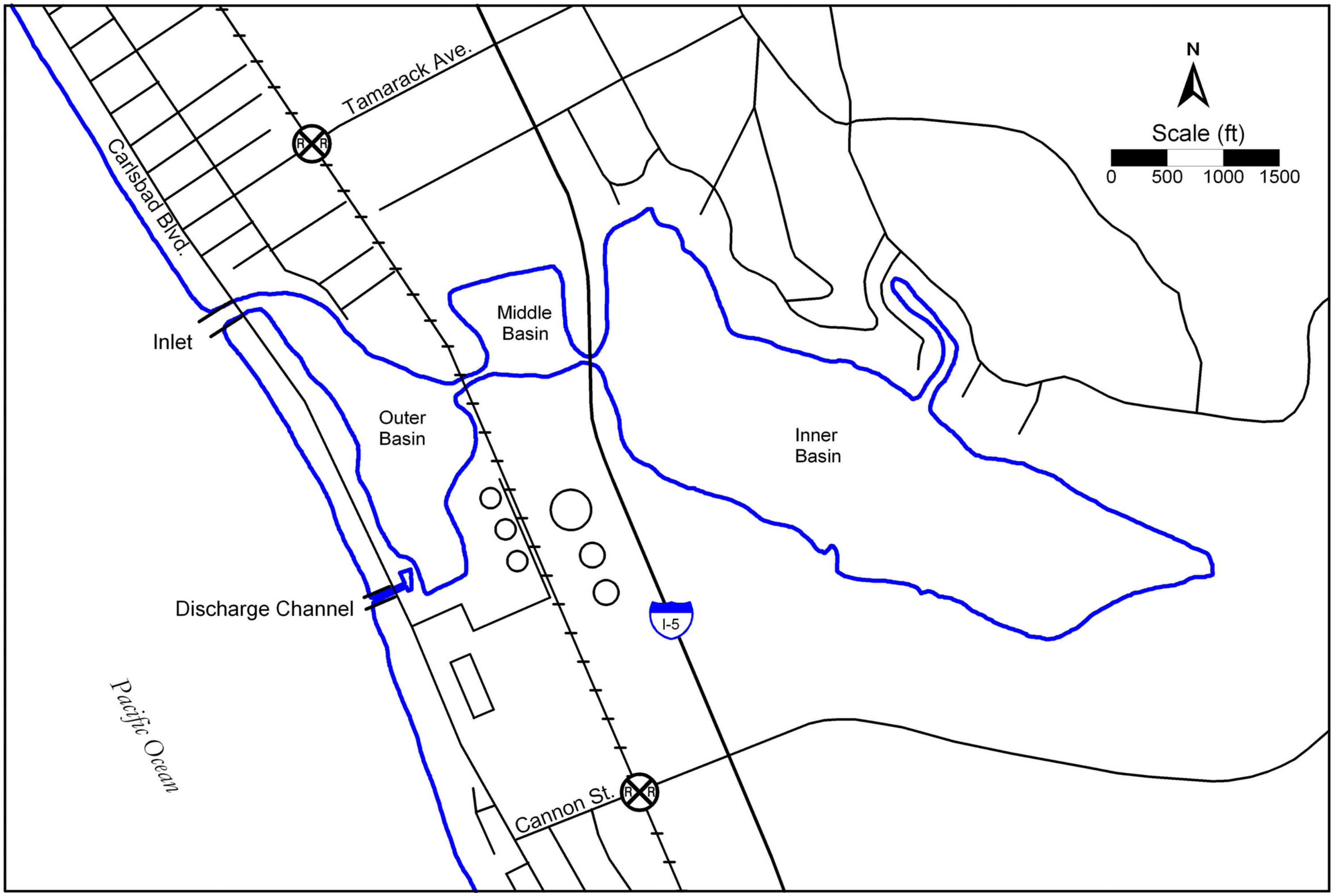


Figure 1-2. Map of Agua Hedionda Lagoon showing the locations of its three basins: the Outer, Inner, and Middle Basins.

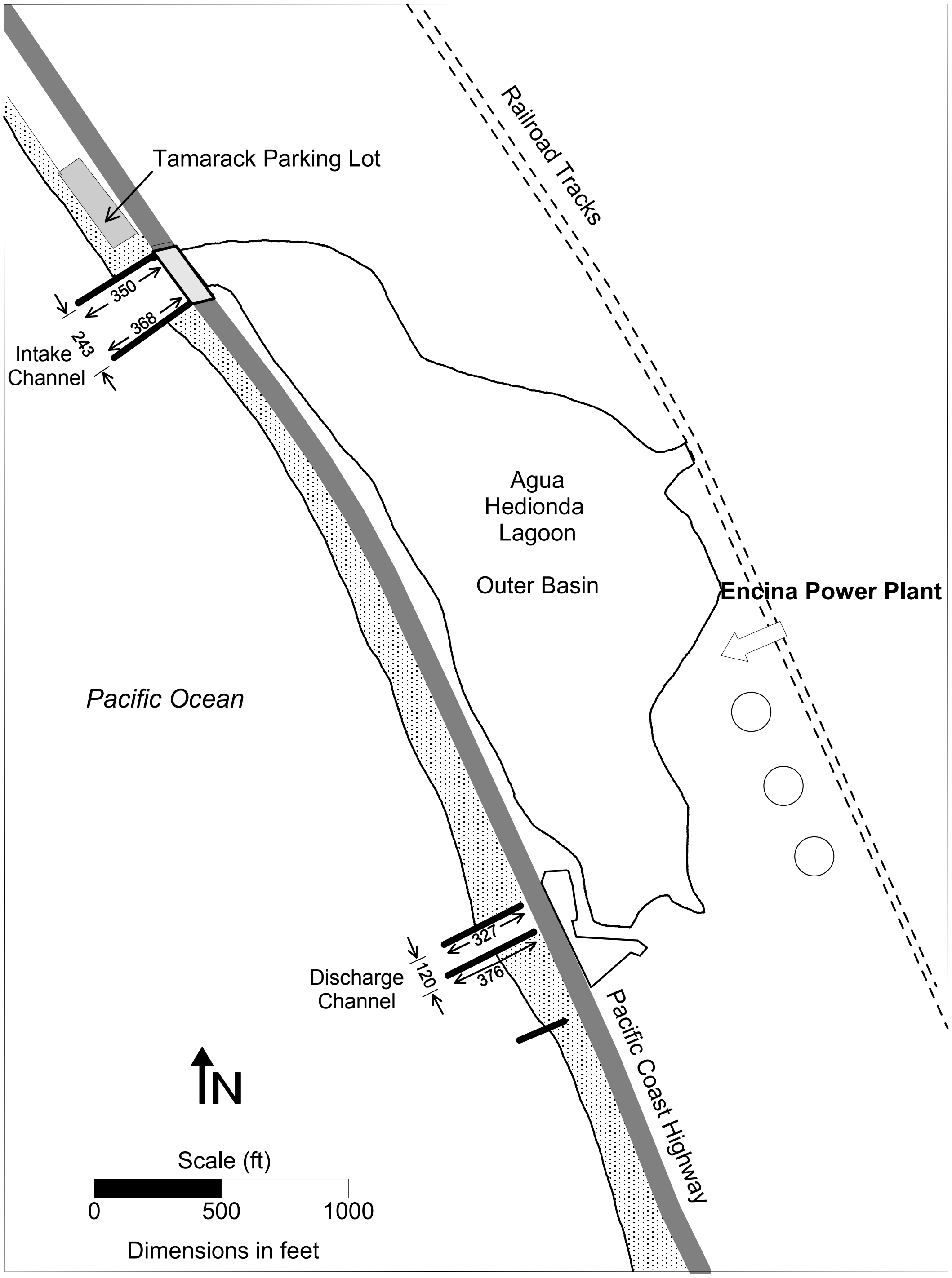


Figure 1-3. Configurations of intake and discharge channels of Agua Hedionda Lagoon.

Several studies have previously been conducted to determine the effect of the operation of the cooling system of Encina Power Station on lagoon sedimentation (Ellis, 1954; Bhogal et al., 1989; EA Engineering Science and Technology, 1997; Jenkins and Wasyl, 2001). Studies to determine the impact on marine environments have been presented by Jenkins and Skelly (1998) and Jenkins et al. (1989). Elwany et al. (1999) described the oceanographic conditions (waves and tides) at Agua Hedionda Lagoon in detail. A bibliography of pertinent research on existing conditions and monitoring studies in the vicinity of Agua Hedionda lagoon is given in Coastal Environments (1998).

2.0 DESCRIPTION OF AGUA HEDIONDA LAGOON

Agua Hedionda Lagoon is located within the City of Carlsbad, California. The lagoon is bounded on the west by the Pacific Coast Highway (called "Carlsbad Boulevard" in this area), on the north by the City of Carlsbad residential community, and on the east and south by undeveloped hill slopes and bluffs. On the south side above the bluffs lie cultivated fields and the EPS.

The Santa Fe Railroad and Interstate 5 freeway ("I-5") divide Agua Hedionda Lagoon into three sections, the Inner, Middle and Outer Basins, which have areas of 186, 22, and 50 acres, respectively. The natural resources of Agua Hedionda Lagoon have been described in Bradshaw et al. (1976).

In 2004 and 2005, the Encina Power Station conducted topographic surveys in the lagoon. Surveys of the Outer, Middle, and Inner Basins were conducted in March 2005, November 2004, and May 2005, respectively. Figure 2-1 is a bathymetric map of the lagoon. There is a cooling water intake channel and an effluent discharge channel offshore from the lagoon. The intake jetties are located west of the Coast Highway bridge and have lengths of about 350 ft (north) and 368 ft (south). The distance between the centerline of the two jetties is about 243 ft. The jetties at the discharge channel are about 327 and 376 ft long, with the south jetty extending longer than the north jetty. The distance that the intake and discharge jetties extend varies with the changing location of the shoreline.

Figures 2-2 through 2-4 show the bathymetry of the Outer, Middle and Inner Basins. The bottom elevations in the basins range from about −42 ft (NGVD 29), in the deepest portion of the Outer and Middle Basins, to about 10 ft NGVD along the shoreline of the Inner Basin. The Outer Basin and the channel leading to the Inner Basin are the deepest areas of the lagoon. The Middle and Inner Basins are shallower at −16 ft, NGVD, in comparison to the majority of the Outer Basin, which is at a depth of −20 to −32 ft, NGVD. From these maps, cumulative surface area (in acres) and cumulative water volume (in acre-ft) were obtained. The potential tidal prism (in acre-ft) versus elevation (ft, NGVD) was computed.

The surface area of the lagoon at 6 ft, NGVD is about 350 acres. The surface area of the lagoon is reduced to about 225 acres at mean low lower water (MLLW). At MLLW, the volume of water in the lagoon is about 1750 acre-ft. The majority of the area and volume come from the large Inner Basin (Figure 2-5).

The potential tidal prism, as a function of lagoon water level elevation, is shown for the Outer, Middle, and Inner Basins and for the total lagoon (Figure 2-6). The tidal prism of the lagoon is defined as the volume of water in the lagoon between the maximum and minimum water levels. Here we assume the minimum water level to be -1 ft, NGVD, for the purpose of computation. Tidal prism is referred to as "potential tidal prism," because we assume that the water level in the entire lagoon is the same, with no friction losses (i.e., no tidal muting). Figure 2-6 shows that the tidal prism of the Inner Basin constitutes the largest portion of the lagoon tidal prism.

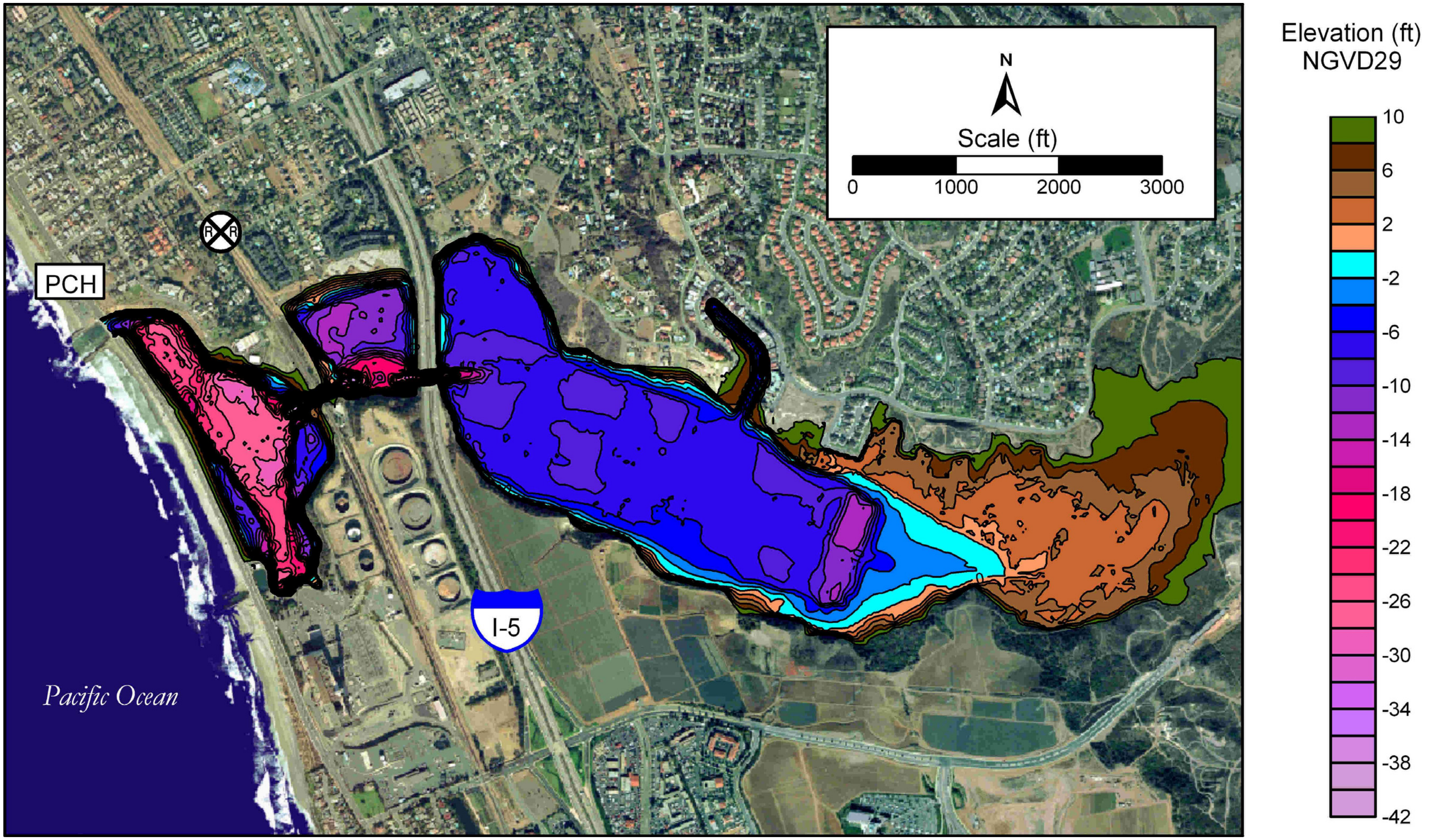


Figure 2-1. Bathymetry map of Agua Hedionda Lagoon.

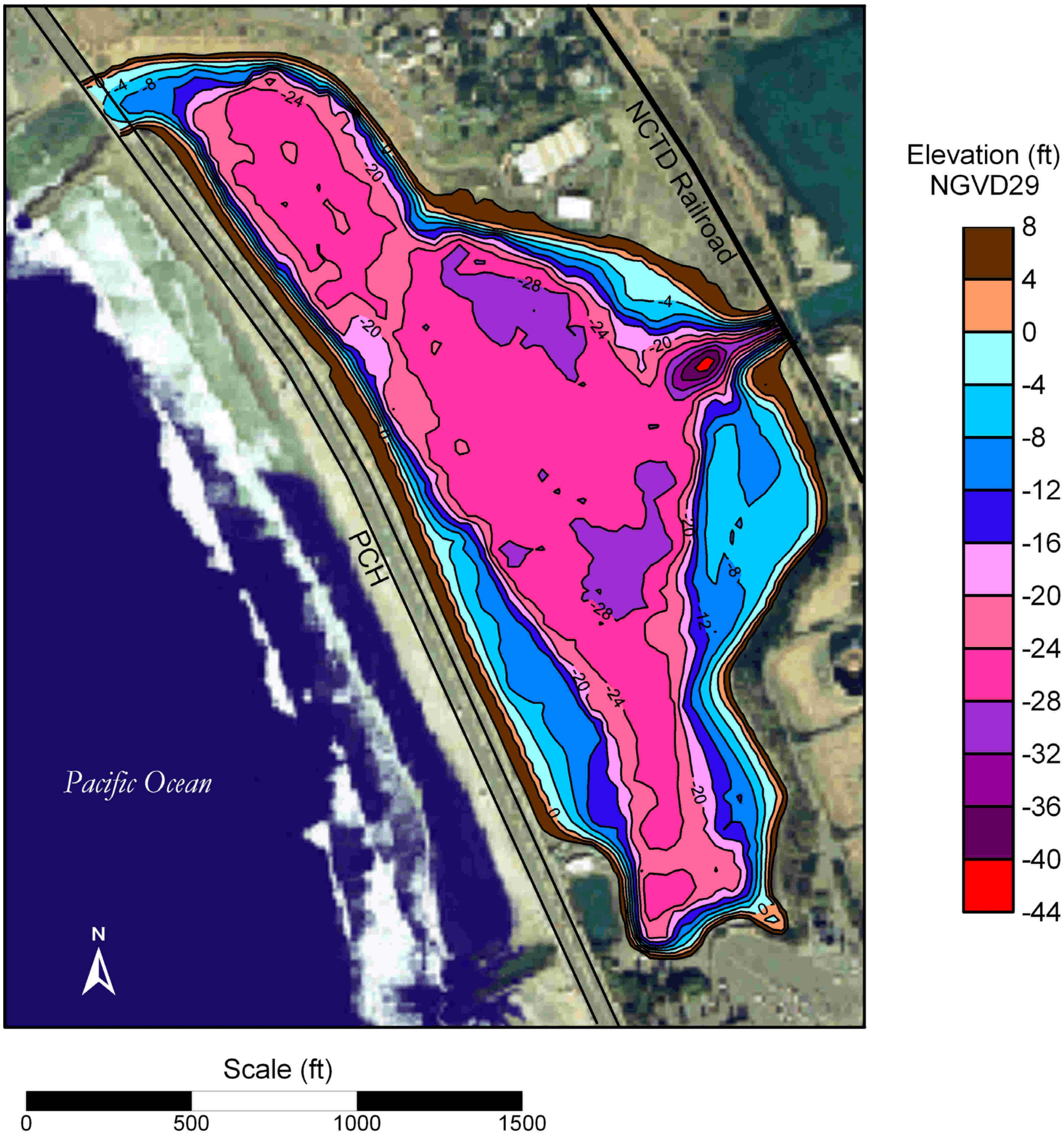


Figure 2-2. Bathymetry map of Outer Basin.

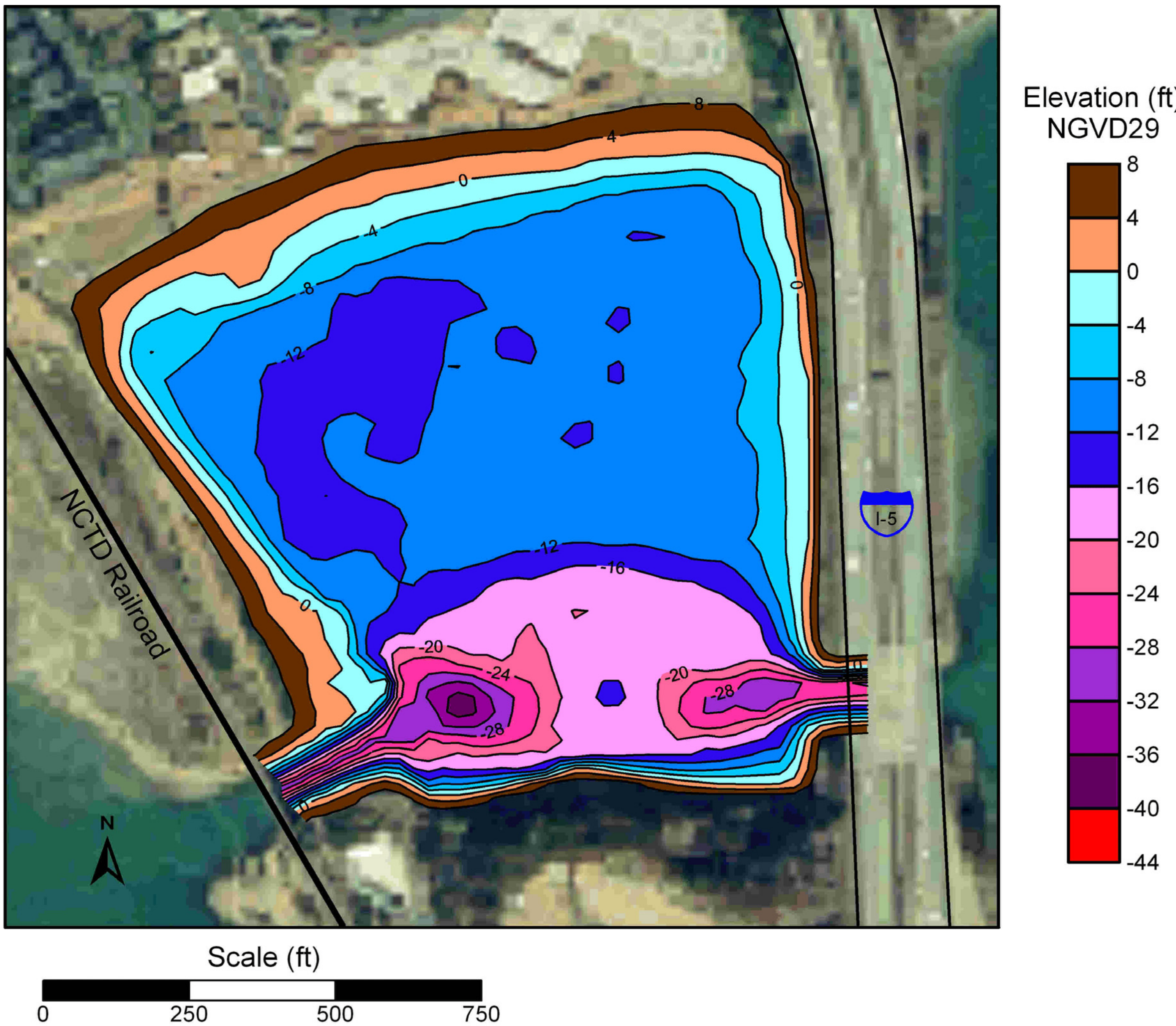


Figure 2-3. Bathymetry map of Middle Basin.

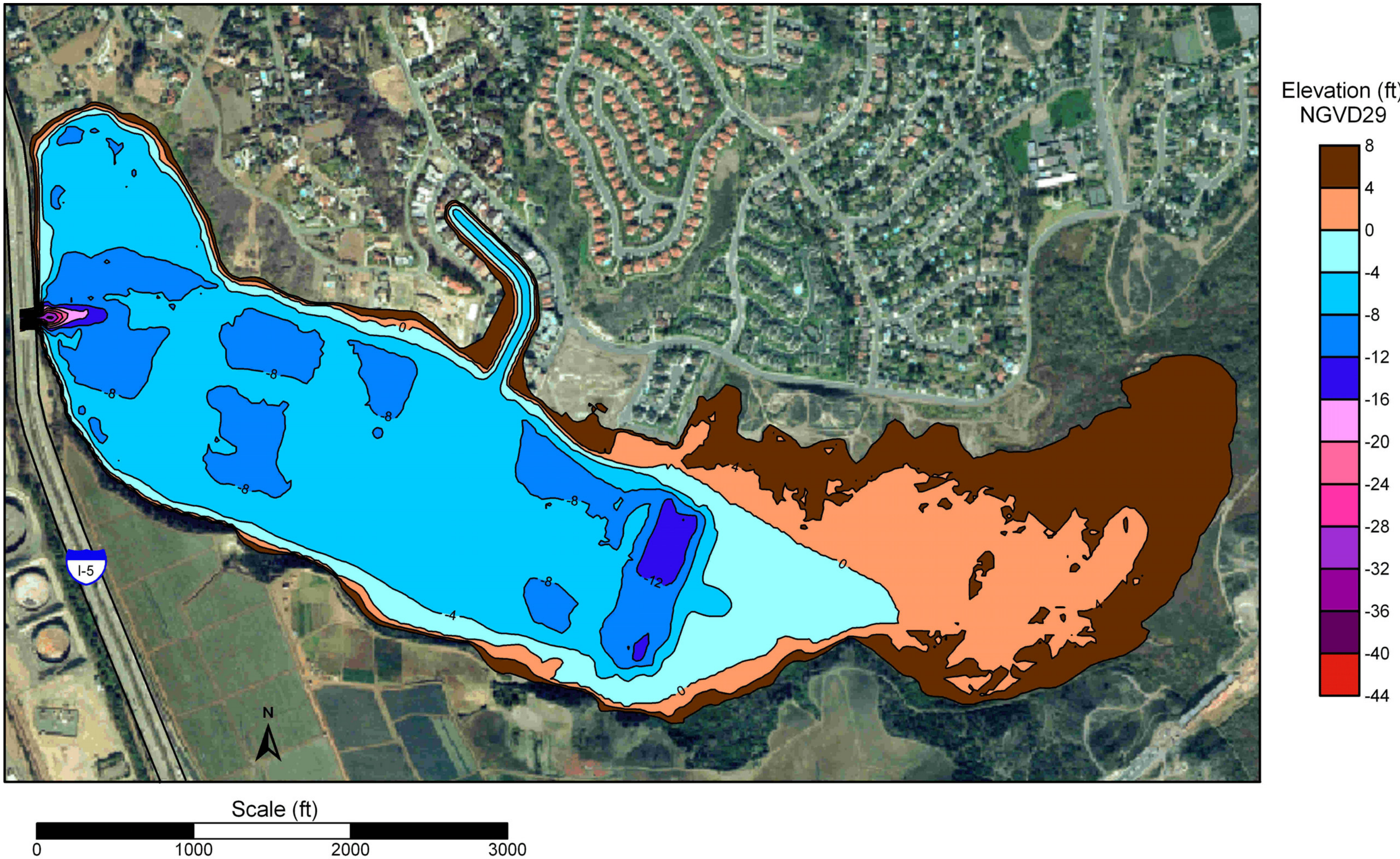


Figure 2-4. Bathymetry map of Inner Basin.

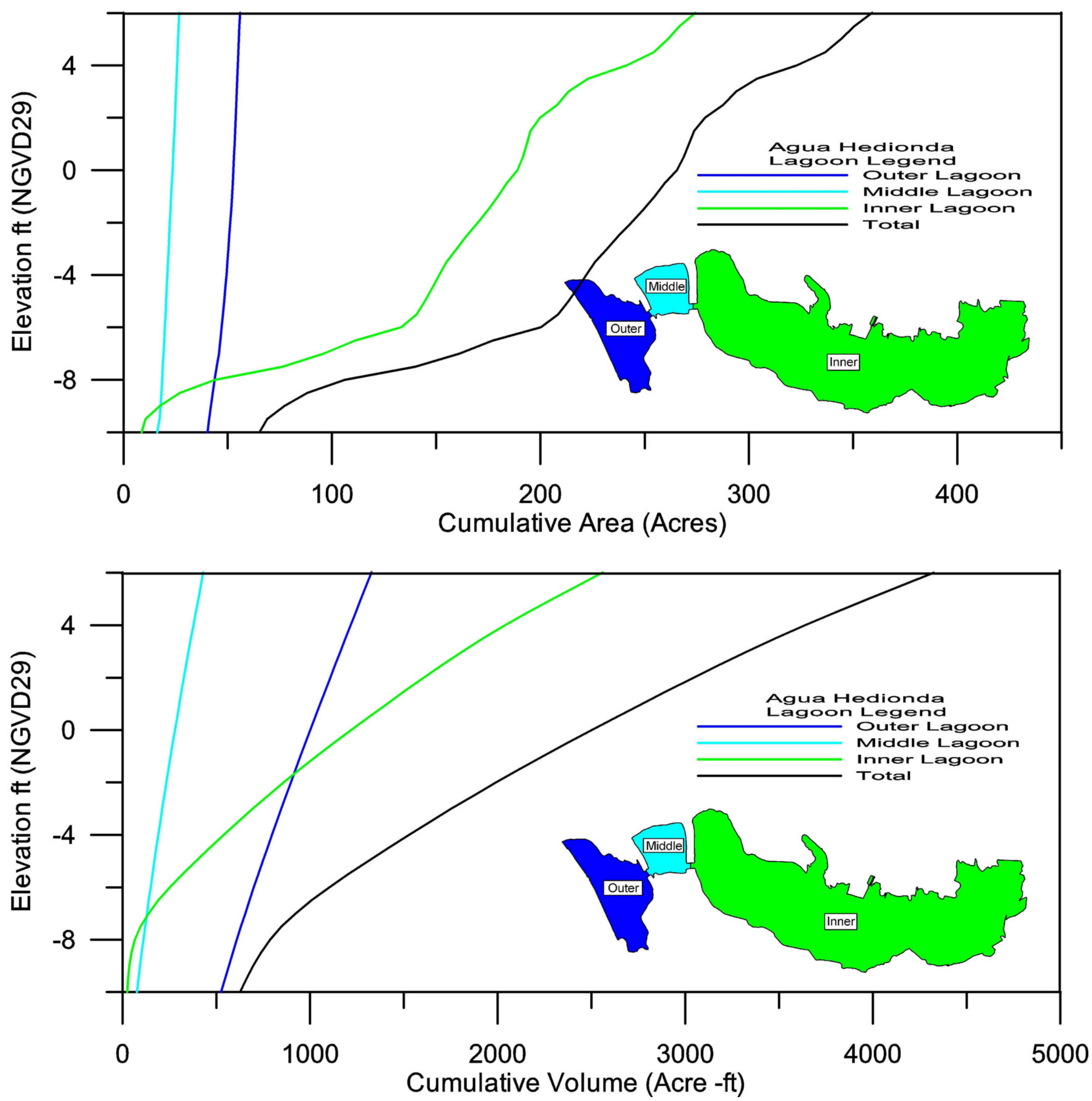


Figure 2-5. Agua Hedionda Lagoon surface area (top) and water volume (bottom).

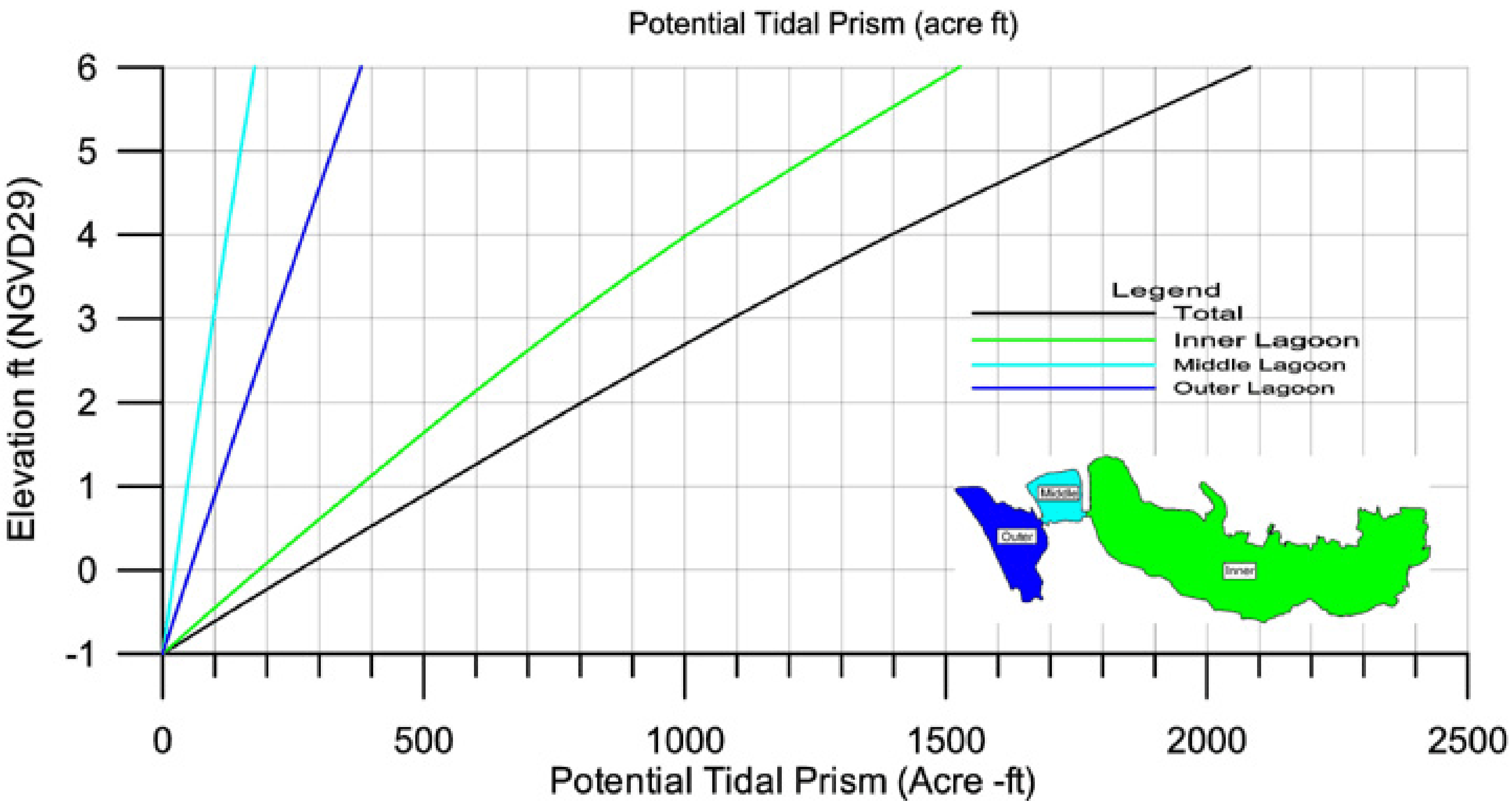


Figure 2-6. Potential tidal prism for the Outer, Middle, and Inner Basins and for the lagoon (total).

2.1 OCEAN TIDES

Ocean tides force water fluctuations in the lagoon. The tide is the change of ocean water level caused by the astronomical forces of the moon and sun. Tides are predictable and can be decomposed into a set of constituent frequencies near one and two cycles per day, each having a given amplitude and phase at any location. Longer period fluctuations in amplitude occur at two cycles per month and two cycles per year, every 4.4 and 18.6 years.

On the San Diego coast, the tide is mixed and has nearly equal semi-daily and daily components (Zetler and Flick, 1985). The highest monthly tides in the winter and summer are higher than the highest monthly tides in the spring and fall as a result of lunar and solar declination effects. Also, the extreme monthly higher-high tide in the winter tends to occur in the morning.

The tidal fluctuations are superimposed at sea level. Seasonal sea level in the San Diego area tends to be highest in the fall and lowest in the spring, with differences of about 0.5 ft. Local warming or cooling resulting from offshore shifts in water masses can alter the average sea level by several tenths of a foot over periods lasting several months (e.g., El Niño years) (Reid and Mantyla, 1976).

Tidal elevations are usually referenced to Mean Lower Low Water (MLLW), which is defined as the average elevation of the lowest water level readings of each day over a specified 19-year interval. In the study area, the maximum tidal range is about 9 ft (7.2 ft above MLLW to 1.8 ft below MLLW). Tidal elevations can be converted to other vertical datum using the appropriate conversion values. Table 2-1 gives some of these datum with respect to MLLW and NGVD.

2.2 POWER PLANT INTAKE FLOW RATES

Figure 2-7 shows the hourly flow rates of the power plant intake between 1 June 2005 and 7 July 2005. Plant diversion of lagoon waters reduces the outflow water from the lagoon to the ocean. Actual plant inflow rates during high-use periods are typically 635 to 670 million gallon per day (mgd). This is about 26 to 28 million gallons per hour.

Table 2-1. Tidal levels with respect to MLLW and NGVD (1960-1978).

Parameters	Mean Lower Low Water (MLLW) ft	National Geodetic Vertical Datum (NGVD) ft
Mean Higher High Water (MHHW)	**5.37**	**2.81**
Mean High Water (MHW)	**4.62**	**2.06**
Mean Sea Level (MSL)	**2.75**	**0.19**
NGVD	**2.56**	**0**
Mean Lower Low Water (MLLW)	**0**	**2.56**

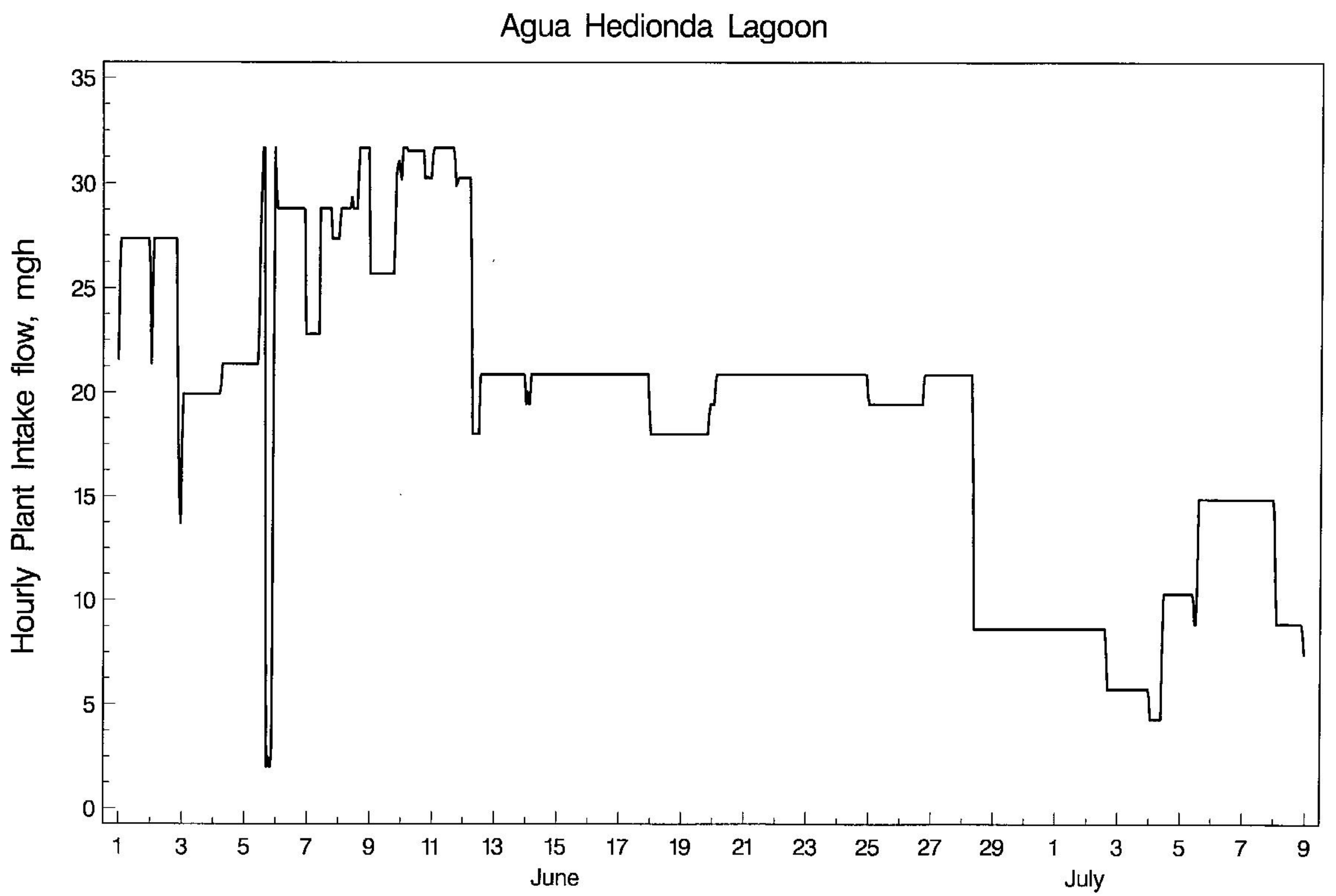


Figure 2-7. Hourly Encina Power Station intake flow.

3.0 WATER LEVEL, VELOCITY, SALINITY, AND TEMPERATURE MEASUREMENTS

3.1 WATER LEVEL

Water level measurements were acquired at four locations throughout the study area (Stations S0, S2A, S2B, and S3) for a period of approximately one month from 1 June 2005 to 7 July 2005. Measurements were taken using self-contained pressure sensors recording water surface elevations at five-minute intervals. Complete results for all locations are shown in Appendix A.

Station S0 is located at the inlet to the Outer Basin; station S2A is located in the northern portion of the Inner Basin; station S2B is located at the inlet to the Inner Basin; and station S3 is located in the southeastern portion of the Inner Basin. The station locations are shown in Figure 3-1, and the benchmarks are shown in Figure 3-2.

Three benchmarks were used during this study to calibrate the pressure data (from the sensors) into water elevations. The process required installing manual tide staffs and taking manual water level elevations for a few hours.

Figures 3-3 through 3-5 show water levels at the four stations during neap, spring, and mean tides, respectively. The measurements presented show that there are only small variations between water level elevations at the four stations during neap tide. There was a time lag between water level at the inlet and water level at the Inner Basin (< 1 hour). During neap tide, water elevation at the entrance to the Outer Basin and water elevation at the interior of the Inner Basin fill to approximately equivalent levels. During spring and mean tides, there is a short time lag and a variation in water elevation (~ 0.25 ft) between the inlet to the lagoon (Station S0) and the interior stations (Figures 3-4 and 3-5).

3.2 WATER VELOCITY

Water velocities were measured at Station S0 during neap, spring, and mean tides (Figures 3-6 through 3-8). Water velocities were high during spring tide (approximately + 4.5 ft to –3.5 ft). The highest water velocity measurements at Station S0 were +5 ft/sec and –3 ft/sec (during spring tide). See Appendix B for further data and figures.

Tidal prism was computed (Figure 3-9) from data collected in the basins during the approximate one-month study period between 1 June and 6 July 2005. During this time period, the cumulative tidal prism for the lagoon ranged from 175 acre-ft to 2075 acre-ft. Water in the Middle and Outer Basins had fewer fluctuations and a much smaller tidal prism (about 50 to 300 acre-ft) than water in the large Inner Basin. The Inner Basin contains the majority of the water in the lagoon (see Appendix C).

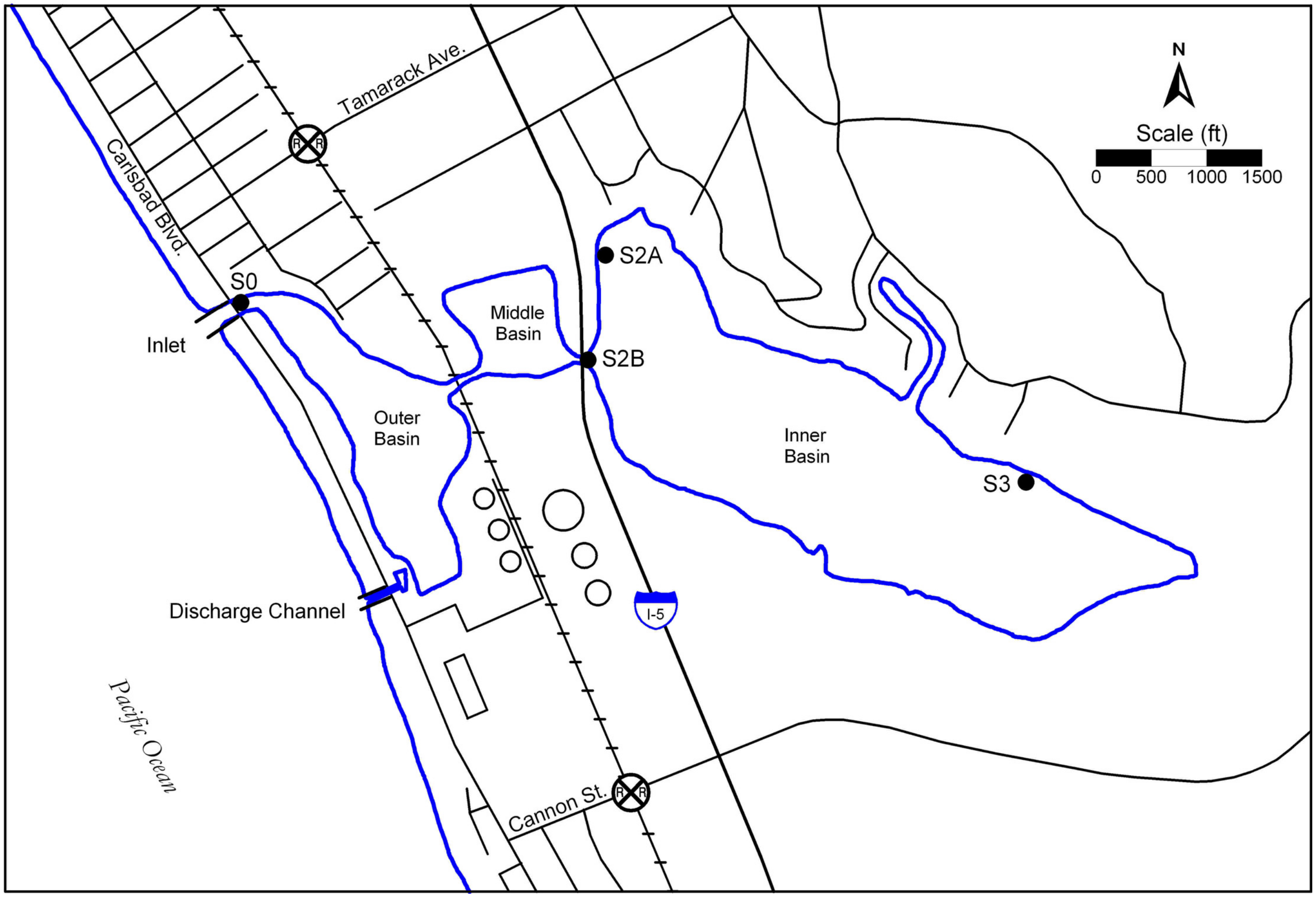


Figure 3-1. Measurement locations for Stations S0 (water level, water velocity, temperature, salinity), S2A (water level), S2B (water level, water velocity, temperature, salinity), and S3 (water level).

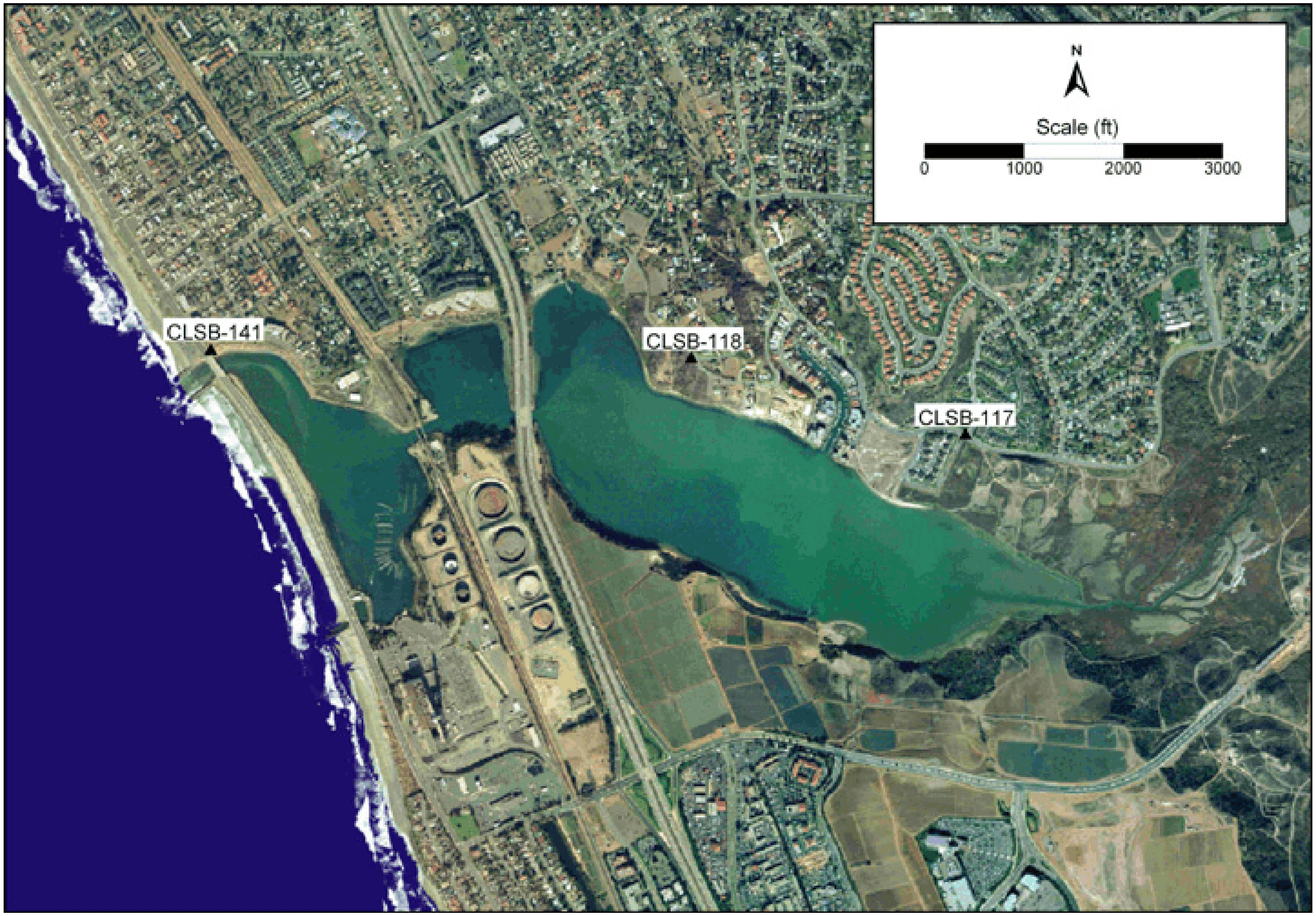


Figure 3-2. Locations of benchmarks used in this study.

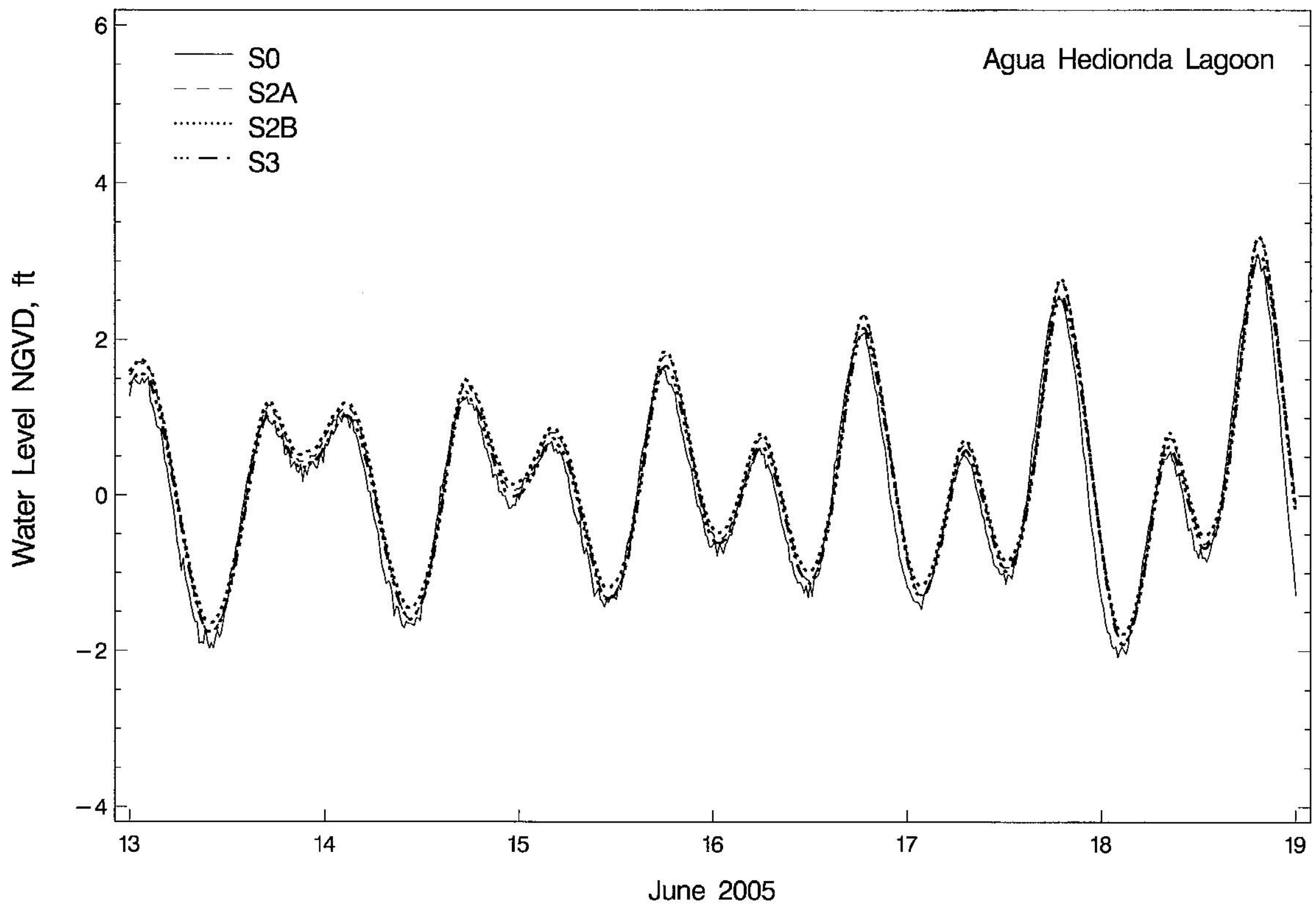


Figure 3-3. Comparison of water level at Stations S0, S2A, S2B, and S3 during neap tide.

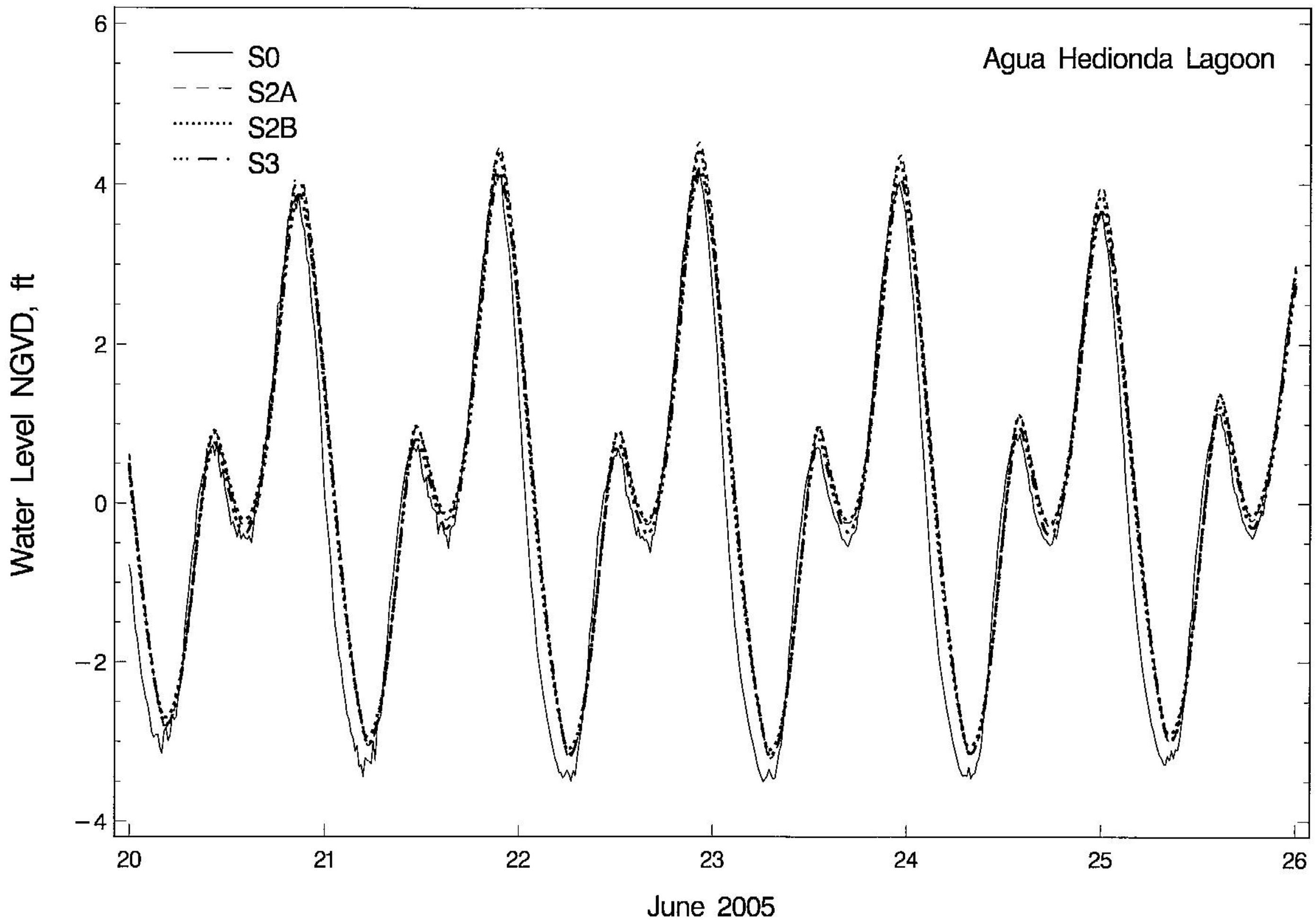


Figure 3-4. Comparison of water level at Stations S0, S2A, S2B, and S3 during spring tide.

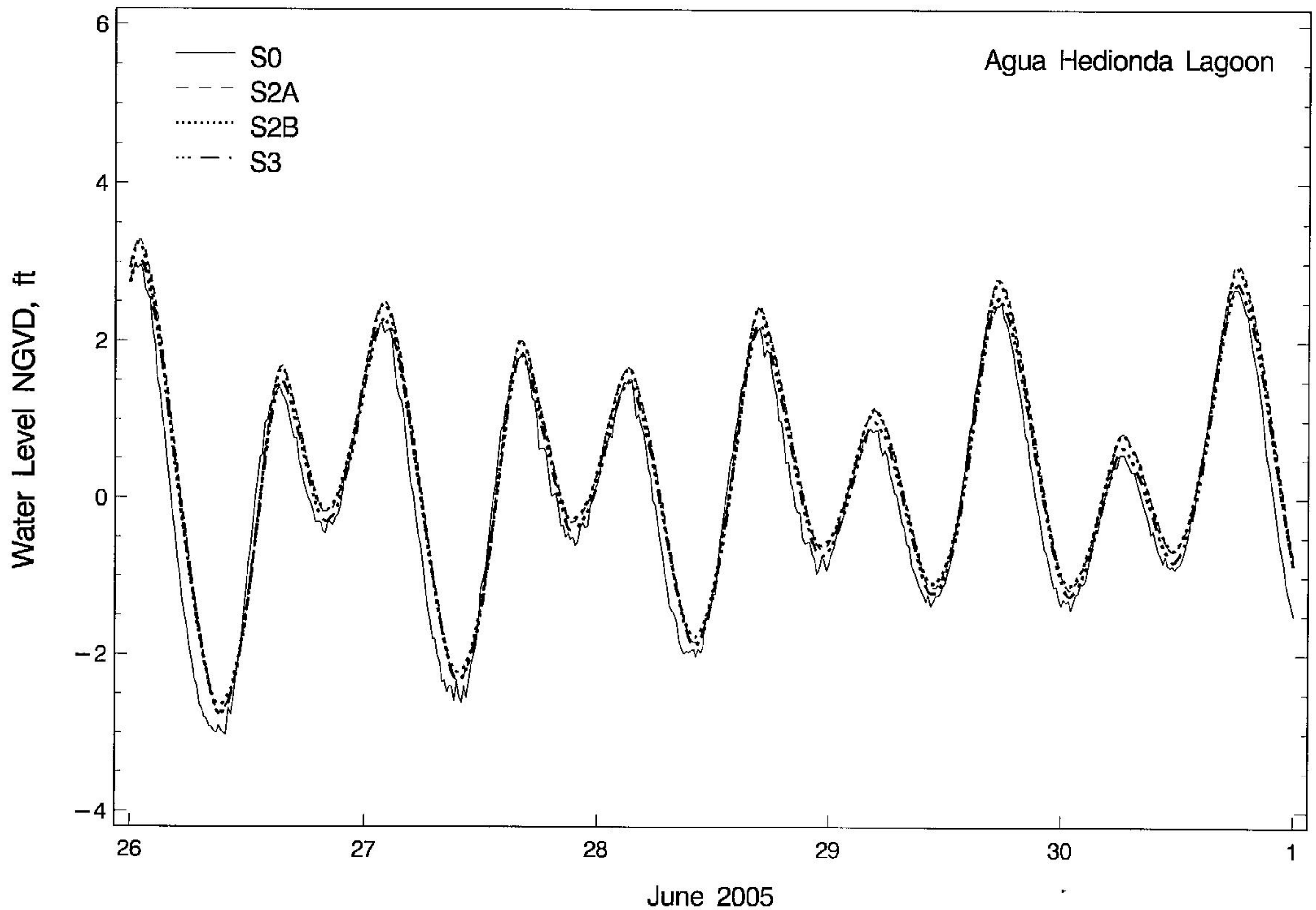


Figure 3-5. Comparison of water level at Stations S0, S2A, S2B, and S3 during mean tide.

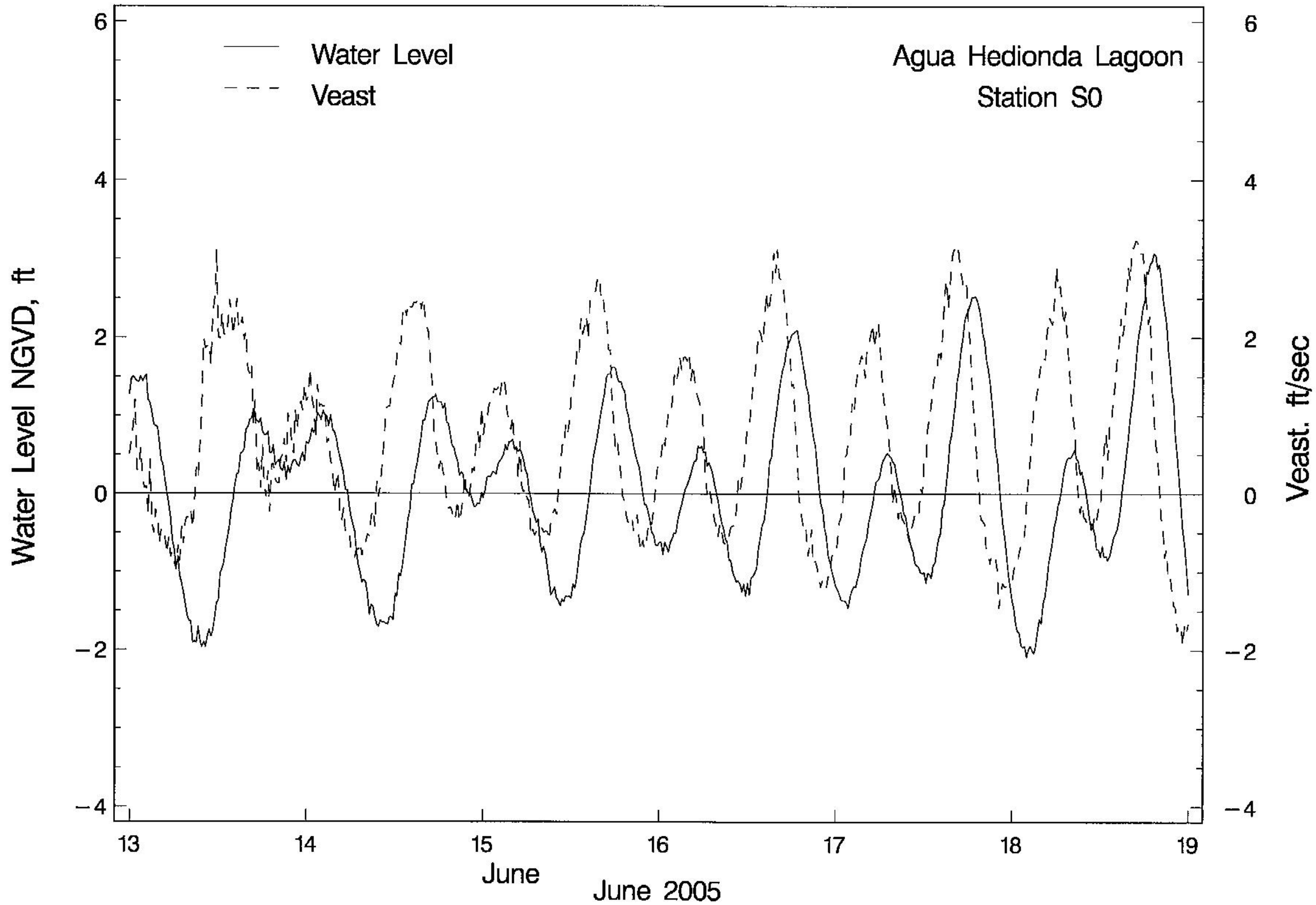


Figure 3-6. Water level and velocity measurements during neap tide.

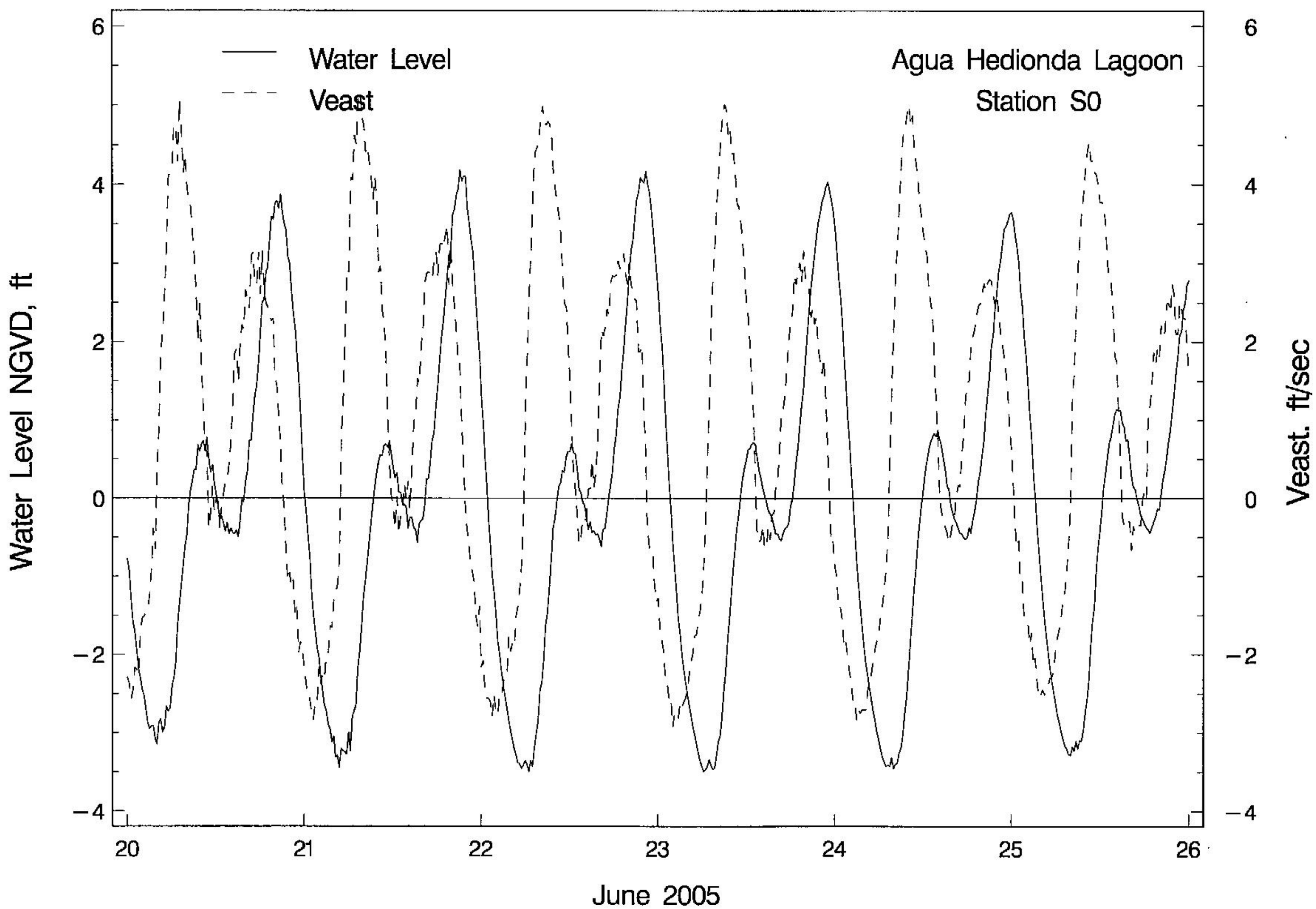


Figure 3-7. Water level and velocity measurements during spring tide.

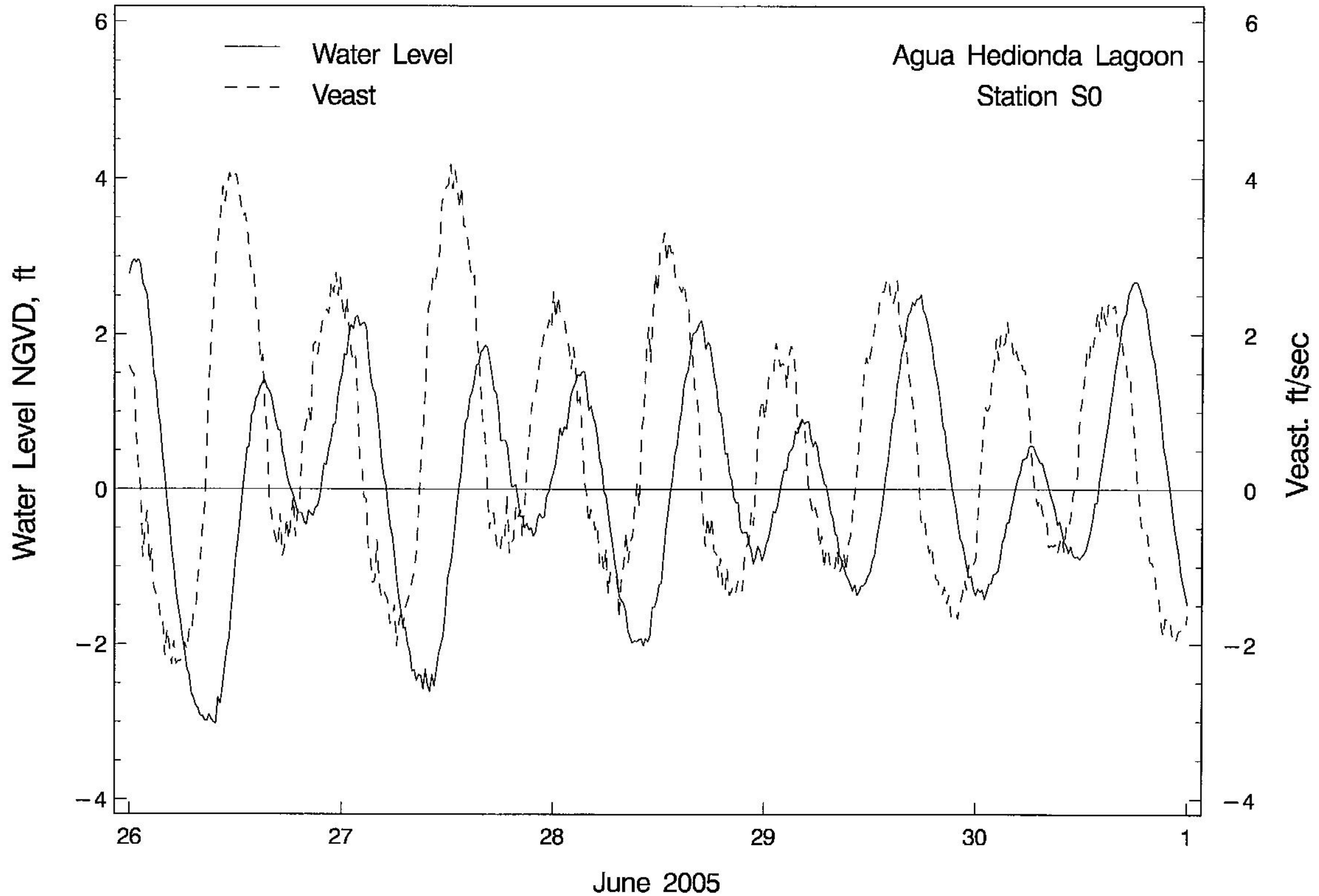


Figure 3-8. Water level and velocity measurements during mean tide.

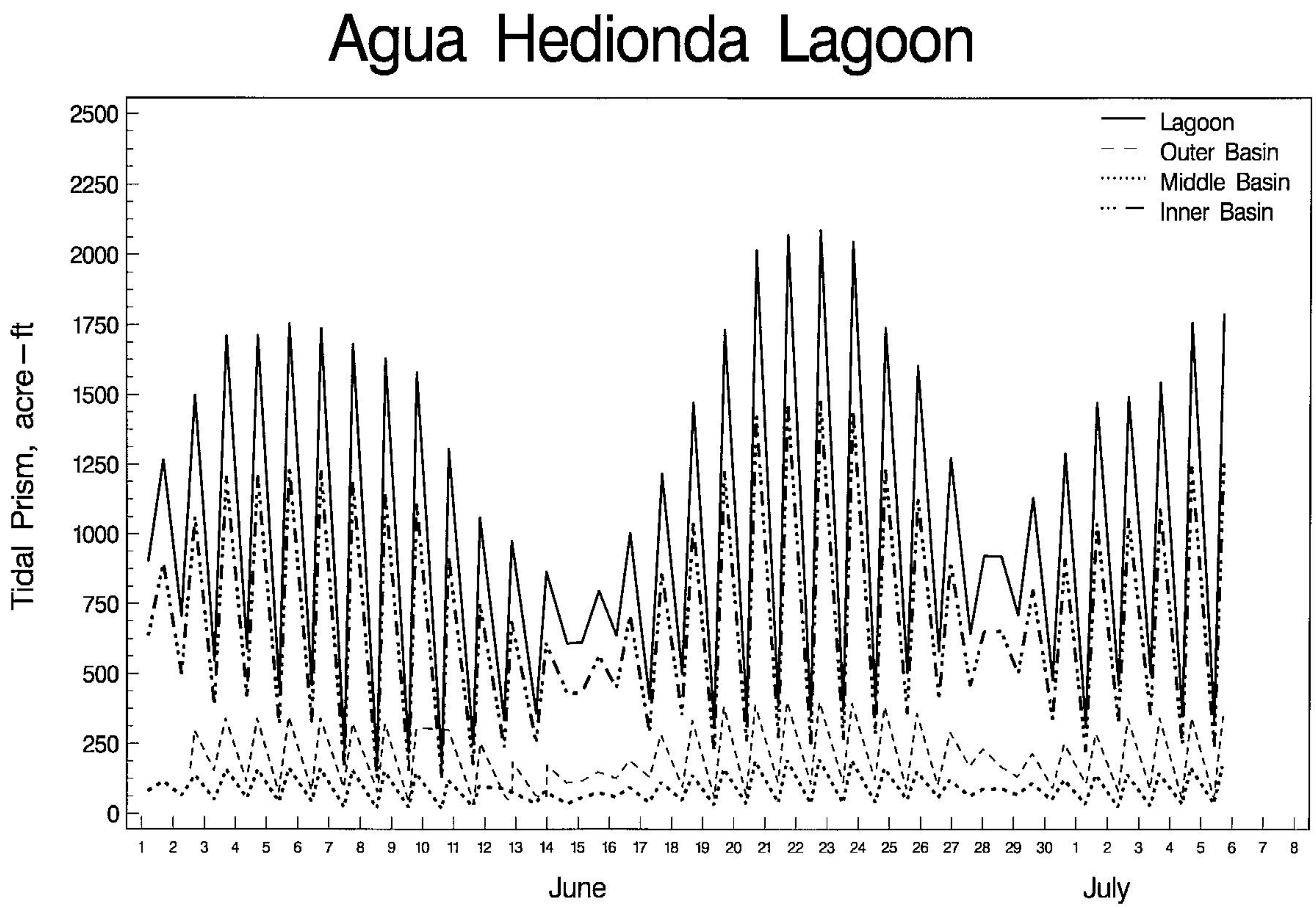


Figure 3-9. Tidal prism of the lagoon between June 1, 2005 and July 6, 2005.

3.3 SALINITY AND TEMPERATURE

Conductivity and temperature measurements were taken at Station S2B over a one-month period in order to compute water salinity. Salinity fluctuated between about 31.5 and 34 PSU (see Appendix D).

Temperature data were collected over a one-month period at Stations S0 and S2B. During the first two weeks of June, the temperature was about 20 to 22º C, while during late June to early July, the temperature decreased and fluctuated significantly, ranging between 14 and 20º C (see Appendix D).

4.0 RESIDENCE TIME OF WATER IN THE LAGOON

The term “old water” is defined here as water that remains in the lagoon system after the water outflow during ebb tide. It is water that has not yet been flushed out of the lagoon. As new water comes into the lagoon during flood tides, the “old water” becomes more diluted with each tidal cycle until all of it is eventually replaced by new water.

A computer program has been written to compute the percentage of remaining old water in the lagoon from the time immediately after the tidal cycle until the time when the remaining old water in the lagoon is less than 2%. The procedure is as follows.

If Q_{min} is the volume of water in the lagoon after the ebb tide, then Q_{min} will be diluted after the first tidal cycle by

$$D_i = (V_{max}(i+1) - V_{min}(i) + I_{pmax}(i+1) / V_{max}(i+1) \qquad (1)$$

where D = dilution,
i = the number of the tidal cycle and takes the values 1, 2, 3, ... , n,
V_{max} = the volume of water in the lagoon corresponding to the maximum water level,
V_{min} = the volume of water in the lagoon corresponding to the minimum water level, and
I_{pmax} = the volume of water taken from the lagoon by the power plant intake between the minimum and maximum water levels.

A tidal cycle is defined as the tidal period between two successive upcrossings of water level above the mean water elevation of the lagoon. The computed values of D_i (< 1) are multiplied after each tidal cycle, until the value of $D_i < 0.02$.

$$D_n = D_1 \times D_2 \times D_3 \times \ldots \times D_n \qquad (2)$$

The incoming water to the lagoon during a tidal cycle is calculated from the equation:

$$Q_{in} = V_{max} - V_{min} + I_{pmax} \qquad (3)$$

while the outgoing water from the lagoon is given by:

$$Q_{out} = V_{max} - V_{min} - I_{pmin} \qquad (4)$$

where I_{pmin} is the volume of water taken from the lagoon by the power plant intake between the maximum and minimum water levels.

In performing the computations for the individual basins, we apportioned the power plant intake flows by the volume of the basins at the minimum water level per tidal cycle. Figures 4-1 and 4-2 present the percentage of “old water” in the lagoon vs. the tidal cycles and daily tidal flushing, respectively. The solid lines show the best-fit curve for the data.

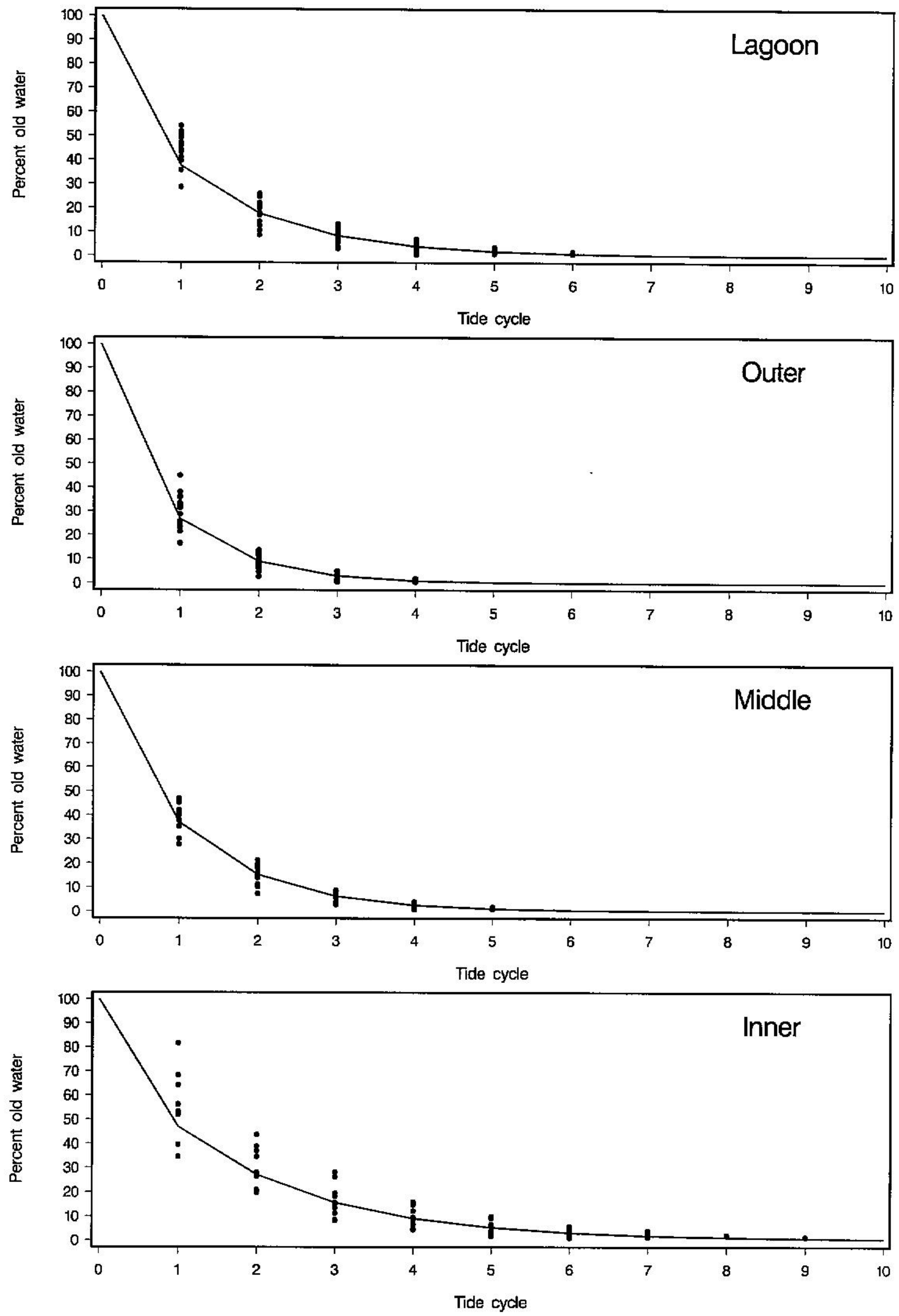


Figure 4-1. Percentage of old water in the lagoon vs. tidal cycles.

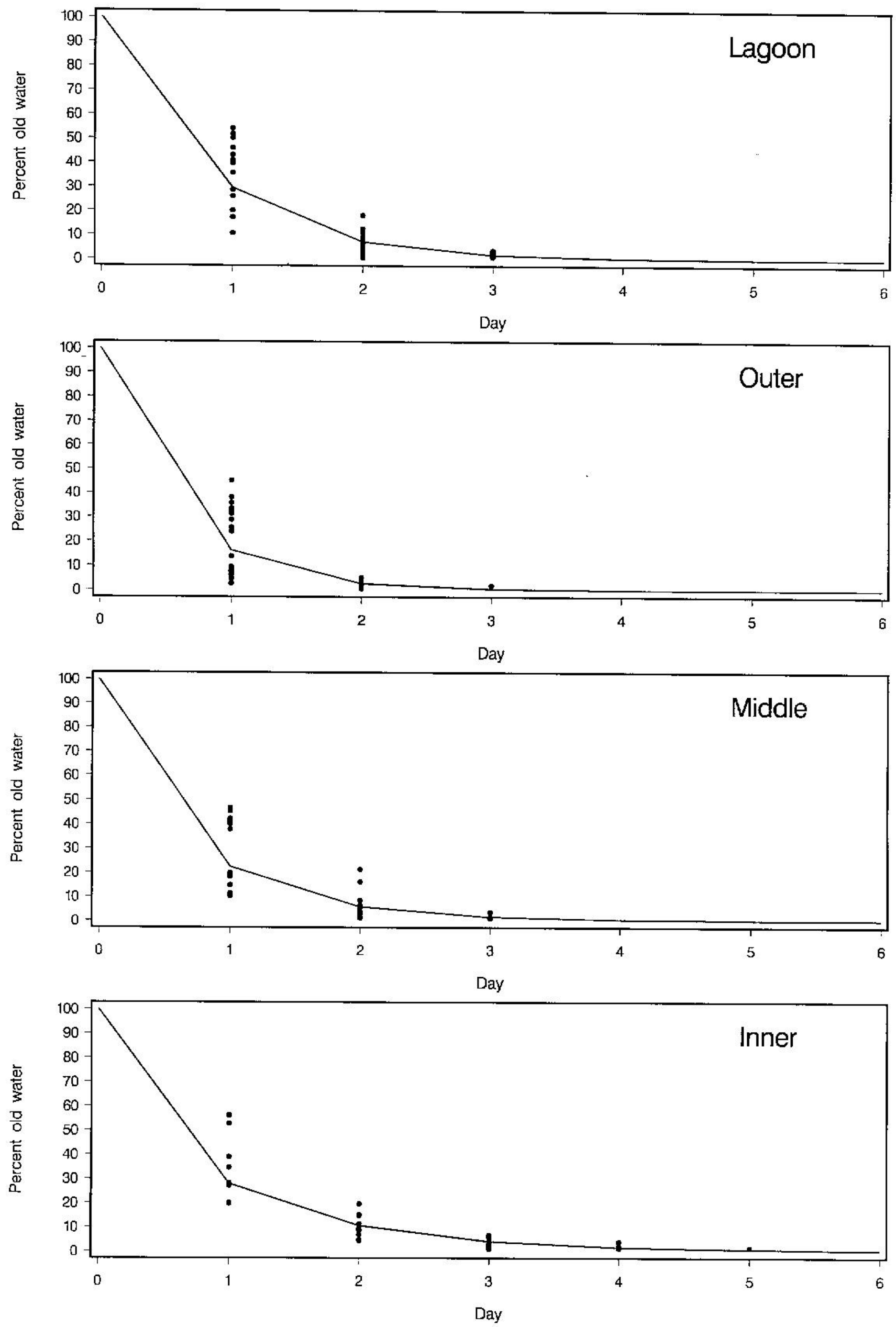


Figure 4-2. Percentage of old water in the lagoon vs. day, with solid line showing best-fit curve.

The best-fit curve is given by the equation:

$$y(x) = A\,e^{-Bx} \qquad (5)$$

where *A* and *B* are equation parameters, and *x* is the number of tidal cycles or days.

Tables 4-1 and 4-2 give the curve-fitting parameters from equation (5), that is *A* and *B*, for the percentage of old water in the lagoon and lagoon basins per tidal cycle and per day, respectively.

Table 4-3 gives the residence time of water in Agua Hedionda Lagoon. This table provides the mean, standard deviation, and range for both tidal cycles and days for the lagoon (total) and for the three basins, Outer, Middle, and Inner. Water remains in the lagoon (total) for a mean period of about 5.0 tidal cycles or 2.6 days. In the Inner Basin, water remains for a mean period of 6.27 tidal cycles or 3.2 days.

The lagoon inflow and outflow through the inlet during the period 1 June 05 through 7 July 05 is shown in Figures 4-3 and Figure 4-4 per tidal cycle and day, respectively. These figures are based on the water level and velocity measurements carried out in this study (Chapter 3).

The ratio between the inflowing water and the water taken in by the power plant cooling system is plotted in Figures 4-5 and 4-6 per tidal cycle and day, respectively. The solid lines in these two figures represent the mean ratio over the measurement time period. On average, the power plant cooling system takes in 51% of the inflowing water per tidal cycle and 46% per day.

Table 4-1. Curve-fitting parameters for "old water" percentage per tidal cycle.

Location	A	B
Lagoon	79.6766	−0.75256
Outer Basin	80.2683	−1.09736
Middle Basin	90.1073	−0.88907
Inner Basin	81.4989	−0.55056

Table 4-2. Curve-fitting parameters for "old water" percentage per day.

Location	A	B
Lagoon	122.360	−1.42331
Outer Basin	100.384	−1.82958
Middle Basin	87.945	−1.36858
Inner Basin	73.958	−0.97584

Table 4-3. Residence time of water in Agua Hedionda Lagoon.

Location	Tidal Cycles			Days		
	Mean	Std[a]	Range	Mean	Std[a]	Range
Lagoon	5.0	1.2	2 - 6	2.6	1.0	1 - 4
Outer Basin	3.6	0.5	2 - 4	1.9	0.5	1 - 3
Middle Basin	4.47	0.8	2 - 5	2.3	0.6	1 - 3
Inner Basin	6.27	1.8	2 - 9	3.2	1.0	1 - 5

[a] Std = Standard Deviation

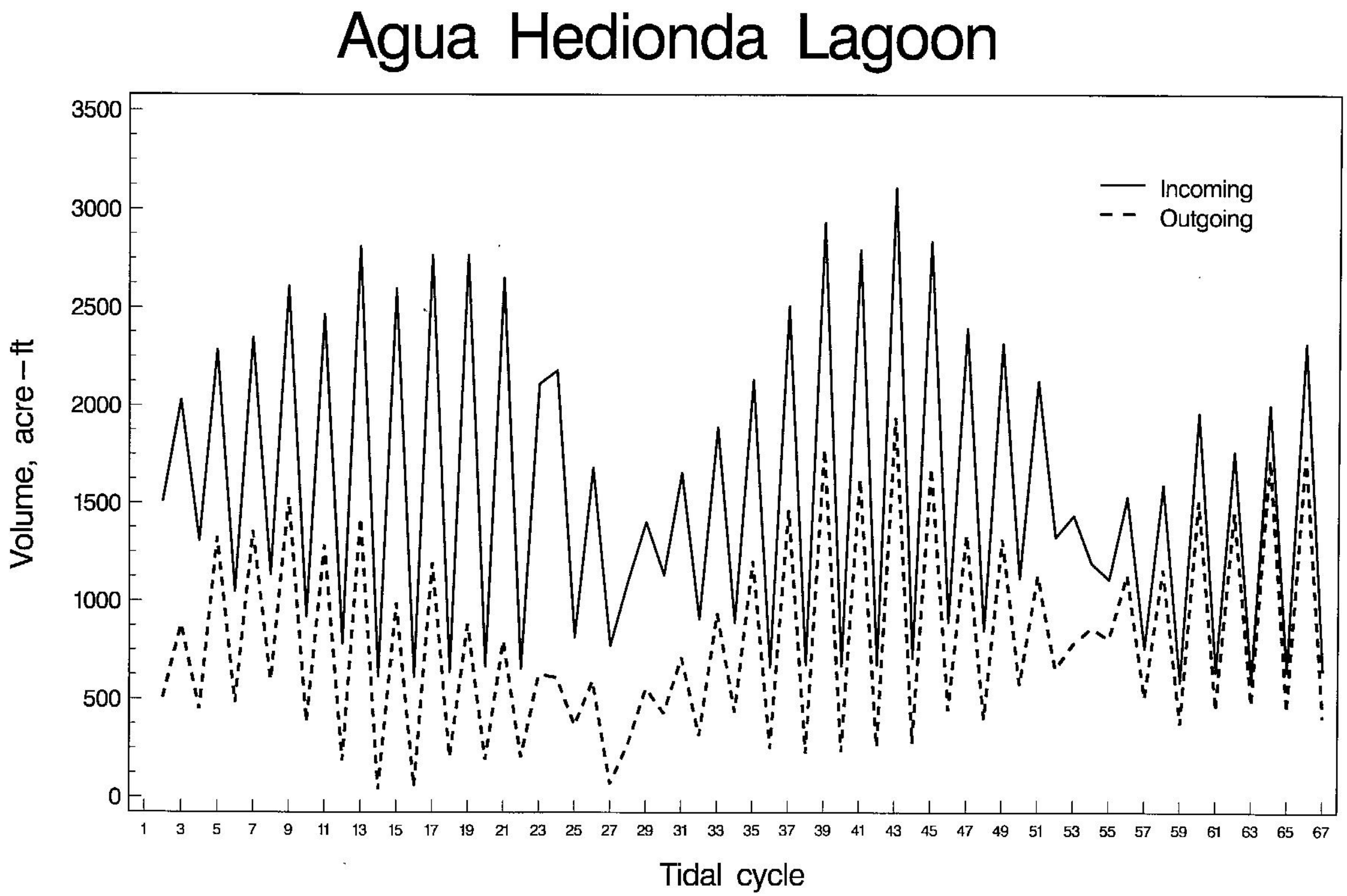


Figure 4-3. Lagoon inflow and outflow through the inlet per tidal cycle during 1 June 05 through 7 July 05.

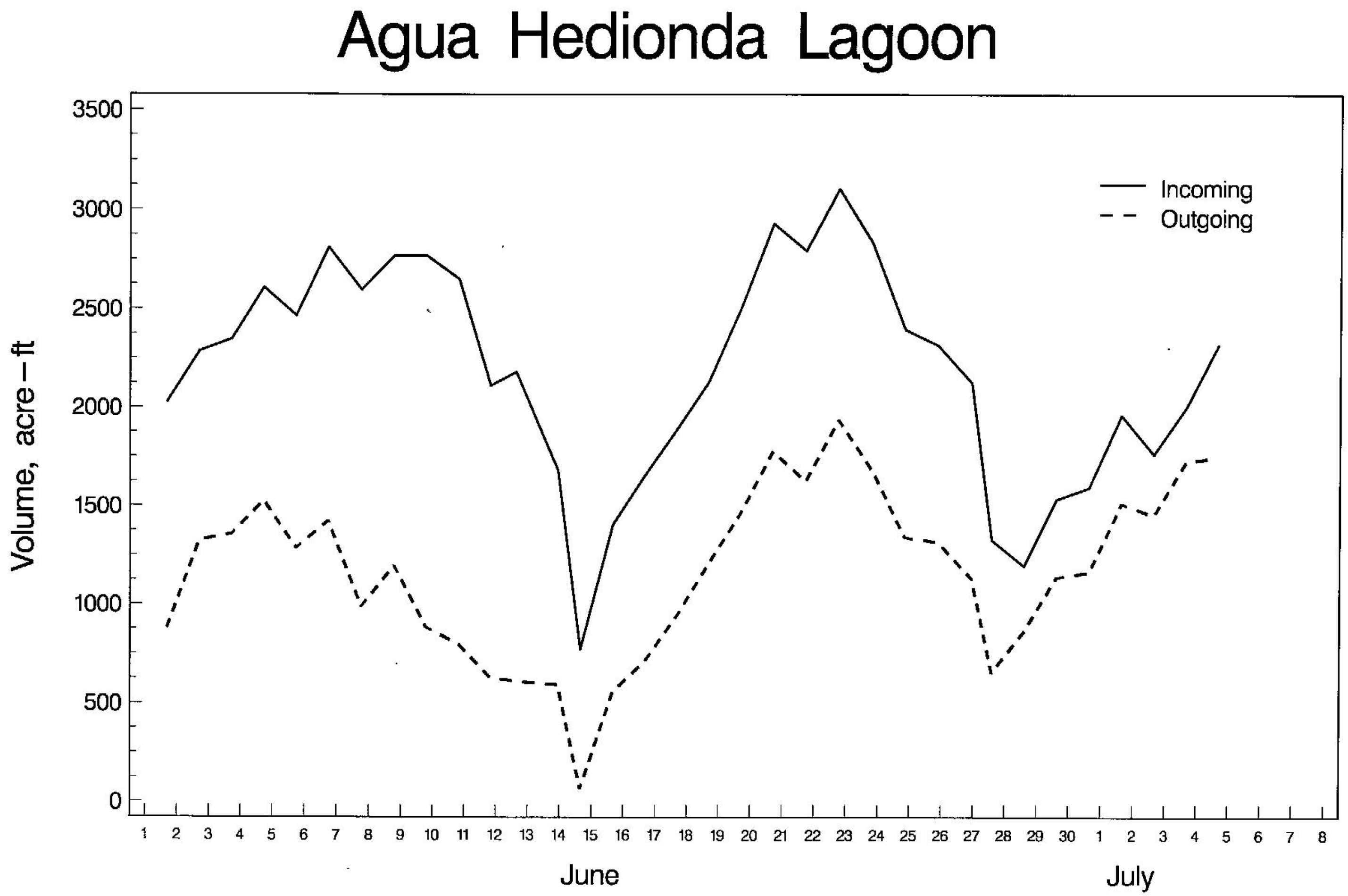


Figure 4-4. Lagoon inflow and outflow through the inlet per day during 1 June 05 through 7 July 05.

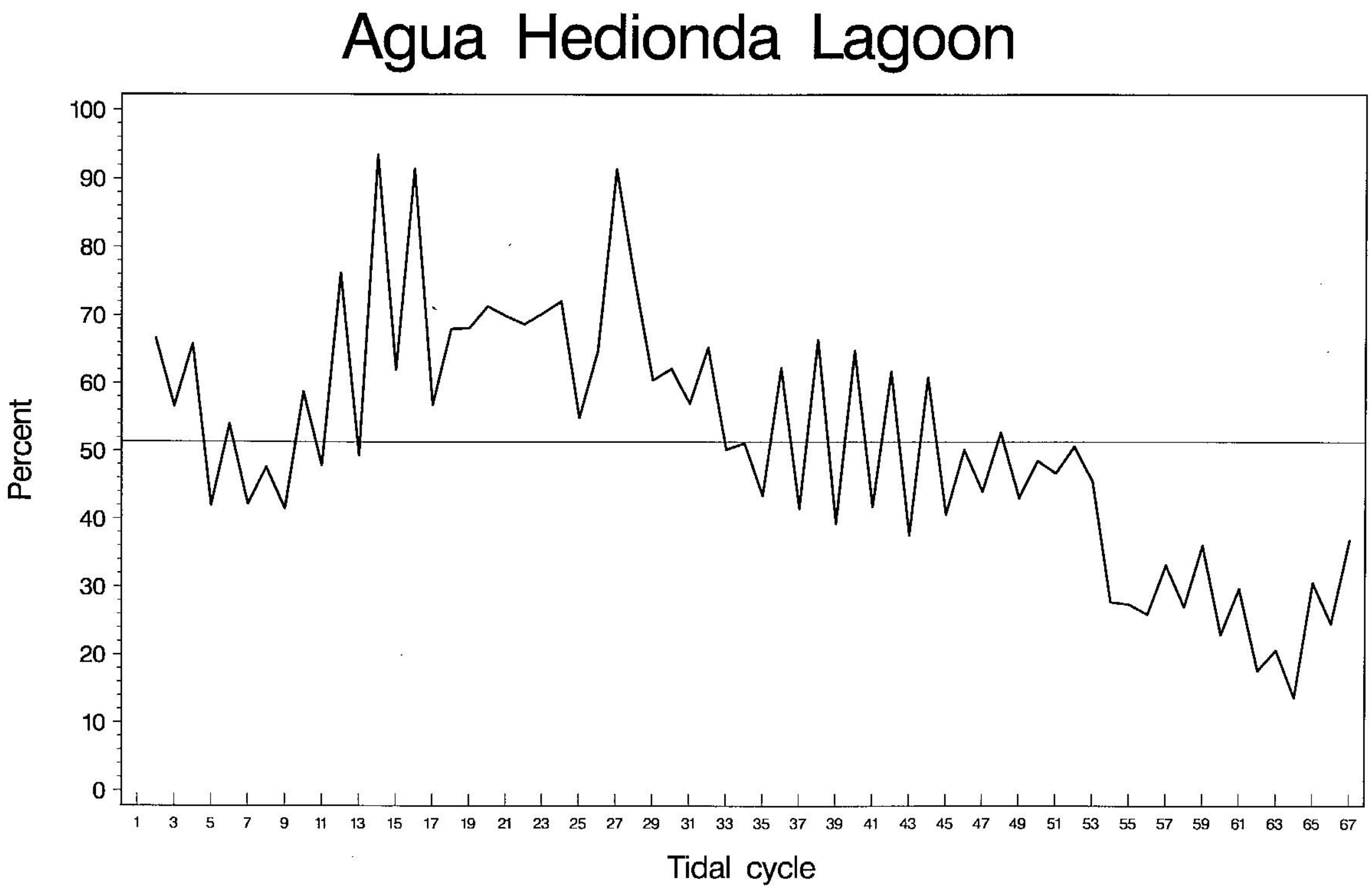


Figure 4-5. Ratio between inflowing water and water taken in by power plant cooling system by tidal cycle. The solid line represents the mean ratio over the measurement time period.

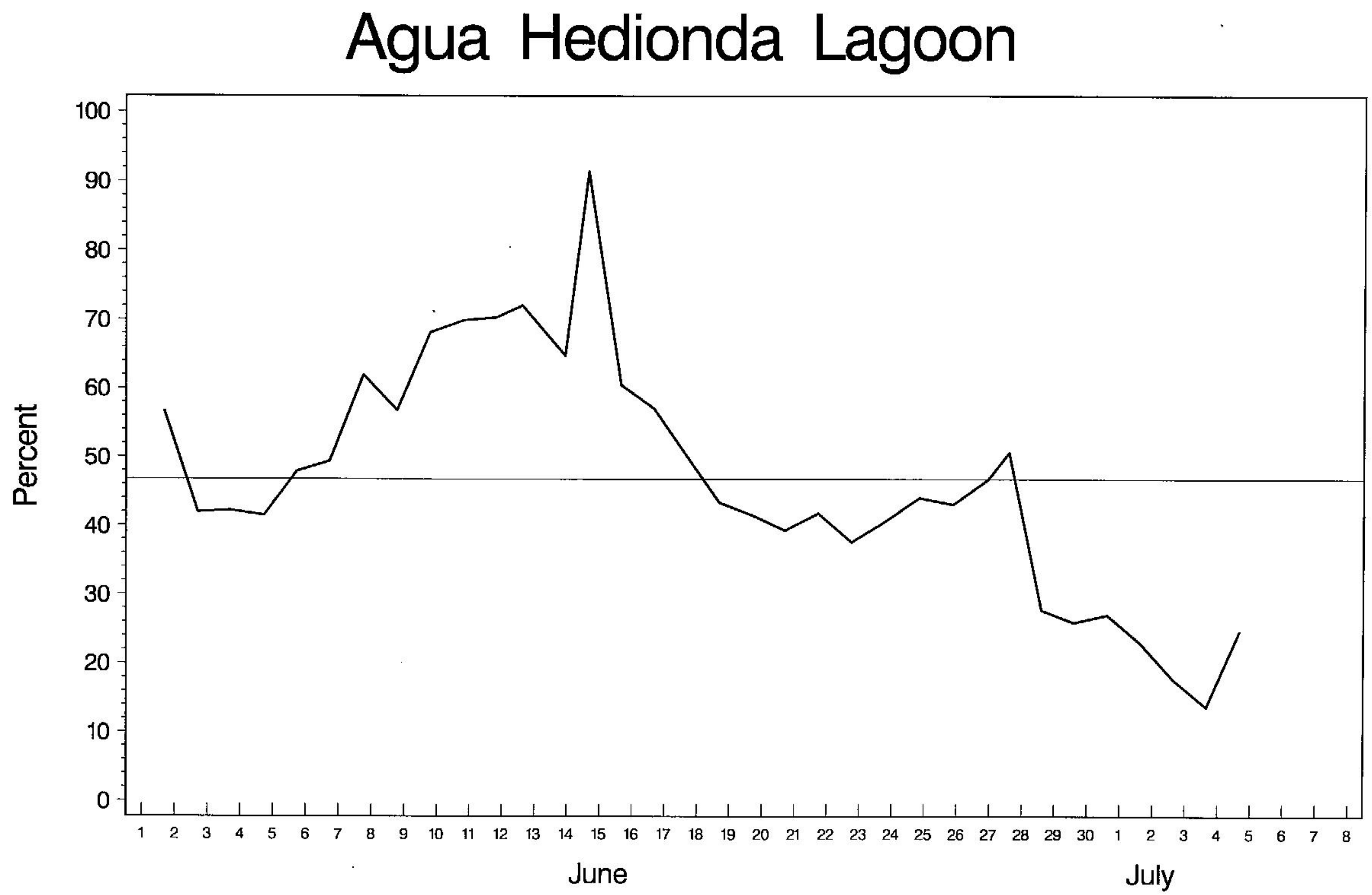


Figure 4-6. Ratio between inflowing water and water taken in by power plant cooling system by day. The solid line represents the mean ratio over the measurement time period.

5.0 SUMMARY AND CONCLUSIONS

In this study, we have provided a description of the Agua Hedionda Lagoon and the general lagoon hydrodynamics. Agua Hedionda Lagoon differs from other southern California lagoons in the respect that the volume of inflowing water is vastly larger than the volume of outflowing water. The operation of the cooling system at the Encina Power Station alters these hydrodynamics. The power generating units take about 625-670 mgd of water from the lagoon to the power plant condenser system for cooling purposes. This process reduces the volume of the outflow water from the lagoon by about 40-50%. The heated water is discharged directly to the ocean through the discharge channel (Figure1-2).

5.1 LAGOON DESCRIPTION

Data from a bathymetry survey conducted in 2005 were used in this study (Figure 2-1). Surface area and water volume in the lagoon were computed from this survey. The results are shown in Figure 2-5. The surface area of the lagoon was about 360 acres at 6 ft NGVD and 225 acres at MLLW. At MLLW, the volume of the lagoon was about 1750 acre-ft. The majority of the area and water volume come from the large Inner Basin.

5.2 FIELD MEASUREMENTS

Data were collected during a one-month survey at four stations (Figure 3-1) in the lagoon from 1 June 2005 to 7 July 2005. The four stations are S0, S2A, S2B, and S3. Water level measurements were taken at all four stations, and water velocity measurements were taken at two of the stations, S0 and S2B. Water levels generally followed the tides (Figures 3-3 to 3-5). Water velocity was predominately in an east-west direction, with a small component in a north-south direction (Appendix B). Tidal conditions during three time periods were identified for neap, spring and mean tides (Figures 3-3, 3-4, and 3-5). Figures overlaying flow velocity over water level measurements are shown in Figures 3-6, 3-7, and 3-8. Water level and velocity measurements were used to estimate tidal prism, determine the volume of inflow and outflow water, and estimate the residence time of water in the lagoon.

Water elevation, velocity, salinity, and temperature measurements were taken. These data were used to describe lagoon dynamics and compute water exchange between the lagoon and ocean. The tidal prism of the lagoon during the time period of the measurements is shown in Figure 3-9. It varied from approximately 1000 acre-ft during neap tide to 2125 acre-ft during spring tide to 1700 acre-ft during mean tide.

Salinity measurements were made primarily to find out whether there was a difference between the salinity of the water coming into the lagoon and the outgoing water. It was found that the difference was so small that the approach used by Largier (1996) in San Francisco Bay and Jay (2001) at Morro Bay to estimate the residence time of water in the lagoon was not appropriate.

5.3 RESIDENCE TIME

A mathematical model designed to compute the residence time of water in the lagoon and its three basins is described in Chapter 4. Based on this model, we determined the amount of "old water" in the lagoon during a tidal cycle. In the lagoon (total) after 5.0 tidal cycles or 2.6 days, the "old water" is essentially flushed out of the lagoon. In the Inner Basin, 6.27 tidal cycles, or 3.2 days, are required to flush out the "old water." Due to water intake by the cooling system of the EPS, the outgoing flow through the inlet is less than the incoming flow through the inlet . Figures 4-3 and 4-4 show the lagoon inflow and outflow during the period of 1 June through 7 July 2005, per tidal cycle and per day, respectively. The mean reduction of the outflow water from the lagoon with respect to incoming water was about 51% per tidal cycle and 48% per day during the time period of the measurements.

6.0 REFERENCES

Bhogal, V., and S. Costa, 1989. Modeling Flood Tidal Deposits in Tidal Inlets. In *Oceans '89: An International Conference Addressing Methods for Understanding the Global Ocean*, Seattle, Washington, September 18-21, 1989, IEEE Publication Number 89CH2780-5, p. 90-95.

Bradshaw, J., B. Browning, K. Smith, J. Speth, and E. Fullerton, 1976. The Natural Resources of Agua Hedionda Lagoon. Coastal Wetlands Series #16. Prepared for U.S. Fish and Wildlife Service, June 1976. 110 pp. + 9 appendices.

Coastal Environments, 1998. Bibliography of Pertinent Research on Existing Conditions and Monitoring Studies in the Vicinity of Agua Hedionda Lagoon. Prepared for the California Coastal Commission, City of Carlsbad, and San Diego Gas and Electric Company, 2 January 1988, CE Ref. No. P98-1. 2 pp. + 3 appendices.

EA Engineering, Science, and Technology, 1997. Final Encina Power Plant Supplemental 316(a) Assessment Report, Volume 2 of 2, Appendices. Prepared for San Diego Gas & Electric Co., July 1997. 2 appendices.

Ellis, J., 1954. Dredging Final Report, October 29, 1954, Agua Hedionda Slough Encina Generating Station. San Diego Gas & Electric Co., Carlsbad, CA, 43 pp.

Elwany, M. H. S., A-L. Lindquist, R. Flick, W. O'Reilly, J. Reitzel, and W. Boyd, 1999. Study of Sediment Transport Conditions in the Vicinity of Agua Hedionda Lagoon, Volume 1: Technical Report. SIO Reference No. 00-07, Scripps Institution of Oceanography, Center for Coastal Studies, La Jolla, CA, 8 January 1999. 10 chapters + 3 appendices.

Jay, D., 2001. The Morro Bay Power Plant and Circulation Processes in Morro Bay. Prepared for Duke Energy North American, Oakland, CA, 15 March 2001. 106 pp.

Jenkins, S., and D. Skelly,1988. An Evaluation of the Coastal Database Pertaining to Seawater Diversion at Encina Power Plant, Carlsbad, CA. Prepared for San Diego Gas & Electric Co., July 1988. 56 pp.

Jenkins, S., D. Skelly, and J. Wasyl, 1989. Dispersion and Momentum Flux Study of the Cooling Water Outfall at Agua Hedionda. Scripps Institution of Oceanography, Center for Coastal Studies, La Jolla, CA. Prepared for San Diego Gas & Electric Co., September 1989. 36 pp. + 3 appendices.

Jenkins, S., and J. Wasyl, 2001. Agua Hedionda Lagoon North Jetty Restoration Project: Sand Influx Study. Submitted to Cabrillo Power LLC, Carlsbad, CA on 14 September 2001. 178 pp. + 8 appendices.

Largier, J. L., 1996. Hydrodynamic Exchange Between San Francisco Bay and the Ocean: The Role of Ocean Circulation and Stratification. In *San Francisco Bay, The Ecosystem: Further Investigations.* Proceedings of the 75th Annual Meeting, Pacific Division, American Association for the Advancement of Science, held in San Francisco, CA, June 19-24, 1994, pp. 69-104.

Reid, J., and A. Mantyla, 1976a. The Effect of the Geostrophic Flow Upon Coastal Sea Elevations in the Northern North Pacific Ocean. *Jour. Geophysical Research,* v.81, n.18, 3100-3110.

Zetler, B., and R. Flick, 1985. Predicted Extreme High Tides for California, 1983–2000. *Jour. Waterway, Port, Coastal, and Ocean Engineering*, ASCE, v. 111 (4), 758–765.

APPENDIX A

WATER LEVEL MEASUREMENTS AT OUTER, MIDDLE, AND INNER BASINS

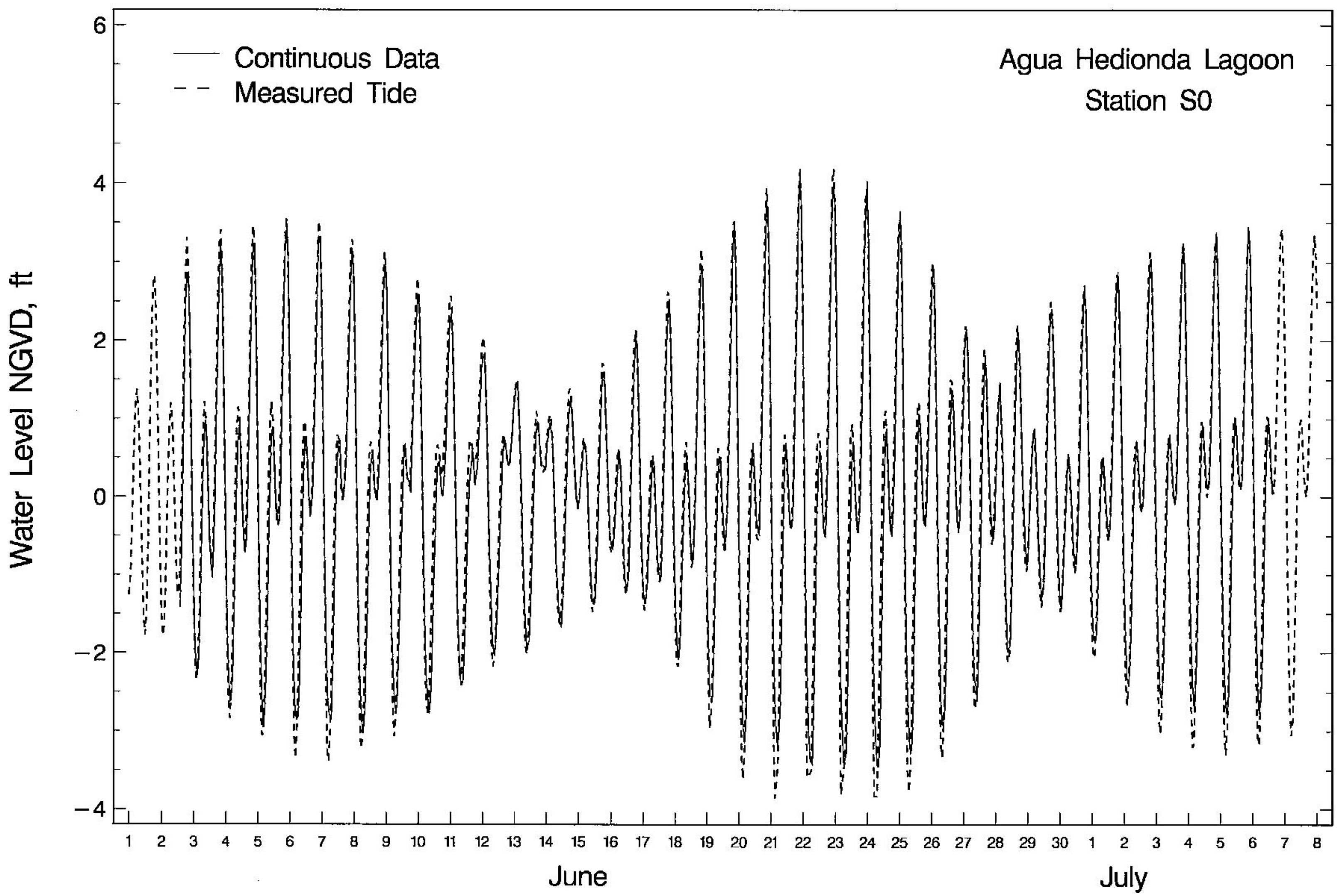


Figure A-1. Comparison between water level measurements at Station S0 and ocean tide.

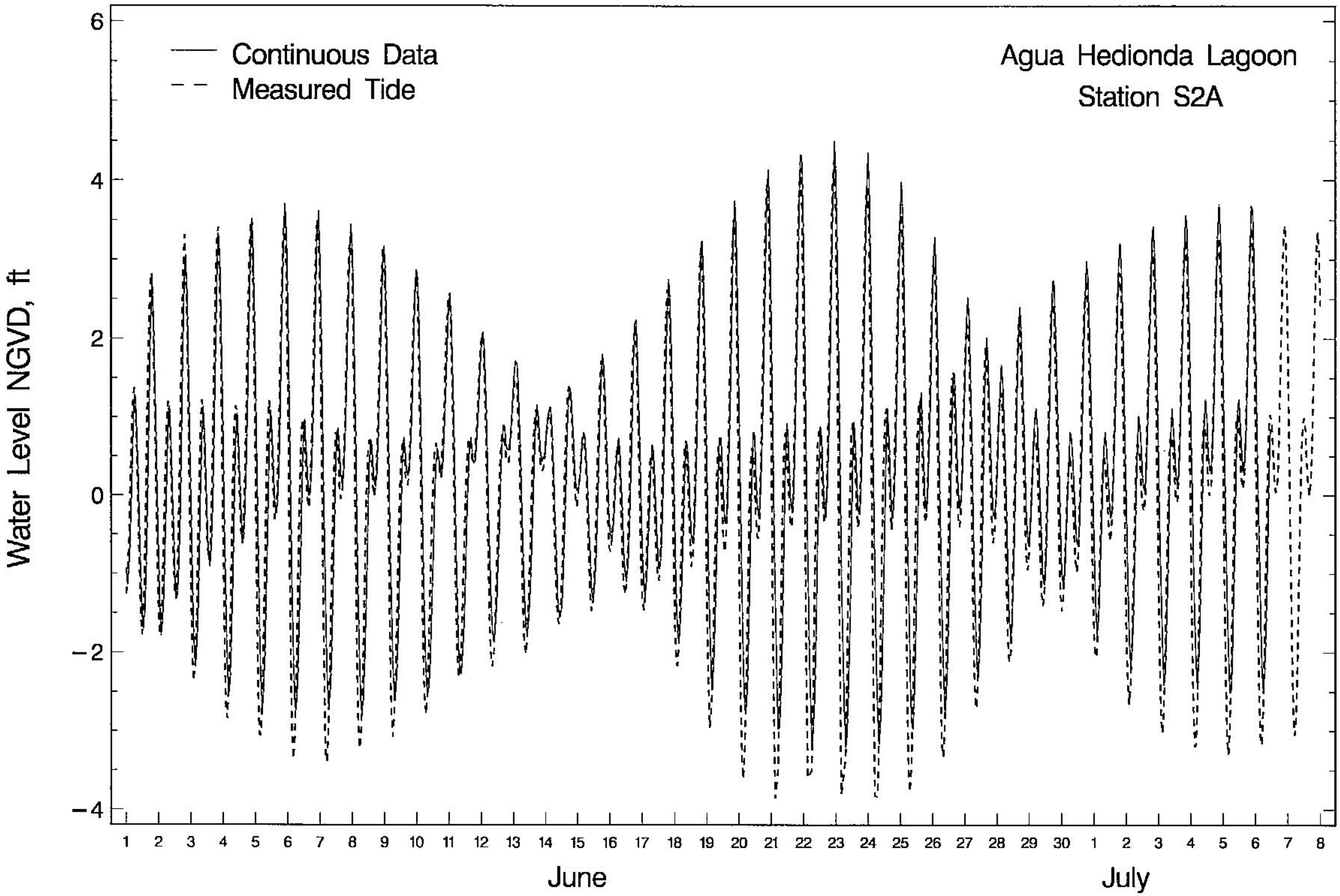


Figure A-2. Comparison between water level measurements at Station S2A and ocean tide.

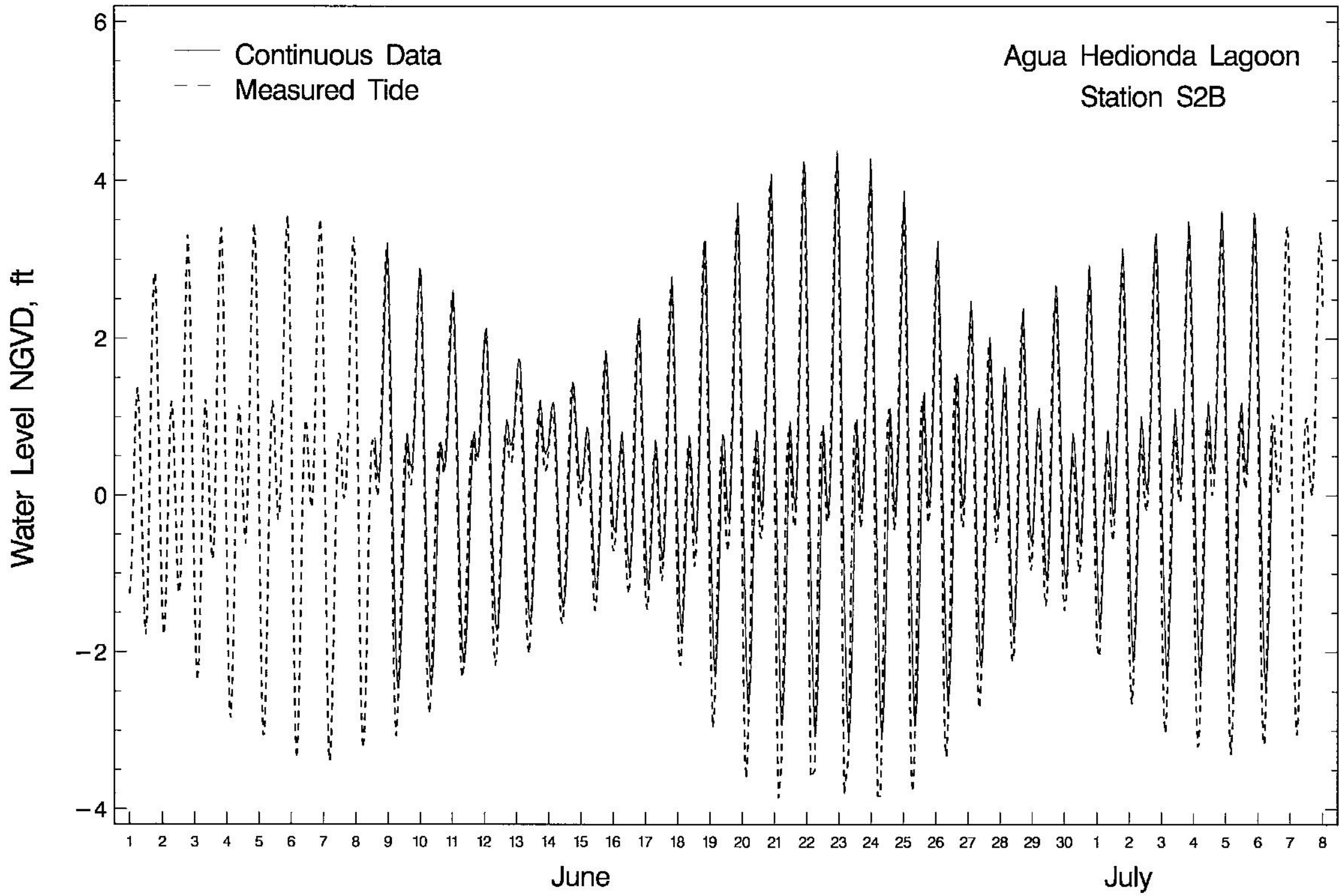


Figure A-3. Comparison between water level measurements at Station S2B and ocean tide.

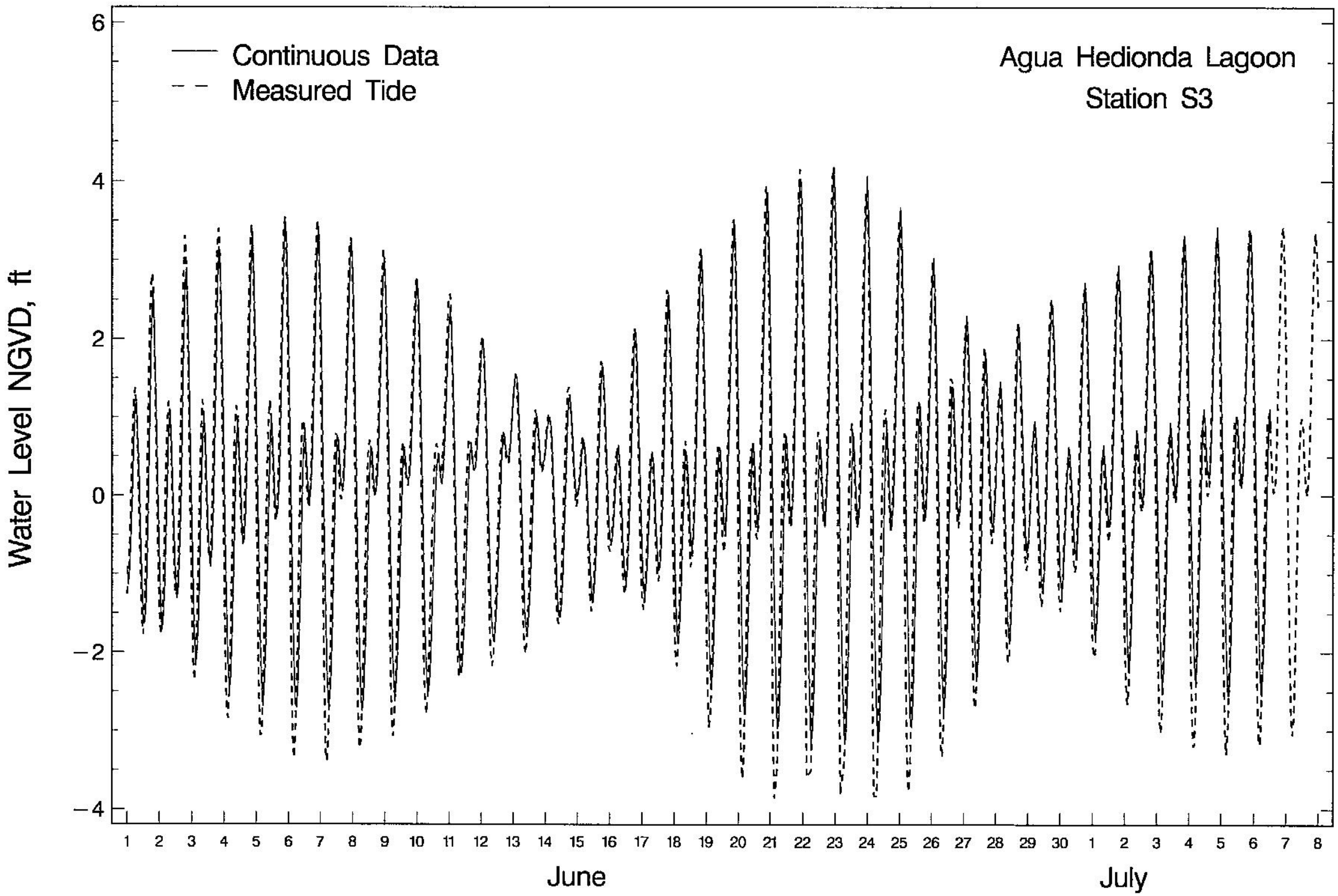


Figure A-4. Comparison between water level measurements at Station S3 and ocean tide.

APPENDIX B

WATER VELOCITY MEASUREMENTS AT OUTER AND INNER BASINS

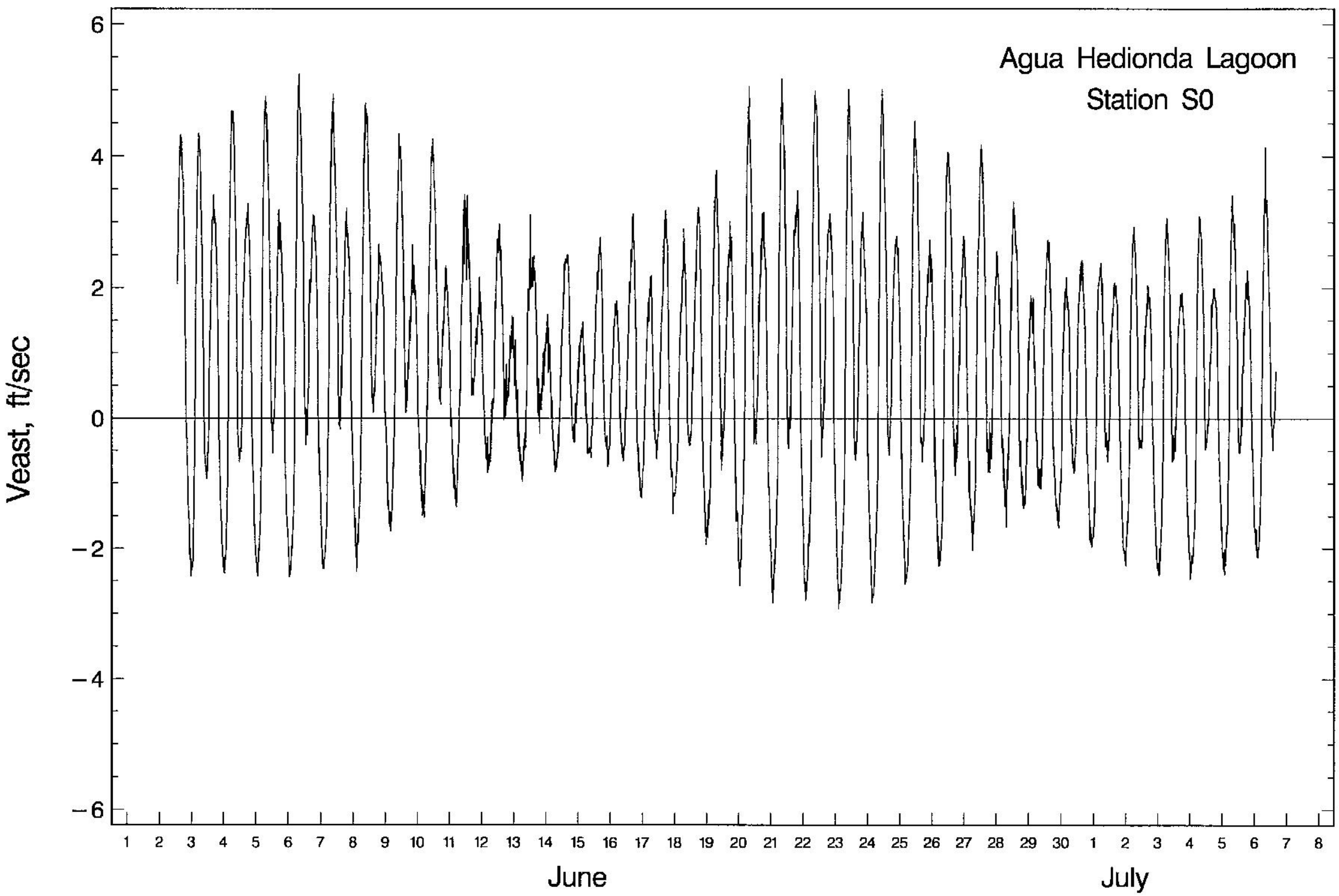


Figure B-1. East component of water velocity at Station S0.

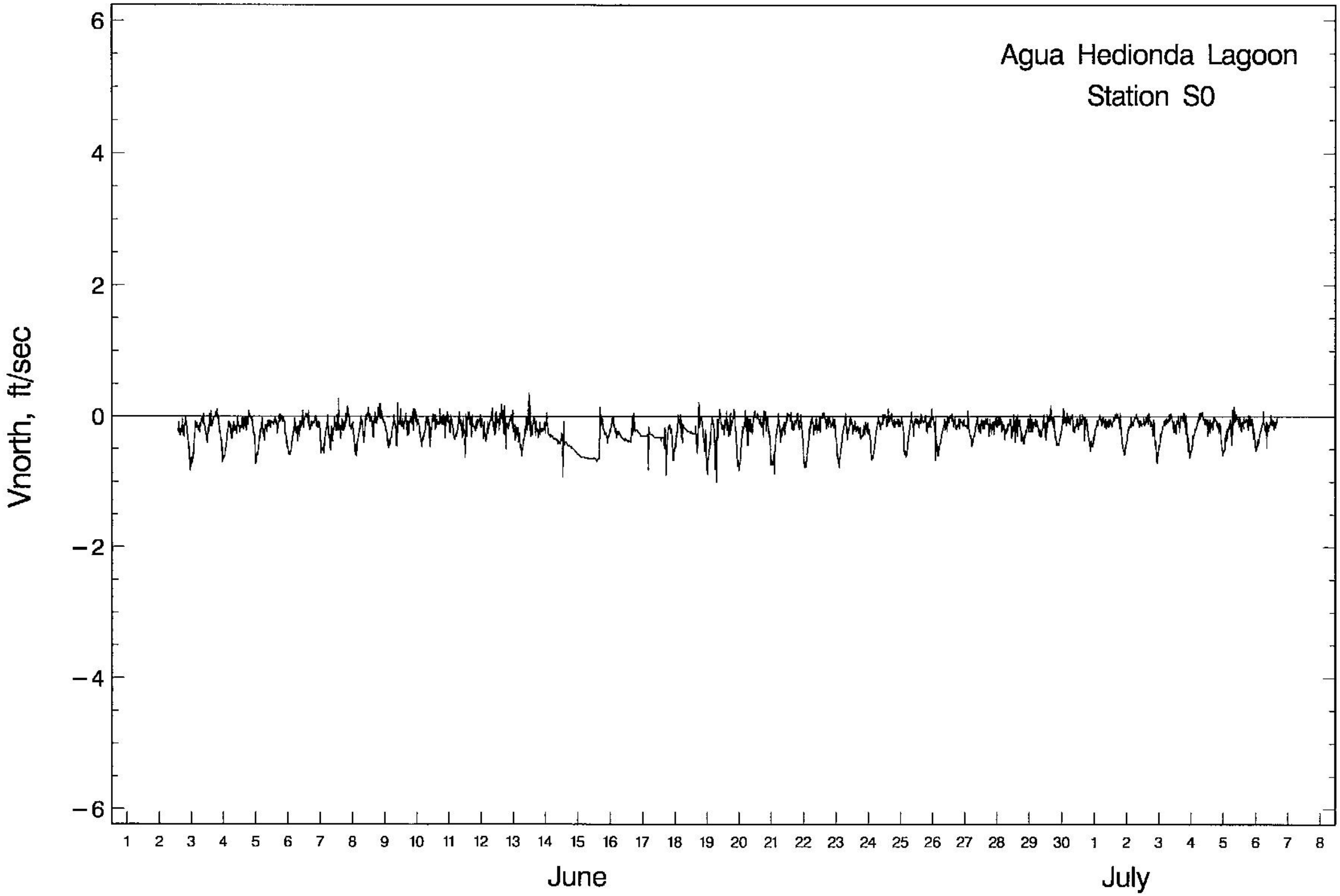


Figure B-2. North component of water velocity at Station S0.

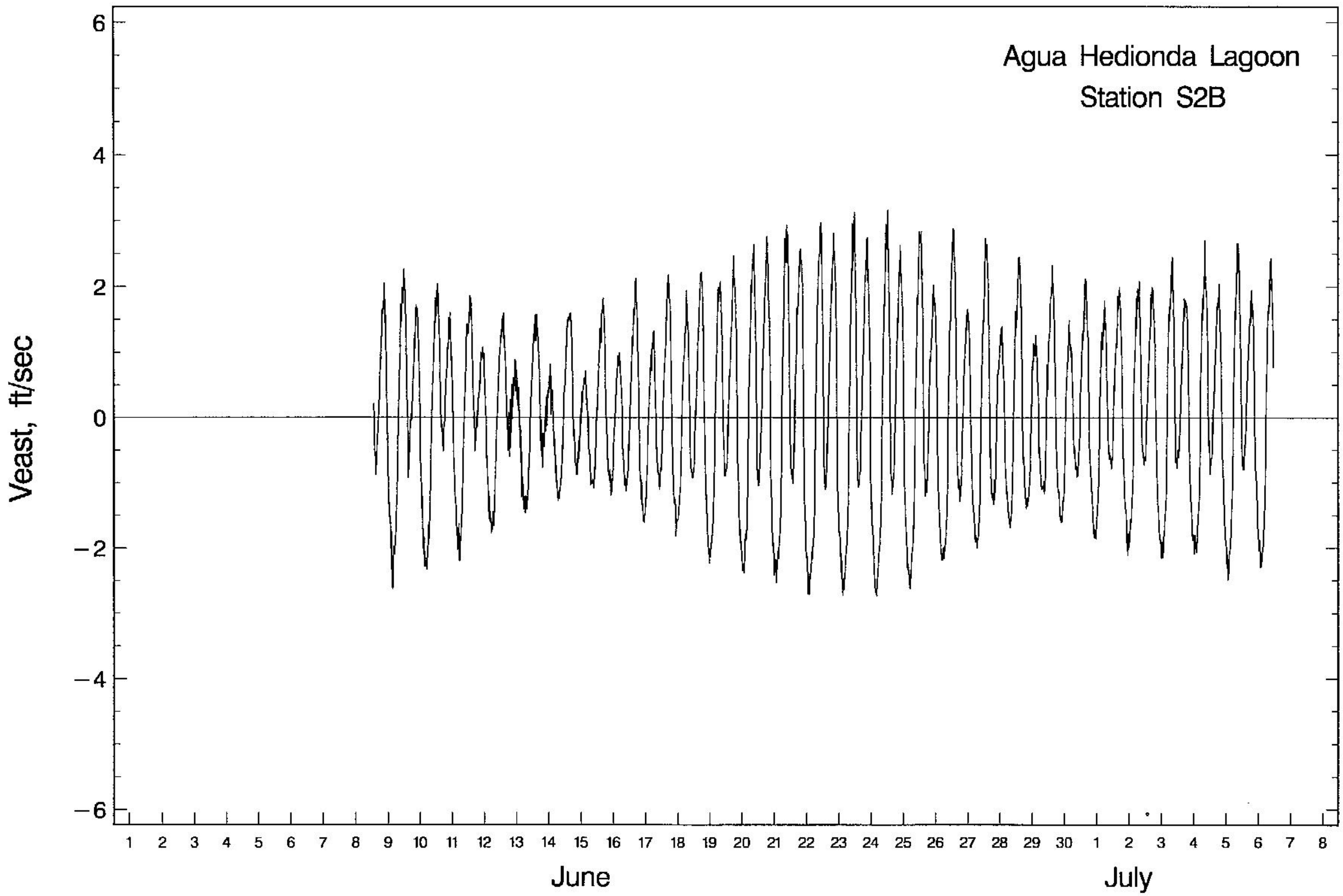


Figure B-3. East component of water velocity at Station S2B.

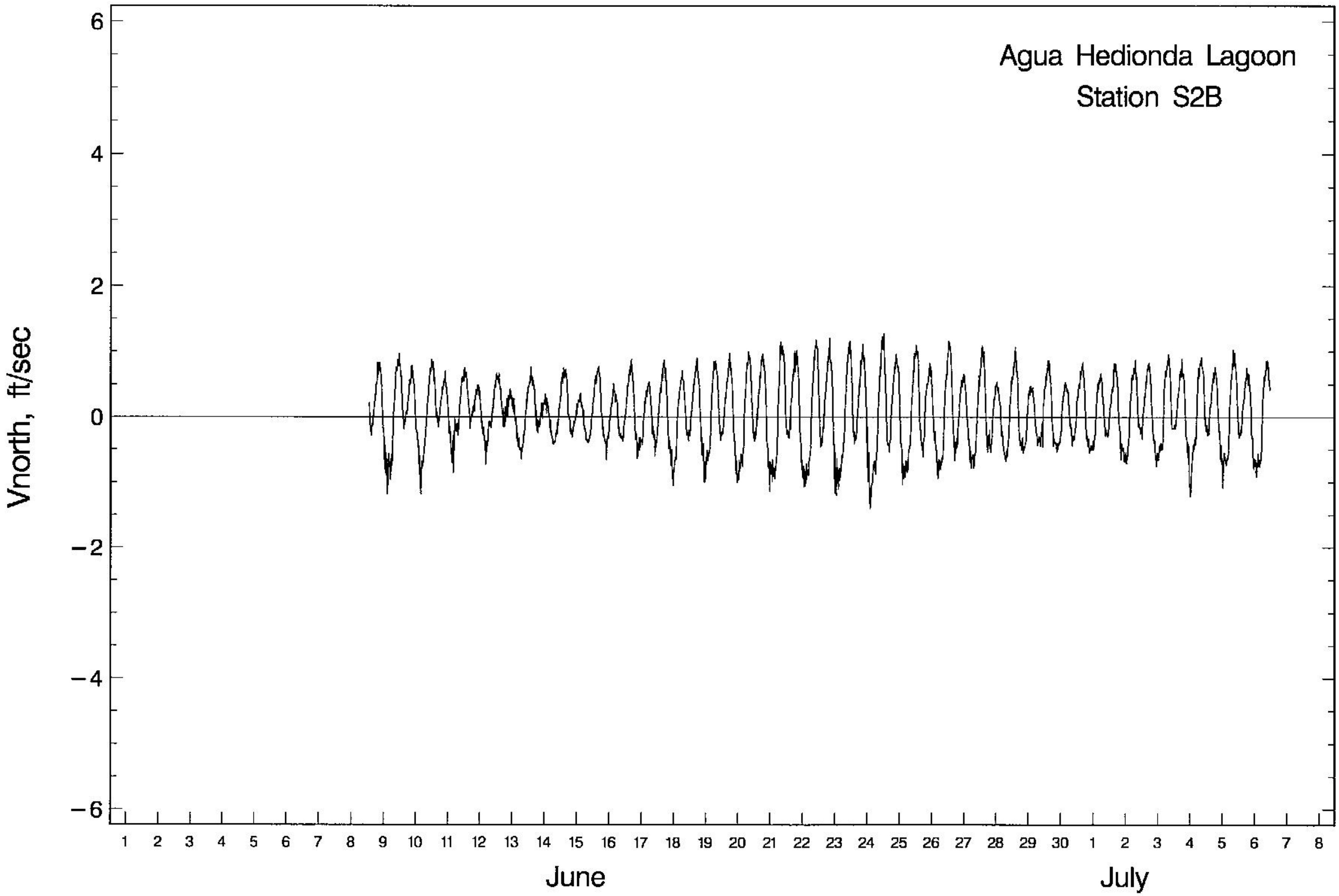


Figure B-4. North component of water velocity at Station S2B.

APPENDIX C

LAGOON TIDAL PRISM ALONG WITH CONTRIBUTIONS OF OUTER, INNER, AND MIDDLE BASINS TO THE TIDAL PRISM

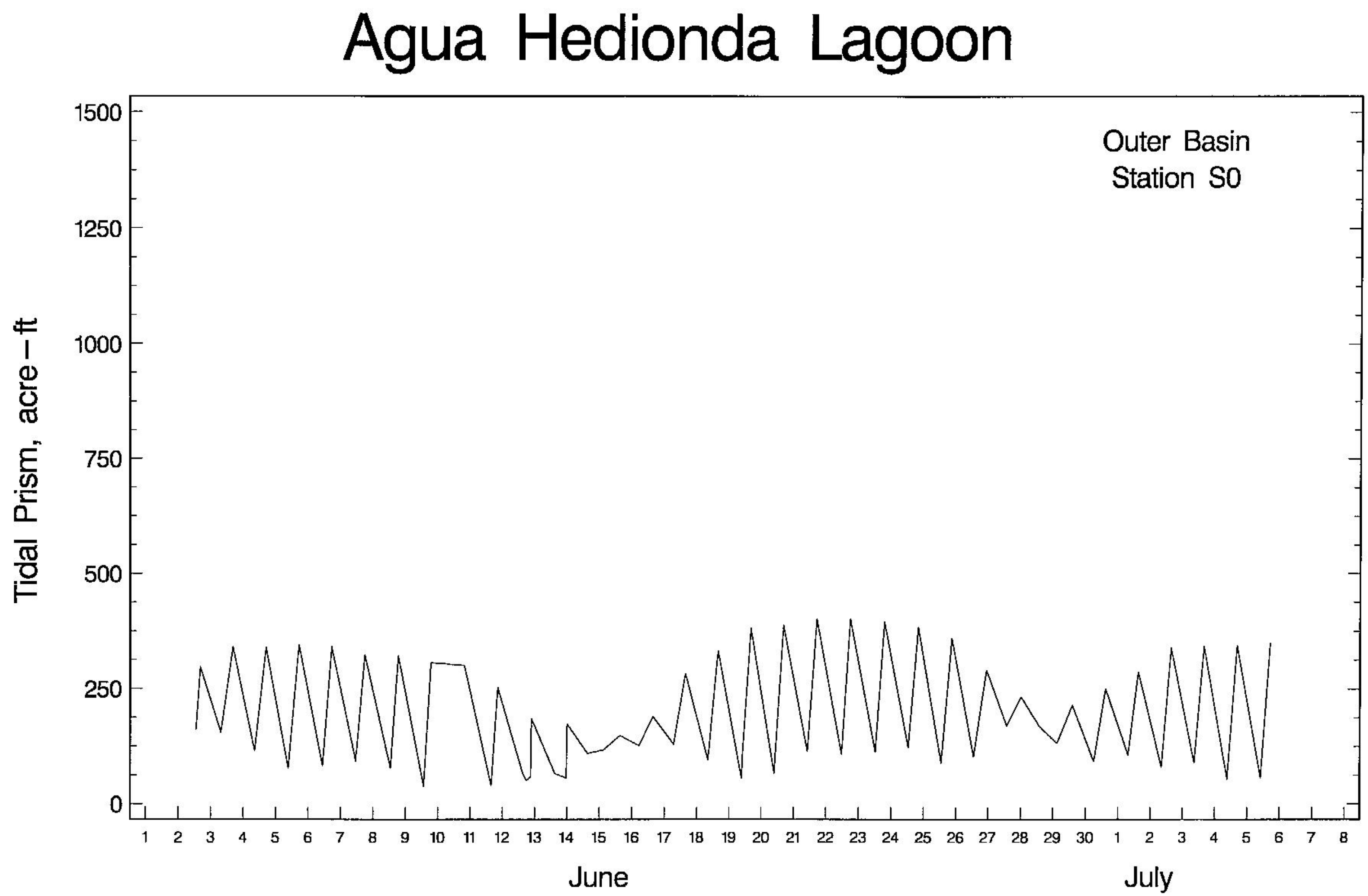


Figure C-1. Tidal prism of Outer Basin as computed from water level measurements at Station S0.

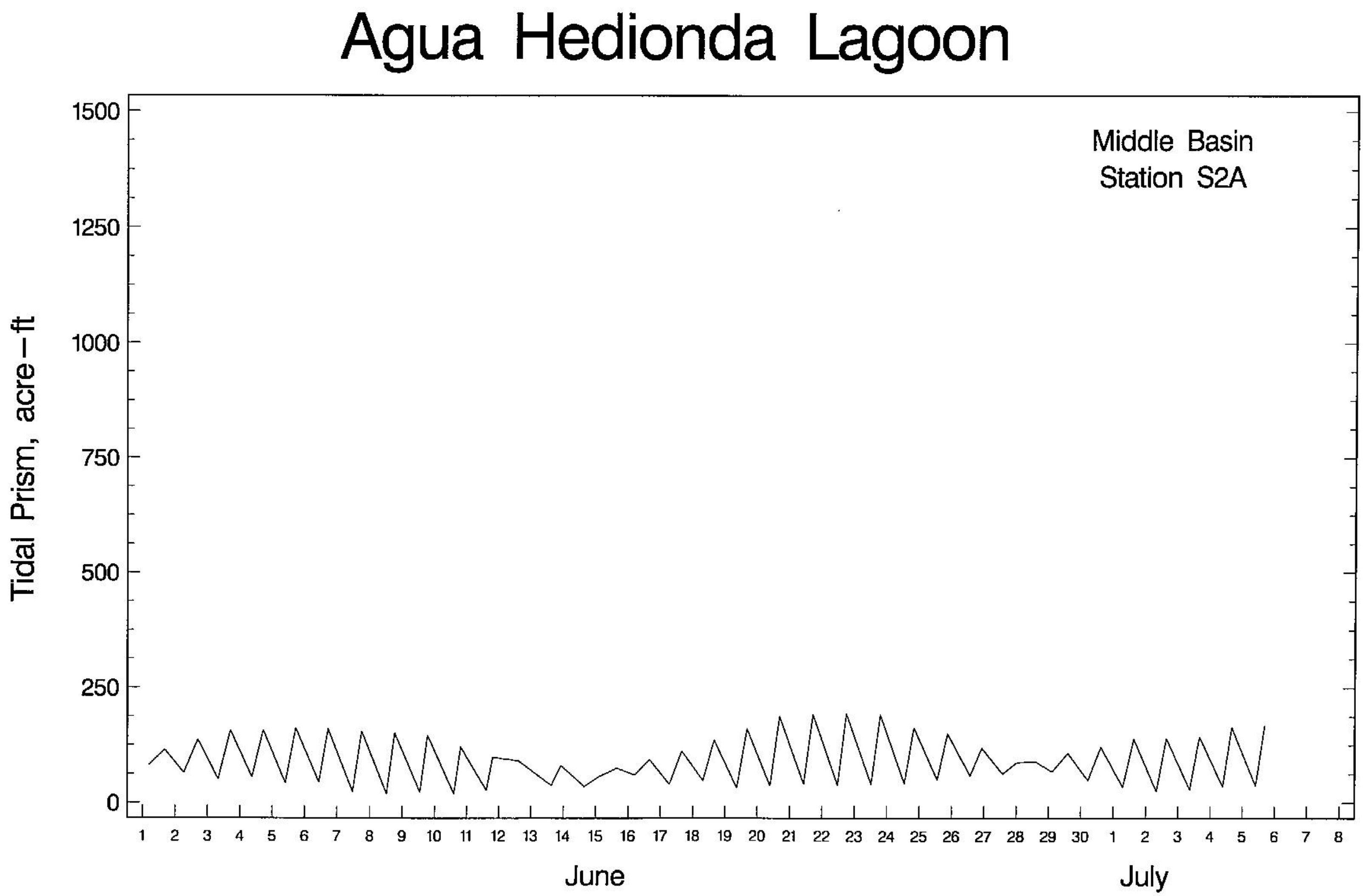


Figure C-2. Tidal prism of Middle Basin as computed from water level measurements at Station S2A.

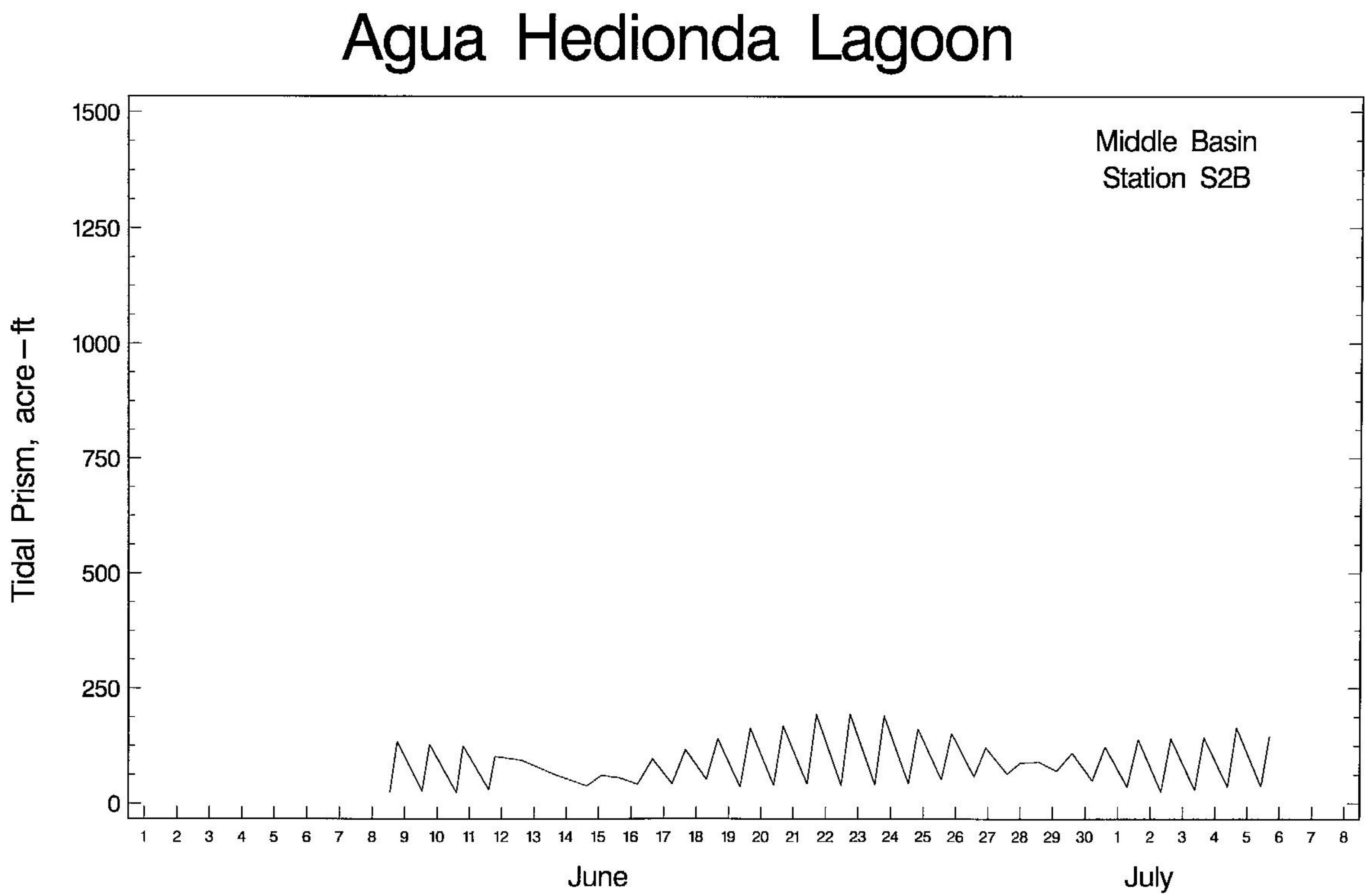


Figure C-3. Tidal prism of Middle Basin as computed from water level measurements at Station S2B.

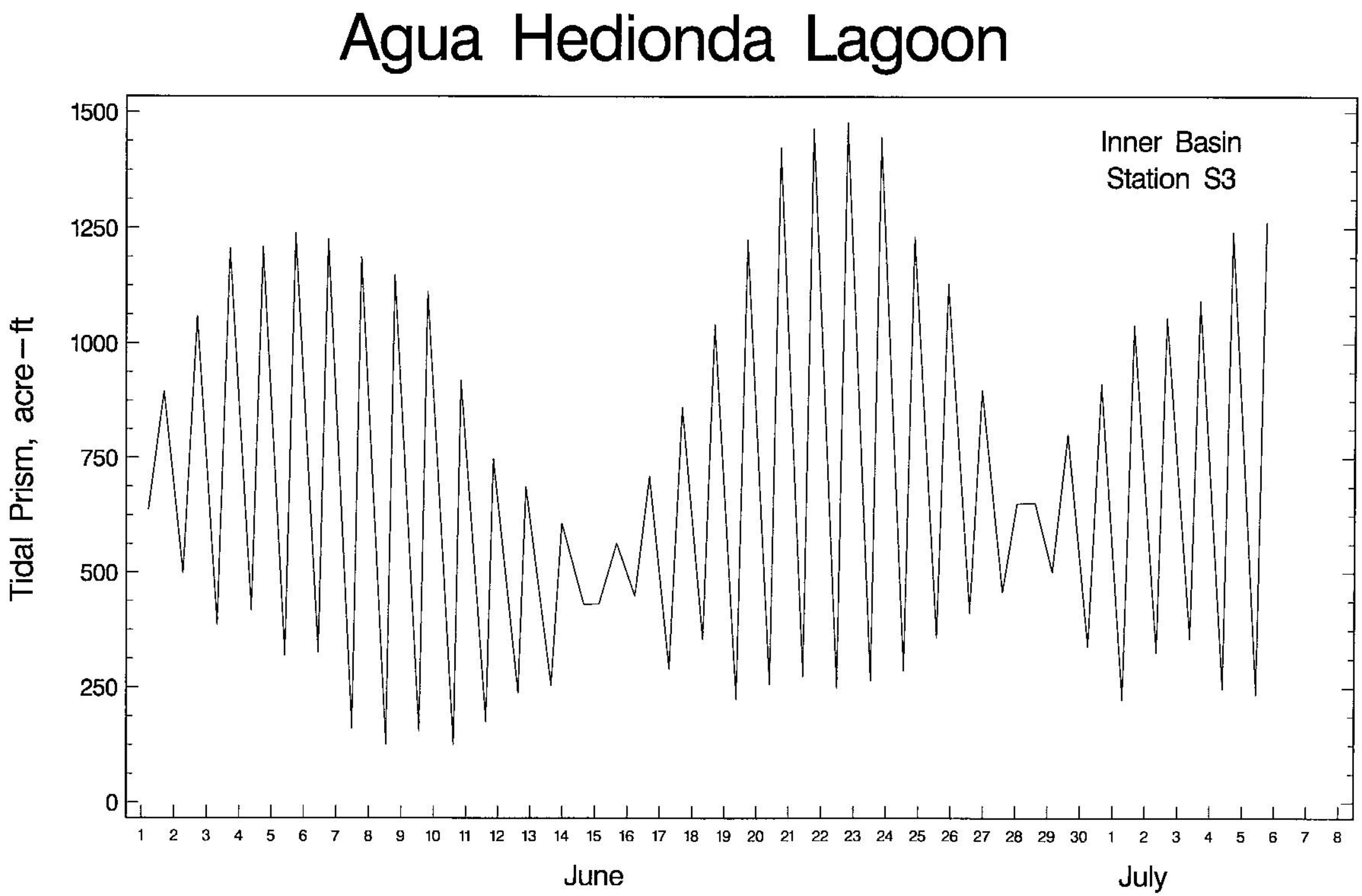


Figure C-4. Tidal prism of Inner Basin as computed from water level measurements at Station S3.

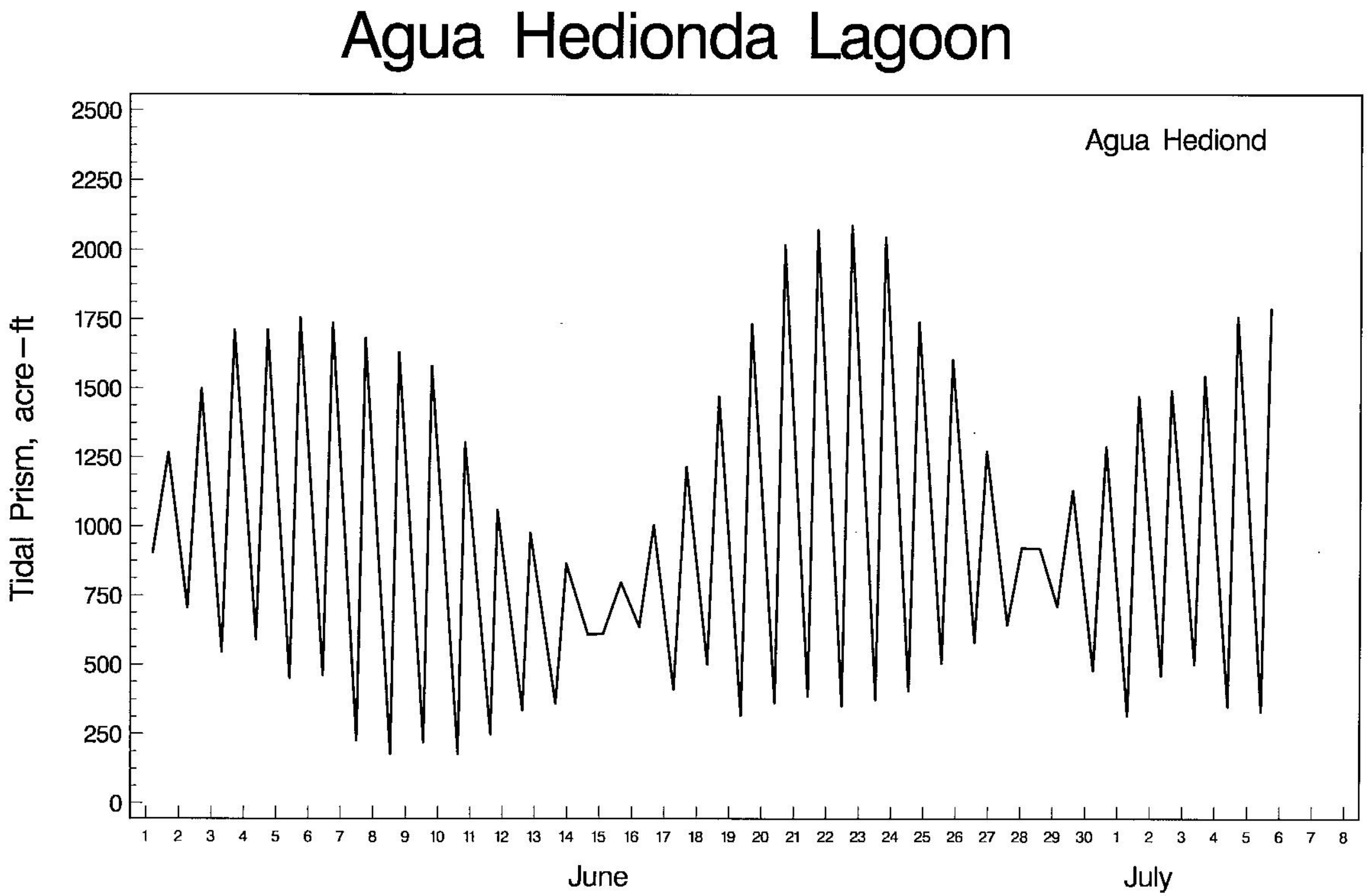


Figure C-5. Agua Hedionda Lagoon tidal prism.

APPENDIX D

TEMPERATURE AND SALINITY MEASUREMENTS AT OUTER AND INNER BASINS

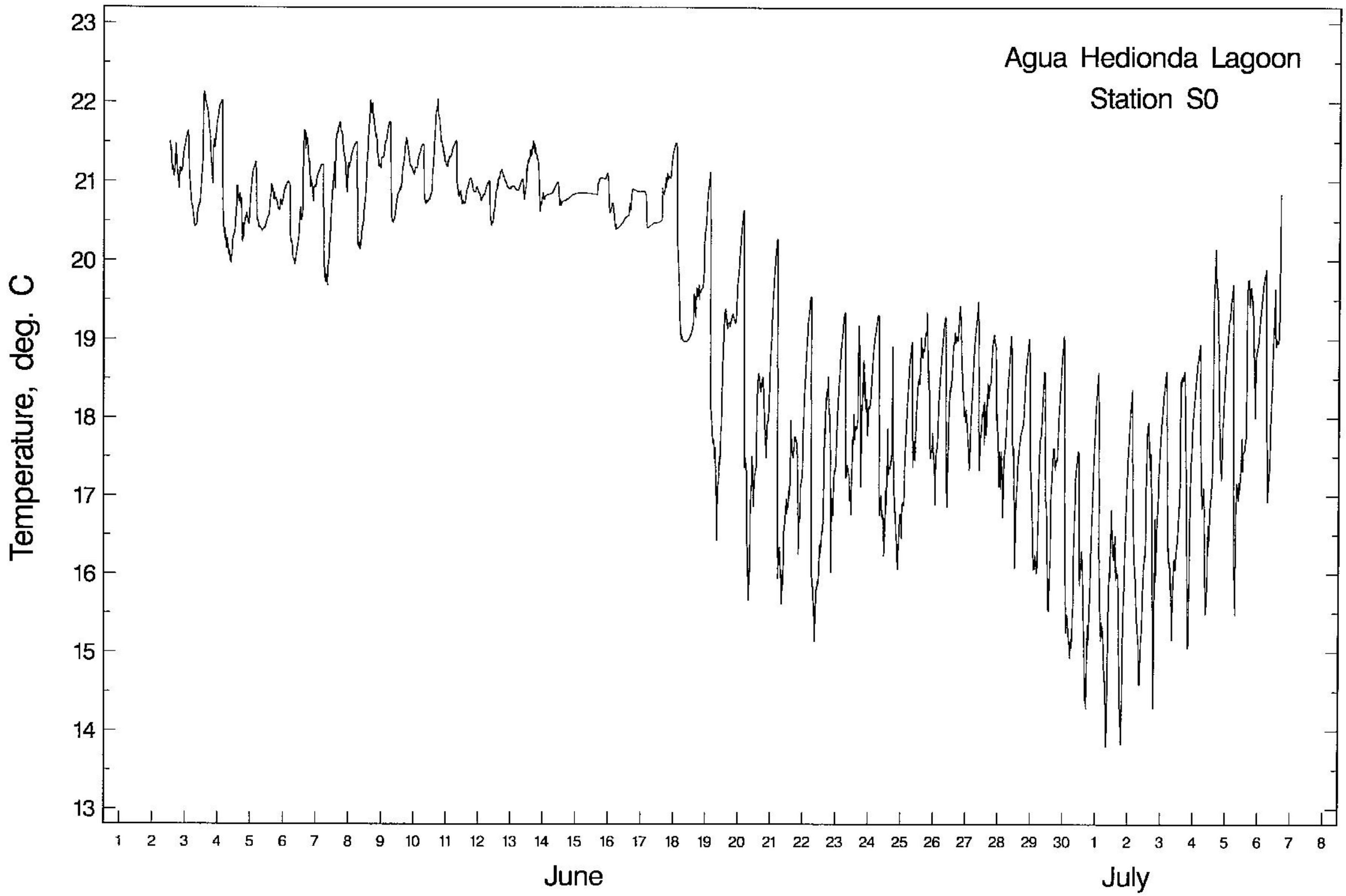


Figure D-1. Water temperature measurements at Station S0.

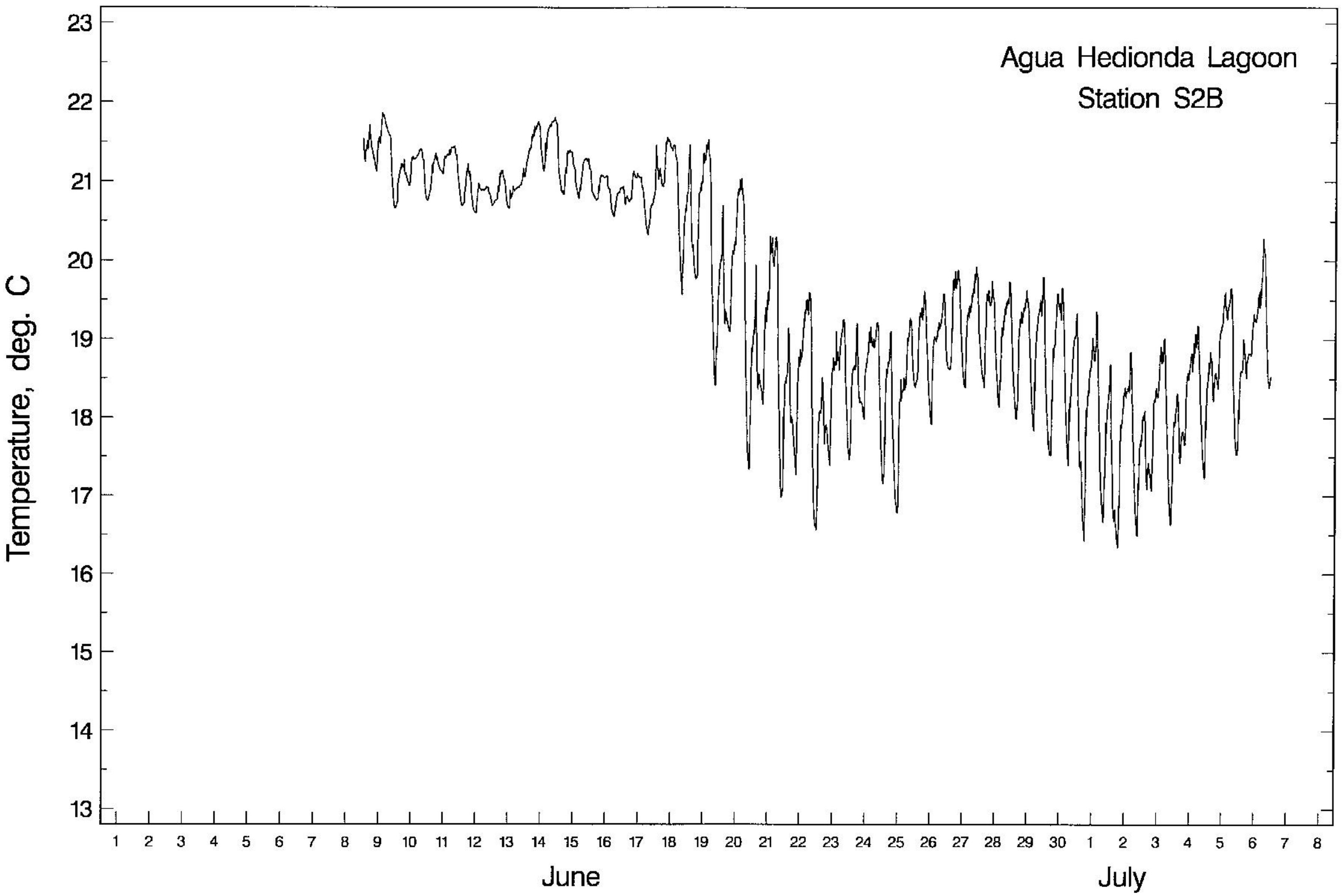


Figure D-2. Water temperature measurements at Station S2B.

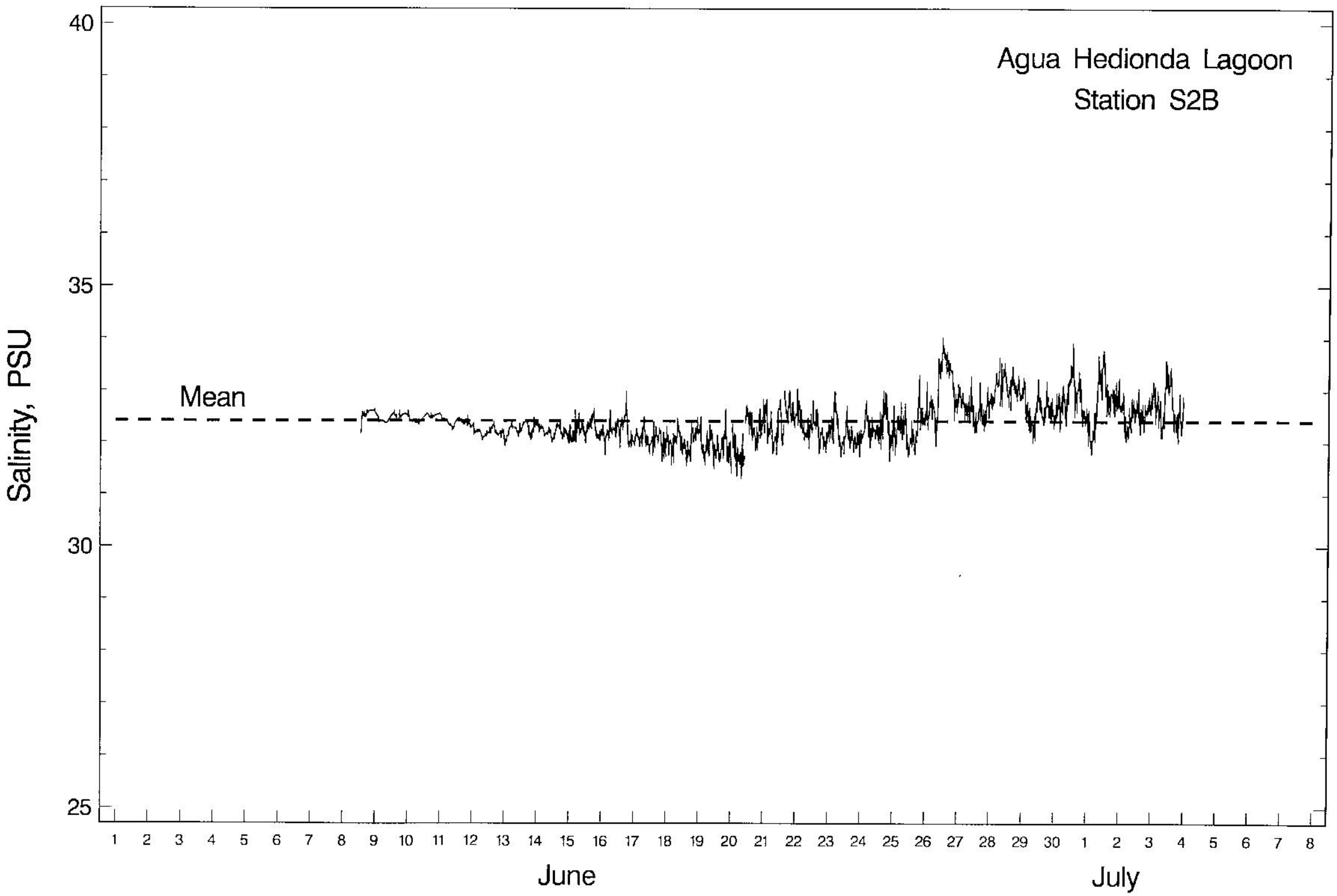


Figure D-3. Water salinity measurements at Station S2B.

Appendix C

Supplemental Fish Studies in Agua Hedionda Lagoon, 2005

Appendix C: Supplemental Fish Studies in Agua Hedionda Lagoon, 2005

Introduction

The following studies were conducted by Tenera Environmental to supplement historical data on fish populations in Agua Hedionda Lagoon (AHL). These supplemental studies on adult fish in AHL were designed to be short-term sampling events that would improve our current knowledge of adult fish abundance, distribution and size composition in certain AHL habitats, especially for species that produce larvae at risk of entrainment to the power plant source cooling water. The studies were designed to sample specific habitats in the lagoon that were not sampled during earlier fish studies performed by MEC Analytical Systems (1995). The information is used to refine the analysis of entrainment and impingement impacts as part of the 316(b) Demonstration Studies for EPS. Comprehensive fish surveys conducted in AHL and nearshore areas in 1979 by SDG&E (1980) as part of the first 316(b) Demonstration provide an excellent historical perspective on the types and abundances of fishes, sharks and rays in the EPS cooling source water.

Supplemental Study 1: Abundances of fishes in Agua Hedionda Lagoon associated with mudflat habitats and artificial substrates

Background and Purpose

The purpose of this study was to provide improved estimates of adult densities of target fish species in Agua Hedionda Lagoon (AHL) that could be compared to historical density estimates in AHL and estimates from other regional estuarine systems not affected by entrainment. The results provide some context for interpreting calculated larval losses due to operation of the EPS cooling water system.

One approach used to model the effects of larval entrainment mortality on source populations is to calculate adult equivalents based on the abundance of entrained larvae. A comparison of calculated losses to adult standing stock in the source water puts the contribution of power plant mortality into perspective for evaluating potential entrainment effects. Gobies and blennies can be very abundant in southern California bays and estuaries (Allen 1982, 1985) and can produce large numbers of larvae. The larvae from these species can be entrained in high numbers (Tenera 2000, 2001, 2004) resulting in large estimated impacts, even though the additional mortality due to entrainment may have little effect on the local densities of adult populations.

Adult fish densities were quantified in AHL in 1994 and 1995 using beam trawls, otter trawls and beach seines (MEC Analytical Systems 1995). Although 29 species were collected, the methods did not adequately sample artificial habitats such as the breakwater areas along the western edge of the outer AHL lagoon, aquaculture mussel floats below the tank farm, or intertidal mud and sandflat habitats. These habitats support blennies, gobies, and other species that spawn larvae that are at risk of entrainment. In addition, the methods used in the earlier surveys likely underestimated the densities of gobies because they can inhabit burrows and may escape capture by traditional sampling methods. Accurate density information on these small cryptic fishes requires the use of enclosure sampling or use of anesthetic solutions to ensure that all individuals are collected within a specified area. The following study sampled specific lagoon habitats to provide improved density estimates of the target species.

Methods

Four methods were used to sample fishes in specific habitats:

1) In the first method, divers counted fishes along nine 30 m by 2 m (98.4 ft by 6.6 ft) transects at four rocky reef sites around the perimeter of the outer lagoon (**Figure C-1**). Site locations were determined based on habitat availability in the lagoon and sampling positions were documented using an onboard GPS. Survey depths were approximately 3-4 m (10-13 ft) below the surface and approximately 1 meter above the base of the sand/rock interface. In order to survey during periods of best underwater visibility, counts were done within 2 hr of the maximum high tide for that day, or as long as current speed and visibility would allow data to be collected. Horizontal visibility conditions for the survey were at least 1 m. Starting at the transect origin point, the dive team deployed a 30 m measuring tape parallel to the shoreline and at a

Figure C-1. Locations of visual fish transects and fish quadrat collections (F1-4), aquaculture float sampling (A1), intertidal enclosures (E1-9), and epibenthic/surface larval fish tows (L3, L4).

constant depth. The team slowly swam along the transect counting non-cryptic fishes 1 m to either side of the tape and up to 2 m off the bottom, also estimating the sizes of the fishes to the nearest centimeter. After surveying the 30 m transect length, the dive team proceeded to deploy and survey a nearby replicate transect at the same site, leaving the first measuring tape in place as a reference for the cryptic fish sampling team. Data were recorded on pre-printed waterproof data sheets.

Figure C-2. Investigators sample fishes in mudflat habitat using a circular plastic enclosure and hinged sweep net.

2) The second survey method was used to sample cryptic fishes at the sites. Using the first measuring tape deployed for the visual counts, five 1-m^2 quadrats were randomly positioned along the transect. Quinaldine solution contained in 500 ml squirt bottles was injected into crevices and beneath cobbles to anesthetize any fishes within the quadrat area. Specimens were collected with hand nets and preserved for later identification and measurement in the laboratory.

3) A third method sampled cryptic fishes that reside within the aquaculture mussel floats in the outer lagoon. The sample location was in the middle of the grow-out area on a mussel line that had been growing for 6 months. A diver carrying cylindrical nets (¼ inch mesh) with a closed end encapsulated thirteen 2.4 m (8 ft) long mussel strands along with their associated float apparatus prior to harvest. Once the nets were in position a harvesting barge lifted the mussel grow-out line out of the water and the netted strands were removed. The netted strands and float apparatus were checked for the presence of cryptic fish. All fish found were identified to species, counted, measured and returned. Although the Aquafarm also grows oysters, the oyster growing area was not sampled because all oysters had been harvested and the grow-out trays had been removed prior to the sample date.

4) The fourth sampling method targeted gobies and other small fishes that typically reside on the substrate or in burrows on intertidal mud and sandflat habitats. This portion of the study was conducted in the intertidal zone of the middle and inner AHL during low-tide periods. The outer lagoon was not sampled using this method because almost all of the intertidal zone in the outer lagoon is armored with rock revetment and there is very little intertidal soft substrate habitat. The methods and apparatus used were similar to those used by other researchers sampling fishes elsewhere in southern California salt marshes (S. Schroeter, UCSB, pers. comm.). At each of nine sites around the AHL lagoons, a circular enclosure (0.43 m^2 [4.74 ft^2]) constructed of 3 mm (1/8 in) thick plastic sheeting was used to sample the fishes (**Figure C-2**). An average of five haphazardly placed replicates was sampled parallel to shore at each site. Enclosures were placed with a short toss in water depths of approximately 0.25 to 0.75 m (0.8 to

2.5 ft). A hinged sweep net with the hinge positioned in the center of the enclosure was unfolded through the enclosure to capture any fish. The enclosure was swept on multiple passes until three consecutive passes yielded no fish. A hand-held dip net was then swept within the enclosure to capture any remaining fish. All fish captured were preserved for later identification and measurement in the laboratory.

Results

Fish surveys in outer AHL

Visual fish surveys using Method 1 were conducted in outer AHL on August 25, 2005 during high tide. Transect depths were site-dependent and varied from 1.5 m at Fishing Beach to 7.0 m at East Channel (**Table C-1**). Underwater visibility varied from approximately 2 m near the Encina Power Plant Intakes to a maximum of 7 m along the North Jetty near the lagoon outlet. A total of 623 fish from 17 taxa was observed on nine transects (**Table C-2**). Total area surveyed was 540 m^2 which was approximately 10% of the available rock habitat in the outer lagoon, including the east and west channels. Juvenile silversides (probably topsmelt, *Atherinops affinis*) were the most common taxon, followed by salema, barred sand bass and kelp bass. The highest density of fishes (133 per transect) and the greatest number of species (12) occurred at Station F3 along the east channel separating the outer and middle lagoons. This station also had the deepest transect at 7.0 m (23 ft). The lowest density and fewest number of species occurred at Station F1 along the North Jetty. Barred sand bass were present at all stations and were equally abundant at the North Jetty and East Channel stations. The mean sizes of the various species are presented in **Table C-3**. Most of the individuals observed were juveniles, although a school of mature mullet and many mature garibaldi were recorded.

Cryptic fishes were sampled using Method 2 from 30 replicate 1 m^2 quadrats at the four outer AHL locations (**Table C-4**). This was less than 1% of the total rock habitat in outer AHL based on a linear area of approximately 1,600 m of rock shoreline with an average width of 3 m from

Table C-1. Physical data for fish transects sampled in outer Agua Hedionda Lagoon, August 25, 2005.

Station/ Replicate	Location	Latitude	Longitude	Time Sampled (PDT)	Mean Depth (m)	Vis (m)	Temp (C)	Salinity (ppt)	Methods: 30 m transect	Methods: 1 m^2 quad
F1-1	North Jetty	33.1454901	-117.3412739	1435	3.7	7.0	20.2	33.7	X	
F1-2	North Jetty	33.1452781	-117.3410839	1445	3.7	7.0	20.2	33.7	X	X
F2-1	Fishing Beach	33.1444687	-117.3419647	1000	2.4	3.0	20.3	33.7	X	X
F2-2	Fishing Beach	33.1441310	-117.3417296	1015	1.5	3.0	20.3	33.7	X	
F3-1	East Channel	33.1434743	-117.3373677	1345	7.0	4.0	20.3	33.7	X	
F3-2	East Channel	33.1430852	-117.3372985	1320	4.3	4.0	20.2	33.7	X	X
F4-1	Intake	33.1392785	-117.3384105	0915	2.4	2.0	19.6	33.7	X	X
F4-2	Intake	33.1389440	-117.3383067	0930	3.0	2.0	19.6	33.7	X	
F4-3	Intake	33.1389131	-117.3375854	1110	3.0	2.0	19.8	33.7	X	X

MSL to the rock-sediment interface. The highest density of cryptic fishes (3.2 per m^2) was found along the North Jetty breakwater and no cryptic fishes were found near the power plant intakes on the east side of the lagoon. Five species were collected with mussel blennies the most abundant species. The largest mean size (standard length) was 10.7 cm for kelp bass and the smallest mean size was 4.3 cm for reef finspots (**Table C-5**).

The thirteen nets were successfully placed on the mussel stands of the Aquafarm grow-out floats (**Figure C-1**) on September 12, 2005. The harvesting barge lifted the nets slowly and no damage occurred to the nets. As the floats were removed from the water, no fish were observed escaping though the net mesh. Each mussel array was shaken and carefully checked for fish but none was found in any of the arrays.

Table C-3. Mean, minimum, and maximum sizes of fishes observed by divers on transects in outer Agua Hedionda Lagoon, August 25, 2005.

Taxon	Common Name	N	Mean Size (TL cm)	Min	Max
Atherinopsidae	silversides	168	5.9	4	8
Xenistius californiensis	salema	150	18.0	18	18
Paralabrax nebulifer	barred sand bass	84	17.6	15	25
Paralabrax clathratus	kelp bass	45	12.5	8	18
Chromis punctipinnis	blacksmith	41	10.0	8	15
Girella nigricans	opaleye	40	16.4	8	25
Engraulis mordax	northern anchovy	30	4.0	4	4
Hypsypops rubicundus	garibaldi	22	18.6	10	22
Embiotoca jacksoni	black surfperch	18	13.7	12	15
Halichoeres semicinctus	rock wrasse	9	15.7	15	18
Mugil cephalus	striped mullet	6	40.0	40	40
Anisotremus davidsoni	sargo	4	6.0	6	6
Scorpaena guttata	California scorpionfish	2	9.0	8	10
Hypsoblennius gentilis	bay blenny	1	10.0	10	10
Rhacochilus vacca	pile surfperch	1	12.0	12	12
Hermosilla azurea	zebra perch	1	20.0	20	20
Phanerodon furcatus	white surfperch	1	18.0	18	18

Table C-2. Abundance per transect and mean density of fishes observed by divers on 30 x 2 m transects along rock rip-rap in outer Agua Hedionda Lagoon, August 25, 2005.

	Location		Intake		Fishing Beach		East Channel		North Jetty	
	Replicates		3		2		2		2	
Taxon	Common Name	Total Abund.	Abund.	Mean / 60 m^2	Abund.	Mean / 60 m^2	Abund.	Mean / 60 m^2	Abund.	Mean / 60 m^2
Atherinopsidae	silversides	168	98	32.67	45	22.50	25	12.50	-	-
Xenistius californiensis	salema	150	-	-	-	-	150	75.00	-	-
Paralabrax nebulifer	barred sand bass	84	8	2.67	17	8.50	29	14.50	30	15.00
Paralabrax clathratus	kelp bass	45	15	5.00	-	-	11	5.50	19	9.50
Chromis punctipinnis	blacksmith	41	20	6.67	-	-	14	7.00	7	3.50
Girella nigricans	opaleye	40	11	3.67	11	5.50	18	9.00	-	-
Engraulis mordax	northern anchovy	30	30	10.00	-	-	-	-	-	-
Hypsypops rubicundus	garibaldi	22	6	2.00	-	-	2	1.00	14	7.00
Embiotoca jacksoni	black surfperch	18	-	-	8	4.00	10	5.00	-	-
Halichoeres semicinctus	rock wrasse	9	-	-	1	0.50	1	0.50	7	3.50
Mugil cephalus	striped mullet	6	-	-	6	3.00	-	-	-	-
Anisotremus davidsoni	sargo	4	-	-	-	-	4	2.00	-	-
Scorpaena guttata	California scorpionfish	2	-	-	-	-	1	0.50	1	0.50
Hypsoblennius gentilis	bay blenny	1	-	-	1	0.50		-	-	-
Rhacochilus vacca	pile surfperch	1	1	0.33	-	-	-	-	-	-
Hermosilla azurea	zebra perch	1	-	-	1	0.50	-	-	-	-
Phanerodon furcatus	white surfperch	1	-	-	-	-	1	0.50	-	-
		623	189	**63.0**	90	**45.0**	266	**133.0**	78	**39.0**
	Total taxa:	17	8		8		12		6	

Fish surveys in inner and middle AHL

Cryptic fishes were sampled at nine stations in low intertidal and shallow subtidal areas around the perimeter of AHL (**Figure C-1**) using the enclosure method. Stations E6–E9 were sampled during afternoon low tides on May 15, 2005 and Stations E1–E5 were sampled during afternoon low tides on October 15, 2005. A total of 37 enclosure replicates was sampled. Arrow goby (*Clevlandia ios*) was the most abundant species, followed by cheekspot goby (*Ilypnus gilberti*), and shadow goby (*Quietula y-cauda*) (**Table C-6**). Densities of arrow goby were greater during the spring when there was an abundance of recently settled individuals less than 25 mm (1 in) (**Figure C-3**).

The habitat area in the inner lagoon that was between the +1 ft and –4 ft MLLW elevations, based on a bathymetric survey in April 1994 was calculated at 16.04 ha, and the area at a similar tidal range in the middle lagoon was 2.52 ha, for a combined area of 18.56 ha. Although gobies are known to inhabit all depths throughout the lagoon, this area was selected because it was the approximate range sampled during the enclosure survey. The average density of CIQ gobies of all sizes was 24.34 per m^2, which yields an estimate of 243,400 per ha. Although it is a rough estimate, at least 4.5 million CIQ gobies inhabited the AHL system, without taking into account habitat exceeding –4 ft MLLW or the habitat of the outer lagoon which, with sandier substrate, does not provide as optimal habitat as the inner lagoon, but is still known from earlier studies (MEC 1995) to support a portion of the local goby population.

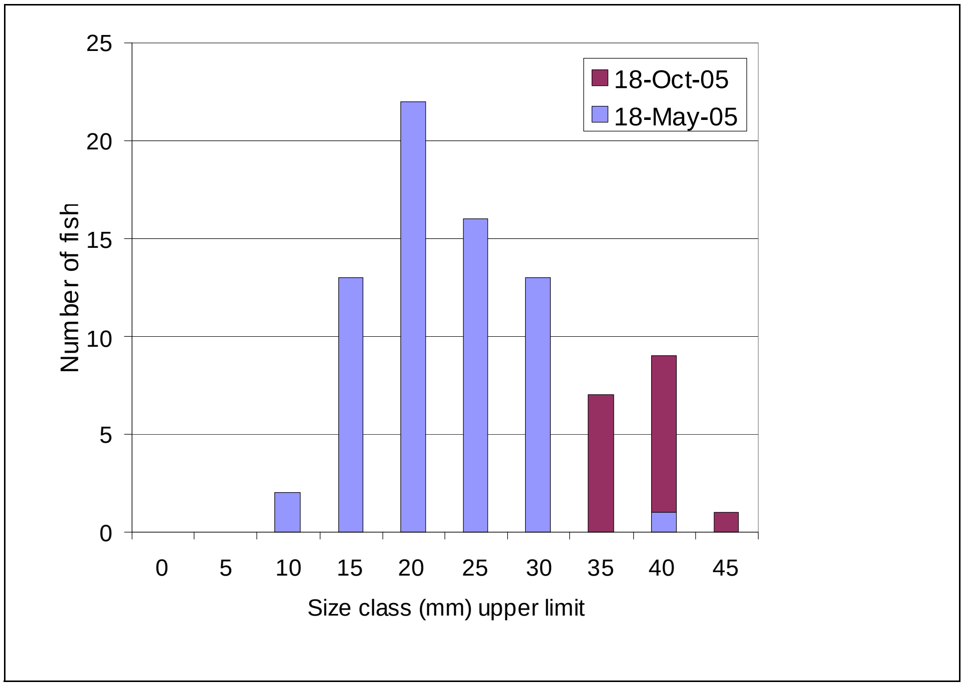


Figure C-3. Size frequency of arrow goby (*Clevelandia ios*) between spring and fall sampling periods.

Table C-4. Abundance per quadrat and mean density of fishes collected in 1m² quadrats in outer Agua Hedionda Lagoon, August 25, 2005.

	Location		Intake		Fishing Beach		East Channel		North Jetty	
	Replicates		10		5		10		5	
Taxon	Common Name	Total Abund	Abund.	Mean per m²	Abund.	Mean per m²	Abund.	Mean per m²	Abund.	Mean per m²
Hypsoblennius jenkinsi	mussel blenny	7	-	-	-	-	1	0.10	6	1.20
Scorpaena guttata	California scorpionfish	6	-	-	1	0.20	-	-	5	1.00
Paraclinus integripinnis	reef finspot	3	-	-	-	-	2	0.20	1	0.20
Paralabrax clathratus	kelp bass	3	-	-	-	-	-	-	3	0.60
Hypsoblennius gentilis	bay blenny	1	-	-	-	-	-	-	1	0.20
		37	0	**0.0**	1	**0.2**	3	**0.3**	16	**3.2**
	Total taxa:	6	0		1		2		5	

Table C-5. Mean, minimum, and maximum sizes of cryptic fishes collected by divers in quadrats in outer Agua Hedionda Lagoon, August 25, 2005.

Taxon	Common Name	Replicates	Mean Size (TL cm)	Min	Max	Mean Weight (g)
Hypsoblennius jenkinsi	mussel blenny	*8	5.8	3.3	8.0	7.2
Scorpaena guttata	California scorpionfish	6	8.8	7.1	12.0	21.6
Paraclinus integripinnis	reef finspot	3	4.3	3.3	5.3	1.5
Paralabrax clathratus	kelp bass	3	10.7	9.6	11.4	24.6
Hypsoblennius gentilis	bay blenny	*2	6.5	3.4	9.5	9.3

* includes 1 additional specimen collected outside of quadrats off transect

Table B-6. Density of fishes (number per m²) from enclosure sampling in middle and inner Agua Hedionda Lagoon.

			Middle Lagoon		Inner Lagoon Stations						
		Station	E1	E2	E3	E4	E5	E6	E7	E8	E9
		Replicates	5	5	5	5	5	6	7	6	4
Taxon	Common Name	Mean									
Clevelandia ios	*arrow goby*	**18.37**	9.09	18.18	2.27	4.55	6.82	38.64	25.00	31.82	29.00
Ilypnus gilberti	cheekspot goby	**3.76**	2.27	–	2.27	2.27	–	15.91	–	9.09	2.00
Quietula y-cauda	shadow goby	**2.21**	–	–	–	–	–	6.82	4.55	4.55	4.00
Hypsopsetta guttulata	diamond turbot	**0.76**	–	–	–	–	–	–	2.27	4.55	–
Leptocottus armatus	staghorn sculpin	**0.76**	–	–	–	–	–	–	6.82	–	–
Citharichthys stigmaeus	spotted sanddab	**0.25**	–	–	–	–	–	–	–	2.27	–
Paralichthys californicus	California halibut	**0.51**	–	2.27	–	2.27	–	–	–	–	–
		Total density:	11.36	20.45	4.55	9.09	6.82	61.36	38.64	52.27	35.00

Discussion

Accurate estimation of fish abundances requires that the sampling methods used are appropriate for the species under consideration by accounting for such variables as preferred habitat and sampling gear avoidance (Allen et al. 2002, Davis and Anderson 1989). The visual fish surveys along the rock rip-rap segments of outer AHL yielded counts and density estimates on several fish species that were not recorded in the 1994-1995 studies by MEC Analytical (1995). Among these were salema, barred sand bass, blacksmith, opaleye, northern anchovy, garibaldi, black surfperch, rock wrasse, striped mullet, sargo, California scorpionfish, pile surfperch, zebra perch, and white surfperch. This was expected because the earlier studies only used beam trawl and otter trawl sampling gear that are designed for use over soft substrates, and not the peripheral rock structure where many of the species in the outer lagoon typically occur. However, the beam trawl and otter trawl surveys did yield density estimates on several species associated with soft bottom and eelgrass that were not observed in visual counts, and soft bottom substrate accounts for most of the habitat in the lagoon system.

A comprehensive survey of fishes in AHL was done monthly from January through December 1979 for the first 316(b) Demonstration at EPS (SDG&E 1980). Three collection methods were used: otter trawl, bag seine, and gill nets. Because multiple surveys were done throughout the year, they were able to capture a greater number of species (52) than the MEC Analytical (1995) study (28) which was done over two periods in July 1994 and April 1995. The SDG&E (1980) sampling did record abundances for many of the species seen in the visual fish surveys presumably because the gill net sampling was effective at capturing species adjacent to the rock substrate areas. However, the methods only allowed relative estimates of species abundances because the gill nets sampled fishes over an unknown area and were biased by mesh size and length of time deployed. Overall, the SDG&E sampling results indicated that topsmelt, deepbody anchovy, and slough anchovy together comprised over 77 percent of all fish caught in the lagoon. Although recorded in the SDG&E study, gobies and blennies were not very abundant in the samples. The sampling conducted in the present study, using the enclosure methods to specifically capture cryptic fishes, yielded density estimates for gobies that were much greater than those that were developed from earlier sampling. For example, arrow gobies of all sizes averaged nearly 20 per m^2 in the inner and middle lagoon shoreline sampling, yielding an estimate of 200,000 per hectare of this species alone. The SDG&E (1980) trawl sampling in the upper lagoon yielded an estimate of less than 2,000 fish per hectare of all species combined, demonstrating the differences in catch rates between the two methods.

The survey for blennies associated with Aquafarm mussel floats was inconclusive based on the single survey in fall. The absence of fish was likely a consequence of a prolonged period of “red tide” conditions in AHL, and along much of the San Diego coastline, in summer 2005 that depleted oxygen and caused fish kills. A few blennies, however, were observed from the mussel “collector” lines that were brought ashore onto the Aquafarm ramp several days after the enclosure net sampling effort (S. LePage, pers. comm.). Therefore, the Aquafarm floating apparatus has the potential for harboring cryptic fishes, but the present sampling methods were ineffective at quantifying their densities in a single survey. There were also no cryptic fish found along the rip-rap habitat adjacent to the intake structure which would normally provide favorable habitat for blennies and other sedentary fish species. This may have been due to a combination of recent "red tide" conditions coupled with the presence of large aggregations of bushy bryozoans that covered the substrate in this area.

Supplemental Study 2: Depth stratification of fish larvae in inner Agua Hedionda Lagoon with special reference to gobies.

Background and Purpose

Larval fishes were sampled in the inner AHL from two depth strata to determine if there were significant differences in larval densities between near-surface and near-bottom strata. The information would mainly be used to determine if density estimates of goby larvae obtained from surface tows in middle and inner AHL during the monthly source water sampling in 2004–2005 could be applied to the entire volume of water within the lagoon segments. Due to the largely shallow depths in the lagoon (<2.5 m MLLW), especially at low tide, a push net that was bow-mounted on a small boat was used to sample the ichthyoplankton during the monthly surveys. Monthly samples from the outer lagoon and at the nearshore stations were collected using an obliquely towed bongo net that sampled from the bottom to the surface. A review of the literature indicated that some estuarine fish larvae can occur in greater abundance near the bottom than in the mid-water or near-surface layers during certain developmental periods or under certain environmental conditions (Fortier and Leggett 1983, Laprise and Dodson 1989, Schultz et al. 2003). Therefore, this supplemental study would collect paired samples from two depths, the near-surface layer and slightly above the bottom (epibenthic habitat), to compare the larval concentrations between depths. A preliminary test of the epibenthic sampling apparatus on March 23, 2005 demonstrated that it was effective in sampling fish larvae in that stratum. It was proposed that if the larval concentrations at the two depths proved to be significantly different then the results would be used to develop a correction factor for the estimates from inner AHL source water samples collected near the surface during the regular monthly surveys. If near-bottom concentrations were greater than surface concentrations, estimates of the source water larval population would increase, thus lowering estimates of fractional entrainment mortality.

Methods

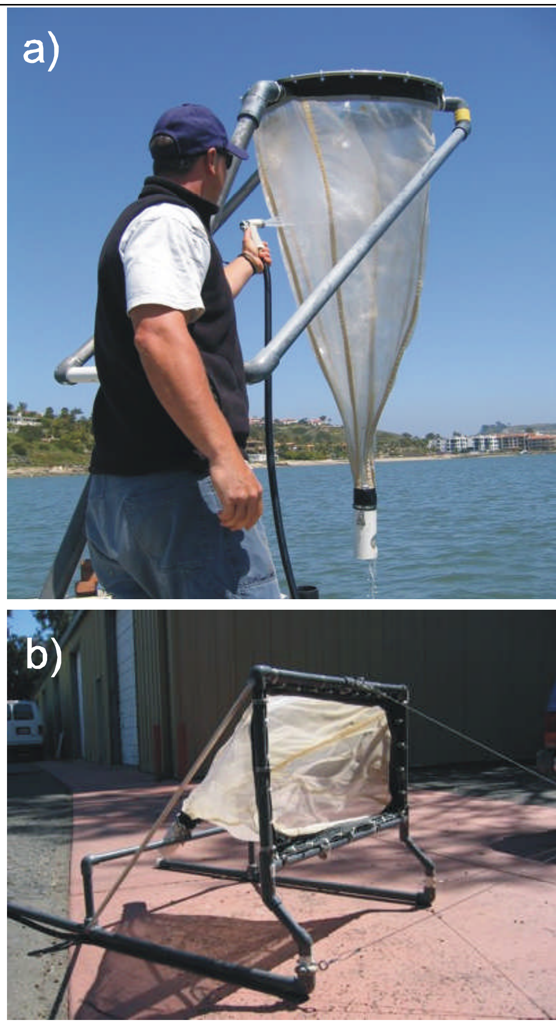


Figure C-4. a) Surface plankton push-net mounted in wash-down position on small boat and b) epibenthic sled with plankton net used to collect fish larvae near the bottom of the inner lagoon.

Paired near-surface and a near-bottom plankton samples were collected at two stations in the inner AHL using 335-micron mesh plankton nets. The stations were the same ones sampled during the regular monthly source water sampling (L3 and L4). Samples were collected during consecutive low tide and high tide periods. Three replicate tows were taken at the two depths at each station. Tow times were approximately three minutes for the surface net and two minutes for the benthic net to allow for equivalent filtering volumes (approximately 20 cubic meters). By reducing the sample volume from the 60 cubic meter target during the regular surveys and increasing the number of replicates, the statistical power to detect a difference between the more abundant larvae (gobies, blennies and anchovies) at each depth would increase for the same level of effort. Uncommon species would be under-represented in the samples, but the study was targeting the few most abundant taxa.

The near-surface samples and near-bottom samples were collected sequentially. Near-surface samples were collected using the same 0.7 m diameter push-net apparatus used during the regular surveys (**Figure C-4a**), and epibenthic samples were collected using a rectangular-opening (0.5 meter x 1.0 meter) plankton net mounted on a small epibenthic sled (**Figure C-4b**) that kept the lower edge of the net frame approximately 40 cm above the bottom and above any patches of eelgrass that may have been growing along the transect corridor. The start location of the tows was with a GPS and marked with a temporary buoy. A General Oceanics 2030R flowmeter was mounted in the opening of each net to record the total volume of water sampled. A total of 12 epibenthic and 12 near-surface samples were collected in the study.

Samples were rinsed into the cod end of the net, transferred to a labeled sample jar, and preserved in 12% formalin. After a minimum of 48 hours the samples were transferred to 100% ethanol, larvae sorted under a dissecting microscope, and the specimens identified to the lowest possible taxon. A subsample of specimens from the surface tows and bottom tows was measured for length under a stereo microscope using calibrated video image software.

Analysis included one-way ANOVA to test the null hypothesis that there was no significant difference between the concentrations of larvae at the two depth treatments. Potential tidal influence and diel differences were also tested using the same analysis methods.

Results

A total of 3,270 fish larvae was collected in paired surface and epibenthic plankton tows in inner AHL on April 20, 2005 (**Table C-6**). Gobies belonging to the genera *Clevelandia*, *Ilypnus*, and *Quietula* (CIQ goby complex) comprised 86% of the larvae collected, followed by combtooth blennies (*Hypsoblennius* spp.) (6%), and anchovies (unidentified Engraulidae and northern anchovies combined) (3%). A total of 19 taxa was identified from the samples, not including unidentified larval fish fragments.

Larval densities were compared between surface and epibenthic samples for the three most abundant taxa. Taxa with fewer larvae were highly variable among replicates and this did not allow a robust test of differences in depth distribution. A statistical comparison showed that there was no significant difference ($p<0.05$) in density for gobies ($p=0.346$) and anchovies ($p=0.751$), but blennies were significantly more abundant in surface samples than in epibenthic samples ($p=0.010$) (**Table C-7**). There were fewer blenny larvae in the epibenthic sample at Station L4, in particular.

Table C-6. Concentration of fish larvae (number per m^2) from surface and epibenthic plankton tows in inner Agua Hedionda Lagoon. Mean concentrations are listed as number of larvae per 1000 m^3 of water.

				Station: L3				Station: L4			
				Surface N = 6		Benthic N = 6		Surface N = 6		Benthic N = 6	
Taxon	**Common Name**	**Mean Conc.**	**Total Count**	**Count**	**Mean Conc**	**Count**	**Mean Conc**	**Count**	**Mean Conc**	**Count**	**Mean Conc**
Gobiidae unid.	gobies	3,740.29	2,820	937	5,404.30	654	3,329.85	590	3,109.17	639	3,117.85
Hypsoblennius spp.	combtooth blennies	270.05	195	68	398.41	41	227.22	72	382.88	14	71.68
Engraulidae unid.	anchovies	89.50	74	6	34.85	20	81.57	26	131.85	22	109.72
Sciaenidae unid.	croakers	65.59	50	10	59.40	4	19.39	13	67.03	23	116.55
Engraulis mordax	northern anchovy	43.12	34	4	22.53	8	35.63	18	93.35	4	20.99
larvae, unidentified yolksac	unid. yolksac larvae	41.14	32	12	73.34	9	34.45	6	31.31	5	25.43
Genyonemus lineatus	white croaker	21.19	16	-	-	1	3.74	6	34.88	9	46.12
Atherinopsidae unid.	silversides	11.39	9	3	15.89	-	-	6	29.66	-	-
Gibbonsia spp.	clinid kelpfishes	7.92	6	3	17.27	1	3.74	1	5.77	1	4.89
Typhlogobius californiensis	blind goby	7.42	6	-	-	1	3.93	4	20.67	1	5.10
Acanthogobius flavimanus	yellowfin goby	7.36	5	1	6.75	2	14.62	-	-	2	8.07
larval fish fragment	unid. larval fishes	6.34	5	2	11.50	1	3.74	-	-	2	10.12
Hypsypops rubicundus	garibaldi	5.45	4	2	11.03	-	-	2	10.78	-	-
Gillichthys mirabilis	longjaw mudsucker	4.96	4	1	5.76	2	9.08	-	-	1	5.02
Citharichthys stigmaeus	speckled sanddab	3.84	3	1	5.76	1	3.74	1	5.86	-	-
Atherinopsis californiensis	jacksmelt	2.76	2	2	11.03	-	-	-	-	-	-
Paralichthys californicus	California halibut	2.67	2	-	-	1	6.58	1	4.10	-	-
Oxyjulis californica	senorita	1.83	1	-	-	1	7.31	-	-	-	-
Sardinops sagax	Pacific sardine	1.69	1	1	6.75	-	-	-	-	-	-
Quietula y-cauda	shadow goby	1.38	1	1	5.52	-	-	-	-	-	-
	Totals:		3,270	1,054		747		746		723	

Table C-7. Results of t-tests for paired sample means between surface and bottom larval fish samples in inner AHL. Only the three most abundant taxa were tested.

Gobiidae	*Surface*	*Bottom*
Mean	4.254	3.219
Variance	15.535	3.216
Observations	12	12
Pearson Correlation	0.387	
Hypothesized Mean Difference	0	
df	11	
t Stat	0.984	
P(T<=t) two-tail	0.346	

***Hypsoblennius* spp.**	*Surface*	*Bottom*
Mean	0.391	0.149
Variance	0.090	0.021
Observations	12	12
Pearson Correlation	0.432	
Hypothesized Mean Difference	0	
df	11	
t Stat	3.090	
P(T<=t) two-tail	**0.010**	

Engraulidae (all)	*Surface*	*Bottom*
Mean	0.141	0.122
Variance	0.017	0.016
Observations	12	12
Pearson Correlation	-0.289	
Hypothesized Mean Difference	0	
df	11	
t Stat	0.325	
P(T<=t) two-tail	0.751	

Discussion

Due to the generally shallow depths of the inner AHL coupled with volume fluctuations caused by daily tidal exchange, significant stratification in larval concentrations would not be expected to occur for most larvae in AHL. Of the three taxa tested for differences, only blennies showed a preference for surface strata over epibenthic strata. The most abundant larval group, CIQ gobies, showed no differences. Studies indicate that the larvae of many bay and estuarine species are adapted to minimizing tidal transport out of bays by concentrating in areas with less current (Pearcy and Myers 1974). Furthermore, behavior of larvae can change as a function of size with larger post-flexion individuals of benthic species moving into lower strata prior to transformation and settlement. Most of the gobies collected in the present were small, recently hatched individuals in the 2.5–3.0 mm range (see Section 3.3.2 – *CIQ Goby Complex*). Brothers (1975) observed that newly hatched goby larvae were weak swimmers and positively phototactic.

Based on the results of this experimental sampling, using a bow-mounted push net to sample larvae should not bias the results by either over- or under-sampling their concentrations in the shallow waters of middle and inner AHL. However, calculated densities of combtooth blenny larvae based on pushnet sampling may overestimate their actual average densities in the inner lagoon segment. Additional stratified sampling could resolve if this difference was significant during all months of their summer recruitment season and under both spring and neap tide periods.

Table C-8. Population sizes of critically-treated fish species within each sampling area based on average trawl and seine population estimates. (from SDG&E 1980, Table 6.5-23)

Species	Common Name	Offshore	Lagoons
Urolophus halleri	round stingray	655	2796
Engraulis mordax	northern anchovy	57,916	9,620
Anchoa compressa	deepbody anchovy	624	179,000
A. delicatissima	slough anchovy	322	172,690
Leuresthes tenuis	California grunion	223,135	20,300
Atherinops affinis	topsmelt	16,010	128,218
Scorpaena guttata	California scorpionfish	1,098	13
Leptocottus armatus	staghorn sculpin	275	1,241
Paralabrax clathratus	kelp bass	–	3,983
P. maculatofasciatus	spotted sand bass	–	3,390
P. nebulifer	barred sand bass	641	1,226
Seriphus politus	queenfish	28,123	8,360
Cynoscion nobilis	white seabass	7	–
Menticirrhus undulatus	California corbina	3,734	179
Genyonemus lineatus	white croaker	12,107	4,133
Roncador stearnsii	yellowfin croaker	59	225
Amphistichus argenteus	barred surfperch	3,592	–
Hyperprosopon argenteum	walleye surfperch	13,594	51
Cymatogaster aggregata	shiner perch	2,553	12,636
Mugil cephalus	striped mullet	146	2,503
Pimelometopon pulchrum	California sheephead	92	–
Heterostichus rostratus	giant kelpfish	190	2,641
Paralichthys californicus	California halibut	10,706	18,585
Citharichthys sordidus	Pacific sanddab	595	–
C. stigmaeus	speckled sanddab	48,222	26
Pleuronichthys verticalis	hornyhead turbot	7,686	51
Hypsopsetta guttulata	diamond turbot	961	3,395

Literature Cited

Allen, L. G. 1982. Seasonal abundance, composition, and productivity of the littoral fish assemblage in upper Newport Bay, California. Fish. Bull. 80:769-790.

Allen, L. G. 1985. A habitat analysis of the nearshore marine fishes from southern California. Bulletin of the Southern California Academy of Sciences 84:133-155.

Brothers, E. B. 1975. The comparative ecology and behavior of three sympatric California gobies. Ph.D. Dissertation, Univ. Calif. San Diego. 370 p.

Fortier, L. and W. C. Leggett. 1983. Vertical migrations and transport of larval fish in a partially mixed estuary. Can J. Fish. Aquat. Sci. 40:1543-1555.

Laprise, R. and Dodson J. J. 1989. Ontogeny and the importance of tidal vertical migrations in the retention of larval smelt *Osmerus mordax* in a well-mixed estuary. Mar. Ecol. Prog. Ser. 55:101-111.

MEC Analytical Systems. 1995. 1994 and 1995 field survey report of the ecological resources of Agua Hedionda Lagoon. Submitted to San Diego Gas and Electric Company. 47 pp. + Appendices.

Pearcy, W. G. and S. S. Myers. 1974. Larval fishes of Yaquina Bay, Oregon: a nursery ground for marine fishes? Fish. Bull., 72:201-213.

Schultz, E. T., K.M.M.L. Lwiza, M. C. Fencil, and J. M. Martin. 2003. Mechanisms promoting upriver transport of larvae of two fishes in the Hudson River Estuary (USA). Marine Ecology Progress Series 251:263-277.

Tenera Environmental. 2000. Moss Landing Power Plant Modernization Project: 316(b) Resource Assessment. Prepared for Duke Energy Moss Landing, L.L.C., Oakland, CA.

Tenera Environmental. 2001. Morro Bay Power Plant Modernization Project 316(b) Resource Assessment. Prepared for Duke Energy Morro Bay LLC.

Tenera Environmental. 2004. SBPP Cooling Water System Effects on San Diego Bay, Volume II: Compliance with Section 316(b) of the Clean Water Act for the South Bay Power Plant. Prepared for Duke Energy South Bay.

Appendix D

Field and Laboratory Procedures

D1 – Larval Fish and Invertebrate Sampling

D2 – Larval Laboratory Sorting

D3 – Larval Laboratory Identification

D4 – Impingement Sampling and Identification

APPENDIX D1: PROCEDURE FOR LARVAL FISH AND INVERTEBRATE SAMPLING

1. PURPOSE

   1.1 The purpose of this procedure is to define the steps required to collect larval fishes and invertebrates with a plankton net in the Agua Hedionda Lagoon and nearshore vicinity of Encina Power Plant.

2. RESPONSIBILITIES

   2.1 The Field Supervisor is responsible for scheduling and coordinating sampling surveys, and assuring that plankton samples are collected in accordance with written procedures.

   2.2 Investigating biologists are responsible for sample collection in accordance with written procedures.

3. INSTRUCTIONS

   3.1 Field Sampling Preparation

      3.1.1 Assemble materials according to *Attachment 5.1*

      3.1.2 Ensure there are enough jars, labels (*Attachment 5.2*), and preservative (formalin) for the sample collection effort. Print the required number of blank field data sheets (*Attachment 5.3*) on waterproof paper.

      3.1.3 Inspect the frame, nets and codends for any damage. If damaged, repairs must be made before sampling begins. Ensure that the flowmeters have been calibrated within the past 90 days and that they are operational. Attach a flowmeter to the mouth of each net using two lanyards.

      3.1.4 Ensure that the remaining equipment is in good operating condition. Make repairs if necessary.

      3.1.5 Send a written notification via FAX to the Department of Fish and Game, San Diego Office [(858) 467-4299] informing them of the sampling date, type of collections, contact information, and scientific collectors permit number.

   3.2 Flowmeter Calibration

      3.2.1 The General Oceanics Model 2030 flowmeters should be calibrated within 90 days of use using the following procedure. Disconnect the flowmeter from the net frame. Record the serial number of the flowmeter on the calibration data sheet. Connect the flowmeter to a rod. Measure and mark a distance of 30 feet on a floating dock (DCPP).

      3.2.2 Record the initial number of spins from the readout on the flowmeter totalizer. Lower the flowmeter into the water slowly so that the impeller does not spin. Walk along the dock towing the flowmeter at a speed of between 1 to 1.5 feet per second for the marked distance, checking to make sure that the impeller is spinning. When the flowmeter has been towed over the measured distance, carefully raise it out of the water without allowing the impeller to spin. Record the end number of spins from the flowmeter totalizer.

3.2.3 Repeat this procedure 10 times for each flowmeter. Subtract the initial reading from the end reading and record the total number of spins per trial on the data sheet. The total spins for each of the ten trials are summed and divided by the number of trials. The resulting mean is the calculated calibration value.

3.2.4 Enter the data on the file "Flowmeter calibration records.xls" located on the Tenera SLO server 'Sebastes' (S:).

3.3 Sample Collection – Inner Agua Hedionda Lagoon Push Net Sampling

3.3.1 Samples will be collected during four cycles in a 24-hr period according to the schedule developed by the Field Supervisor. A survey team consists of a boat driver and sampling technician.

3.3.2 To sample Stations L2, L3 and L4 (*Attachment 5.4*), attach a .71 m diameter 335 micron mesh plankton net and GO 2030 flowmeter to the push net frame on the small Whaler.

3.3.3 Locate station start point using GPS and/or shore line-ups.

3.3.4 Determine the water depth with the fathometer or other depth measuring device. Record the water depth on the field data sheet.

3.3.5 Record each flowmeter's serial number and number of spins from the unit's totalizer on the field data sheet. Make sure that the propeller does not spin while lowering the frame and net into the water.

3.3.6 Record the start time (Pacific Standard Time) on the field data sheet.

3.3.7 The Lower the net until the entire frame is underwater. Put the boat in gear and slowly proceed into the current, fishing the net for approximately 5 minutes or until the flowmeter has tallied approximately 4500 spins.

3.3.8 Pull the frame out of the water and check the flowmeter reading. If more spins are needed, lower the frame and continue sampling along the same transect line. Raise the frame and record the ending totalizer reading on the field data sheet.

3.3.9 Record the end time and total time of the collection on the field data sheet.

3.3.10 Beginning at the top of the net, rinse the sample down into the codend. Since the wash water is not filtered and may contain plankton, rinse the net from the outside only ensuring that unfiltered water does not contaminate the sample. Inspect the net to ensure that it has been thoroughly rinsed.

3.3.11 Place a pre-printed sample label in the jar sample containing the following information: Survey serial number, date, station number, and cycle number. The station number and cycle are to be marked on the jar lid using a permanent marker.

3.3.12 After the sample is rinsed into the codend, detach the codend from the net and pour the sample into the jar using a funnel. Rinse and inspect the codend before reattaching to the net. Preserve the sample by adding formalin to make an approximately 10% solution. Attach the lid and invert the jar to thoroughly mix the preservative.

3.3.13 Deliver the samples to the laboratory at the completion of the sampling effort.

3.3.14 After at least 2 days, the samples preserved in formalin are transferred to a solution of 100% ethanol.

3.4 Sample Collection – Outer Agua Hedionda Lagoon and Nearshore Towed Net Sampling

3.4.1 Samples will be collected during four cycles in a 24-hr period according to the schedule developed by the Field Supervisor. A survey team consists of a boat driver and sampling technician.

3.4.2 Locate the station using latitude/longitude coordinates. Determine the water depth with the fathometer and record the water depth on the field data sheet.

3.4.3 Ensure that the winch line is attached to the bongo net frame, and a weight (15-20# salmon ball) is attached to the center of the frame. Ensure that the nets, codends and flowmeters are securely attached.

3.4.4 Record each flowmeter serial number on the field data sheet. Record the initial number of spins from each flowmeter on the field data sheet. Record the start time (Pacific Standard Time) on the field data sheet.

3.4.5 Using the measured marks on the winch cable, lower the nets and frame through the water column until the frame is approximately 10 feet from the bottom. When the appropriate depth is reached, the boat is motored forward and the cable is retrieved, trying to maintain a 45 degree tow angle. When the frame reaches the surface, carefully return it to the side of the boat.

3.4.6 Record the end time (Pacific Standard Time) on the field data sheet.

3.4.7 Record the end number of spins from each of the flowmeters on the field data sheet. Subtract the initial number of spins from the end number and record the total on the field data sheet. If the integrity of either or both flowmeter readings is questionable (e.g., seaweed wrapped around the propellers), discard both samples. Detach the codends. Rinse the nets and reattach the codends. Record the circumstance on the data sheet. Repeat the sample collection.

3.4.8 Beginning at the top of the net, rinse the collected material down into the codend. Since the wash water is not filtered and may contain plankton, rinse the net from the outside ensuring that unfiltered water does not contaminate the sample. Inspect the net to ensure that it has been thoroughly rinsed.

3.4.9 Detach the codends from each net and concentrate the sample at the bottom of the bucket. To combine the samples, pour the sample from the codend bucket of Net #1 into the codend bucket of Net #2. Rinse the entire combined sample into a sample jar (500 ml canning-type jar) using a squirt bottle or pump spray. Formalin can be pre-measured into the sample jars, or added to yield a 10% concentrated solution. Rinse and inspect the codends before reattaching to the nets.

3.4.10 Ensure that the sample jar contains an inner label and that the jar-top is pre-labeled with the station and cycle number labeled with a permanent marker. The permanent external labels with adhesive backs are affixed to the lids back in the lab after drying the lids with a paper towel.

3.4.11 The following is an explanation of the coding for the study grid field data sheet sequence numbers and jar labels.

a. Each serial number on the data sheet for sample identification consists of a series of 5 letters followed by 4 numbers (EPSEA###). The first three letters, "EPS" designate the ENCINA POWER STATION. The fourth and fifth letters designate "EA" for ENTRAINMENT ABUNDANCE. Each sampling SURVEY is assigned a three-digit number beginning with 001.

b. The station designation consists of a letter-number-letter-number combination. The first letter/number combination designates the STATION sampled. The second letter designates the station station replicate, and the second number designates the net number, either "1" or "2." For example, L3A1 means that the sample was collected from Station L3, Replicate A, Net 1.

c. The date of sampling will correspond to the actual date of each sampling effort. At the start of a new day (midnight), use a new sequenced field data sheet.

d. The cycle number (1-4) is also used to maintain consistency with the concurrent impingement sampling database.

3.4.12 Deliver the samples to the laboratory at the completion of the sampling effort.

3.5 Sample Voiding in the Field

3.5.1 Samples should be voided if any of the following occurs: 1) possible flowmeter obstruction due to kelp or other debris on the propeller, 2) obviously malfunctioning or damaged flowmeters; 3) damaged (torn) nets found after a sample is collected; 4) gear failure which prevents completion of any tows/hauls; 5) an incident or situation which may prevent reliable data collection; 6) an incident or situation which may jeopardize the safety of sampling personnel.

3.5.2 If a hole or tear is found in the net mesh, mark the damaged area and either repair or replace the net. Discard both samples. Record the circumstance on the data sheet. Repeat the sample collection.

3.5.3 The number of flowmeter spins from the paired bongo nets was checked in the field to confirm that the measured volumes were similar.

4. <u>RECORDS</u>

4.1 The Task Leader should review, initial, and code all data sheets.

4.2 Submit the data to the Data Coordinator for logging, computer entry, and storage.

4.3 Original data sheets are permanently stored.

5. <u>ATTACHMENTS</u>

5.1 Equipment List

5.2 Field Data Labels

5.3 Field Data Sheet

5.4 Survey Station Locations

ATTACHMENT 5.1

TITLE: EQUIPMENT LIST

1. Bongo net frame, attached 335 mesh nets with codends
2. General Oceanics Model 2030 flowmeters (2) per frame
3. Winch line
4. Winch for net deployment and retrieval
5. Stock buffered formaldehyde solution (approximately 37-40% solution from the manufacturer)
6. Squeeze bottle
7. Labeled jars for sample storage
8. Data sheets, pencils and labels
9. Wash-down pump
10. Watch
11. Temperature/Salinity measuring instrument
12. Fathometer
13. GPS for nearshore sampling

ATTACHMENT 5.2

TITLE: FIELD DATA LABELS

LABELS SHOULD HAVE THE FOLLOWING INFORMATION

Serial #______	Date_______
Station_____	Cycle # ___
Sample # __	Start Time______

(Example of entrainment sample label.)

EADCM0002	10/17/96
IMB2	Cycle # 5
Sample # 1	2135

ATTACHMENT 5.3

TITLE: FIELD DATA SHEET

Encina Power Plant — Plankton Collection Field Data — Sheet #: ______

Survey #: E P S E A 0 0 — Net Dia.: 0.71 m — Flowmeter 1: ______ — Conversion 1: ______

Date: ______ — Mesh: 0.335 mm — Crew: ______ — Flowmeter 2: ______ — Conversion 2: ______

Station	Start Flow	End Flow	Total	Volume (cu. m)	Comb. Vol.	Sample Number	Cycle (1-4)	Tide (E,F,HS,LS)	Temp (C°)	Salinity (ppt)	Depth (m)	Start Time (PST)	End Time (PST)	Total (min)

NOTES:

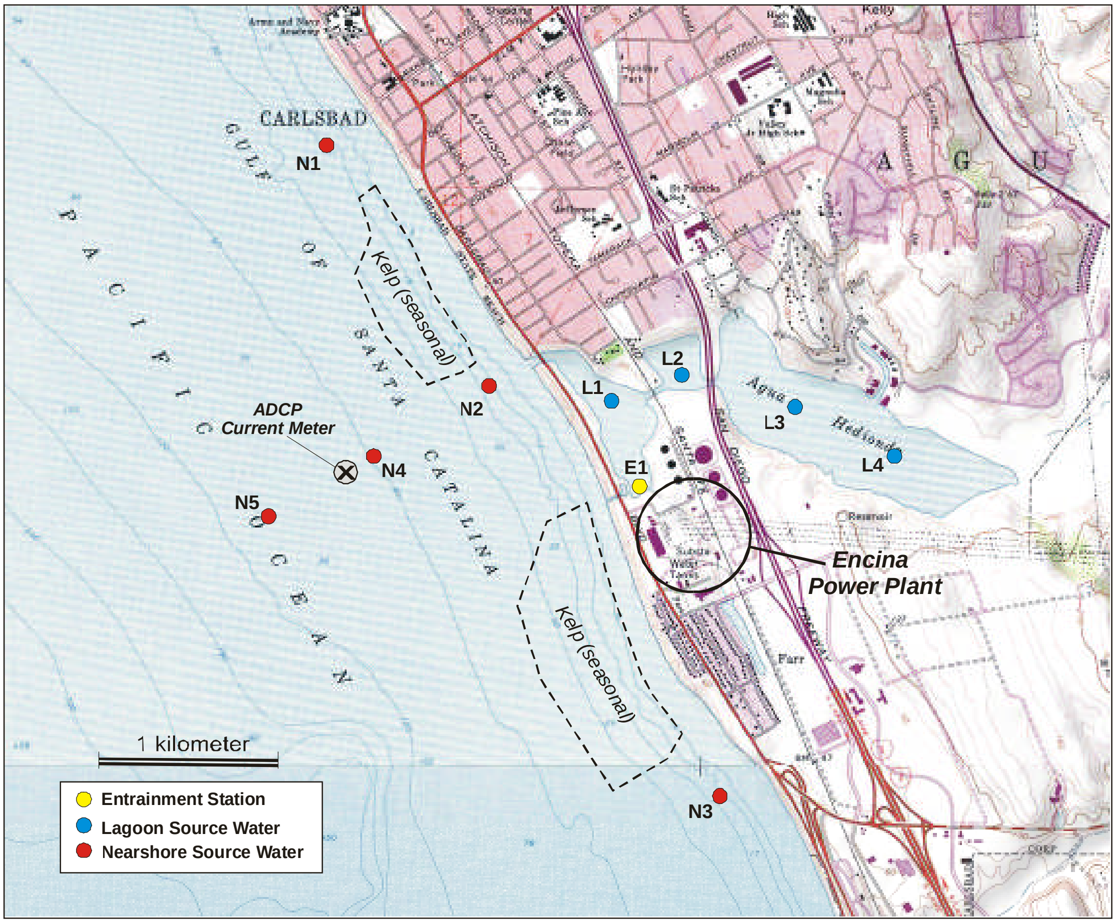
Example station designation: L1A1 = Station L1; Replicate A; Net 1

Reviewed By / Date: ______ Entered By / Date: ______ Copied By / Date: ______

Note: Print on waterproof paper at 8.5” x 11” landscape format from original file.

ATTACHMENT 5.4

TITLE: SURVEY STATION LOCATIONS



Encina Power Station 316(b) entrainment and source water sampling locations.

APPENDIX D2: PROCEDURE FOR SORTING PLANKTON SAMPLES IN THE LABORATORY

1. PURPOSE

1.1 The purpose of this procedure is to define the steps for sorting target organisms from plankton samples collected at Encina Power Plant, and to describe the Quality Control Program (QC) used to monitor the sorting accuracy of individual sorters.

2. RESPONSIBILITIES

2.1 The Laboratory Supervisor is responsible for assuring that plankton sample sorting is in accordance with written procedures.

2.2 The Quality Control Supervisor is responsible for implementing the Quality Control Program which monitors sorting accuracy in accordance with written procedures.

2.3 Investigating biologists are responsible for sorting samples in accordance with written procedures.

3. INSTRUCTIONS

3.1 Sorting Procedures

3.1.1 Sample Processing

a. Ensure that the proper equipment necessary for sample processing is available (*Attachment 5.1*).

b. Transfer the samples to be sorted to the laboratory trailer.

c. Samples that were originally fixed in formaldehyde after collection, must be transferred to 100% ethanol before laboratory processing. This is done outside to lessen the exposure to formaldehyde fumes.

1. A funnel with the appropriate mesh size attached to its bottom opening is placed into a jar or can. The mesh must not be larger than that used during sample collection. Place the jar and funnel in a tray so the sample can be retrieved if spillage occurs.

2. Pour the sample carefully into the canning funnel. The sample jar and jar lid are rinsed with water, directing the water and organisms into the funnel. Rinse the sample with water to flush the formaldehyde from the sample.

3. Rinse the sample into a labeled jar with 100% ethanol from a squeeze bottle. Make certain that the jar has both an inner label and a jar top label. Additional ethanol is added to the sample jar to cover the sample.

4. The waste formaldehyde and rinse water is then discarded into the appropriate hazardous waste container.

d. Consult the sorting schedule posted in the processing laboratory to determine sorting priorities.

e. Sign out the sample on the Laboratory Sample Tracking Sheet (*Attachment 5.2*) by writing your initials under the 'sorter' column.

Transcribe information from the sample label into the Sorter's Log Book (*Attachment 5.3*) and into the sorter's notebook (each sorter has separate log sheets and a notebook for this purpose).

f. Take two clean canning funnels with attached mesh netting, one labeled 'sorted' and the other labeled 'unsorted'. The mesh size should be no larger than that used to collect the samples.

g. Place the 'unsorted' canning funnel on a clean jar. Next, place the jar and funnel in a dish so samples can be retrieved if spillage occurs. Pour a sample into the funnel. The funnel will contain the material to be sorted, while the ethanol will drain into the jar.

h. Place the 'unsorted' funnel on a second jar or can. Using fresh water in a squeeze bottle, rinse any remaining sample from the sample jar, the jar lid and inner sample label into the funnel containing the unsorted sample.

i. Pour the ethanol that was filtered through the canning funnel into the original sample jar. Keep the original ethanol-filled sample jar with the sample. Dispose of the alcohol waste-water from the second jar into the appropriate waste container.

j. Place the 'unsorted' funnel containing the sample and the empty 'sorted' funnel into individual glass bowls in a tray. Do not let the sample dehydrate during processing.

k. Transfer a small amount of the sample from the 'unsorted' funnel to the sorting tray. Add enough water to cover the sample. Distribute the sample in the sorting tray.

l. Place the sorting tray on the base of the dissecting microscope. Adjust the magnification so that the field of view is slightly larger than the width of an individual marked grid.

m. Arrange the light source to provide adequate illumination.

n. Carefully scan the entire sorting tray using the grids for orientation. Remove the target organism with forceps and place them either into a shell vial containing 70-80% ethanol or into a small dish containing water.

o. Log the number of organisms removed from the sample in the sorter notebook.

p. Scan the tray a second time. If target organisms are found on the second pass, repeat a third time. Continue this process until a scan does not produce any additional target organisms.

q. Once sorted, pour the sorted sample into the 'sorted' funnel and rinse with a small amount of water. Take a second aliquot from the 'unsorted' funnel as described above. Repeat the above steps until the entire sample has been sorted.

r. When the sorting has been completed, the sorted organisms should be placed into a shell vial containing ethanol. Place cotton into the top end of the vial to keep the organisms inside. Place the vial into a labeled jar containing ethanol.

s. Add enough ethanol to at least cover the shell vials and label each jar lid with a colored dot label. (The jar lid color coding system is posted in the lab.) Prepare a waterproof inner label for the jar containing the shell vial. Both labels should contain the following information:

1. Serial number
2. Date the sample was collected
3. Station, cycle and sample number
4. Collection start time
5. Jar number (if more than one jar)
6. Sorter’s initials
7. Number of organisms in shell vial

t. The total number of sorted organisms and the total time required to process the sample is recorded in the sorter's notebook.

u. Put the sorted sample back into the original sample jar containing the ethanol. Rinse any remaining sample from the funnel into the jar using a squirt bottle containing ethanol. Make sure the inner waterproof label is in the sample jar. Thoroughly clean the funnels of all the remaining sample.

v. For samples that do not contain any larval fish, an empty jar is labeled with the above information with zero (0) organisms indicated, and placed in the appropriate storage location.

w. If a sample must be stored before completion:

1. Put the sorted portion of the sample back into the original sample jar. Rinse any remaining material from the funnel into the jar using a squirt bottle containing ethanol. Make sure that the sample is adequately covered with ethanol.
2. Put the unsorted sample into a second jar. Rinse any sample from the ‘unsorted’ funnel into the jar using a squirt bottle containing ethanol. Using a dot label, label the jar lid with the sample identification information, sorter’s initials, and the word “unsorted”. Make an additional inner label with the sample identification information and marked ‘unsorted’. Place the label inside the jar with the ‘unsorted’ sample. Make certain that the ‘unsorted’ sample is adequately covered with ethanol.
3. The sorted and unsorted portion of the sample should be stored in a flammable materials storage cabinet until sorting can continue.

3.1.2 Once the sample is completed, place an appropriately colored dot label on the jar top with the sorter's initials and date of sorting. Return the jar to the box from which it was originally removed.

a. Transcribe the information recorded in the sorter's notebook to the Laboratory Sample Tracking Sheet (*Attachment 5.2*), and to the Sorter's Log (*Attachment 5.3*).

3.2 Sorting Quality Control Program

3.2.1 QC Sorting Criteria

a. The first ten samples that are sorted by an individual are completely resorted by a designated QC sorter. A sorter is allowed to miss one target organism when the original sorted count is 1–19. For original counts above 20 a sorter must maintain a sorting accuracy of 90%.

b. After the sorter has passed 10 consecutive sorts, the program is switched to a ‘1 sample in 10’ QC program for that sorter. After the sorter has completed another 10 samples, one sample is randomly selected by the designated QC sorter for a QC resort.

c. If the sorter maintains the 90% accuracy sorting rate for this sample, then the sorter continues in the ‘1 sample in 10’ QC mode.

d. If a sample does not meet the 90% accuracy rate their subsequent samples will be resorted until 10 consecutive samples meet the criteria.

3.2.2 QC Resorting

a. Sorting procedures used during the QC resort are the same as the sorting procedures described in Section 3.1.

b. All fish and selected invertebrate larvae that were missed by the sorter are removed during the QC resort.

c. For the QC process, a larval fish is defined as having a head plus at least 50% of the body. Any parts without a head and/or less than 50% of the body will be considered a fragments and will not be counted against the original sorter as a missed fish. However, it is important for each sorter to remove all fish and fragments from each sample that is sorted and correctly record them as # fish / # fragments in the sorter’s notebook and on the tracking sheet.

d. Any vials of fish larvae or selected invertebrate larvae generated from the resort are labeled with an orange dot label, and labeled as described in the sorting procedures with the addition of “QC” added to the label.

e. An orange dot label should also be placed on the top of the jar of the sample that was resorted and labeled with the QC person’s initials, survey number, sample number, and date the resort was completed.

f. The vials are stored in the appropriate location.

3.3 Waste Disposal

3.3.1 No formaldehyde or water contaminated with formaldehyde should be disposed of into the sewage system. Dispose of any water contaminated with this chemical in the designated waste water container to be disposed of at a local hazardous materials waste depository.

4. RECORDS

4.1 All data sheets are later reviewed, initialed, and coded by the Task Leader or his designate, and submitted to the Data Coordinator for logging, computer entry, and storage.

4.2 Original data sheets are permanently stored.

5. ATTACHMENTS

5.1 Equipment List

5.2 Laboratory Sample Tracking Sheet

5.3 Sorter’s Log Book Sheet

ATTACHMENT 5.1

TITLE: EQUIPMENT LIST

1. Tray or dish
2. Bowls
3. Sample jars
4. Two canning funnels with attached plankton mesh netting, labeled with mesh size, and labeled ‘sorted’ and ‘unsorted’
5. Squeeze bottle containing 100 percent ethanol (denatured)
6. Squeeze bottle containing fresh water
7. Sorting tray or petri dish marked with a sorting grid
8. Dissecting microscope with light source
9. Dissecting microscope with camera attachment connected to computer equipped with Optimas 6.2
10. Glass shell vials and cotton
11. Jar/vials with lids
12. Forceps
13. Waterproof labels
14. Dot labels
15. Sorter's notebook
16. Plankton splitter
17. Micrometer

ATTACHMENT 5.2

TITLE: LABORATORY SAMPLE TRACKING SHEET

Entrainment Abundance / Source Water / Plankton Tow Serial Number___

Lab Sample Tracking Sheet

Sample Information						**Invertebrate Sort Information**												**Fish Sort Information**											
Collection Date	Station	Cycle	Sample	Start Time	% Detrit	Sorter	Date Sorted	Time (hrs)	# Invt.	# Jars	QC Sorter	Date QC'd	# Invt.	ID'er	Date ID'd	QC ID'er	Date QC ID	Sorter	Date Sorted	Time (hrs)	# Invt	# Jars	QC Sorter	Date QC'd	# Invt	ID'er	Date ID'd	QC ID'er	Date QC ID

ATTACHMENT 5.3

TITLE: SORTER'S LOG BOOK SHEET

Sorters Log:

Name: ______________________________

Sample Identification						Sort Information		Quality control Checks					
Serial Number	Collection Date	Station	Cycle	Sample	Start Time	Date Sorted	Sort Time	By	Date QC'ed	Resort Time	Count Sort/Resort	Count Sort/Resort	Pass / Fail

APPENDIX D3: PROCEDURES FOR THE IDENTIFICATION OF LARVAL FISHES, *CANCER* SPP. AND *PANULIRUS* SPP.

1. PURPOSE

   1.1 The purpose of these procedures is to define the steps for identifying planktonic organisms, and to describe the Quality Control (QC) Program used to monitor the accuracy of each individual's identification performance.

2. RESPONSIBILITIES

   2.1 The Lead Taxonomist is responsible for assuring that plankton identifications are performed in accordance with written procedures and for implementing the Quality Control Program.

   2.2 Investigating biologists are responsible for plankton identifications and for monitoring accuracy in accordance with written procedures.

3. INSTRUCTIONS

   3.1 Identification procedures for larval fishes, *Cancer* spp. crab and *Panulirus* lobsters.

      3.1.1 Ensure that the proper equipment necessary for the identification of target organisms is available (*Attachment 5.1*).

      3.1.2 The fish and target invertebrates from each sample are kept in separate containers and processed following this procedure in essentially the same manner.

      3.1.3 Sign out the sample to be identified by placing your initials in the "ID'er" column on the Laboratory Sample Tracking Sheet (*Attachment 5.2*).

      3.1.4 The container of target organisms to be identified is carefully emptied into a dish. The dish is placed on the microscope stage and the lighting adjusted to provide adequate illumination.

      3.1.5 Each target organism is identified to the lowest taxonomic classification possible. The total number of each taxon is recorded on the Entrainment /Source Water Plankton Tow Lab Data Sheet (*Attachment 5.3*).

      3.1.6 All individuals of each identified taxon of larvae from a sample should be put into a shell vial containing 100% ethanol. Each vial should contain a label with the taxon name and sample number. Cotton should be pushed into the upper end of the vial to keep the label and organisms enclosed.

      3.1.7 Mutilated larvae (partial organisms that are missing body parts and are unable to be identified) are placed in a separate labeled vial. Whole larvae that are unidentified, are placed in a separate labeled vial.

      3.1.8 All vials containing target organisms from an individual sample should be put into a labeled jar containing enough ethanol to cover the vials. The jar should contain both an inside label and a label attached to the outside of the lid denoting the sample number, date and time collected, and identifier's initials. Tighten the jar lid to prevent evaporation of the preservative. Samples with many different fish taxa may require more than one labeled jar.

3.1.9 On the Laboratory Sample Tracking Sheet, record the identifier's initials and date sample was logged in. The identifier's log will contain the total number of larvae identified and the date identified. If more than one day was needed to complete the identification, record the date the sample identification was completed.

3.1.10 Place the jar into the appropriate box containing identified samples.

3.1.11 Dispose of any liquids containing ethanol into the appropriate waste container.

3.2 Identification Quality Control (QC) Program

3.2.1 Fishes

a. The first ten samples of larval fishes that are identified by an individual identifying biologist will be completely re-identified by a designated identification QC biologist. A total of at least 50 individuals from at least 5 taxa (50/5 criteria) must be present in these first ten samples. If the first 10 consecutive samples do not pass the 50/5 criteria, additional samples must be re-identified until this criteria is met.

b. The identifying biologist must maintain a 95% identification accuracy level in these first 10 samples. For all samples, if a sample contains between 1–19 larvae, one larvae can be misidentified and the sample will not fail the QC check.

c. If the identifying biologist identifies a larval fish to a certain family or genus and subsequently the identification QC biologist is able to refine the identification to a lower taxonomic level, this will not be considered a misidentification pertaining to the 95% identification accuracy level. A misidentification will be one in which the identifying biologist identifies the fish as belonging to a certain family, genus or species, and then the identification QC biologist determines that the initial identification was incorrect and changes the identification to a different family, genus or species or changes it to a higher taxonomic group.

d. After the identifying biologist has passed 10 consecutive samples, the program is switched to a "1 sample in 10" QC program. After the identifying biologist has completed another 10 samples, one sample is randomly selected by the designated identification QC biologist for a QC review.

e. If this sample maintains the 95% accuracy level as determined by the identification QC biologist, then the identifying biologist continues in the "1 sample in 10" QC mode. If a sample does not meet the 95% accuracy level, their subsequent samples will be re-identified until 10 consecutive samples meet this level of accuracy.

f. Any misidentified fish found by the identification QC biologist, will be placed into the appropriate labeled vial for that sample. This information will be recorded on the Fish Identification Data Sheet.

3.2.2 *Cancer* spp. and *Panulirus* spp.

a. The first ten samples identified by an individual identifying biologist will be completely re-identified by a designated identification QC biologist.

b. The identifying biologist must maintain a 95% accuracy level in these first 10 samples. For all samples, if a sample contains between 1-19 larvae, one larvae can be misidentified and the sample will not fail the QC check.

c. After the identifying biologist has passed 10 consecutive samples, the program is switched to a "1 sample in 10" QC program. After the identifying biologist has completed another 10 samples, one sample is randomly selected by the designated identification QC biologist for a QC review.

d. If this sample maintains the 95% accuracy level as determined by the identification QC biologist, then the identifying biologist continues in the "1 sample in 10" QC mode.

e. If an identifier's sample does not meet the 95% accuracy level, their subsequent samples will be re-identified until 10 consecutive samples meet this level.

f. Any misidentified larva found by the identification QC biologist, will be placed into the appropriate labeled vial for that sample and recorded on the appropriate laboratory identification data sheet.

3.3 Larval Fish Measuring

3.3.1 Larval Fish Measuring Procedure

a. Turn on the computer, camera, and light source at the measuring station.

b. Consult posted notices near the measuring station to determine measuring priorities and retrieve the binder containing the appropriate data sheets.

c. Locate the box containing the fish to be measured and place it in a easily accessible area close to the measuring station.

d. Open the Optimas Image Analysis software by clicking with the mouse on the Optimas icon.

e. Open the Larval Fish Measuring macro in Optimas, and follow the macro's directions.

f. Select the jar of fish to be measured and consult the jar label. Compare data on the jar label with the inner label and the data sheet for this sample. Consult an identifier regarding discrepancies between labels.

g. Enter the data queried for by the macro including the last five digits of the serial number, the measurer's initials, the data sheet sequence number and the species code.

h. Open the jar and remove the vials for the target taxa to be measured as per the posted list. Place the vials in a rack designed to allow the vials to maintain an upright posture so as to reduce spillage.

i. Select the first vial to be measured. Remove the cotton and the label. Compare the label with the data sheet for confirmation.

j. Empty the vial into a shallow dish. Remove any fish that have adhered to the vial, cotton, the label, or any tools used in the transferring process and place the fish in the dish. Add alcohol to the dish if necessary to prevent desiccation.

k. If the number of larval fish in the vial exceeds fifty or what can be reasonably measured on a single image capture, transfer some of the fish to another glass dish and immerse them in alcohol.

l. Place the dish on the stage of the microscope. Arrange the fish so that all fish appear on the screen. Adjust the zoom, focus, and lighting for the best possible image. If this is the first group of larval fish being measured, or if the magnification has been changed, it is necessary to re-calibrate. Place the micrometer on the stage of the microscope and re-calibrate by drawing a line from one of the micrometers millimeter marks to another, noting the distance between the two marks, and entering that value when queried. Replace the dish containing the larval fish to be measured.

m. Measure larval fish by drawing a line from the pre-maxillary to the end of the notochord, being careful to follow the contours of the fish. If the fish is too damaged to find either the pre-maxillary or to estimate the path taken by the notochord, do not measure, and proceed to the next larval fish. If the line does not adequately approximate the larval fish's length it must be re-measured.

n. Note the program's display of the measurement, check that it seems reasonable. If it does not seem reasonable, it may be necessary to re-calibrate and re-measure. If the problem persists, contact an identifier. Make note of any problems in measuring and post near the measuring station.

o. The macro will store the measurement in at least two separate data files along with the necessary sample information.

p. Repeat the above steps for all fish in the dish.

q. When all larval fish in the dish have been measured, fill the vial that originally contained the fish with alcohol and transfer the measured fish to the vial.

r. If the larval fish from this vial have been segregated into two or more groups, place another group into the dish, being careful to submerse them in alcohol, and measure as above. Do not measure more than fifty larval fish of any one taxon from each sample.

4. RECORDS

4.1 All data sheets are later reviewed, initialed, and coded by the Task Leader or his designate, and submitted to the Data Coordinator for logging, computer entry, and storage.

4.2 Original data sheets are permanently stored.

5. ATTACHMENTS

5.1 Equipment List

5.2 Laboratory Sample Tracking Sheet

5.3 Entrainment Abundance/ Source Water Plankton Tow Lab Data Sheet

5.4 Larval Fish Length Data Sheet (not needed for measurements completed with a computer-based measuring system.)

ATTACHMENT 5.1

TITLE: EQUIPMENT LIST

1. Dissecting microscope with light source and calibrated ocular micrometer
2. Sorting tray or petri dish
3. Squeeze bottle containing 100% ethanol (denatured)
4. Glass shell vials
5. Holder for shell vials
6. Jar containing target organisms to be identified
7. Cotton
8. Forceps
9. Waterproof labels
10. Dot labels
11. Data sheets
12. Identifier's log sheet
13. Taxonomic references

ATTACHMENT 5.2

TITLE: LABORATORY SAMPLE TRACKING SHEET

EPS 316(b) Entrainment / Source Water / Plankton Tow Serial Number__

Lab Sample Tracking Sheet

Sample Information						**Invertebrate Sort Information**												**Fish Sort Information**											
Collection Date	Station	Cycle	Sample	Start Time	% Detrit	Sorter	Date Sorted	Time (hrs)	# Invt.	# Jars	QC Sorter	Date QC'd	# Invt.	ID'er	Date ID'd	QC ID'er	Date QC ID	Sorter	Date Sorted	Time (hrs)	# Invt	# Jars	QC Sorter	Date QC'd	# Invt	ID'er	Date ID'd	QC ID'er	Date QC ID

ATTACHMENT 5.3

TITLE: ENTRAINMENT /SOURCE WATER PLANKTON TOW LAB DATA SHEET

EPS 316(b) Entrainment / Source Water Plankton Tow Lab Data Sheet, **Sequence**________________________

Serial No._____________ **Collection Date**_____________ **Station**_________ **Tow / Cycle #**_______________

Sample_______________ **Start Time**_____________ **Sort Type**_____________

Species Code	Species	Count	QC Resort Additional Count	Total Count	Notes / Comments
			Total		

Notes:

Identification By / Date: ________________________ Identification QC By / Date: ________________________

QC Resort ID By / Date: ________________________ Reviewed By / Date: ________________________

Entered By / Date: ________________________ Copied By / Date: ________________________

ATTACHMENT 5.4

TITLE: LARVAL FISH LENGTH DATA SHEET

EPS 316(b) Demonstration Larval Fish Lengths, Form # **Sequence #__________________**

Serial #______________________ **Sample____________** **Microscope_____________** **Page__________ of __________**

Species	Species Code	Mag.	Ocular Unit																		

Measurements By / Date:_______________ Entered By / Date: _______________ Verified By / Date: _____________ Copied By / Date:_________

APPENDIX D4: PROCEDURE FOR IMPINGEMENT COLLECTIONS

1. PURPOSE

   1.1 The purpose of this procedure is to define the steps required for quantifying the abundance, biomass and condition of organisms impinged on the bar racks and traveling debris screens at the Encina Power Plant cooling water intakes.

2. RESPONSIBILITIES

   2.1 The Field Supervisor is responsible for assuring that samples are collected in accordance with written procedures.

   2.2 Investigating biologists are responsible for sample collection in accordance with written procedures.

3. INSTRUCTIONS

   3.1 General instructions

      3.1.1 There is one 24-hour impingement survey during each week. Adjust the sampling day based on work activities at the plant. Tunnel shock (thermal treatment) events are scheduled approximately every two months. Regular impingement sampling should be conducted on a day of the week prior to the tunnel shock cleaning.

      3.1.2 Write legibly on all data sheets using a pencil.

      3.1.3 Use military time (0000 – 2400) when recording times on all data sheets. Record all times as Pacific Standard Time (PST). During Pacific Daylight Time, adjust your watch to record in PST (i.e., subtract 1 hour from the time on your watch).

      3.1.4 The survey number will be determine based on the week corresponding to that survey (e. g., week 1 = survey 1). Prepare by knowing the correct survey number.

      3.1.5 Record the names of all personnel present during data collection. Sampling teams will consist of 2−3 people on each shift.

      3.1.6 Taxa codes and tide determination will be recorded by the Task Leader in the lab at the conclusion of each survey.

   3.2 Bar Racks Collections

      3.2.1 At the beginning of the 24-hour sampling period request that plant personnel clean the bar racks of all impinged material using the rake assembly. This material is discarded.

      3.2.2 At the end of the 24-hour period request that plant personnel clean the bar racks again and put all collected material into the metal catch tub. Sort through the collected material and remove all fishes and invertebrates. These organisms should be processed the same the organisms that are impinged on the traveling screens (see below), but the data will be recorded on the bar rack data sheet for that survey.

3.2.3 Record the dates and times of the initial and final cleaning of the bar racks. If intermediate cleaning of the bar racks is required during the 24-hour sampling period, please note the approximate time that the cleanings occur in the notes section of the data sheet. This material will be processed as in Step 3.2.2.

3.3 Traveling Screen Collections

3.3.1 The estimated time for a complete revolution of the traveling screens is 35 minutes for Units 1-3 and Unit 4, and 30 minutes for Unit 5.

3.3.2 The 24-hour sampling period (survey) is divided into six 4-hour cycles. The traveling screens are rinsed of all impinged material at the last 30-35 minutes of each cycle based on the times listed above.

3.3.3 Verify that the initial traveling screen cleaning washes have been completed as scheduled for all units that are in operation. This material should be discarded.

3.3.4 During periods when no water is being drawn through the traveling screens (unit outages), no collection of impinged material will be conducted for that set of traveling screens.

3.3.5 During each cycle and before the screen wash, ensure that a mesh bag liner is placed in the metal basket. If, at the end of the rinse, some impinged material is collected in the metal basket, remove it and add it to the material in the mesh bag.

3.3.6 Remove all impinged fish and invertebrates, including damaged or mutilated individuals, from the impinged debris. Keep all impinged organisms separate for each unit and each cycle.

3.3.7 If the traveling screens automatically begin operation before the 4-hour cycle is over, collect all material and process it as part of the current cycle. Have the screen wash system run at the scheduled times.

3.3.8 If for any reason the unit’s traveling screens are rinsed out of order (say Unit 5 is rinsed before Unit 4) during a cycle, attempt to get the cycle order back on schedule during the next cycle. For example, if during Cycle 2 Unit 5 is rinsed before Unit 4, during Cycle 3 try to have Unit 4 traveling screens rinsed before Unit 5 based on the original written schedule. If you are not going to be a part of the sampling team during next cycle, ensure that the sampling personnel during the next cycle are advised that the screen rinsing order has been changed and to attempt to get the scheduled sampling back on track.

3.3.9 Keep all information on the data sheets separate for each unit and cycle. Do not put information for two cycles on the same data sheet.

3.3.10 Ensure that the Unit #s and cycle numbers recorded on the datasheet are correct. Record the date and time for the start and end of each screen wash (generally 30 or 35 minutes at the Encina Power Station) and the cycle duration times (generally 4 hours).

3.3.11 During each screen wash, verify that the screens are operating properly (the screens should be moving and the water should be spraying). Check with the operator to find out how many circulating water pumps are operating.

3.3.12 If a survey cannot be completed or is cancelled, make a note on the appropriate data sheet explaining the reason for the cancellation, write the survey number that corresponds to that week, and date and sign the sheet.

3.4 Tunnel shock (thermal treatment) collections

3.4.1 Upon arrival to EPS, check in with Plant Operations staff to verify the time that the intake and discharge gates were put in place and record this on the Tunnel Shock data sheets.

3.4.2 Once the cooling water in the tunnels has been heated and the tunnels have been soaked for a period, operations staff will begin removing the collection baskets and emptying the impinged materials on a large sorting table.

3.4.3 Remove all impinged fish and invertebrates from the debris. Materials from the different units do not need to be kept separated.

3.4.4 Processing of impinged organisms is conducted the same as for Traveling Screens. However, debris composition does not need to be recorded.

3.4.5 In the event that a large number of specimens are impinged, sub-sampling of small fishes can be done using the following procedure:

a. Once the impinged organisms are separated from the debris, pull out all larger fishes (>15 cm). All larger fishes must be processed.

b. Collect a 4-gallon sub-sample of the remaining organisms. Randomly select organisms from different areas of the sorting table.

c. Record the sub-sample volume on the data sheet along with the total volume of the material from the basket. Sub-sampled data should be clearly noted on the data sheet so that it can be traced back the original sample for accurate density calculations.

3.4.6 Continue to process all organisms until operations staff have removed the intake and discharge gates and all heat-treated organisms have been collected in debris baskets.

3.4.7 Record the time the gates were removed on the Tunnel Shock data sheets.

3.5 Species identification, count and measuring procedures

3.5.1 When writing names of impinged organisms, use complete scientific names or abbreviations whenever possible.

3.5.2 If many individuals of the same taxon are collected, they should be listed consecutively on the sheet. When this is done, draw a vertical line below the taxon name and extend the line down the page to indicate that information is being recorded for the same taxon. Information for all impinged fishes and countable invertebrates should be recorded using the procedures below. Make certain of all identifications before entering them on the datasheets. If unsure of the identity, save the specimen for possible identification by sampling personnel on the next shift. If the specimen still remains unidentified, it should be preserved in a labeled jar and returned to the lab for subsequent identification.

3.5.3 If more than 50 individuals of a species are collected during a cycle, only measure and weigh 50 randomly-selected individuals of this species. Count the remaining specimens and record this value on a separate line on the datasheet. For example, if 198 deepbody anchovies are collected, randomly select 50 individuals and record on the first row *Anchoa compressa* with the following information:

- Count = 1,
- Length = standard length to nearest mm (SL = the distance from the tip of the snout to the posterior vertical margin of the hypural plate)
- Weight = weight to nearest 0.1 g,
- Sex = '-' (if cannot be determined without sacrificing), M or F, and
- Condition = alive (A), dead (D), or mutilated (M).

Continue this procedure for the other 49 randomly-chosen specimens. Count the additional individuals of the taxon (148 in this example) and record the number in the row following the data for the last measured specimen of that taxon with '–' in the length and sex boxes. Determine the total batch weigh of the additional individuals and enter this value in the data box for 'weight'. If all of the individuals are alive, put an "A" in the 'condition' box. If some are dead and some mutilated, use additional rows to fill in the appropriate information in the corresponding row(s).

3.5.4 Any colonial animals (e.g., tunicates, sponges, hydroids, etc.) in the sample will simply be recorded as 'present' (letter "P" in the count box) and identified to the lowest practical taxon. Do not weigh or measure. Any bivalve clams or mussels in the sample were likely detached from the intake structure and should also only be recorded as 'present'.

3.5.5 The following measurements will be taken for certain groups: crabs–carapace width at widest point; shrimp–body length excluding antennae; mollusks–shell length for bivalves and mantle length for cephalopods.

3.5.6 Determine the sex of specimens if possible based on dimorphic characteristics such as telson width in crabs, presence of egg masses, or sexually dimorphic coloration in certain fish species. Assign the letter **M** to refer to males, **F** for females, **J** for juveniles, and **G** for gravid. Put a "**-**" if the sex of a specimen cannot be determined. Do not dissect specimens to determine sex.

3.5.7 Record condition of organisms: **A** for alive; **D** for dead; **M** for mutilated. Mutilated specimens should not be measured. If there are more than 50 non-mutilated individuals, the mutilated individual(s) can be weighed with the batch weight of the additional individuals. If there are fewer than 50 non-mutilated individuals, record the weight of the mutilated individual(s) but not their lengths (there can be one count and weight for all mutilated individuals).

3.5.8 Estimate the volume (gallons) of debris collected and record the composition and approximate percentage of each debris category (e.g., eelgrass, kelp, etc.).

3.5.9 During each cycle make an effort to keep any surviving specimens alive by placing them in a bucket of seawater before and after processing. At the conclusion of the cycle release any surviving specimens at the discharge area.

3.5.10 Any remarks concerning unusual events during a cycle or comments should be recorded on the datasheet in the ‘notes’ section.

3.5.11 At the conclusion of each cycle the recorder will review the data sheet and then sign and date in the ‘Reviewed by/Date’ section at the bottom of the datasheet.

3.6 Quality Control Checks

3.6.1 QC checks of the field impingement sampling are performed quarterly to verify that the procedures are being followed, that all organisms are being removed from the impinged debris, and that the identification, measuring and weighting are being recorded correctly on the data sheets.

3.6.2 The QC check shall be done by a senior scientist familiar with all procedures and the identity of all specimens likely to be encountered.

3.6.3 The QC biologist will re-count, re-measure, and re-weigh a subsample of the collected material.

3.6.4 Any discrepancies will be brought to the attention of the Task Leader, and all personnel involved in the sampling effort will be informed of any deficiencies that require corrective action.

3.6.5 The QC biologist will write a summary report of the QC activities that will be reviewed by the Project Manager.

4. RECORDS

4.1 The Task Leader should review and initial all data sheets.

4.2 Submit the data to the Data Coordinator for logging, computer entry, and storage.

4.3 Original data sheets are permanently stored.

5. ATTACHMENTS

5.1 Equipment List

5.2 Field Data Sheet (Bar Racks)

5.3 Field Data Sheet (Traveling Screens)

5.4 Field Data Sheet (Tunnel Shock)

ATTACHMENT 5.1

TITLE: EQUIPMENT LIST

1. Data sheets and pencils
2. Wristwatch (set to PST)
3. Measuring deviceS (rulers, fish measuring board, and\or calipers)
4. Electronic balance
5. (5) 5-gallon plastic buckets
6. Fish and invertebrate identification guides

ATTACHMENT 5.2

TITLE: FIELD DATA SHEET FOR BAR RACK SAMPLING

Encina Power Station **BAR RACKS** - Impingement Abundance Data Sheet

Sheet No:

(EPSIA####)

Survey: EPS**IA**0

Screen Wash (PST)

DATE TIME

Start ________ ________

End ________ ________

Observers: __________________ Total Time ________

Comments

	Sp. Code	Taxon	Count	Length (mm)	Weight (g)	Sex (M/F/J/G)	Cond. (A/D/M)		Sp. Code	Taxon	Count	Length	Weight (g)	Sex (M/F/J/G)	Cond. (A/D/M)
1								31							
2								32							
3								33							
4								34							
5								35							
6								36							
7								37							
8								38							
9								39							
10								40							
11								41							
12								42							
13								43							
14								44							
15								45							
16								46							
17								47							
18								48							
19								49							
20								50							
21								51							
22								52							
23								53							
24								54							
25								55							
26								56							
27								57							
28								58							
29								59							
30								60							

Notes:

Debris Composition and Percentage:

________________ ________ %

________________ ________ %

________________ ________ %

________________ ________ %

Approximate volume of debris:

_____x_____x_____ = _____m^3

(Use meter tape to measure volume)

Reviewed By/Date: ______________ Entered By/Date: ______________ Copied By/Date: ______________

ATTACHMENT 5.3

TITLE: FIELD DATA SHEET FOR TRAVELING SCREEN SAMPLING

Encina Power Station **TRAVELING SCREENS** - Impingement Abundance Data Sheet **Sheet No:** ____

Survey: (EPSIA####) EPS**IA**0 ____ Units: (1-3 or 4 or 5) ____ Cycle: (1-6) ____ Height: (Tide Level at Cycle's Screen Wash) ____ Ebb/Flood/Slack: ____

Screen Wash (PST)	DATE	TIME	Cycle Duration (PST)	DATE	TIME
Start			Start		
End			End		
Total Time			Total Time		

NUMBER OF:
Pumps Operating: ____
Screens Operating: ____
Observers: ____

Comments

	Sp. Code	Taxon	Count	Length (mm)	Weight (g)	Sex (M/F/JG)	Cond. (A/D/M)		Sp. Code	Taxon	Count	Length	Weight (g)	Sex (M/F/JG)	Cond. (A/D/M)
1								31							
2								32							
3								33							
4								34							
5								35							
6								36							
7								37							
8								38							
9								39							
10								40							
11								41							
12								42							
13								43							
14								44							
15								45							
16								46							
17								47							
18								48							
19								49							
20								50							
21								51							
22								52							
23								53							
24								54							
25								55							
26								56							
27								57							
28								58							
29								59							
30								60							

Notes:

Debris Composition and Percentage:
____ ____%
____ ____%
____ ____%
____ ____%

Approximate volume of debris:
_____x_____x_____ = ______m^3
(Use meter tape to measure volume)

Reviewed By/Date: ____ Entered By/Date: ____ Copied By/Date: ____

ATTACHMENT 5.4

TITLE: FIELD DATA SHEET FOR TUNNEL SHOCK (THERMAL TREATMENT) SAMPLING

Encina Power Station **TUNNEL SHOCK** - Impingement Abundance Data Sheet **Sheet No:** ______

(EPSTS###)
Survey: EPS**TS**0 __

Tunnel Shock (PST)

	DATE	TIME
Gates Installed	______	______
Gates Removed	______	______
Total Time		______

Observers: ______

NOTES

	Sp. Code	Taxon	Count	Length (mm)	Weight (g)	Sex (M/F/J/G)	Cond. (A/D/M)		Sp. Code	Taxon	Count	Length	Weight (g)	Sex (M/F/J/G)	Cond. (A/D/M)
1								31							
2								32							
3								33							
4								34							
5								35							
6								36							
7								37							
8								38							
9								39							
10								40							
11								41							
12								42							
13								43							
14								44							
15								45							
16								46							
17								47							
18								48							
19								49							
20								50							
21								51							
22								52							
23								53							
24								54							
25								55							
26								56							
27								57							
28								58							
29								59							
30								60							

Notes:

Debris Composition and Percentage:

______ ______%
______ ______%
______ ______%
______ ______%

~~Approximate~~ volume of debris:
_____x_____x_____ = _____ m^3
(Use meter tape to measure volume)

Reviewed By/Date: ______ Entered By/Date: ______ Copied By/Date: ______

Appendix E

Entrainment Results

E1 – EPS Entrainment Station

E2 – Agua Hedionda Lagoon Stations

E3 – Nearshore Stations

Table E1. Monthly abundance and mean concentration (#/1,000m^3) of larval fishes and target invertebrates at entrainment Station E1.

		Survey Number:			1		2	
		Survey Date:			06/10/04		06/24/04	
		Sample Count:			8		8	
	Taxon	**Common Name**	**Total Count**	**Mean Conc.**	**Count**	**Conc.**	**Count**	**Conc.**
	Fishes							
1	Gobiidae unid.	gobies	12,762	2,222.69	609	2,059.68	576	1,622.60
2	*Hypsoblennius* spp.	combtooth blennies	5,838	1,107.67	784	2,712.14	438	1,197.26
3	*Engraulis mordax*	northern anchovy	505	84.40	6	17.86	-	-
4	Engraulidae unid.	anchovies	314	49.88	-	-	2	5.15
5	*Hypsypops rubicundus*	garibaldi	188	40.99	79	268.68	8	23.41
6	*Typhlogobius californiensis*	blind goby	148	24.65	2	4.80	-	-
7	*Gibbonsia* spp.	clinid kelpfishes	125	22.45	3	11.11	2	5.24
8	Labrisomidae unid.	labrisomid kelpfishes	81	17.65	26	92.41	10	28.36
9	*Acanthogobius flavimanus*	yellowfin goby	87	14.41	-	-	-	-
10	larval fish fragment	larval fishes	56	9.65	8	25.54	-	-
11	larvae, unidentified yolksac	yolksac larvae	39	8.36	5	16.62	6	18.21
12	*Roncador stearnsi*	spotfin croaker	42	8.33	1	2.40	1	2.57
13	*Syngnathus leptorhynchus*	bay pipefish	36	8.20	7	21.36	8	22.75
14	*Atherinopsis californiensis*	jacksmelt	47	7.99	-	-	-	-
15	*Rimicola* spp.	kelp clingfishes	43	7.92	3	9.95	1	2.49
16	*Syngnathus* spp.	pipefishes	47	7.85	2	6.39	-	-
17	*Genyonemus lineatus*	white croaker	44	7.04	-	-	-	-
18	*Seriphus politus*	queenfish	29	5.50	2	6.65	-	-
19	*Paraclinus integripinnis*	reef finspot	31	4.95	-	-	-	-
20	*Paralichthys californicus*	California halibut	21	3.73	1	2.40	-	-
21	*Sardinops sagax*	Pacific sardine	16	2.66	-	-	-	-
22	*Gillichthys mirabilis*	longjaw mudsucker	13	2.14	-	-	-	-
23	Sciaenidae unid.	croaker	11	1.86	-	-	1	2.49
24	*Hypsopsetta guttulata*	diamond turbot	10	1.78	-	-	-	-
25	larval/post-larval fish unid.	larval fishes	10	1.61	1	2.40	-	-
26	*Citharichthys stigmaeus*	speckled sanddab	8	1.33	-	-	-	-
27	*Paralabrax* spp.	sand bass	7	1.15	-	-	-	-
28	Atherinopsidae unid.	silverside	5	0.82	-	-	-	-
29	*Citharichthys sordidus*	Pacific sanddab	5	0.79	-	-	-	-
30	*Paralabrax clathratus*	kelp bass	4	0.71	-	-	-	-
31	Pleuronectiformes unid.	flatfishes	4	0.63	-	-	-	-
32	*Heterostichus rostratus*	giant kelpfish	3	0.54	1	2.40	-	-
33	*Clinocottus analis*	wooly sculpin	3	0.51	-	-	-	-
34	*Stenobrachius leucopsarus*	northern lampfish	2	0.37	-	-	-	-
35	*Atherinops affinis*	topsmelt	2	0.36	-	-	-	-
36	*Cheilotrema saturnum*	black croaker	2	0.35	-	-	-	-
37	*Scomber japonicus*	Pacific mackerel	1	0.35	1	4.51	-	-
38	*Quietula y-cauda*	shadow goby	1	0.25	-	-	-	-
39	Ophidiidae unid.	cusk-eels	1	0.21	-	-	-	-
40	*Gobiesox* spp.	clingfishes	1	0.20	-	-	1	2.66
41	*Diaphus theta*	California headlight fish	1	0.19	-	-	-	-
42	*Semicossyphus pulcher*	California sheephead	1	0.19	-	-	-	-
43	*Menticirrhus undulatus*	California corbina	1	0.18	-	-	-	-
44	Haemulidae unid.	grunts	1	0.18	-	-	-	-
45	Labridae unid.	wrasses	1	0.17	-	-	-	-
46	Myctophidae unid.	lanternfishes	1	0.16	-	-	-	-
47	*Symbolophorus californiensis*	California lanternfish	1	0.16	-	-	-	-
48	*Oxyjulis californica*	senorita	1	0.14	-	-	-	-
49	*Citharichthys* spp.	sanddabs	1	0.13	-	-	-	-
	Invertebrates							
	Cancer anthonyi (megalops)	yellow crab	1	2.21	-	-	-	-
			20,602		1,541		1,054	

Table E1 (continued). Monthly abundance and mean concentration (#/1,000m^3) of larval fishes and target invertebrates at entrainment Station E1.

Survey Number:	3		4		5		6	
Survey Date:	**07/06/04**		**08/13/04**		**09/23/04**		**10/21/04**	
Sample Count:	**8**		**8**		**8**		**8**	
Taxon	**Count**	**Conc.**	**Count**	**Conc.**	**Count**	**Conc.**	**Count**	**Conc.**
Fishes								
Gobiidae unid.	1,349	3,651.19	3,347	6,989.90	992	2,259.40	454	1,118.40
Hypsoblennius spp.	615	1,857.95	1,843	3,900.14	917	2,056.02	115	275.79
Engraulis mordax	7	19.60	-	-	2	4.55	2	4.43
Engraulidae unid.	17	41.45	6	11.44	-	-	-	-
Hypsypops rubicundus	24	76.54	8	16.58	-	-	-	-
Typhlogobius californiensis	1	3.57	-	-	-	-	-	-
Gibbonsia spp.	-	-	1	1.85	-	-	16	42.17
Labrisomidae unid.	20	52.50	2	4.38	20	45.30	1	2.62
Acanthogobius flavimanus	-	-	-	-	-	-	-	-
larval fish fragment	-	-	3	6.62	4	8.90	8	19.52
larvae, unidentified yolksac	16	46.61	-	-	3	7.57	-	-
Roncador stearnsi	11	34.26	1	2.09	28	67.03	-	-
Syngnathus leptorhynchus	19	57.50	-	-	-	-	1	2.83
Atherinopsis californiensis	-	-	-	-	-	-	-	-
Rimicola spp.	12	29.44	15	31.44	3	6.87	9	22.75
Syngnathus spp.	-	-	32	67.29	13	28.39	-	-
Genyonemus lineatus	-	-	1	1.93	7	16.59	-	-
Seriphus politus	-	-	3	6.38	22	53.74	2	4.77
Paraclinus integripinnis	-	-	31	64.39	-	-	-	-
Paralichthys californicus	-	-	1	2.09	5	13.58	2	5.23
Sardinops sagax	-	-	-	-	-	-	-	-
Gillichthys mirabilis	-	-	-	-	-	-	-	-
Sciaenidae unid.	1	3.20	-	-	3	6.64	1	2.62
Hypsopsetta guttulata	-	-	-	-	3	7.81	-	-
larval/post-larval fish unid.	1	2.39	5	9.76	-	-	-	-
Citharichthys stigmaeus	-	-	-	-	-	-	2	5.54
Paralabrax spp.	-	-	3	5.69	4	9.26	-	-
Atherinopsidae unid.	-	-	-	-	-	-	-	-
Citharichthys sordidus	-	-	-	-	-	-	-	-
Paralabrax clathratus	-	-	-	-	4	9.21	-	-
Pleuronectiformes unid.	-	-	-	-	-	-	-	-
Heterostichus rostratus	-	-	-	-	-	-	-	-
Clinocottus analis	-	-	-	-	-	-	-	-
Stenobrachius leucopsarus	-	-	-	-	-	-	-	-
Atherinops affinis	1	2.50	-	-	-	-	-	-
Cheilotrema saturnum	1	2.50	1	2.02	-	-	-	-
Scomber japonicus	-	-	-	-	-	-	-	-
Quietula y-cauda	1	3.20	-	-	-	-	-	-
Ophidiidae unid.	-	-	-	-	-	-	1	2.71
Gobiesox spp.	-	-	-	-	-	-	-	-
Diaphus theta	-	-	-	-	-	-	-	-
Semicossyphus pulcher	-	-	-	-	-	-	-	-
Menticirrhus undulatus	1	2.39	-	-	-	-	-	-
Haemulidae unid.	-	-	-	-	1	2.29	-	-
Labridae unid.	-	-	-	-	1	2.19	-	-
Myctophidae unid.	-	-	-	-	-	-	-	-
Symbolophorus californiensis	-	-	-	-	-	-	-	-
Oxyjulis californica	-	-	-	-	-	-	-	-
Citharichthys spp.	-	-	-	-	-	-	-	-
Invertebrates								
Cancer anthonyi (megalops)	-	-	-	-	-	-	-	-
	2,097		5,303		2,032		614	

Table E1 (continued). Monthly abundance and mean concentration (#/1,000m^3) of larval fishes and target invertebrates at entrainment Station E1.

Survey Number:	7		8		9		10	
Survey Date:	11/18/04		12/16/04		01/13/05		02/24/05	
Sample Count:	8		8		8		8	
Taxon	**Count**	**Conc.**	**Count**	**Conc.**	**Count**	**Conc.**	**Count**	**Conc.**
Fishes								
Gobiidae unid.	203	411.13	102	233.48	118	263.27	555	1,179.31
Hypsoblennius spp.	151	320.89	5	11.75	4	8.53	-	-
Engraulis mordax	26	48.05	-	-	1	2.22	25	51.06
Engraulidae unid.	-	-	-	-	-	-	-	-
Hypsypops rubicundus	-	-	-	-	-	-	-	-
Typhlogobius californiensis	-	-	-	-	-	-	4	8.61
Gibbonsia spp.	7	13.96	6	13.51	61	141.98	11	22.93
Labrisomidae unid.	1	1.75	-	-	-	-	-	-
Acanthogobius flavimanus	-	-	-	-	19	44.01	63	133.24
larval fish fragment	2	3.95	-	-	1	2.28	4	8.48
larvae, unidentified yolksac	-	-	-	-	-	-	-	-
Roncador stearnsi	-	-	-	-	-	-	-	-
Syngnathus leptorhynchus	-	-	-	-	-	-	-	-
Atherinopsis californiensis	-	-	2	4.93	13	29.82	22	47.31
Rimicola spp.	-	-	-	-	-	-	-	-
Syngnathus spp.	-	-	-	-	-	-	-	-
Genyonemus lineatus	4	7.92	1	2.47	3	6.50	13	26.67
Seriphus politus	-	-	-	-	-	-	-	-
Paraclinus integripinnis	-	-	-	-	-	-	-	-
Paralichthys californicus	1	1.75	1	2.22	2	4.40	3	5.75
Sardinops sagax	2	3.49	-	-	-	-	5	10.93
Gillichthys mirabilis	3	7.07	1	2.15	1	2.22	5	10.56
Sciaenidae unid.	1	1.85	-	-	-	-	-	-
Hypsopsetta guttulata	2	4.02	1	1.71	4	9.59	-	-
larval/post-larval fish unid.	-	-	-	-	3	6.33	-	-
Citharichthys stigmaeus	4	7.32	-	-	-	-	-	-
Paralabrax spp.	-	-	-	-	-	-	-	-
Atherinopsidae unid.	-	-	-	-	-	-	2	4.61
Citharichthys sordidus	3	5.24	-	-	-	-	-	-
Paralabrax clathratus	-	-	-	-	-	-	-	-
Pleuronectiformes unid.	3	5.70	-	-	-	-	-	-
Heterostichus rostratus	1	2.18	-	-	-	-	1	2.41
Clinocottus analis	-	-	1	2.20	1	2.28	1	2.15
Stenobrachius leucopsarus	-	-	-	-	2	4.82	-	-
Atherinops affinis	-	-	-	-	-	-	-	-
Cheilotrema saturnum	-	-	-	-	-	-	-	-
Scomber japonicus	-	-	-	-	-	-	-	-
Quietula y-cauda	-	-	-	-	-	-	-	-
Ophidiidae unid.	-	-	-	-	-	-	-	-
Gobiesox spp.	-	-	-	-	-	-	-	-
Diaphus theta	-	-	-	-	-	-	-	-
Semicossyphus pulcher	-	-	-	-	-	-	-	-
Menticirrhus undulatus	-	-	-	-	-	-	-	-
Haemulidae unid.	-	-	-	-	-	-	-	-
Labridae unid.	-	-	-	-	-	-	-	-
Myctophidae unid.	-	-	-	-	-	-	-	-
Symbolophorus californiensis	-	-	-	-	-	-	-	-
Oxyjulis californica	-	-	-	-	-	-	-	-
Citharichthys spp.	-	-	-	-	-	-	-	-
Invertebrates								
Cancer anthonyi (megalops)	-	-	1	2.21	-	-	-	-
	414		121		233		714	

Table E1 (continued). Monthly abundance and mean concentration (#/1,000m^3) of larval fishes and target invertebrates at entrainment Station E1

Survey Number:	11		12		13	
Survey Date:	03/23/05		04/21/05		05/19/05	
Sample Count:	8		8		8	
Taxon	**Count**	**Conc.**	**Count**	**Conc.**	**Count**	**Conc.**
Fishes						
Gobiidae unid.	1,357	2,700.63	1,314	2,649.98	1,786	3,755.99
Hypsoblennius spp.	49	99.47	86	174.14	831	1,785.69
Engraulis mordax	89	182.27	284	642.95	63	124.21
Engraulidae unid.	60	140.57	14	28.03	215	421.84
Hypsypops rubicundus	-	-	15	30.54	54	117.11
Typhlogobius californiensis	110	238.12	17	34.38	14	31.01
Gibbonsia spp.	12	26.60	2	3.96	4	8.59
Labrisomidae unid.	-	-	-	-	1	2.13
Acanthogobius flavimanus	5	10.08	-	-	-	-
larval fish fragment	12	24.32	4	8.17	10	17.70
larvae, unidentified yolksac	1	2.43	3	7.12	5	10.12
Roncador stearnsi	-	-	-	-	-	-
Syngnathus leptorhynchus	-	-	-	-	1	2.21
Atherinopsis californiensis	10	21.80	-	-	-	-
Rimicola spp.	-	-	-	-	-	-
Syngnathus spp.	-	-	-	-	-	-
Genyonemus lineatus	5	9.18	10	20.28	-	-
Seriphus politus	-	-	-	-	-	-
Paraclinus integripinnis	-	-	-	-	-	-
Paralichthys californicus	1	1.82	3	7.12	1	2.13
Sardinops sagax	1	1.86	8	18.35	-	-
Gillichthys mirabilis	2	3.89	1	1.88	-	-
Sciaenidae unid.	2	3.67	-	-	2	3.75
Hypsopsetta guttulata	-	-	-	-	-	-
larval/post-larval fish unid.	-	-	-	-	-	-
Citharichthys stigmaeus	-	-	2	4.37	-	-
Paralabrax spp.	-	-	-	-	-	-
Atherinopsidae unid.	-	-	2	3.89	1	2.21
Citharichthys sordidus	-	-	2	4.98	-	-
Paralabrax clathratus	-	-	-	-	-	-
Pleuronectiformes unid.	-	-	1	2.49	-	-
Heterostichus rostratus	-	-	-	-	-	-
Clinocottus analis	-	-	-	-	-	-
Stenobrachius leucopsarus	-	-	-	-	-	-
Atherinops affinis	-	-	-	-	1	2.21
Cheilotrema saturnum	-	-	-	-	-	-
Scomber japonicus	-	-	-	-	-	-
Quietula y-cauda	-	-	-	-	-	-
Ophidiidae unid.	-	-	-	-	-	-
Gobiesox spp.	-	-	-	-	-	-
Diaphus theta	-	-	1	2.49	-	-
Semicossyphus pulcher	-	-	1	2.49	-	-
Menticirrhus undulatus	-	-	-	-	-	-
Haemulidae unid.	-	-	-	-	-	-
Labridae unid.	-	-	-	-	-	-
Myctophidae unid.	-	-	1	2.14	-	-
Symbolophorus californiensis	-	-	1	2.14	-	-
Oxyjulis californica	-	-	-	-	1	1.78
Citharichthys spp.	1	1.72	-	-	-	-
Invertebrates						
Cancer anthonyi (megalops)	-	-	-	-	-	-
	1,717		1,772		2,990	

Table E2. Monthly abundance and mean concentration (#/1,000m^3) of larval fishes and target invertebrates at source water Stations L1-L4 in Agua Hedionda Lagoon.

			Survey Number:		**1**		**2**	
			Survey Date:		**06/10/04**		**06/24/04**	
			Sample Count:		**16**		**16**	
	Taxon	**Common Name**	**Total Count**	**Mean Conc.**	**Count**	**Conc.**	**Count**	**Conc.**
	Fishes							
1	Gobiidae unid.	gobies	30,229	2,714.74	7,936	9,400.29	4,466	5,925.43
2	*Hypsoblennius* spp.	combtooth blennies	4,725	467.32	614	901.83	398	547.24
3	Engraulidae unid.	anchovies	652	57.90	54	72.86	141	182.94
4	*Engraulis mordax*	northern anchovy	558	45.51	2	2.79	1	1.33
5	*Acanthogobius flavimanus*	yellowfin goby	499	38.98	-	-	-	-
6	Labrisomidae unid.	labrisomid kelpfishes	366	35.30	166	220.73	71	93.10
7	*Hypsypops rubicundus*	garibaldi	352	35.12	94	134.38	53	76.48
8	*Atherinopsis californiensis*	jacksmelt	279	23.93	-	-	-	-
9	*Gibbonsia* spp.	clinid kelpfishes	182	16.74	8	11.54	4	5.44
10	larval fish fragment	unid. larval fishes	174	15.02	17	19.27	21	30.99
11	*Typhlogobius californiensis*	blind goby	118	9.63	2	2.79	-	-
12	*Roncador stearnsi*	spotfin croaker	74	6.82	1	1.29	-	-
13	Sciaenidae unid.	croakers	73	6.56	23	29.17	-	-
14	*Gillichthys mirabilis*	longjaw mudsucker	62	5.17	-	-	-	-
15	*Genyonemus lineatus*	white croaker	54	4.25	2	2.14	-	-
16	*Rimicola eigenmanni*	slender clingfish	53	4.13	-	-	-	-
17	Atherinopsidae unid.	silversides	41	3.40	3	3.43	-	-
18	*Rimicola* spp.	kelp clingfishes	34	3.28	-	-	2	2.98
19	*Syngnathus leptorhynchus*	bay pipefish	33	3.19	12	15.60	9	11.57
20	larvae, unidentified yolksac	unid. yolksac larvae	32	3.12	6	8.47	-	-
21	*Paraclinus integripinnis*	reef finspot	31	2.88	-	-	-	-
22	*Seriphus politus*	queenfish	26	2.40	1	1.64	5	5.51
23	*Atherinops affinis*	topsmelt	28	2.40	6	7.00	4	5.54
24	*Quietula y-cauda*	shadow goby	26	2.38	5	5.45	5	6.68
25	*Syngnathus* spp.	pipefishes	19	2.01	-	-	2	2.99
26	*Paralichthys californicus*	California halibut	22	1.93	2	2.63	-	-
27	larval/post-larval fish unid.	larval fishes	16	1.36	-	-	-	-
28	*Ilypnus gilberti*	cheekspot goby	14	1.35	-	-	-	-
29	*Oxyjulis californica*	senorita	8	0.75	2	2.36	-	-
30	*Sardinops sagax*	Pacific sardine	9	0.74	-	-	-	-
31	*Citharichthys stigmaeus*	speckled sanddab	9	0.73	-	-	-	-
32	*Paralabrax* spp.	sand basses	8	0.68	-	-	-	-
33	*Hypsopsetta guttulata*	diamond turbot	7	0.55	-	-	-	-
34	*Leptocottus armatus*	Pacific staghorn sculpin	6	0.51	-	-	-	-
35	*Gobiesox* spp.	clingfishes	5	0.49	-	-	2	3.29
36	*Menticirrhus undulatus*	California corbina	5	0.47	-	-	-	-
37	*Cheilotrema saturnum*	black croaker	4	0.36	-	-	-	-
38	Blennioidei unid.	blennies	4	0.36	1	1.11	1	1.40
39	*Citharichthys sordidus*	Pacific sanddab	5	0.34	-	-	-	-
40	*Clinocottus analis*	wooly sculpin	4	0.31	-	-	-	-
41	*Xenistius californiensis*	salema	3	0.30	-	-	-	-
42	*Xystreurys liolepis*	fantail sole	2	0.21	-	-	-	-
43	*Pleuronichthys ritteri*	spotted turbot	2	0.17	-	-	-	-
44	Haemulidae unid.	grunts	2	0.17	-	-	-	-
45	*Sphyraena argentea*	California barracuda	2	0.17	-	-	-	-
46	*Triphoturus mexicanus*	Mexican lampfish	2	0.16	-	-	-	-
47	Gobiesocidae unid.	clingfishes	2	0.15	-	-	-	-
48	*Clevelandia ios*	arrow goby	1	0.11	-	-	-	-
49	Syngnathidae unid.	pipefishes	1	0.11	-	-	-	-
50	Ophidiidae unid.	cusk-eels	1	0.09	-	-	-	-
51	*Umbrina roncador*	yellowfin croaker	1	0.09	-	-	-	-
52	*Lepidogobius lepidus*	bay goby	1	0.09	-	-	-	-
53	*Pleuronichthys* spp.	turbots	1	0.08	-	-	-	-
54	*Atractoscion nobilis*	white seabass	1	0.08	-	-	-	-
55	Pleuronectiformes unid.	flatfishes	1	0.07	-	-	-	-
56	*Clinocottus* spp.	sculpins	1	0.07	-	-	-	-
57	*Citharichthys* spp.	sanddabs	1	0.06	-	-	-	-
58	*Semicossyphus pulcher*	California sheephead	1	0.06	1	0.78	-	-
	Invertebrates							
	Panulirus interruptus (larvae)	California spiny lobster	2	0.21	-	-	-	-
	Cancer antennarius (megalops)	brown rock crab	1	0.09	-	-	-	-
	Cancer anthonyi (megalops)	yellow crab	1	0.08	-	-	-	-
		Totals:	**38,876**		**8,958**		**5,185**	

Table E2 (continued). Monthly abundance and mean concentration (#/1,000m^3) of larval fishes and target invertebrates at source water Stations L1-L4 in Agua Hedionda Lagoon.

Survey Number:	3		4		5		6	
Survey Date:	07/06/04		08/13/04		09/23/04		10/21/04	
Sample Count:	16		16		20		16	
Taxon	**Conc.**	**Count**	**Count**	**Conc.**	**Count**	**Conc.**	**Count**	**Conc.**
Fishes								
Gobiidae unid.	3,034.53	30,229	1,498	1,925.13	1,115	1,272.53	550	690.51
Hypsoblennius spp.	1,053.95	4,725	1,004	1,421.30	360	398.18	245	290.58
Engraulidae unid.	57.39	652	-	-	-	-	-	-
Engraulis mordax	12.07	558	-	-	-	-	4	5.58
Acanthogobius flavimanus	-	499	-	-	-	-	-	-
Labrisomidae unid.	44.54	366	23	29.27	68	70.20	-	-
Hypsypops rubicundus	122.15	352	1	1.38	-	-	-	-
Atherinopsis californiensis	1.15	279	-	-	-	-	-	-
Gibbonsia spp.	4.46	182	1	1.38	3	3.04	12	19.17
larval fish fragment	4.41	174	9	10.98	3	3.48	8	9.95
Typhlogobius californiensis	11.38	118	-	-	-	-	-	-
Roncador stearnsi	34.73	74	-	-	48	51.42	-	-
Sciaenidae unid.	10.27	73	4	4.85	17	17.20	-	-
Gillichthys mirabilis	-	62	-	-	-	-	-	-
Genyonemus lineatus	-	54	4	4.85	6	6.58	1	1.81
Rimicola eigenmanni	-	53	-	-	53	53.73	-	-
Atherinopsidae unid.	1.15	41	-	-	-	-	3	3.66
Rimicola spp.	6.03	34	-	-	9	9.96	10	13.61
Syngnathus leptorhynchus	7.04	33	-	-	5	4.97	1	1.33
larvae, unidentified yolksac	12.08	32	6	7.87	2	2.11	-	-
Paraclinus integripinnis	-	31	31	37.45	-	-	-	-
Seriphus politus	6.58	26	1	1.26	8	8.51	6	7.72
Atherinops affinis	1.15	28	-	-	-	-	-	-
Quietula y-cauda	2.29	26	4	5.80	1	1.01	-	-
Syngnathus spp.	-	19	15	20.83	-	-	1	1.09
Paralichthys californicus	1.63	22	1	1.21	7	7.51	2	3.18
larval/post-larval fish unid.	-	16	2	2.42	3	3.03	-	-
Ilypnus gilberti	-	14	3	4.46	-	-	-	-
Oxyjulis californica	-	8	5	6.24	-	-	-	-
Sardinops sagax	-	9	-	-	-	-	-	-
Citharichthys stigmaeus	1.36	9	1	1.20	2	2.12	-	-
Paralabrax spp.	-	8	3	3.63	5	5.24	-	-
Hypsopsetta guttulata	-	7	-	-	2	2.20	-	-
Leptocottus armatus	-	6	-	-	-	-	-	-
Gobiesox spp.	-	5	-	-	-	-	-	-
Menticirrhus undulatus	1.63	5	1	1.21	3	3.33	-	-
Cheilotrema saturnum	1.32	4	1	1.21	2	2.19	-	-
Blennioidei unid.	-	4	-	-	-	-	-	-
Citharichthys sordidus	-	5	-	-	-	-	-	-
Clinocottus analis	-	4	-	-	-	-	-	-
Xenistius californiensis	-	3	-	-	2	2.03	1	1.81
Xystreurys liolepis	2.77	2	-	-	-	-	-	-
Pleuronichthys ritteri	-	2	-	-	2	2.20	-	-
Haemulidae unid.	-	2	1	1.21	1	0.96	-	-
Sphyraena argentea	-	2	1	1.17	1	0.99	-	-
Triphoturus mexicanus	-	2	-	-	1	1.10	-	-
Gobiesocidae unid.	-	2	-	-	-	-	2	2.01
Clevelandia ios	-	1	1	1.45	-	-	-	-
Syngnathidae unid.	-	1	-	-	-	-	1	1.38
Ophidiidae unid.	-	1	1	1.21	-	-	-	-
Umbrina roncador	-	1	-	-	1	1.21	-	-
Lepidogobius lepidus	-	1	-	-	-	-	-	-
Pleuronichthys spp.	-	1	-	-	1	1.10	-	-
Atractoscion nobilis	-	1	-	-	-	-	-	-
Pleuronectiformes unid.	-	1	-	-	-	-	-	-
Clinocottus spp.	-	1	-	-	-	-	-	-
Citharichthys spp.	-	1	-	-	-	-	-	-
Semicossyphus pulcher	-	1	-	-	-	-	-	-
Invertebrates								
Panulirus interruptus	2.73	2	-	-	-	-	-	-
Cancer antennarius (megalops)	-	1	-	-	-	-	-	-
Cancer anthonyi (megalops)	-	1	-	-	1	1.01	-	-
		38,876	**2,622**		**1,732**		**847**	

Table E2 (continued). Monthly abundance and mean concentration (#/1,000m^3) of larval fishes and target invertebrates at source water Stations L1-L4 in Agua Hedionda Lagoon.

Survey Number:	7		8		9		10	
Survey Date:	11/18/04		12/16/04		01/13/05		02/24/05	
Sample Count:	16		16		16		16	
Total								
Taxon	Count	Conc.	Count	Conc.	Count	Conc.	Count	Conc.
Fishes								
Gobiidae unid.	706	734.73	1,032	1,201.76	368	402.81	1,873	1,867.75
Hypsoblennius spp.	59	61.74	4	5.26	3	3.22	2	2.05
Engraulidae unid.	2	2.12	-	-	2	2.42	-	-
Engraulis mordax	30	28.07	2	2.43	-	-	21	21.19
Acanthogobius flavimanus	-	-	-	-	140	152.20	300	298.81
Labrisomidae unid.	-	-	-	-	-	-	-	-
Hypsypops rubicundus	-	-	-	-	-	-	-	-
Atherinopsis californiensis	5	5.80	16	18.84	52	61.60	167	185.66
Gibbonsia spp.	13	13.30	56	65.83	43	52.02	21	20.79
larval fish fragment	11	11.11	11	12.69	-	-	49	48.54
Typhlogobius californiensis	-	-	2	2.23	-	-	8	8.22
Roncador stearnsi	-	-	-	-	-	-	-	-
Sciaenidae unid.	-	-	-	-	3	3.65	-	-
Gillichthys mirabilis	4	4.25	21	24.94	14	14.54	15	15.16
Genyonemus lineatus	1	0.95	-	-	2	2.27	23	21.56
Rimicola eigenmanni	-	-	-	-	-	-	-	-
Atherinopsidae unid.	4	4.47	-	-	-	-	12	11.64
Rimicola spp.	1	1.14	5	5.82	-	-	-	-
Syngnathus leptorhynchus	-	-	-	-	-	-	1	0.94
larvae, unidentified yolksac	-	-	1	1.31	-	-	-	-
Paraclinus integripinnis	-	-	-	-	-	-	-	-
Seriphus politus	-	-	-	-	-	-	-	-
Atherinops affinis	-	-	-	-	-	-	12	12.21
Quietula y-cauda	2	2.24	4	4.22	-	-	3	3.18
Syngnathus spp.	1	1.28	-	-	-	-	-	-
Paralichthys californicus	2	1.67	-	-	2	2.31	2	1.80
larval/post-larval fish unid.	-	-	-	-	10	11.33	1	0.89
Ilypnus gilberti	1	0.86	5	5.99	5	6.28	-	-
Oxyjulis californica	1	1.12	-	-	-	-	-	-
Sardinops sagax	-	-	-	-	1	1.23	4	4.40
Citharichthys stigmaeus	1	0.81	-	-	-	-	-	-
Paralabrax spp.	-	-	-	-	-	-	-	-
Hypsopsetta guttulata	2	1.68	-	-	1	1.34	1	1.01
Leptocottus armatus	-	-	-	-	6	6.63	-	-
Gobiesox spp.	-	-	-	-	-	-	3	3.04
Menticirrhus undulatus	-	-	-	-	-	-	-	-
Cheilotrema saturnum	-	-	-	-	-	-	-	-
Blennioidei unid.	-	-	1	1.24	-	-	1	0.94
Citharichthys sordidus	4	3.66	-	-	-	-	1	0.77
Clinocottus analis	-	-	2	2.27	-	-	2	1.74
Xenistius californiensis	-	-	-	-	-	-	-	-
Xystreurys liolepis	-	-	-	-	-	-	-	-
Pleuronichthys ritteri	-	-	-	-	-	-	-	-
Haemulidae unid.	-	-	-	-	-	-	-	-
Sphyraena argentea	-	-	-	-	-	-	-	-
Triphoturus mexicanus	1	0.95	-	-	-	-	-	-
Gobiesocidae unid.	-	-	-	-	-	-	-	-
Clevelandia ios	-	-	-	-	-	-	-	-
Syngnathidae unid.	-	-	-	-	-	-	-	-
Ophidiidae unid.	-	-	-	-	-	-	-	-
Umbrina roncador	-	-	-	-	-	-	-	-
Lepidogobius lepidus	-	-	-	-	1	1.18	-	-
Pleuronichthys spp.	-	-	-	-	-	-	-	-
Atractoscion nobilis	-	-	-	-	-	-	-	-
Pleuronectiformes unid.	-	-	-	-	-	-	-	-
Clinocottus spp.	-	-	1	0.93	-	-	-	-
Citharichthys spp.	1	0.81	-	-	-	-	-	-
Semicossyphus pulcher	-	-	-	-	-	-	-	-
Invertebrates								
Panulirus interruptus	-	-	-	-	-	-	-	-
Cancer antennarius (megalops)	-	-	1	1.22	-	-	-	-
Cancer anthonyi (megalops)	-	-	-	-	-	-	-	-
	852		**1,164**		**653**		**2,522**	

Table E2 (continued). Monthly abundance and mean concentration (#/1,000m^3) of larval fishes and target invertebrates at source water Stations L1-L4 in Agua Hedionda Lagoon.

Survey Number:	11		12		13	
Survey Date:	03/23/05		04/21/05		05/19/05	
Sample Count:	16		16		16	
Taxon	**Count**	**Conc.**	**Count**	**Conc.**	**Count**	**Conc.**
Fishes						
Gobiidae unid.	1,923	1,908.93	2,314	2,455.55	3,980	4,471.69
Hypsoblennius spp.	81	80.32	175	181.27	1,013	1,128.18
Engraulidae unid.	57	55.27	22	22.80	331	356.88
Engraulis mordax	104	98.45	151	155.03	235	264.72
Acanthogobius flavimanus	54	50.65	3	2.95	2	2.12
Labrisomidae unid.	-	-	-	-	1	1.06
Hypsypops rubicundus	-	-	62	63.71	48	58.49
Atherinopsis californiensis	38	37.99	-	-	-	-
Gibbonsia spp.	4	4.30	4	4.07	10	12.22
larval fish fragment	16	15.83	14	14.73	12	13.31
Typhlogobius californiensis	85	84.34	10	10.82	4	5.36
Roncador stearnsi	-	-	1	1.18	-	-
Sciaenidae unid.	7	6.96	6	6.27	6	6.88
Gillichthys mirabilis	5	5.20	3	3.16	-	-
Genyonemus lineatus	2	1.95	12	12.02	1	1.12
Rimicola eigenmanni	-	-	-	-	-	-
Atherinopsidae unid.	6	7.09	7	7.50	5	5.29
Rimicola spp.	-	-	-	-	3	3.09
Syngnathus leptorhynchus	-	-	-	-	-	-
larvae, unidentified yolksac	5	4.69	-	-	4	4.10
Paraclinus integripinnis	-	-	-	-	-	-
Seriphus politus	-	-	-	-	-	-
Atherinops affinis	1	0.81	2	2.23	2	2.27
Quietula y-cauda	-	-	-	-	-	-
Syngnathus spp.	-	-	-	-	-	-
Paralichthys californicus	2	1.92	1	1.18	-	-
larval/post-larval fish unid.	-	-	-	-	-	-
Ilypnus gilberti	-	-	-	-	-	-
Oxyjulis californica	-	-	-	-	-	-
Sardinops sagax	-	-	4	3.93	-	-
Citharichthys stigmaeus	1	1.05	3	2.97	-	-
Paralabrax spp.	-	-	-	-	-	-
Hypsopsetta guttulata	1	0.89	-	-	-	-
Leptocottus armatus	-	-	-	-	-	-
Gobiesox spp.	-	-	-	-	-	-
Menticirrhus undulatus	-	-	-	-	-	-
Cheilotrema saturnum	-	-	-	-	-	-
Blennioidei unid.	-	-	-	-	-	-
Citharichthys sordidus	-	-	-	-	-	-
Clinocottus analis	-	-	-	-	-	-
Xenistius californiensis	-	-	-	-	-	-
Xystreurys liolepis	-	-	-	-	-	-
Pleuronichthys ritteri	-	-	-	-	-	-
Haemulidae unid.	-	-	-	-	-	-
Sphyraena argentea	-	-	-	-	-	-
Triphoturus mexicanus	-	-	-	-	-	-
Gobiesocidae unid.	-	-	-	-	-	-
Clevelandia ios	-	-	-	-	-	-
Syngnathidae unid.	-	-	-	-	-	-
Ophidiidae unid.	-	-	-	-	-	-
Umbrina roncador	-	-	-	-	-	-
Lepidogobius lepidus	-	-	-	-	-	-
Pleuronichthys spp.	-	-	-	-	-	-
Atractoscion nobilis	-	-	1	0.99	-	-
Pleuronectiformes unid.	-	-	1	0.93	-	-
Clinocottus spp.	-	-	-	-	-	-
Citharichthys spp.	-	-	-	-	-	-
Semicossyphus pulcher	-	-	-	-	-	-
Invertebrates						
Panulirus interruptus	-	-	-	-	-	-
Cancer antennarius (megalops)	-	-	-	-	-	-
Cancer anthonyi (megalops)	-	-	-	-	-	-
	2,392		**2,796**		**5,657**	

Table E3. Monthly abundance and mean concentration (#/1,000m^3) of larval fishes and target invertebrates at source water Stations N1-N5 in nearshore area adjacent to EPS.

		Survey Number:			1		2	
		Survey Date:			06/10/04		06/24/04	
		Sample Count:			20		19	
	Taxon	Common Name	Total Count	Mean Conc.	Count	Conc.	Count	Conc.
	Fishes							
1	*Engraulis mordax*	northern anchovy	6,318	423.31	285	211.27	27	24.69
2	*Hypsoblennius* spp.	combtooth blennies	1,959	137.11	936	747.96	325	335.32
3	Engraulidae unid.	anchovies	1,313	102.17	80	54.22	2	1.74
4	Gobiidae unid.	gobies	920	69.06	150	118.83	22	22.51
5	*Genyonemus lineatus*	white croaker	921	64.66	-	-	3	2.82
6	larvae, unidentified yolksac	unid. yolksac larvae	678	45.82	86	68.17	45	40.04
7	*Paralichthys californicus*	California halibut	601	42.91	39	28.28	45	40.90
8	*Seriphus politus*	queenfish	365	23.79	81	59.98	126	109.01
9	Sciaenidae unid.	croaker	306	22.55	52	36.56	17	15.94
10	*Roncador stearnsi*	spotfin croaker	286	20.17	105	84.11	66	63.55
11	*Citharichthys stigmaeus*	speckled sanddab	309	20.01	7	5.17	11	10.03
12	*Gibbonsia* spp.	clinid kelpfishes	277	19.29	36	29.62	5	6.93
13	Labrisomidae unid.	labrisomid kelpfishes	219	16.36	87	73.38	47	48.08
14	*Paralabrax clathratus*	kelp bass	213	14.12	29	20.88	43	36.99
15	*Sardinops sagax*	Pacific sardine	202	13.21	3	1.99	-	-
16	*Paralabrax* spp.	sand bass	159	10.76	12	9.46	8	7.03
17	larval fish fragment	unid. larval fishes	145	10.50	13	9.98	11	9.51
18	Haemulidae unid.	grunts	116	8.80	10	6.71	4	3.34
19	*Scomber japonicus*	Pacific mackerel	110	7.07	32	25.62	9	7.39
20	*Hypsypops rubicundus*	garibaldi	110	7.03	84	66.63	6	5.73
21	larval/post-larval fish unid.	larval fishes	93	6.81	8	5.67	5	4.57
22	*Oxyjulis californica*	senorita	79	5.55	12	8.05	2	1.98
23	*Paralabrax nebulifer*	barred sand bass	82	5.08	-	-	2	1.67
24	*Sphyraena argentea*	California barracuda	59	3.74	8	6.51	8	6.60
25	*Xenistius californiensis*	salema	55	3.61	-	-	31	25.82
26	*Lepidogobius lepidus*	bay goby	56	3.59	-	-	-	-
27	*Stenobrachius leucopsarus*	northern lampfish	51	3.26	-	-	-	-
28	*Pleuronichthys verticalis*	hornyhead turbot	43	2.79	-	-	3	2.56
29	*Atherinopsis californiensis*	jacksmelt	35	2.78	-	-	-	-
30	*Umbrina roncador*	yellowfin croaker	39	2.62	1	0.71	24	21.89
31	*Pleuronichthys ritteri*	spotted turbot	34	2.51	-	-	-	-
32	*Xystreurys liolepis*	fantail sole	27	1.97	-	-	-	-
33	*Hypsopsetta guttulata*	diamond turbot	30	1.97	-	-	-	-
34	*Rimicola* spp.	kelp clingfishes	22	1.79	-	-	-	-
35	*Peprilus simillimus*	Pacific butterfish	28	1.78	-	-	15	12.77
36	*Cheilotrema saturnum*	black croaker	24	1.71	6	4.76	4	3.79
37	*Semicossyphus pulcher*	California sheephead	21	1.49	6	4.23	-	-
38	*Ophidion scrippsae*	basketweave cusk-eel	22	1.48	-	-	-	-
39	*Diaphus theta*	California headlight fish	24	1.46	1	0.76	1	0.83
40	*Acanthogobius flavimanus*	yellowfin goby	22	1.46	-	-	-	-
41	*Pleuronichthys* spp.	turbots	19	1.30	-	-	1	0.83
42	Pleuronectiformes unid.	flatfishes	21	1.25	-	-	-	-
43	*Menticirrhus undulatus*	California corbina	16	1.21	4	3.04	4	4.05
44	*Atractoscion nobilis*	white seabass	18	1.18	2	1.48	9	8.43
45	Ophidiidae unid.	cusk-eels	15	1.14	-	-	-	-
46	*Sebastes* spp.	rockfishes	18	1.09	-	-	-	-
47	*Girella nigricans*	opaleye	16	1.06	2	1.36	1	0.80
48	*Typhlogobius californiensis*	blind goby	15	0.99	4	3.24	1	0.81
49	*Citharichthys sordidus*	Pacific sanddab	16	0.99	-	-	1	0.83
50	Pleuronectidae unid.	flounders	16	0.98	-	-	-	-
51	*Trachurus symmetricus*	jack mackerel	17	0.96	13	9.40	-	-
52	*Halichoeres semicinctus*	rock wrasse	15	0.95	-	-	-	-
53	*Syngnathus* spp.	pipefishes	10	0.84	-	-	1	0.81
54	Labridae	wrasses	11	0.83	-	-	-	-

Table E3 (continued). Monthly abundance and mean concentration (#/1,000m^3) of larval fishes and target invertebrates at source water Stations N1-N5 in nearshore area adjacent to EPS.

		Survey Number:			1		2	
		Survey Date:			06/10/04		06/24/04	
		Sample Count:			20		19	
	Taxon	Common Name	Total Count	Mean Conc.	Count	Conc.	Count	Conc.
	Fishes							
55	*Paraclinus integripinnis*	reef finspot	14	0.81	7	4.25	-	-
56	*Symphurus atricauda*	California tonguefish	11	0.77	-	-	-	-
57	*Triphoturus mexicanus*	Mexican lampfish	12	0.73	-	-	1	0.83
58	*Citharichthys* spp.	sanddabs	9	0.70	-	-	1	0.83
59	*Nannobrachium* spp.	lanternfishes	9	0.57	-	-	-	-
60	*Medialuna californiensis*	halfmoon	7	0.53	2	1.69	-	-
61	*Gillichthys mirabilis*	longjaw mudsucker	8	0.51	-	-	-	-
62	*Chilara taylori*	spotted cusk-eel	7	0.50	-	-	-	-
63	*Heterostichus rostratus*	giant kelpfish	7	0.50	1	1.00	1	1.39
64	*Hypsoblennius jenkinsi*	mussel blenny	7	0.46	-	-	-	-
65	Paralichthyidae unid.	lefteye flounders & sandd	7	0.44	-	-	-	-
66	Atherinopsidae	silverside	4	0.31	-	-	-	-
67	*Parophrys vetulus*	English sole	5	0.30	-	-	-	-
68	Myctophidae unid.	lanternfishes	4	0.30	-	-	-	-
69	*Hippoglossina stomata*	bigmouth sole	5	0.29	-	-	-	-
70	*Zaniolepis frenata*	shortspine combfish	5	0.25	-	-	-	-
71	*Ruscarius creaseri*	rouchcheek sculpin	3	0.22	-	-	-	-
72	Clupeiformes	herrings and anchovies	3	0.21	2	1.92	-	-
73	*Syngnathus leptorhynchus*	bay pipefish	3	0.18	3	2.37	-	-
74	Clupeidae unid.	herrings	3	0.18	-	-	-	-
75	*Lyopsetta exilis*	slender sole	3	0.16	-	-	-	-
76	Pomacentridae	damselfishes	2	0.14	-	-	-	-
77	*Rhinogobiops nicholsi*	blackeye goby	2	0.14	-	-	-	-
78	*Nannobrachium ritteri*	broadfin lampfish	2	0.13	-	-	-	-
79	*Cyclothone* spp.	bristlemouths	2	0.13	-	-	-	-
80	*Chromis punctipinnis*	blacksmith	2	0.13	-	-	-	-
81	*Icelinus* spp.	sculpins	3	0.13	-	-	-	-
82	Gobiesocidae unid.	clingfishes	2	0.12	1	0.88	-	-
83	*Anisotremus davidsonil*	sargo	2	0.12	-	-	-	-
84	*Sebastes jordani*	shortbelly rockfish	2	0.10	-	-	-	-
85	Blennioidei	blennies	1	0.08	-	-	-	-
86	Clinidae unid.	clinid kelpfishes	1	0.08	1	1.00	-	-
87	Chaenopsidae unid.	tube blennies	1	0.07	-	-	-	-
88	*Leptocottus armatus*	Pacific staghorn sculpin	1	0.07	-	-	-	-
89	Cynoglossidae	tongue soles	1	0.07	-	-	-	-
90	Kyphosidae	sea chubs	1	0.07	-	-	-	-
91	*Cyclothone acclinidens*	bent tooth bristlemouth	1	0.07	-	-	-	-
92	*Ilypnus gilberti*	cheekspot goby	1	0.06	-	-	-	-
93	*Gobiesox* spp.	clingfishes	1	0.06	-	-	-	-
94	Hexagrammidae unid.	greenlings	1	0.06	-	-	-	-
95	*Bathylagus ochotensis*	popeye blacksmelt	1	0.06	-	-	-	-
96	*Hypsoblennius gentilis*	bay blenny	1	0.05	1	0.64	-	-
	Invertebrates							
	Panulirus interruptus (larvae)	California spiny lobster	98	7.04	1	0.82	71	64.80
	Cancer anthonyi (megalops)	yellow crab	80	4.74	-	-	2	2.38
	Cancer antennarius (megalops)	brown rock crab	71	4.11	-	-	3	3.15
	Cancer gracilis (megalops)	slender crab	48	2.93	2	1.35	-	-
	Cancer spp. (megalops)	cancer crabs	4	0.23	-	-	-	-
	Cancer productus (megalops)	red rock crab	3	0.22	-	-	-	-
		Totals:	17,067		40,384		39,197	

Table E3 (continued). Monthly abundance and mean concentration (#/1,000m^3) of larval fishes and target invertebrates at source water Stations N1-N5 in nearshore area adjacent to EPS.

	3		4		5		6	
	07/06/04		08/13/04		09/23/04		10/21/04	
	20		20		20		20	
Taxon	**Count**	**Conc.**	**Count**	**Conc.**	**Count**	**Conc.**	**Count**	**Conc.**
Fishes								
Engraulis mordax	214	168.35	73	62.19	204	167.31	94	81.59
Hypsoblennius spp.	183	181.20	234	255.74	64	66.94	1	0.90
Engraulidae unid.	24	19.48	-	-	3	2.95	8	9.23
Gobiidae unid.	86	82.38	154	190.83	48	52.35	44	48.00
Genyonemus lineatus	13	10.58	12	14.77	300	280.83	33	25.28
larvae, unidentified yolksac	347	291.29	72	75.56	60	58.18	16	15.29
Paralichthys californicus	194	173.39	37	38.97	170	171.01	32	30.06
Seriphus politus	50	42.17	8	6.62	97	88.33	2	1.94
Sciaenidae unid.	102	99.70	25	28.73	39	38.37	6	4.90
Roncador stearnsi	52	47.53	10	10.18	53	56.79	-	-
Citharichthys stigmaeus	16	14.03	5	4.29	158	124.03	93	85.55
Gibbonsia spp.	4	4.35	3	3.96	2	2.46	11	11.57
Labrisomidae unid.	46	46.77	22	27.32	15	15.46	1	0.90
Paralabrax clathratus	34	27.63	2	1.75	105	96.31	-	-
Sardinops sagax	9	8.07	5	4.93	25	22.04	3	2.47
Paralabrax spp.	50	40.52	31	29.86	55	50.38	2	1.92
larval fish fragment	41	35.90	16	19.10	29	30.59	6	5.77
Haemulidae unid.	5	4.12	4	2.79	91	95.77	2	1.68
Scomber japonicus	39	30.95	-	-	29	27.04	1	0.89
Hypsypops rubicundus	13	11.43	1	1.32	-	-	-	-
larval/post-larval fish unid.	39	34.86	14	17.27	16	16.26	6	5.81
Oxyjulis californica	17	15.21	16	16.22	17	17.56	9	7.70
Paralabrax nebulifer	-	-	-	-	80	64.38	-	-
Sphyraena argentea	27	20.12	9	8.12	7	7.31	-	-
Xenistius californiensis	-	-	2	1.90	22	19.24	-	-
Lepidogobius lepidus	-	-	1	1.18	3	2.32	-	-
Stenobrachius leucopsarus	-	-	-	-	-	-	-	-
Pleuronichthys verticalis	10	7.29	3	3.18	18	15.33	2	1.69
Atherinopsis californiensis	-	-	-	-	-	-	-	-
Umbrina roncador	14	11.41	-	-	-	-	-	-
Pleuronichthys ritteri	4	3.41	5	5.87	15	14.28	6	5.25
Xystreurys liolepis	12	11.12	1	1.14	9	9.07	3	2.82
Hypsopsetta guttulata	-	-	2	1.93	8	7.31	6	4.26
Rimicola spp.	2	1.96	-	-	12	13.28	3	3.20
Peprilus simillimus	6	4.66	-	-	4	3.42	-	-
Cheilotrema saturnum	10	9.25	1	0.80	3	3.60	-	-
Semicossyphus pulcher	1	1.05	3	2.95	8	8.18	2	2.27
Ophidion scrippsae	-	-	6	6.04	11	8.98	4	3.21
Diaphus theta	1	0.81	-	-	3	2.41	1	0.89
Acanthogobius flavimanus	-	-	-	-	-	-	-	-
Pleuronichthys spp.	1	0.52	1	1.14	11	9.76	3	3.18
Pleuronectiformes unid.	-	-	-	-	1	0.78	5	3.67
Menticirrhus undulatus	-	-	2	2.14	6	6.54	-	-
Atractoscion nobilis	5	3.58	-	-	-	-	-	-
Ophidiidae unid.	-	-	1	0.93	5	5.38	8	7.74
Sebastes spp.	-	-	1	1.14	2	1.85	-	-
Girella nigricans	-	-	-	-	3	2.62	6	5.49
Typhlogobius californiensis	-	-	1	0.60	-	-	-	-
Citharichthys sordidus	-	-	-	-	2	1.53	2	1.89
Pleuronectidae unid.	-	-	-	-	1	0.76	-	-
Trachurus symmetricus	-	-	-	-	-	-	2	1.76
Halichoeres semicinctus	1	0.81	-	-	10	8.07	4	3.52
Syngnathus spp.	-	-	6	7.95	1	0.78	-	-
Labridae	7	6.83	1	1.34	-	-	1	0.68

Table E3 (continued). Monthly abundance and mean concentration (#/1,000m^3) of larval fishes and target invertebrates at source water Stations N1-N5 in nearshore area adjacent to EPS.

	3		**4**		**5**		**6**	
	07/06/04		**08/13/04**		**09/23/04**		**10/21/04**	
	20		**20**		**20**		**20**	
Taxon	**Count**	**Conc.**	**Count**	**Conc.**	**Count**	**Conc.**	**Count**	**Conc.**
Fishes								
Paraclinus integripinnis	-	-	7	6.28	-	-	-	-
Symphurus atricauda	-	-	-	-	10	8.81	1	1.23
Triphoturus mexicanus	-	-	1	0.60	6	5.23	2	1.30
Citharichthys spp.	-	-	1	1.14	-	-	3	3.36
Nannobrachium spp.	-	-	-	-	-	-	-	-
Medialuna californiensis	-	-	4	4.48	-	-	1	0.68
Gillichthys mirabilis	-	-	-	-	-	-	-	-
Chilara taylori	-	-	-	-	-	-	6	5.72
Heterostichus rostratus	-	-	-	-	-	-	-	-
Hypsoblennius jenkinsi	-	-	1	0.70	5	4.55	1	0.68
Paralichthyidae unid.	2	1.04	-	-	1	1.11	-	-
Atherinopsidae	-	-	-	-	-	-	-	-
Parophrys vetulus	-	-	-	-	-	-	-	-
Myctophidae unid.	1	1.21	-	-	1	0.75	-	-
Hippoglossina stomata	-	-	1	0.78	2	1.52	-	-
Zaniolepis frenata	-	-	-	-	-	-	-	-
Ruscarius creaseri	-	-	-	-	-	-	-	-
Clupeiformes	-	-	-	-	-	-	-	-
Syngnathus leptorhynchus	-	-	-	-	-	-	-	-
Clupeidae unid.	1	0.71	-	-	-	-	1	0.89
Lyopsetta exilis	-	-	-	-	-	-	-	-
Pomacentridae	-	-	1	0.97	-	-	1	0.90
Rhinogobiops nicholsi	-	-	-	-	1	1.01	-	-
Nannobrachium ritteri	-	-	-	-	-	-	-	-
Cyclothone spp.	-	-	-	-	1	0.77	-	-
Chromis punctipinnis	-	-	-	-	-	-	1	0.83
Icelinus spp.	-	-	-	-	-	-	-	-
Gobiesocidae unid.	-	-	-	-	-	-	-	-
Anisotremus davidsonii	1	0.67	-	-	1	0.90	-	-
Sebastes jordani	-	-	-	-	-	-	-	-
Blennioidei	1	1.05	-	-	-	-	-	-
Clinidae unid.	-	-	-	-	-	-	-	-
Chaenopsidae unid.	-	-	-	-	-	-	-	-
Leptocottus armatus	-	-	-	-	-	-	-	-
Cynoglossidae	-	-	-	-	-	-	1	0.89
Kyphosidae	-	-	-	-	-	-	1	0.89
Cyclothone acclinidens	-	-	-	-	-	-	-	-
Ilypnus gilberti	-	-	-	-	-	-	-	-
Gobiesox spp.	-	-	-	-	-	-	-	-
Hexagrammidae unid.	-	-	-	-	1	0.75	-	-
Bathylagus ochotensis	-	-	-	-	-	-	-	-
Hypsoblennius gentilis	-	-	-	-	-	-	-	-
Invertebrates								
Panulirus interruptus	19	18.79	5	5.56	2	1.49	-	-
Cancer anthonyi (megalops)	29	22.66	17	11.75	16	12.25	1	0.63
Cancer antennarius (megalops)	1	0.67	50	35.14	4	3.35	2	2.08
Cancer gracilis (megalops)	-	-	33	26.49	6	4.92	-	-
Cancer spp. (megalops)	-	-	4	2.93	-	-	-	-
Cancer productus (megalops)	-	-	1	1.32	-	-	-	-
	39,931		**39,152**	**959**	**40,160**		**38,757**	

Table E3 (continued). Monthly abundance and mean concentration (#/1,000m^3) of larval fishes and target invertebrates at source water Stations N1-N5 in nearshore area adjacent to EPS.

	7		8		9		10	
	11/18/04		12/16/04		01/13/05		02/24/05	
	20		20		20		20	
Taxon	**Count**	**Conc.**	**Count**	**Conc.**	**Count**	**Conc.**	**Count**	**Conc.**
Fishes								
Engraulis mordax	153	122.98	2	1.47	43	35.34	82	68.40
Hypsoblennius spp.	10	8.40	1	0.76	-	-	-	-
Engraulidae unid.	-	-	-	-	11	10.07	2	1.62
Gobiidae unid.	22	17.02	21	17.62	38	33.74	125	118.27
Genyonemus lineatus	78	63.14	8	6.99	46	38.44	143	124.31
larvae, unidentified yolksac	1	0.76	-	-	8	6.08	11	9.22
Paralichthys californicus	11	8.76	3	2.80	5	4.30	20	17.53
Seriphus politus	-	-	-	-	-	-	-	-
Sciaenidae unid.	1	0.67	-	-	6	5.75	3	3.04
Roncador stearnsi	-	-	-	-	-	-	-	-
Citharichthys stigmaeus	12	10.73	2	1.75	-	-	1	0.67
Gibbonsia spp.	6	5.19	40	32.33	61	57.65	52	48.45
Labrisomidae unid.	-	-	-	-	-	-	-	-
Paralabrax clathratus	-	-	-	-	-	-	-	-
Sardinops sagax	5	4.12	-	-	-	-	34	26.67
Paralabrax spp.	-	-	-	-	-	-	-	-
larval fish fragment	7	6.37	1	0.89	2	1.69	4	3.60
Haemulidae unid.	-	-	-	-	-	-	-	-
Scomber japonicus	-	-	-	-	-	-	-	-
Hypsypops rubicundus	-	-	-	-	-	-	-	-
larval/post-larval fish unid.	-	-	-	-	2	1.90	-	-
Oxyjulis californica	-	-	-	-	1	0.81	-	-
Paralabrax nebulifer	-	-	-	-	-	-	-	-
Sphyraena argentea	-	-	-	-	-	-	-	-
Xenistius californiensis	-	-	-	-	-	-	-	-
Lepidogobius lepidus	13	9.84	4	4.20	20	16.88	4	3.75
Stenobrachius leucopsarus	-	-	-	-	41	34.59	-	-
Pleuronichthys verticalis	1	1.08	-	-	-	-	-	-
Atherinopsis californiensis	-	-	3	2.10	10	9.29	7	6.78
Umbrina roncador	-	-	-	-	-	-	-	-
Pleuronichthys ritteri	-	-	-	-	2	1.77	-	-
Xystreurys liolepis	1	0.77	-	-	-	-	-	-
Hypsopsetta guttulata	2	1.51	1	1.05	8	6.75	2	1.60
Rimicola spp.	-	-	1	1.05	3	2.59	1	1.15
Peprilus simillimus	-	-	-	-	-	-	-	-
Cheilotrema saturnum	-	-	-	-	-	-	-	-
Semicossyphus pulcher	-	-	-	-	-	-	-	-
Ophidion scrippsae	1	0.95	-	-	-	-	-	-
Diaphus theta	-	-	-	-	-	-	-	-
Acanthogobius flavimanus	-	-	-	-	11	8.45	8	8.00
Pleuronichthys spp.	-	-	-	-	-	-	-	-
Pleuronectiformes unid.	10	7.45	-	-	-	-	-	-
Menticirrhus undulatus	-	-	-	-	-	-	-	-
Atractoscion nobilis	-	-	-	-	-	-	-	-
Ophidiidae unid.	1	0.76	-	-	-	-	-	-
Sebastes spp.	7	5.29	6	4.35	-	-	-	-
Girella nigricans	4	3.47	-	-	-	-	-	-
Typhlogobius californiensis	-	-	-	-	-	-	2	1.80
Citharichthys sordidus	9	7.31	-	-	-	-	-	-
Pleuronectidae unid.	1	0.88	-	-	-	-	-	-
Trachurus symmetricus	-	-	-	-	-	-	-	-
Halichoeres semicinctus	-	-	-	-	-	-	-	-
Syngnathus spp.	-	-	1	0.74	1	0.66	-	-
Labridae	-	-	-	-	-	-	-	-

Table E3 (continued). Monthly abundance and mean concentration (#/1,000m^3) of larval fishes and target invertebrates at source water Stations N1-N5 in nearshore area adjacent to EPS.

	7		**8**		**9**		**10**	
	11/18/04		**12/16/04**		**01/13/05**		**02/24/05**	
	20		**20**		**20**		**20**	
Taxon	**Count**	**Conc.**	**Count**	**Conc.**	**Count**	**Conc.**	**Count**	**Conc.**
Fishes								
Paraclinus integripinnis	-	-	-	-	-	-	-	-
Symphurus atricauda	-	-	-	-	-	-	-	-
Triphoturus mexicanus	2	1.54	-	-	-	-	-	-
Citharichthys spp.	-	-	1	0.89	2	1.60	-	-
Nannobrachium spp.	1	0.76	1	0.84	4	3.51	1	0.90
Medialuna californiensis	-	-	-	-	-	-	-	-
Gillichthys mirabilis	-	-	1	0.72	4	3.37	3	2.59
Chilara taylori	1	0.81	-	-	-	-	-	-
Heterostichus rostratus	2	1.83	1	0.88	2	1.35	-	-
Hypsoblennius jenkinsi	-	-	-	-	-	-	-	-
Paralichthyidae unid.	2	1.95	-	-	1	1.01	1	0.61
Atherinopsidae	1	0.84	-	-	-	-	-	-
Parophrys vetulus	-	-	-	-	-	-	-	-
Myctophidae unid.	-	-	-	-	1	0.96	-	-
Hippoglossina stomata	2	1.49	-	-	-	-	-	-
Zaniolepis frenata	-	-	1	0.64	2	1.33	1	0.70
Ruscarius creaseri	-	-	-	-	1	0.68	-	-
Clupeiformes	-	-	-	-	-	-	1	0.78
Syngnathus leptorhynchus	-	-	-	-	-	-	-	-
Clupeidae unid.	-	-	-	-	-	-	1	0.67
Lyopsetta exilis	-	-	-	-	-	-	-	-
Pomacentridae	-	-	-	-	-	-	-	-
Rhinogobiops nicholsi	1	0.85	-	-	-	-	-	-
Nannobrachium ritteri	2	1.75	-	-	-	-	-	-
Cyclothone spp.	-	-	-	-	-	-	1	0.90
Chromis punctipinnis	1	0.82	-	-	-	-	-	-
Icelinus spp.	-	-	-	-	-	-	-	-
Gobiesocidae unid.	-	-	1	0.72	-	-	-	-
Anisotremus davidsonil	-	-	-	-	-	-	-	-
Sebastes jordani	-	-	-	-	2	1.33	-	-
Blennioidei	-	-	-	-	-	-	-	-
Clinidae unid.	-	-	-	-	-	-	-	-
Chaenopsidae unid.	-	-	-	-	-	-	1	0.97
Leptocottus armatus	-	-	-	-	-	-	1	0.90
Cynoglossidae	-	-	-	-	-	-	-	-
Kyphosidae	-	-	-	-	-	-	-	-
Cyclothone acclinidens	1	0.85	-	-	-	-	-	-
Ilypnus gilberti	-	-	1	0.84	-	-	-	-
Gobiesox spp.	-	-	-	-	-	-	-	-
Hexagrammidae unid.	-	-	-	-	-	-	-	-
Bathylagus ochotensis	-	-	-	-	-	-	-	-
Hypsoblennius gentilis	-	-	-	-	-	-	-	-
Invertebrates								
Panulirus interruptus	-	-	-	-	-	-	-	-
Cancer anthonyi (megalops)	8	5.93	2	1.26	3	2.96	1	1.01
Cancer antennarius (megalops)	4	2.91	1	1.12	-	-	-	-
Cancer gracilis (megalops)	2	1.44	2	1.73	1	1.05	-	-
Cancer spp. (megalops)	-	-	-	-	-	-	-	-
Cancer productus (megalops)	-	-	-	-	-	-	-	-
	38,722		**38,471**		**38,736**		**38,950**	

Table E3 (continued). Monthly abundance and mean concentration (#/1,000m^3) of larval fishes and target invertebrates at source water Stations N1-N5 in nearshore area adjacent to EPS.

	11		**12**		**13**	
	03/23/05		**04/21/05**		**05/19/05**	
	15		**20**		**20**	
Taxon	**Count**	**Conc.**	**Count**	**Conc.**	**Count**	**Conc.**
Fishes						
Engraulis mordax	1,767	1,805.85	3,356	2,740.48	18	13.11
Hypsoblennius spp.	3	3.31	11	8.69	191	173.15
Engraulidae unid.	1,163	1,211.29	10	8.62	10	8.93
Gobiidae unid.	98	99.04	21	20.98	91	76.18
Genyonemus lineatus	234	235.43	45	33.43	6	4.54
larvae, unidentified yolksac	19	20.47	2	1.58	11	9.07
Paralichthys californicus	28	27.91	11	9.12	6	4.78
Seriphus politus	-	-	1	1.22	-	-
Sciaenidae unid.	38	44.51	6	5.95	11	9.01
Roncador stearnsi	-	-	-	-	-	-
Citharichthys stigmaeus	2	1.93	2	2.00	-	-
Gibbonsia spp.	15	15.39	2	2.29	40	30.54
Labrisomidae unid.	-	-	1	0.74	-	-
Paralabrax clathratus	-	-	-	-	-	-
Sardinops sagax	-	-	118	101.46	-	-
Paralabrax spp.	-	-	1	0.69	-	-
larval fish fragment	5	5.02	8	6.78	2	1.32
Haemulidae unid.	-	-	-	-	-	-
Scomber japonicus	-	-	-	-	-	-
Hypsypops rubicundus	-	-	1	0.94	5	5.36
larval/post-larval fish unid.	-	-	2	1.69	1	0.55
Oxyjulis californica	1	1.20	4	3.35	-	-
Paralabrax nebulifer	-	-	-	-	-	-
Sphyraena argentea	-	-	-	-	-	-
Xenistius californiensis	-	-	-	-	-	-
Lepidogobius lepidus	3	2.73	2	1.99	6	3.84
Stenobrachius leucopsarus	-	-	10	7.78	-	-
Pleuronichthys verticalis	4	3.45	2	1.74	-	-
Atherinopsis californiensis	15	17.97	-	-	-	-
Umbrina roncador	-	-	-	-	-	-
Pleuronichthys ritteri	1	1.34	1	0.74	-	-
Xystreurys liolepis	-	-	-	-	1	0.75
Hypsopsetta guttulata	1	1.20	-	-	-	-
Rimicola spp.	-	-	-	-	-	-
Peprilus simillimus	-	-	3	2.33	-	-
Cheilotrema saturnum	-	-	-	-	-	-
Semicossyphus pulcher	-	-	-	-	1	0.75
Ophidion scrippsae	-	-	-	-	-	-
Diaphus theta	-	-	13	10.38	4	2.94
Acanthogobius flavimanus	3	2.58	-	-	-	-
Pleuronichthys spp.	-	-	1	0.74	1	0.75
Pleuronectiformes unid.	-	-	3	1.94	2	2.42
Menticirrhus undulatus	-	-	-	-	-	-
Atractoscion nobilis	-	-	2	1.91	-	-
Ophidiidae unid.	-	-	-	-	-	-
Sebastes spp.	-	-	1	0.77	1	0.75
Girella nigricans	-	-	-	-	-	-
Typhlogobius californiensis	2	1.94	2	2.17	3	2.30
Citharichthys sordidus	-	-	2	1.29	-	-
Pleuronectidae unid.	1	0.93	13	10.21	-	-
Trachurus symmetricus	-	-	2	1.38	-	-
Halichoeres semicinctus	-	-	-	-	-	-
Syngnathus spp.	-	-	-	-	-	-
Labridae	-	-	2	1.88	-	-

Table E3 (continued). Monthly abundance and mean concentration (#/1,000m^3) of larval fishes and target invertebrates at source water Stations N1-N5 in nearshore area adjacent to EPS.

	11		12		13	
	03/23/05		04/21/05		05/19/05	
	15		20		20	
Taxon	**Count**	**Conc.**	**Count**	**Conc.**	**Count**	**Conc.**
Fishes						
Paraclinus integripinnis	-	-	-	-	-	-
Symphurus atricauda	-	-	-	-	-	-
Triphoturus mexicanus	-	-	-	-	-	-
Citharichthys spp.	-	-	-	-	1	1.24
Nannobrachium spp.	-	-	1	0.65	1	0.75
Medialuna californiensis	-	-	-	-	-	-
Gillichthys mirabilis	-	-	-	-	-	-
Chilara taylori	-	-	-	-	-	-
Heterostichus rostratus	-	-	-	-	-	-
Hypsoblennius jenkinsi	-	-	-	-	-	-
Paralichthyidae unid.	-	-	-	-	-	-
Atherinopsidae	3	3.21	-	-	-	-
Parophrys vetulus	-	-	5	3.93	-	-
Myctophidae unid.	-	-	1	0.94	-	-
Hippoglossina stomata	-	-	-	-	-	-
Zaniolepis frenata	-	-	-	-	1	0.55
Ruscarius creaseri	2	2.15	-	-	-	-
Clupeiformes	-	-	-	-	-	-
Syngnathus leptorhynchus	-	-	-	-	-	-
Clupeidae unid.	-	-	-	-	-	-
Lyopsetta exilis	-	-	3	2.04	-	-
Pomacentridae	-	-	-	-	-	-
Rhinogobiops nicholsi	-	-	-	-	-	-
Nannobrachium ritteri	-	-	-	-	-	-
Cyclothone spp.	-	-	-	-	-	-
Chromis punctipinnis	-	-	-	-	-	-
Icelinus spp.	-	-	-	-	3	1.65
Gobiesocidae unid.	-	-	-	-	-	-
Anisotremus davidsonil	-	-	-	-	-	-
Sebastes jordani	-	-	-	-	-	-
Blennioidei	-	-	-	-	-	-
Clinidae unid.	-	-	-	-	-	-
Chaenopsidae unid.	-	-	-	-	-	-
Leptocottus armatus	-	-	-	-	-	-
Cynoglossidae	-	-	-	-	-	-
Kyphosidae	-	-	-	-	-	-
Cyclothone acclinidens	-	-	-	-	-	-
Ilypnus gilberti	-	-	-	-	-	-
Gobiesox spp.	-	-	-	-	1	0.75
Hexagrammidae unid.	-	-	-	-	-	-
Bathylagus ochotensis	-	-	1	0.75	-	-
Hypsoblennius gentilis	-	-	-	-	-	-
Invertebrates						
Panulirus interruptus	-	-	-	-	-	-
Cancer anthonyi (megalops)	-	-	-	-	1	0.77
Cancer antennarius (megalops)	-	-	-	-	6	4.99
Cancer gracilis (megalops)	-	-	-	-	2	1.10
Cancer spp. (megalops)	-	-	-	-	-	-
Cancer productus (megalops)	-	-	-	-	2	1.54
	41,868		**42,167**		**38,953**	

Appendix F

Modeling Results for Entrainment

F1 – Calculated Entrainment by Survey for Selected Species

F2 – *AEL* Modeling Results

F3 – *FH* Modeling Results

Table F1-1. Estimated monthly entrainment of larval Engraulidae based on actual and maximum circulating water pump flows at EPS.

Engraulidae Survey	Date	Actual Average Daily Flow	Actual Average Daily Entrainment	Actual Average Daily Variance	Actual Period Total Flow	Actual Period Entrainment	Actual Period Std. Error
EPSEA001	6/1/2004	2,684,966	47,963	75,843	42,959,457	767,413	303,371
EPSEA002	6/17/2004	2,612,081	13,453	27,085	33,957,052	174,892	97,656
EPSEA003	6/30/2004	2,673,312	163,227	212,123	66,832,808	4,080,666	1,060,614
EPSEA004	7/25/2004	2,795,888	31,995	64,433	111,835,525	1,279,783	407,509
EPSEA005	9/3/2004	3,001,341	13,665	15,871	102,045,587	464,596	92,542
EPSEA006	10/7/2004	1,972,581	8,745	10,348	55,232,277	244,867	54,757
EPSEA007	11/4/2004	2,048,287	98,410	178,387	57,352,032	2,755,494	943,937
EPSEA008	12/2/2004	2,621,271	0	0	73,395,577	0	0
EPSEA009	12/30/2004	1,839,003	4,092	8,853	64,365,098	143,212	52,374
EPSEA010	2/3/2005	1,959,696	100,058	123,083	68,589,345	3,502,014	728,168
EPSEA011	3/10/2005	2,191,468	707,505	920,025	61,361,101	19,810,147	4,868,313
EPSEA012	4/7/2005	2,763,761	1,854,426	2,131,363	77,385,295	51,923,915	11,278,115
EPSEA013	5/5/2005	2,408,779	1,315,337	816,024	65,037,024	35,514,087	4,240,184
					Totals ->	**120,661,087**	**13,103,572**

Engraulidae Survey	Date	Maximum Average Daily Flow	Maximum Average Daily Entrainment	Maximum Average Daily Variance	Maximum Period Total Flow	Maximum Period Entrainment	Maximum Period Std. Error
EPSEA001	6/1/2004	3,244,431	57,957	91,183	51,910,896	927,319	364,730
EPSEA002	6/17/2004	3,244,431	16,710	33,420	42,177,603	217,231	120,498
EPSEA003	6/30/2004	3,244,431	198,098	253,861	81,110,775	4,952,448	1,269,305
EPSEA004	7/25/2004	3,244,431	37,127	74,255	129,777,240	1,485,098	469,629
EPSEA005	9/3/2004	3,244,431	14,771	17,090	110,310,654	502,226	99,653
EPSEA006	10/7/2004	3,244,431	14,384	16,627	90,844,068	402,749	87,980
EPSEA007	11/4/2004	3,244,431	155,880	277,135	90,844,068	4,364,627	1,466,459
EPSEA008	12/2/2004	3,244,431	0	0	90,844,068	0	0
EPSEA009	12/30/2004	3,244,431	7,219	14,438	113,555,085	252,659	85,414
EPSEA010	2/3/2005	3,244,431	165,653	198,594	113,555,085	5,797,862	1,174,897
EPSEA011	3/10/2005	3,244,431	1,047,449	1,330,856	90,844,068	29,328,585	7,042,227
EPSEA012	4/7/2005	3,244,431	2,176,945	2,498,081	90,844,068	60,954,471	13,218,604
EPSEA013	5/5/2005	3,244,431	1,771,652	1,095,732	87,599,637	47,834,617	5,693,592
					Totals ->	**157,019,892**	**16,194,954**

Table F1-2. Estimated monthly entrainment of larval *Genyonemus lineatus* based on actual and maximum circulating water pump flows at EPS.

Genyonemus lineatus Survey	Date	Actual Average Daily Flow	Actual Average Daily Entrainment	Actual Average Daily Variance	Actual Period Total Flow	Actual Period Entrainment	Actual Period Std. Error
EPSEA001	6/1/2004	2,527,027	0	0	42,959,457	0	0
EPSEA002	6/17/2004	2,612,081	0	0	33,957,052	0	0
EPSEA003	6/30/2004	2,673,312	0	0	66,832,808	0	0
EPSEA004	7/25/2004	2,795,888	5,408	10,892	111,835,525	216,333	68,885
EPSEA005	9/3/2004	3,001,341	49,790	76,065	102,045,587	1,692,854	443,531
EPSEA006	10/7/2004	1,972,581	0	0	55,232,277	0	0
EPSEA007	11/4/2004	2,048,287	16,212	33,060	57,352,032	453,950	174,936
EPSEA008	12/2/2004	2,621,271	6,468	13,217	73,395,577	181,098	69,940
EPSEA009	12/30/2004	1,839,003	11,950	16,202	64,365,098	418,248	95,854
EPSEA010	2/3/2005	1,959,696	52,266	33,958	68,589,345	1,829,300	200,898
EPSEA011	3/10/2005	2,191,468	20,111	31,062	61,361,101	563,099	164,363
EPSEA012	4/7/2005	2,763,761	56,057	58,973	77,385,295	1,569,588	312,058
EPSEA013	5/5/2005	2,417,371	0	0	67,686,388	0	0
					Totals ->	**6,924,470**	**641,017**

Genyonemus lineatus Survey	Date	Maximum Average Daily Flow	Maximum Average Daily Entrainment	Maximum Average Daily Variance	Maximum Period Total Flow	Maximum Period Entrainment	Maximum Period Std. Error
EPSEA001	6/1/2004	3,244,431	0	0	55,155,327	0	0
EPSEA002	6/17/2004	3,244,431	0	0	42,177,603	0	0
EPSEA003	6/30/2004	3,244,431	0	0	81,110,775	0	0
EPSEA004	7/25/2004	3,244,431	6,276	12,552	129,777,240	251,039	79,386
EPSEA005	9/3/2004	3,244,431	53,822	81,909	110,310,654	1,829,965	477,608
EPSEA006	10/7/2004	3,244,431	0	0	90,844,068	0	0
EPSEA007	11/4/2004	3,244,431	25,680	51,360	90,844,068	719,044	271,773
EPSEA008	12/2/2004	3,244,431	8,005	16,011	90,844,068	224,151	84,721
EPSEA009	12/30/2004	3,244,431	21,082	26,424	113,555,085	737,887	156,324
EPSEA010	2/3/2005	3,244,431	86,530	54,791	113,555,085	3,028,551	324,148
EPSEA011	3/10/2005	3,244,431	29,774	44,932	90,844,068	833,658	237,759
EPSEA012	4/7/2005	3,244,431	65,806	69,120	90,844,068	1,842,569	365,750
EPSEA013	5/5/2005	3,244,431	0	0	90,844,068	0	0
					Totals ->	**9,466,865**	**797,033**

Table F1-3. Estimated monthly entrainment of larval Gobiidae based on actual and maximum circulating water pump flows at EPS.

Gobiidae Survey	Date	Actual Average Daily Flow	Actual Average Daily Entrainment	Actual Average Daily Variance	Actual Period Total Flow	Actual Period Entrainment	Actual Period Std. Error
EPSEA001	6/1/2004	2,684,966	5,530,170	5,912,361	42,959,457	88,482,715	23,649,444
EPSEA002	6/17/2004	2,612,081	4,238,352	2,441,033	33,957,052	55,098,573	8,801,270
EPSEA003	6/30/2004	2,673,312	9,769,319	10,400,810	66,832,808	244,232,970	52,004,050
EPSEA004	7/25/2004	2,795,888	19,542,972	23,060,055	111,835,525	781,718,892	145,844,590
EPSEA005	9/3/2004	3,001,341	6,781,226	6,421,615	102,045,587	230,561,671	37,444,130
EPSEA006	10/7/2004	1,972,581	2,206,134	872,041	55,232,277	61,771,757	4,614,408
EPSEA007	11/4/2004	2,048,287	842,107	410,104	57,352,032	23,578,994	2,170,067
EPSEA008	12/2/2004	2,621,271	612,012	393,377	73,395,577	17,136,323	2,081,555
EPSEA009	12/30/2004	1,839,003	484,158	189,060	64,365,098	16,945,525	1,118,497
EPSEA010	2/3/2005	1,959,696	2,311,097	518,381	68,589,345	80,888,403	3,066,783
EPSEA011	3/10/2005	2,191,468	5,918,341	2,133,955	61,361,101	165,713,553	11,291,831
EPSEA012	4/7/2005	2,763,761	7,323,919	8,161,145	77,385,295	205,069,744	43,184,721
EPSEA013	5/5/2005	2,408,779	9,047,337	8,137,567	65,037,024	244,278,098	42284037
					Totals ->	**2,215,477,218**	**172,728,815**

Gobiidae Survey	Date	Maximum Average Daily Flow	Maximum Average Daily Entrainment	Maximum Average Daily Variance	Maximum Period Total Flow	Maximum Period Entrainment	Maximum Period Std. Error
EPSEA001	6/1/2004	3,244,431	6,682,488	7,108,192	51,910,896	106,919,810	28,432,766
EPSEA002	6/17/2004	3,244,431	5,264,400	3,011,999	42,177,603	68,437,205	10,859,917
EPSEA003	6/30/2004	3,244,431	11,856,408	12,447,313	81,110,775	296,410,192	62,236,564
EPSEA004	7/25/2004	3,244,431	22,678,241	26,575,280	129,777,240	907,129,648	168,076,829
EPSEA005	9/3/2004	3,244,431	7,330,463	6,914,992	110,310,654	249,235,754	40,320,983
EPSEA006	10/7/2004	3,244,431	3,628,570	1,401,143	90,844,068	101,599,969	7,414,150
EPSEA007	11/4/2004	3,244,431	1,333,875	637,120	90,844,068	37,348,488	3,371,322
EPSEA008	12/2/2004	3,244,431	757,506	476,511	90,844,068	21,210,178	2,521,461
EPSEA009	12/30/2004	3,244,431	854,168	308,330	113,555,085	29,895,870	1,824,106
EPSEA010	2/3/2005	3,244,431	3,826,204	836,407	113,555,085	133,917,148	4,948,249
EPSEA011	3/10/2005	3,244,431	8,762,004	3,086,860	90,844,068	245,336,100	16,334,128
EPSEA012	4/7/2005	3,244,431	8,597,688	9,565,335	90,844,068	240,735,270	50,614,995
EPSEA013	5/5/2005	3,244,431	12,186,035	10,926,880	87,599,637	329,022,938	56,777,735
					Totals ->	**2,767,198,570**	**202,060,017**

Table F1-4. Estimated monthly entrainment of larval *Hypsoblennius* spp. based on actual and maximum circulating water pump flows at EPS.

Hypsoblennius spp. Survey	Date	Actual Average Daily Flow	Actual Average Daily Entrainment	Actual Average Daily Variance	Actual Period Total Flow	Actual Period Entrainment	Actual Period Std. Error
EPSEA001	6/1/2004	2,684,966	7,282,012	7,617,565	42,959,457	116,512,195	30,470,261
EPSEA002	6/17/2004	2,612,081	3,127,328	2,063,840	33,957,052	40,655,265	7,441,279
EPSEA003	6/30/2004	2,673,312	4,966,893	3,905,980	66,832,808	124,172,325	19,529,899
EPSEA004	7/25/2004	2,795,888	10,904,353	15,934,511	111,835,525	436,174,112	100,778,698
EPSEA005	9/3/2004	3,001,341	6,170,805	9,578,665	102,045,587	209,807,379	55,852,737
EPSEA006	10/7/2004	1,972,581	544,016	682,732	55,232,277	15,232,444	3,612,679
EPSEA007	11/4/2004	2,048,287	657,271	827,985	57,352,032	18,403,588	4,381,284
EPSEA008	12/2/2004	2,621,271	30,802	48,428	73,395,577	862,450	256,255
EPSEA009	12/30/2004	1,839,003	15,682	23,648	64,365,098	548,887	139,905
EPSEA010	2/3/2005	1,959,696	0	0	68,589,345	0	0
EPSEA011	3/10/2005	2,191,468	217,986	146,011	61,361,101	6,103,621	772,620
EPSEA012	4/7/2005	2,763,761	481,272	408,327	77,385,295	13,475,613	2,160,662
EPSEA013	5/5/2005	2,408,779	4,301,323	5,729,259	65,037,024	116,135,734	29,770,104
					Totals ->	**1,098,083,615**	**124,759,598**

Hypsoblennius spp. Survey	Date	Maximum Average Daily Flow	Maximum Average Daily Entrainment	Maximum Average Daily Variance	Maximum Period Total Flow	Maximum Period Entrainment	Maximum Period Std. Error
EPSEA001	6/1/2004	3,244,431	8,799,361	9,158,290	51,910,896	140,789,777	36,633,158
EPSEA002	6/17/2004	3,244,431	3,884,413	2,546,579	42,177,603	50,497,365	9,181,820
EPSEA003	6/30/2004	3,244,431	6,028,006	4,674,535	81,110,775	150,700,140	23,372,676
EPSEA004	7/25/2004	3,244,431	12,653,732	18,363,534	129,777,240	506,149,298	116,141,187
EPSEA005	9/3/2004	3,244,431	6,670,603	10,314,600	110,310,654	226,800,491	60,143,934
EPSEA006	10/7/2004	3,244,431	894,778	1,096,972	90,844,068	25,053,777	5,804,632
EPSEA007	11/4/2004	3,244,431	1,041,100	1,286,321	90,844,068	29,150,786	6,806,572
EPSEA008	12/2/2004	3,244,431	38,124	58,662	90,844,068	1,067,482	310,411
EPSEA009	12/30/2004	3,244,431	27,668	38,567	113,555,085	968,366	228,165
EPSEA010	2/3/2005	3,244,431	0	0	113,555,085	0	0
EPSEA011	3/10/2005	3,244,431	322,725	211,212	90,844,068	9,036,307	1,117,628
EPSEA012	4/7/2005	3,244,431	564,974	478,583	90,844,068	15,819,278	2,532,421
EPSEA013	5/5/2005	3,244,431	5,793,537	7,693,077	87,599,637	156,425,488	39,974,401
					Totals ->	**1,312,458,555**	**144,098,684**

Table F1-5. Estimated monthly entrainment of larval *Hypsypops rubicundus* based on actual and maximum circulating water pump flows at EPS.

Hypsypops rubicundus Survey	Date	Actual Average Daily Flow	Actual Average Daily Entrainment	Actual Average Daily Variance	Actual Period Total Flow	Actual Period Entrainment	Actual Period Std. Error
EPSEA001	6/1/2004	2,684,966	721,397	1,039,344	42,959,457	11,542,357	4,157,375
EPSEA002	6/17/2004	2,612,081	61,153	76,275	33,957,052	794,992	275,012
EPSEA003	6/30/2004	2,673,312	204,612	211,910	66,832,808	5,115,306	1,059,548
EPSEA004	7/25/2004	2,795,888	46,370	80,078	111,835,525	1,854,783	506,457
EPSEA005	9/3/2004	3,001,341	0	0	102,045,587	0	0
EPSEA006	10/7/2004	1,972,581	0	0	55,232,277	0	0
EPSEA007	11/4/2004	2,048,287	0	0	57,352,032	0	0
EPSEA008	12/2/2004	2,621,271	0	0	73,395,577	0	0
EPSEA009	12/30/2004	1,839,003	0	0	64,365,098	0	0
EPSEA010	2/3/2005	1,959,696	0	0	68,589,345	0	0
EPSEA011	3/10/2005	2,191,468	0	0	61,361,101	0	0
EPSEA012	4/7/2005	2,763,761	84,419	73,776	77,385,295	2,363,724	390,387
EPSEA013	5/5/2005	2,417,371	282,092	343,379	65,037,024	7,616,483	1,784,249
					Totals ->	**29,287,646**	**4,698,349**

Hypsypops rubicundus Survey	Date	Maximum Average Daily Flow	Maximum Average Daily Entrainment	Maximum Average Daily Variance	Maximum Period Total Flow	Maximum Period Entrainment	Maximum Period Std. Error
EPSEA001	6/1/2004	3,244,431	871,714	1,249,561	51,910,896	13,947,432	4,998,243
EPSEA002	6/17/2004	3,244,431	75,958	94,116	42,177,603	987,450	339,338
EPSEA003	6/30/2004	3,244,431	248,325	253,606	81,110,775	6,208,125	1,268,029
EPSEA004	7/25/2004	3,244,431	53,809	92,285	129,777,240	2,152,345	583,660
EPSEA005	9/3/2004	3,244,431	0	0	110,310,654	0	0
EPSEA006	10/7/2004	3,244,431	0	0	90,844,068	0	0
EPSEA007	11/4/2004	3,244,431	0	0	90,844,068	0	0
EPSEA008	12/2/2004	3,244,431	0	0	90,844,068	0	0
EPSEA009	12/30/2004	3,244,431	0	0	113,555,085	0	0
EPSEA010	2/3/2005	3,244,431	0	0	113,555,085	0	0
EPSEA011	3/10/2005	3,244,431	0	0	90,844,068	0	0
EPSEA012	4/7/2005	3,244,431	99,101	86,470	90,844,068	2,774,820	457,556
EPSEA013	5/5/2005	3,244,431	379,955	461,079	87,599,637	10,258,790	2,395,835
					Totals ->	**36,328,962**	**5,744,173**

Table F1-6. Estimated monthly entrainment of larval *Paralichthys californicus* based on actual and maximum circulating water pump flows at EPS.

Paralichthys californicus Survey	Date	Actual Average Daily Flow	Actual Average Daily Entrainment	Actual Average Daily Variance	Actual Period Total Flow	Actual Period Entrainment	Actual Period Std. Error
EPSEA001	6/1/2004	2684966	6,448	12,962	42,959,457	103,169	51,847
EPSEA002	6/17/2004	2,612,081	0	0	33,957,052	0	0
EPSEA003	6/30/2004	2,673,312	0	0	66,832,808	0	0
EPSEA004	7/25/2004	2,795,888	5,836	11,754	111,835,525	233,458	74,338
EPSEA005	9/3/2004	3,001,341	40,756	64,161	102,045,587	1,385,699	374,118
EPSEA006	10/7/2004	1,972,581	10,325	21,140	55,232,277	289,114	111,861
EPSEA007	11/4/2004	2,048,287	3,578	7,296	57,352,032	100,182	38,606
EPSEA008	12/2/2004	2,621,271	5,811	11,874	73,395,577	162,696	62,833
EPSEA009	12/30/2004	1,839,003	8,100	10,136	64,365,098	283,503	59,966
EPSEA010	2/3/2005	1,959,696	11,260	14,271	68,589,345	394,105	84,426
EPSEA011	3/10/2005	2,191,468	3,982	8,150	61,361,101	111,485	43,126
EPSEA012	4/7/2005	2,763,761	19,668	26,123	77,385,295	550,718	138,232
EPSEA013	5/5/2005	2408779	5,127	10,285	65,037,024	138,424	53,444
					Totals ->	**3,752,551**	**447,971**

Paralichthys californicus Survey	Date	Maximum Average Daily Flow	Maximum Average Daily Entrainment	Maximum Average Daily Variance	Maximum Period Total Flow	Maximum Period Entrainment	Maximum Period Std. Error
EPSEA001	6/1/2004	3,244,431	7,792	15,583	51,910,896	124,666	62,333
EPSEA002	6/17/2004	3,244,431	0	0	42,177,603	0	0
EPSEA003	6/30/2004	3,244,431	0	0	81,110,775	0	0
EPSEA004	7/25/2004	3,244,431	6,773	13,546	129,777,240	270,911	85,670
EPSEA005	9/3/2004	3,244,431	44,057	69,090	110,310,654	1,497,932	402,862
EPSEA006	10/7/2004	3,244,431	16,983	33,966	90,844,068	475,524	179,731
EPSEA007	11/4/2004	3,244,431	5,667	11,335	90,844,068	158,685	59,977
EPSEA008	12/2/2004	3,244,431	7,192	14,384	90,844,068	201,375	76,112
EPSEA009	12/30/2004	3,244,431	14,290	16,531	113,555,085	500,166	97,796
EPSEA010	2/3/2005	3,244,431	18,642	23,026	113,555,085	652,472	136,221
EPSEA011	3/10/2005	3,244,431	5,895	11,789	90,844,068	165,051	62,383
EPSEA012	4/7/2005	3,244,431	23,089	30,618	90,844,068	646,498	162,016
EPSEA013	5/5/2005	3,244,431	6,905	13,811	87,599,637	186,446	71,763
					Totals ->	**4,879,725**	**527,852**

Table F1-7. Estimated monthly entrainment of larval *Roncador stearnsi* based on actual and maximum circulating water pump flows at EPS.

Roncador stearnsi Survey	Date	Actual Average Daily Flow	Actual Average Daily Entrainment	Actual Average Daily Variance	Actual Period Total Flow	Actual Period Entrainment	Actual Period Std. Error
EPSEA001	6/1/2004	2,684,966	6,448	12,962	42,959,457	103,169	51,847
EPSEA002	6/17/2004	2,612,081	6,711	13,512	33,957,052	87,248	48,718
EPSEA003	6/30/2004	2,673,312	91,591	146,690	66,832,808	2,289,769	733,448
EPSEA004	7/25/2004	2,795,888	5,836	11,754	111,835,525	233,458	74,338
EPSEA005	9/3/2004	3,001,341	201,191	186,028	102,045,587	6,840,495	1,084,718
EPSEA006	10/7/2004	1,972,581	0	0	55,232,277	0	0
EPSEA007	11/4/2004	2,048,287	0	0	57,352,032	0	0
EPSEA008	12/2/2004	2,621,271	0	0	73,395,577	0	0
EPSEA009	12/30/2004	1,839,003	0	0	64,365,098	0	0
EPSEA010	2/3/2005	1,959,696	0	0	68,589,345	0	0
EPSEA011	3/10/2005	2,191,468	0	0	61,361,101	0	0
EPSEA012	4/7/2005	2,763,761	0	0	77,385,295	0	0
EPSEA013	5/5/2005	2,417,371	0	0	67,686,388	0	0
					Totals ->	**9,554,139**	**1,313,449**

Roncador stearnsi Survey	Date	Maximum Average Daily Flow	Maximum Average Daily Entrainment	Maximum Average Daily Variance	Maximum Period Total Flow	Maximum Period Entrainment	Maximum Period Std. Error
EPSEA001	6/1/2004	3,244,431	7,792	15,583	51,910,896	124,666	62,333
EPSEA002	6/17/2004	3,244,431	8,336	16,672	42,177,603	108,370	60,113
EPSEA003	6/30/2004	3,244,431	111,158	175,553	81,110,775	2,778,948	877,764
EPSEA004	7/25/2004	3,244,431	6,773	13,546	129,777,240	270,911	85,670
EPSEA005	9/3/2004	3,244,431	217,486	200,320	110,310,654	7,394,533	1,168,058
EPSEA006	10/7/2004	3,244,431	0	0	90,844,068	0	0
EPSEA007	11/4/2004	3,244,431	0	0	90,844,068	0	0
EPSEA008	12/2/2004	3,244,431	0	0	90,844,068	0	0
EPSEA009	12/30/2004	3,244,431	0	0	113,555,085	0	0
EPSEA010	2/3/2005	3,244,431	0	0	113,555,085	0	0
EPSEA011	3/10/2005	3,244,431	0	0	90,844,068	0	0
EPSEA012	4/7/2005	3,244,431	0	0	90,844,068	0	0
EPSEA013	5/5/2005	3,244,431	0	0	90,844,068	0	0
					Totals ->	**10,677,429**	**1,466,174**

Table F1-8. Estimated monthly entrainment of larval *Seriphus politus* based on actual and maximum circulating water pump flows at EPS.

Seriphus politus Survey	Date	Actual Average Daily Flow	Actual Average Daily Entrainment	Actual Average Daily Variance	Actual Period Total Flow	Actual Period Entrainment	Actual Period Std. Error
EPSEA001	6/1/2004	2,684,966	17,852	35,886	42,959,457	285,635	143,543
EPSEA002	6/17/2004	2,612,081	0	0	33,957,052	0	0
EPSEA003	6/30/2004	2,673,312	0	0	66,832,808	0	0
EPSEA004	7/25/2004	2,795,888	17,843	35,934	111,835,525	713,727	227,266
EPSEA005	9/3/2004	3,001,341	161,277	165,526	102,045,587	5,483,435	965,175
EPSEA006	10/7/2004	1,972,581	9,416	11,337	55,232,277	263,651	59,991
EPSEA007	11/4/2004	2,048,287	0	0	57,352,032	0	0
EPSEA008	12/2/2004	2,621,271	0	0	73,395,577	0	0
EPSEA009	12/30/2004	1,839,003	0	0	64,365,098	0	0
EPSEA010	2/3/2005	1,959,696	0	0	68,589,345	0	0
EPSEA011	3/10/2005	2,191,468	0	0	61,361,101	0	0
EPSEA012	4/7/2005	2,763,761	0	0	77,385,295	0	0
EPSEA013	5/5/2005	2,417,371	0	0	67,686,388	0	0
					Totals ->	**6,746,448**	**1,003,701**

Seriphus politus Survey	Date	Maximum Average Daily Flow	Maximum Average Daily Entrainment	Maximum Average Daily Variance	Maximum Period Total Flow	Maximum Period Entrainment	Maximum Period Std. Error
EPSEA001	6/1/2004	3,244,431	21,572	43,144	51,910,896	345,152	172,576
EPSEA002	6/17/2004	3,244,431	0	0	42,177,603	0	0
EPSEA003	6/30/2004	3,244,431	0	0	81,110,775	0	0
EPSEA004	7/25/2004	3,244,431	20,706	41,412	129,777,240	828,230	261,909
EPSEA005	9/3/2004	3,244,431	174,340	178,244	110,310,654	5,927,559	1,039,330
EPSEA006	10/7/2004	3,244,431	15,487	18,216	90,844,068	433,644	96,390
EPSEA007	11/4/2004	3,244,431	0	0	90,844,068	0	0
EPSEA008	12/2/2004	3,244,431	0	0	90,844,068	0	0
EPSEA009	12/30/2004	3,244,431	0	0	113,555,085	0	0
EPSEA010	2/3/2005	3,244,431	0	0	113,555,085	0	0
EPSEA011	3/10/2005	3,244,431	0	0	90,844,068	0	0
EPSEA012	4/7/2005	3,244,431	0	0	90,844,068	0	0
EPSEA013	5/5/2005	3,244,431	0	0	90,844,068	0	0
					Totals ->	**7,534,586**	**1,089,898**

Appendix G

Impingement Results

G1 – Traveling Screen and Bar Rack Weekly Surveys

G2 – Heat Treatment Surveys

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA001 **Survey Date: June 24 - 25, 2004**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Cymatogaster aggregata	shiner surfperch	186	40-84	1.3-15.3	729.7
Engraulis mordax	northern anchovy	46	37-90	0.4-10.5	69.2
Heterostichus rostratus	giant kelpfish	8	81-113	4.1-8.2	47.9
Heterostichus spp.	kelpfish	7	81-118	4.0-12.2	47.8
Anchoa compressa	deepbody anchovy	6	31-107	0.1-11.6	13.7
Engraulidae	anchovies	4	-	1.6	1.6
Atherinops affinis	topsmelt	3	54-115	0.9-18.8	25.5
Porichthys myriaster	specklefin midshipman	3	300-378	210	210.0
unidentified fish	unid. fish	3	34	0.5-2.0	4.4
Hyporhamphus rosae	California halfbeak	2	111-125	10.9-11.7	22.6
Paralabrax spp.	sand bass	2	33-55	0.7-2.0	2.7
Anchoa delicatissima	slough anchovy	1	-	3.0	2.8
Atherinopsidae	silverside	1	46	1.0	1.0
Hypsoblennius spp.	blennies	1	252	267	267.0
Pleuronichthys verticalis	hornyhead turbot	1	291	227	226.5
Sphyraena argentea	California barracuda	1	136	0.8	0.8
Syngnathus leptorhynchus	bay pipefish	1	290	9.7	9.7
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	9	253-410	143-521	1,984.7
Urolophus halleri	round stingray	2	285-337	244-444	688.0
INVERTEBRATES					
Pachygrapsus crassipes	striped shore crab	7	15-34	2.0-18.0	66.1
	Total:	**294**			

Survey: EPSIA002 **Survey Date: June 30 - July 1, 2004**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Cymatogaster aggregata	shiner surfperch	242	40-115	1.6-31.0	957.0
Roncador stearnsi	spotfin croaker	51	33-205	0.6-106	260.4
Engraulis mordax	northern anchovy	36	35-103	0.2-14.0	57.6
Heterostichus rostratus	giant kelpfish	33	74-128	3.4-16.0	209.8
Atherinops affinis	topsmelt	29	34-115	0.5-15.2	117.3
Strongylura exilis	California needlefish	5	95-142	0.6-2.0	6.1
Hypsopsetta guttulata	diamond turbot	3	104-140	27.7-79.4	173.4
Porichthys myriaster	specklefin midshipman	3	250-305	160-312	633.0
Anchoa delicatissima	slough anchovy	2	65	1.1-3.1	4.2
Paralichthys californicus	California halibut	2	55-95	2.9-11.5	14.4
Sphyraena argentea	California barracuda	2	78-85	2.0-3.6	5.6
Anchoa compressa	deepbody anchovy	1	43	2.2	2.2
Paralabrax nebulifer	barred sand bass	1	230	312	312.0
Seriphus politus	queenfish	1	102	15.7	15.7
unidentified fish	unid. fish	1	-	0.1	0.1
unidentified fish, damaged	unid. damaged fish	1	-	0.4	0.4
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	5	224-505	112-600	1,505.6
Myliobatis californica	bat ray	1	295	392.0	391.5
INVERTEBRATES					
Pachygrapsus crassipes	striped shore crab	5	19-47	5.7-47.6	96.3
Octopus spp.	octopus	1	-	10.1	10.1
	Total:	**425**			

Encina Power Station Impingement Abundance: : Traveling Screen and Bar Rack Survey Data

Survey: EPSIA003 **Survey Date: July 07 - 08, 2004**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Cymatogaster aggregata	shiner surfperch	83	45-66	2.5-7.0	363.0
Roncador stearnsi	spotfin croaker	31	35-52	0.7-2.0	40.1
Heterostichus rostratus	giant kelpfish	29	75-123	3.2-14.9	181.2
Anchoa compressa	deepbody anchovy	17	35-99	0.9-10.5	64.1
Strongylura exilis	California needlefish	13	75-135	0.3-9.5	64.4
Engraulis mordax	northern anchovy	9	42-46	0.5-1.3	6.5
Atherinops affinis	topsmelt	4	60-110	2.2-28.8	43.4
Anchoa delicatissima	slough anchovy	3	-	1.3	1.3
Paralichthys californicus	California halibut	3	43-63	1.5-3.8	7.3
Engraulidae	anchovies	2	-	1.2	1.2
Porichthys myriaster	specklefin midshipman	2	249-270	200-250	450.0
Anchoa spp.	anchovy	1	65	2.5	2.5
Cheilotrema saturnum	black croaker	1	48	1.8	1.8
Gibbonsia montereyensis	crevice kelpfish	1	88	8.3	8.3
Hypsopsetta guttulata	diamond turbot	1	285	400	400.0
Sardinops sagax	Pacific sardine	1	35	0.4	0.4
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	7	225-293	165-375	1,715.1
Myliobatis californica	bat ray	1	245	240	239.5
INVERTEBRATES					
Pachygrapsus crassipes	striped shore crab	6	26-34.5	6.2-12.1	54.0
	Total:	**215**			

Survey: EPSIA004 **Survey Date: July 14 - 15, 2004**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Engraulis mordax	northern anchovy	228	34-109	0.4-11.0	186.9
Cymatogaster aggregata	shiner surfperch	191	45-228	2.3-326	1,327.3
Atherinops affinis	topsmelt	126	45-139	0.8-26.9	472.1
Heterostichus rostratus	giant kelpfish	119	57-137	1.5-19.6	834.0
Roncador stearnsi	spotfin croaker	38	37-226	0.8-149	306.5
Anchoa delicatissima	slough anchovy	28	33-42	0.2-1.5	24.4
Seriphus politus	queenfish	25	35-60	0.7-3.3	41.7
Strongylura exilis	California needlefish	17	84-375	0.6-45.4	91.8
Sardinops sagax	Pacific sardine	15	35-59	0.4-2.3	15.4
Anchoa compressa	deepbody anchovy	10	60-116	2.5-22.5	76.1
Porichthys myriaster	specklefin midshipman	7	164-354	53.3-369.3	1,692.9
Paralichthys californicus	California halibut	5	41-99	1.3-10.6	32.5
Syngnathus spp.	pipefishes	4	103-179	0.8-4.2	11.6
Hypsopsetta guttulata	diamond turbot	1	145	79.1	79.1
Scomber japonicus	Pacific mackerel	1	63	2.2	2.2
Symphurus atricauda	California tonguefish	1	90	7.3	7.3
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	20	268-421	179-600	5,135.9
Urolophus halleri	round stingray	1	85	29.7	29.7
Myliobatis californica	bat ray	5	248-317	236.7-531.3	2,010.0
INVERTEBRATES					
Pachygrapsus crassipes	striped shore crab	3	21-33	5.8-16.1	32.7
Octopus spp.	octopus	1	-	239.4	239.4
	Total:	**846**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA005 **Survey Date: July 21 - 22, 2004**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Cymatogaster aggregata	shiner surfperch	70	51-71	3.5-10.0	459.0
Sardinops sagax	Pacific sardine	64	40-68	0.5-4.0	90.5
Engraulis mordax	northern anchovy	35	41-106	0.5-9.6	35.1
Seriphus politus	queenfish	20	36-499	0.9-97.6	160.4
Heterostichus rostratus	giant kelpfish	13	81-116	3.6-12.5	93.9
Atherinops affinis	topsmelt	9	54-129	0.8-20.1	56.6
Roncador stearnsi	spotfin croaker	9	46-76	2.4-7.7	35.2
Porichthys myriaster	specklefin midshipman	6	233-378	132-600	1,766.6
Anchoa delicatissima	slough anchovy	5	45	0.6	4.5
Cheilotrema saturnum	black croaker	5	43-52	1.3-2.3	9.3
Syngnathus spp.	pipefishes	4	137-207	0.8-3.8	8.0
Anchoa compressa	deepbody anchovy	3	80-116	5.9-19.9	32.7
Atractoscion nobilis	white seabass	2	79-83	7.6-11.4	19.0
Hypsopsetta guttulata	diamond turbot	2	141-163	73-124	196.7
unidentified fish	unid. fish	2	50-58	1.4-1.6	3.0
Paralichthys californicus	California halibut	1	54	2.2	2.2
Scomber japonicus	Pacific mackerel	1	89	7.8	7.8
Strongylura exilis	California needlefish	1	377	39.3	39.3
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	11	273-618	191-1212	4,244.2
INVERTEBRATES					
Pachygrapsus crassipes	striped shore crab	3	21-42	2.2-14.8	21.1
	Total:	**266**			

Survey: EPSIA006 **Survey Date: July 28 - 29, 2004**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Seriphus politus	queenfish	95	41-240	1.1-156	530.0
Cymatogaster aggregata	shiner surfperch	53	52-109	2.2-25.5	341.2
Heterostichus rostratus	giant kelpfish	23	45-116	1.9-12.9	130.0
Engraulis mordax	northern anchovy	22	41-93	0.4-7.8	28.0
Atherinops affinis	topsmelt	17	55-107	1.2-11.9	86.1
Strongylura exilis	California needlefish	11	76-372	0.4-55.7	90.4
Porichthys myriaster	specklefin midshipman	8	285-380	226-410	2,608.8
Anchoa delicatissima	slough anchovy	4	65-84	3.4-6.5	17.9
Sardinops sagax	Pacific sardine	3	55-72	1.5-5.1	9.4
Anchoa spp.	anchovy	2	-	7.4	7.4
Paralichthys californicus	California halibut	2	87-114	8.6-16.3	24.9
Anchoa compressa	deepbody anchovy	1	66	2.9	2.9
Cheilotrema saturnum	black croaker	1	50	2.9	2.9
Sphyraena argentea	California barracuda	1	45	0.3	0.3
Syngnathus spp.	pipefishes	1	175	1.1	1.1
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	8	265-368	160-410	1,898.7
Urolophus halleri	round stingray	2	160-170	217-278	495.0
Myliobatis californica	bat ray	1	254	204.3	204.3
INVERTEBRATES					
Pachygrapsus crassipes	striped shore crab	2	25-42	8.4-24.1	32.5
	Total:	**257**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA007 **Survey Date: August 04 - 05, 2004**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Seriphus politus	queenfish	19	43-80	1.4-6.3	63.0
Atherinops affinis	topsmelt	13	57-100	0.9-9.8	38.0
Cymatogaster aggregata	shiner surfperch	11	55-99	2.9-21.1	77.4
Heterostichus rostratus	giant kelpfish	3	83-115	5.1-11.4	26.6
Porichthys myriaster	specklefin midshipman	3	294-309	242-331	872.5
Hypsopsetta guttulata	diamond turbot	2	139-270	69.5-282.5	352.0
Strongylura exilis	California needlefish	2	62-131	0.1-1.1	1.2
Anchoa compressa	deepbody anchovy	1	104	15.9	15.9
Anchoa delicatissima	slough anchovy	1	92	9.4	9.4
Engraulis mordax	northern anchovy	1	70	4.0	4.0
Sardinops sagax	Pacific sardine	1	57	1.4	1.4
Sciaenidae unid.	croaker	1	25	0.1	0.1
Syngnathus spp.	pipefishes	1	186	1.4	1.4
unidentified fish	unid. fish	1	315	700	700.0
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	7	252-296	133-213	1,250.8
Myliobatis californica	bat ray	3	240-250	175.4-183.9	537.3
INVERTEBRATES					
Pachygrapsus crassipes	striped shore crab	1	25	6.3	6.3
Loxorhynchus crispatus	moss crab	1	7.3	1.1	1.1
	Total:	**72**			

Survey: EPSIA008 **Survey Date: August 11 - 12, 2004**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Atherinops affinis	topsmelt	375	37-156	0.5-40.8	1,068.2
Cymatogaster aggregata	shiner surfperch	97	56-109	5.1-29.4	895.0
Anchoa compressa	deepbody anchovy	43	64-169	3.1-19.9	426.7
Seriphus politus	queenfish	28	35-167	1.0-62.1	239.2
Heterostichus rostratus	giant kelpfish	24	73-137	2.9-21.6	175.2
Sardinops sagax	Pacific sardine	17	59-92	2.5-9.3	65.8
Syngnathus spp.	pipefishes	16	145-210	0.5-2.8	23.3
Engraulis mordax	northern anchovy	12	54-95	1.7-7.7	37.6
Strongylura exilis	California needlefish	12	78-297	0.8-20.2	59.6
Porichthys myriaster	specklefin midshipman	9	53-309	1.9-306.2	1,556.9
Leuresthes tenuis	California grunion	8	52-71	1.4-2.9	17.9
Anchoa delicatissima	slough anchovy	2	75-101	4.6-11.1	15.7
Cheilotrema saturnum	black croaker	2	62-119	3.7-20.7	24.4
Hypsopsetta guttulata	diamond turbot	2	91-202	8.4-190	198.1
Anisotremus davidsonii	sargo	1	243	341.2	341.2
Hyperprosopon argenteum	walleye surfperch	1	153	96.9	96.9
Paralabrax spp.	sand bass	1	32	0.9	0.9
Pleuronichthys verticalis	hornyhead turbot	1	152	97.3	97.3
Roncador stearnsi	spotfin croaker	1	164	57.1	57.1
Sciaenidae unid.	croaker	1	38	2.7	2.7
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	8	259-341	150-297	1,595.1
Urolophus halleri	round stingray	8	124-242	133-600	2,290.9
Myliobatis californica	bat ray	9	230-315	111.6-404.8	2,602.8
Platyrhinoidis triseriata	thornback	1	53	10.2	10.2
INVERTEBRATES					
Pachygrapsus crassipes	striped shore crab	3	25.3-36	8.0-21.1	38.7
Loxorhynchus crispatus	moss crab	1	11	0.8	0.8
Hemigrapsus oregonensis	yellow shore crab	2	18-20	0.9-2.8	3.7
Pelia tumida	dwarf teardrop crab	1	13	1.9	1.9
	Total:	**686**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA009 **Survey Date: August 18 - 19, 2004**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Atherinops affinis	topsmelt	18	56-124	1.7-15.8	81.2
Heterostichus rostratus	giant kelpfish	14	66-158	3.4-33.2	122.2
Strongylura exilis	California needlefish	13	87-170	0.4-3.7	28.3
Sardinops sagax	Pacific sardine	10	65-85	3.0-9.4	90.6
Cymatogaster aggregata	shiner surfperch	5	57-75	5.0-11.3	41.6
Seriphus politus	queenfish	5	57-70	3.5-5.5	22.9
Anchoa delicatissima	slough anchovy	2	70-71	3.6-4.4	8.0
Hermosilla azurea	zebra perch	2	53-260	4.8-600	604.8
Paralichthys californicus	California halibut	2	81-103	6.9-16.0	22.9
Porichthys myriaster	specklefin midshipman	2	75-268	5.5-200	205.5
unidentified fish	unid. fish	2	37-44	2.1-2.6	4.7
Hypsoblennius gentilis	bay blenny	1	95	14.7	14.7
Hypsopsetta guttulata	diamond turbot	1	136	57.9	57.9
Leuresthes tenuis	California grunion	1	146	19.9	19.9
Syngnathus spp.	pipefishes	1	184	2.5	2.5
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	2	270-288	162-190	352.2
Urolophus halleri	round stingray	2	133-230	95-123	218.0
Myliobatis californica	bat ray	1	340	550	550.0
Ophichthus zophochir	yellow snake eel	1	420	51.8	51.8
Platyrhinoidis triseriata	thornback	1	630	1,500	1,500.0
INVERTEBRATES					
Pachygrapsus crassipes	striped shore crab	2	22-30	6.1-15.6	21.7
Pyromaia tuberculata	tuberculate pea crab	1	15	3.2	3.2
Octopus spp.	octopus	-	-	-	-
	Total:	**89**			

Survey: EPSIA010 **Survey Date: August 25 - 26, 2004**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Anchoa compressa	deepbody anchovy	24	39-115	0.7-16.1	110.5
Seriphus politus	queenfish	13	46-121	1.5-20.2	80.6
Atherinops affinis	topsmelt	9	64-133	2.1-17.0	68.0
Heterostichus rostratus	giant kelpfish	9	74-125	3.1-15.8	60.8
Sardinops sagax	Pacific sardine	8	-	8.0	36.8
Cymatogaster aggregata	shiner surfperch	7	64-80	6.3-11.3	60.7
Leuresthes tenuis	California grunion	6	59-81	1.6-3.4	13.4
Engraulis mordax	northern anchovy	3	54-56	1-1.8	4.4
Porichthys myriaster	specklefin midshipman	3	275-314	180-350	725.8
Hermosilla azurea	zebra perch	2	35-70	1.1-8.1	9.2
Hypsopsetta guttulata	diamond turbot	2	188-216	39.1-254	293.4
Strongylura exilis	California needlefish	2	105-508	1.2-290	291.2
Paralabrax nebulifer	barred sand bass	1	57	2.6	2.6
Roncador stearnsi	spotfin croaker	1	280	500	500.0
unidentified fish	unid. fish	1	-	20.1	20.1
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	3	260-300	145-220	546.2
Urolophus halleri	round stingray	3	125-147	89.4-148	353.4
Myliobatis californica	bat ray	2	208-240	148-185	332.4
Rhinobatos productus	shovelnose guitarfish	1	410	300	300.0
INVERTEBRATES					
Pachygrapsus crassipes	striped shore crab	4	18.5-39	0.8-24.3	25.1
Lophopanopeus spp.	black-clawed crabs	1	14	1.3	1.3
	Total:	**105**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA011 **Survey Date: September 01 - 02, 2004**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Heterostichus rostratus	giant kelpfish	10	80-97	3.8-10.1	60.6
Anchoa delicatissima	slough anchovy	4	60-73	2.1-4.0	10.4
Leuresthes tenuis	California grunion	4	65-112	2.2-13.5	25.7
Seriphus politus	queenfish	3	55-63	2.3-5.9	11.9
Cymatogaster aggregata	shiner surfperch	2	68-70	8.2-8.9	17.1
Paralichthys californicus	California halibut	2	59-118	3.1-25.8	28.9
Anchoa compressa	deepbody anchovy	1	79	7.4	7.4
Paralabrax spp.	sand bass	1	39	1.1	1.1
Porichthys myriaster	specklefin midshipman	1	400	550	550.0
Sardinops sagax	Pacific sardine	1	75	3.6	3.6
Strongylura exilis	California needlefish	1	-	1.8	1.8
Syngnathus spp.	pipefishes	1	152	0.6	0.6
unidentified fish, damaged	unid. damaged fish	1	-	137.4	137.4
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	1	327	233.3	233.3
Myliobatis californica	bat ray	1	340	400	400.0
INVERTEBRATES					
Pachygrapsus crassipes	striped shore crab	1	25	4.0	4.0
Taliepus nuttallii	globose kelp crab	1	11	0.7	0.7
	Total:	**36**			

Survey: EPSIA012 **Survey Date: September 08 - 09, 2004**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Anchoa compressa	deepbody anchovy	93	42-94	0.2-12.3	301.0
Leuresthes tenuis	California grunion	43	54-73	1.0-5.0	94.7
Seriphus politus	queenfish	29	32-155	0.6-53.0	218.0
Heterostichus rostratus	giant kelpfish	24	60-122	2.1-16.2	172.7
Engraulis mordax	northern anchovy	15	52-71	1.2-4.1	29.5
Cymatogaster aggregata	shiner surfperch	7	53-95	4.9-25.0	79.0
Porichthys notatus	plainfin midshipman	5	53-400	1.6-420	723.6
Sphyraena argentea	California barracuda	5	48-73	0.6-3.3	10.2
Xenistius californiensis	salema	4	31-55	0.7-2.3	4.9
Paralabrax nebulifer	barred sand bass	3	46-124	2.0-28.4	43.5
Sardinops sagax	Pacific sardine	3	68-75	3.5-4.1	11.2
Cheilotrema saturnum	black croaker	2	35-55	1.2-4.3	5.5
Phanerodon furcatus	white surfperch	2	85-93	19.7-20.0	39.7
Porichthys myriaster	specklefin midshipman	2	54-360	1.8-410	411.8
Atherinops affinis	topsmelt	1	103	9.9	9.9
Hypsopsetta guttulata	diamond turbot	1	231	380	380.0
Paralichthys californicus	California halibut	1	105	19.0	19.0
Pleuronectiformes unid.	flatfishes	1	-	54.7	54.7
Roncador stearnsi	spotfin croaker	1	250	380	380.0
Strongylura exilis	California needlefish	1	138	2.0	2.0
Syngnathus spp.	pipefishes	1	133	0.9	0.9
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	4	254-599	137-265	708.2
Myliobatis californica	bat ray	1	-	110	110.0
Urolophus halleri	round stingray	1	-	200	200.0
INVERTEBRATES					
Hemigrapsus oregonensis	yellow shore crab	1	18	2.5	2.5
	Total:	**251**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA013 **Survey Date: September 15 - 16, 2004**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Cymatogaster aggregata	shiner surfperch	24	55-100	5.1-29.6	216.5
Leuresthes tenuis	California grunion	15	48-124	0.9-15.8	72.3
Anchoa delicatissima	slough anchovy	10	40-70	0.5-3.5	22.4
Anchoa compressa	deepbody anchovy	9	58-86	2.0-5.7	30.9
Heterostichus rostratus	giant kelpfish	8	82-124	3.4-15.8	59.2
Sphyraena argentea	California barracuda	4	81-90	2.8-3.6	13.3
Trachurus symmetricus	jack mackerel	4	36-40	0.6-0.9	3.0
Atherinops affinis	topsmelt	3	79-101	3.9-9.8	19.5
Strongylura exilis	California needlefish	3	184-410	4.0-64.8	89.5
Porichthys myriaster	specklefin midshipman	2	57-229	1.8-247	248.8
Sardinops sagax	Pacific sardine	2	67-73	3.1-3.2	6.3
Seriphus politus	queenfish	2	71-73	4.0-5.2	9.2
Xenistius califoriensis	salema	2	37-40	0.8-1.2	2.0
Brachyistius frenatus	kelp surfperch	1	95	28.9	28.9
Cheilotrema saturnum	black croaker	1	43	0.6	0.6
Engraulis mordax	northern anchovy	1	72	2.6	2.6
Paralichthys californicus	California halibut	1	60	3.1	3.1
Umbrina roncador	yellowfin croaker	1	37	1.0	1.0
unidentified fish, damaged	unid. damaged fish	1	-	20.3	20.3
SHARKS/RAYS					
Myliobatis californica	bat ray	2	299-422	201-298	499.0
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	5	30-58	2.5-17.5	33.2
Pachygrapsus crassipes	striped shore crab	2	18-35	0.5-24.8	25.3
Pugettia spp.	kelp crabs	1	22	4.1	4.1
	Total:	**104**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA014 | **Survey Date: September 22 - 23, 2004**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Anchoa compressa	deepbody anchovy	52	22-94	0.8-9.3	119.4
Seriphus politus	queenfish	34	22-82	0.1-8.4	102.1
Leuresthes tenuis	California grunion	20	49-115	1.0-17.1	89.4
Cymatogaster aggregata	shiner surfperch	17	56-90	5.6-18.3	162.5
Anchoa delicatissima	slough anchovy	5	50-76	1.8-4.0	12.3
Sardinops sagax	Pacific sardine	4	62-80	2.8-10.6	20.3
Anisotremus davidsonii	sargo	3	42-72	1.9-10.6	16.9
Heterostichus rostratus	giant kelpfish	3	90-98	5.2-7.3	17.7
Roncador stearnsi	spotfin croaker	3	90-93	9.6-17.7	42.3
Xenistius califoriensis	salema	3	30-41	0.6-1.9	4.2
Atractoscion nobilis	white seabass	2	36-75	0.5-3.4	3.9
Cheilopogon pinnatibarbatus	spotted flyingfish	2	310-313	291-310	601.1
Cheilotrema saturnum	black croaker	2	62-87	5.9-14.4	20.3
Engraulis mordax	northern anchovy	2	57-58	1.1-1.5	2.6
Paralabrax nebulifer	barred sand bass	2	43-50	1.5-3.0	4.5
Sphyraena argentea	California barracuda	2	72-111	2.3-8.3	10.6
Strongylura exilis	California needlefish	2	118-225	1.7-12.5	14.2
Umbrina roncador	yellowfin croaker	2	50-55	2.5-3.6	6.1
Atherinopsis californiensis	jacksmelt	1	125	22.1	22.1
Menticirrhus undulatus	California corbina	1	108	18.9	18.9
Oxylebius pictus	painted greenling	1	66	4.8	4.8
Porichthys myriaster	specklefin midshipman	1	163	41.2	41.2
Syngnathus spp.	pipefishes	1	505	50.0	50.0
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	1	340	330	330.0
Myliobatis californica	bat ray	1	297	375	375.0
INVERTEBRATES					
Loligo opalescens	market squid	3	75-129	7.4-10.8	26.2
Callinectes spp.	crab	1	26	13.8	13.8
Pachygrapsus crassipes	striped shore crab	1	28	10.1	10.1
Pyromaia tuberculata	tuberculate pea crab	1	12	-	-
	Total:	**173**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA015 **Survey Date: September 29 - 30, 2004**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Seriphus politus	queenfish	28	35-78	0.5-7.0	77.4
Leuresthes tenuis	California grunion	16	57-150	1.5-36.0	136.0
Engraulis mordax	northern anchovy	11	33-116	0.2-14.0	24.7
Anchoa compressa	deepbody anchovy	10	45-81	0.5-5.0	22.0
Hyperprosopon argenteum	walleye surfperch	10	49-85	2.0-15.0	80.5
Xenistius califoriensis	salema	10	35-63	0.5-4.0	19.5
Anchoa delicatissima	slough anchovy	5	56-77	1.0-5.0	14.0
Anisotremus davidsonii	sargo	4	38-58	1.0-5.0	9.5
Heterostichus rostratus	giant kelpfish	4	95-121	4.0-22.0	45.0
Sphyraena argentea	California barracuda	4	88-115	4.0-10.0	24.0
Strongylura exilis	California needlefish	4	139-325	0.7-42.0	54.7
Atherinops affinis	topsmelt	2	64-78	3.0-6.0	9.0
Embiotoca jacksoni	black surfperch	2	164-175	170-200	370.0
Paralichthys californicus	California halibut	2	120-133	20.0-35.0	55.0
Sardinops sagax	Pacific sardine	2	71-75	2.0-3.5	5.5
Atherinopsis californiensis	jacksmelt	1	181	47.0	47.0
Atractoscion nobilis	white seabass	1	145	45.0	45.0
Genyonemus lineatus	white croaker	1	100	2.1	2.1
Paralabrax maculatofasciatus	spotted sand bass	1	81	10.5	10.5
Peprilus simillimus	Pacific butterfish	1	130	50.0	50.0
Roncador stearnsi	spotfin croaker	1	115	20.0	20.0
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	1	292	190	190.0
Urolophus halleri	round stingray	1	272	270	270.0
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	7	18-33	2.5-9.0	36.2
Cancer antennarius	brown rock crab	2	11-25	0.2-1.7	1.9
Lophopanopeus frontalis	molarless crestleg crab	2	11-13	0.4	0.8
Cancer productus	red rock crab	1	26	3.4	3.4
Loligo opalescens	market squid	1	70	7.0	7.0
Panulirus interruptus	California spiny lobster	1	-	66.0	66.0
Pyromaia tuberculata	tuberculate pea crab	1	9	0.6	0.6
	Total:	**137**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA016
Sample Count: 19

Survey Date: October 06 - 07, 2004

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Atherinopsidae	silverside	57	48-130	0.5-20.8	289.5
Seriphus politus	queenfish	47	35-98	1.0-14.8	222.3
Anchoa compressa	deepbody anchovy	35	45-95	1.0-10.7	141.8
Cymatogaster aggregata	shiner surfperch	19	57-82	5.0-13.7	175.2
Engraulis mordax	northern anchovy	17	50-103	1.2-8.9	30.5
Xenistius califoriensis	salema	17	27-58	0.5-4.0	22.6
Anchoa delicatissima	slough anchovy	5	53-85	1.0-6.0	14.0
Sphyraena argentea	California barracuda	4	96-435	3.0-110	139.9
Porichthys myriaster	specklefin midshipman	3	87-390	7.2-460	822.2
Heterostichus rostratus	giant kelpfish	2	72-275	1.0-195	196.0
Paralichthys californicus	California halibut	2	128-133	39.0-40.0	79.0
Strongylura exilis	California needlefish	2	73-82	0.3	0.7
Leuresthes tenuis	California grunion	1	68	2.0	2.0
Paralabrax maculatofasciatus	spotted sand bass	1	29	1.5	1.5
Sardinops sagax	Pacific sardine	1	66	3.0	3.0
SHARKS/RAYS					
Urolophus halleri	round stingray	3	60-154	13.6-195	368.6
Myliobatis californica	bat ray	2	294	400	400.0
INVERTEBRATES					
Loligo opalescens	market squid	11	47-66	4.0-10.0	70.6
Portunus xantusii	Xantus' swimming crab	10	10-50	0.5-9.0	38.9
Taliepus nuttallii	globose kelp crab	2	5-6	0.5	1.0
Cancer spp.	cancer crabs	1	24	2.6	2.6
Pachygrapsus crassipes	striped shore crab	1	12	2.5	2.5
Pachygrapsus spp.	shore crab	1	15	0.9	0.9
Pugettia producta	northern kelp crab	1	8	-	-
Pyromaia tuberculata	tuberculate pea crab	1	6	-	-
	Total:	**246**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA017 **Survey Date: October 13 - 14, 2004**
Sample Count: 13

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Atherinopsidae	silverside	5	55-65	1.2-3.0	2.0
Atractoscion nobilis	white seabass	2	252	140-144	1.2
Engraulis mordax	northern anchovy	2	48-51	1.2	2.4
Seriphus politus	queenfish	2	43-65	1.1-3.9	1.3
Anchoa compressa	deepbody anchovy	1	56	2.0	4.6
Anchoa delicatissima	slough anchovy	1	58	1.2	3.1
Cymatogaster aggregata	shiner surfperch	1	74	8.1	8.1
Sardinops sagax	Pacific sardine	1	77	3.1	11.9
unidentified fish	unid. fish	1	-	4.6	284.0
Xenistius califoriensis	salema	1	44	1.3	5.0
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	20	23-41	2.6-12.9	113.4
Pugettia producta	northern kelp crab	1	80	5.4	5.4
Taliepus nuttallii	globose kelp crab				
	Total:	**38**			

Survey: EPSIA018 **Survey Date; October 20 - 21, 2004**
Sample Count: 13

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Atherinopsidae	silverside	114	52-193	1.4-32.0	905.9
Seriphus politus	queenfish	35	28-77	0.4-7.1	61.0
Xenistius califoriensis	salema	32	30-50	0.4-2.0	30.0
Anchoa compressa	deepbody anchovy	18	40-68	1.3-3.7	41.0
Engraulis mordax	northern anchovy	16	54-70	1.8-4.0	42.6
Brachyistius frenatus	kelp surfperch	14	62-102	6.0-25.0	135.6
Atractoscion nobilis	white seabass	4	223-243	135.2-185.0	640.2
Lepomis cyanellus	green sunfish	4	104-126	26.0-68.0	194.7
Ameiurus natalis	yellow bullhead	3	162-175	65.0-80.0	220.0
Paralichthys californicus	California halibut	3	110-151	21.0-45.0	111.0
Strongylura exilis	California needlefish	3	370-397	67.0-84.0	221.0
Acanthogobius flavimanus	yellowfin goby	2	115-148	18.0-37.2	55.2
Anisotremus davidsonii	sargo	2	44-69	1.8-7.0	8.8
Anchoa spp.	anchovy	1	-	6.8	6.8
Cymatogaster aggregata	shiner surfperch	1	84	7.5	7.5
Hypsopsetta guttulata	diamond turbot	1	125	53.0	53.0
Paralabrax clathratus	kelp bass	1	48	2.0	2.0
Porichthys myriaster	specklefin midshipman	1	47	1.0	1.0
Sardinops sagax	Pacific sardine	1	65	3.0	3.0
Sphyraena argentea	California barracuda	1	72	2.0	2.0
SHARKS/RAYS					
Myliobatis californica	bat ray	1	300	200	200.0
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	6	21-46	2.1-12.4	38.4
Pugettia producta	northern kelp crab	6	4-15	0.1-1.4	2.8
Loxorhynchus spp.	spider crabs	2	5	0.1-0.5	0.6
Brachyuran unid.	unidentified crab	1	8	0.4	0.4
Caridean unid.	unidentified shrimp	1	159	28.0	28.0
	Total:	**274**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA019 **Survey Date: October 27 - 28, 2004**
Sample Count: 13

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Atherinopsidae	silverside	64	52-134	1.0-27.0	256.5
Xenistius californiensis	salema	41	19-45	0.3-1.7	43.8
Seriphus politus	queenfish	32	32-78	1.3-6.4	94.4
Lepomis cyanellus	green sunfish	10	95-117	30.5-77.5	442.8
Micropterus salmoides	large mouth bass	9	49-57	2.4-3.4	26.9
Cymatogaster aggregata	shiner surfperch	8	63-82	5.9-11.6	66.0
Engraulis mordax	northern anchovy	8	59-64	2.1-2.7	19.0
Strongylura exilis	California needlefish	5	392-577	70.0-230	635.0
Anchoa delicatissima	slough anchovy	4	42-66	1.7-7.1	22.2
Lepomis macrochirus	bluegill	3	34-121	1.8-55.5	111.3
Anchoa compressa	deepbody anchovy	2	60-77	2.5-5.7	8.2
Paralichthys californicus	California halibut	2	42-44	1.2-1.3	2.5
Phanerodon furcatus	white surfperch	2	89-119	13.5-27.4	40.9
Sphyraena argentea	California barracuda	2	48-63	0.9-1.6	2.5
Tilapia spp.	tilapia	2	27-46	2.4-4.2	6.6
Trachurus symmetricus	jack mackerel	2	37-38	1.1	2.2
Rhacochilus vacca	pile surfperch	1	263	465	465.0
Heterostichus rostratus	giant kelpfish	1	96	5.4	5.4
Porichthys myriaster	specklefin midshipman	1	342	221	221.0
Porichthys notatus	plainfin midshipman	1	385	460	460.0
Syngnathus spp.	pipefishes	1	161	1.3	1.3
unidentified fish, damaged	unid. damaged fish	1	-	16.0	16.0
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	4	272-550	165-1,100	1,775.0
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	31	7-41	0.9-13.9	195.5
Octopus bimaculatus	California two-spot octopus	4	-	5.2-25.3	58.1
Loxorhynchus crispatus	moss crab	1	7	0.3	0.3
Pugettia spp.	kelp crabs	1	2	0.1	0.1
	Total:	**243**			

Survey: EPSIA020 **Survey Date: November 03 - 04, 2004**
Sample Count: 13

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Anchoa compressa	deepbody anchovy	35	37-85	0.9-7.1	101.6
Engraulis mordax	northern anchovy	30	57-76	1.9-4.6	85.8
Atherinopsidae	silverside	20	50-147	1.1-33.0	148.5
Seriphus politus	queenfish	9	34-66	0.8-4.3	19.8
Xenistius californiensis	salema	2	37-42	0.9-1.3	2.1
Cymatogaster aggregata	shiner surfperch	1	70	8.7	8.7
Trachurus symmetricus	jack mackerel	1	-	2.0	2.0
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	1	304	120	120.0
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	8	21-29	3.8-9.7	58.4
Brachyuran unid.	unidentified crab	1	17	2.8	2.8
Crangon spp.	bay shrimp	1	107	20.9	20.9
Loligo opalescens	market squid	1	-	-	-
Rhithropanopeus harrisii	Harris' mud crab	1	30	18.0	18.0
	Total:	**111**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA021 **Survey Date: November 10 - 11, 2004**
Sample Count: 13

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Atherinopsidae	silverside	14	62-164	2.0-21.3	76.0
Seriphus politus	queenfish	5	46-82	1.4-7.1	13.9
Scorpaena guttata	spotted scorpinfish	1	110	38.0	38.0
Xenistius califoriensis	salema	1	40	1.1	1.1
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	26	15-60	0.9-15.7	193.5
Pachygrapsus crassipes	striped shore crab	2	12-27	0.5	0.5
Cycloxanthops novemdentatus	ninetooth pebble crab	1	19	2.6	2.6
	Total:	**50**			

Survey: EPSIA022 **Survey Date: November 17 - 18, 2004**
Sample Count: 13

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Atherinopsis californiensis	jacksmelt	29	45-146	0.8-33.0	123.9
Seriphus politus	queenfish	18	37-89	0.8-11.1	41.6
Atherinops affinis	topsmelt	4	70-124	2.5-17.6	27.3
Hyperprosopon argenteum	walleye surfperch	2	135-160	61.5-101	162.0
Paralichthys californicus	California halibut	2	49-132	1.8-35.6	37.3
Anchoa compressa	deepbody anchovy	1	66	3.5	3.5
Cheilotrema saturnum	black croaker	1	127	38.6	38.6
Leuresthes tenuis	California grunion	1	63	1.7	1.7
Sarda chiliensis	Pacific bonito	1	336	500	500.0
Xenistius califoriensis	salema	1	48	2.0	2.0
SHARKS/RAYS					
Urolophus halleri	round stingray	1	80	27.7	27.7
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	9	16-36	2.0-17.0	68.4
Pachygrapsus crassipes	striped shore crab	3	32-35	15.0-18.8	49.5
	Total:	**73**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA023 **Survey Date; November 22 - 23, 2004**
Sample Count: 13

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Leuresthes tenuis	California grunion	12	59-155	1.6-31.2	70.1
Seriphus politus	queenfish	11	30-82	0.7-6.7	22.3
Anchoa compressa	deepbody anchovy	5	55-70	1.5-4.8	12.9
Atherinopsis californiensis	jacksmelt	3	62-160	2.3-45.3	56.1
Atractoscion nobilis	white seabass	2	255-291	200-302	502.1
Engraulis mordax	northern anchovy	2	65	2.0-2.9	4.9
Hypsoblennius spp.	blennies	1	50	3.5	3.5
Menticirrhus undulatus	California corbina	1	72	5.1	5.1
Micrometrus minimus	dwarf surfperch	1	70	8.3	8.3
Paralabrax clathratus	kelp bass	1	40	1.7	1.7
Paralichthys californicus	California halibut	1	50	1.7	1.7
unidentified fish, damaged	unid. damaged fish	1	250	200	200.0
Xenistius californiensis	salema	1	47	1.8	1.8
SHARKS/RAYS					
Myliobatis californica	bat ray	1	400	460	460.0
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	34	18-46	2.4-18.2	154.9
Cancer magister	dungeness crab	1	-	-	-
Pugettia richii	cryptic kelp crab	1	12	1.3	1.3
Pugettia spp.	kelp crabs	1	-	-	-
	Total:	**80**			

Survey: EPSIA024 **Survey Date: December 01 - 02, 2004**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Anchoa compressa	deepbody anchovy	801	50-112	0.7-12.1	2,471.4
Xenistius californiensis	salema	514	40-60	1.1-5.3	1,404.0
Seriphus politus	queenfish	320	29-100	0.5-19.3	1,941.7
Cymatogaster aggregata	shiner surfperch	212	61-94	5.1-18.1	2,343.6
Leuresthes tenuis	California grunion	65	31-125	0.3-18.5	265.2
unidentified fish, damaged	unid. damaged fish	6	-	-	-
Anisotremus davidsonii	sargo	4	51-70	2.9-8.3	22.5
Atherinops affinis	topsmelt	4	57-118	1.2-14.2	19.2
Atherinopsis californiensis	jacksmelt	4	63-108	2.2-10.5	19.8
Sardinops sagax	Pacific sardine	3	82-91	4.8-7.5	17.2
Genyonemus lineatus	white croaker	1	115	30.0	30.0
Heterostichus rostratus	giant kelpfish	1	65	5.3	5.3
Hypsoblennius gentilis	bay blenny	1	56	2.6	2.6
Hypsoblennius gilberti	rockpool blenny	1	70	4.3	4.3
Menticirrhus undulatus	California corbina	1	74	5.0	5.0
Paralichthys californicus	California halibut	1	160	60.1	60.1
Sphyraena argentea	California barracuda	1	115	7.4	7.4
Strongylura exilis	California needlefish	1	462	115.1	115.1
Syngnathus spp.	pipefishes	1	249	3.0	3.0
Umbrina roncador	yellowfin croaker	1	67	5.4	5.4
SHARKS/RAYS					
Platyrhinoidis triseriata	thornback	2	181-192	305-342	647.0
Urolophus halleri	round stingray	2	149-155	183-210	393.0
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	13	20-65	2.7-23.6	110.9
Loligo opalescens	market squid	4	88-114	-	-
Pachygrapsus crassipes	striped shore crab	3	6-35	0.2-19.5	31.3
Pugettia spp.	kelp crabs	1	9	0.3	0.3
	Total:	**1,968**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA025 **Survey Date: December 08 - 09, 2004**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Leuresthes tenuis	California grunion	96	49-130	1.1-26.5	440.8
Seriphus politus	queenfish	90	27-175	0.5-58.9	512.7
Anchoa compressa	deepbody anchovy	71	53-111	0.9-12.6	223.8
Xenistius californiensis	salema	23	20-70	0.9-5.6	51.4
Cymatogaster aggregata	shiner surfperch	16	65-105	7.1-25.1	223.8
Sardinops sagax	Pacific sardine	10	73-108	3.7-13.3	70.9
Atherinops affinis	topsmelt	7	63-140	2.2-11.0	30.7
unidentified fish, damaged	unid. damaged fish	4	-	14.8	14.8
Strongylura exilis	California needlefish	2	455-482	120-125	245.0
Chromis punctipinnis	blacksmith	1	105	27.0	27.0
Micrometrus minimus	dwarf surfperch	1	54	4.4	4.4
Paraclinus integripinnis	reef finspot	1	65	3.7	3.7
SHARKS/RAYS					
Myliobatis californica	bat ray	1	305	400	400.0
Platyrhinoidis triseriata	thornback	1	490	650	650.0
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	14	23-60	3.0-19.0	101.5
Pachygrapsus crassipes	striped shore crab	4	5-40	0.1-20.9	29.7
Pugettia spp.	kelp crabs	2	10-13	0.4-1.1	1.5
Octopus spp.	octopus	1	-	200	200.0
Pyromaia tuberculata	tuberculate pea crab	1	22	2.3	2.3
	Total:	**346**			

Survey: EPSIA026 **Survey Date: December 15 - 16, 2004**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Leuresthes tenuis	California grunion	99	20-124	0.6-21.2	341.8
Seriphus politus	queenfish	44	47-102	1.4-13.5	268.2
Xenistius californiensis	salema	28	38-57	1.1-3.5	55.3
Cymatogaster aggregata	shiner surfperch	11	64-83	7.8-16.5	112.9
Atractoscion nobilis	white seabass	8	229-295	150-310	1,655.0
Engraulis mordax	northern anchovy	6	38-109	0.5-13.6	24.1
Anchoa compressa	deepbody anchovy	5	55-92	1.0-8.6	15.4
Atherinops affinis	topsmelt	2	53-84	1.4-6.2	7.6
Chromis punctipinnis	blacksmith	1	39	1.0	1.0
Hyperprosopon argenteum	walleye surfperch	1	140	75.4	75.4
Sardinops sagax	Pacific sardine	1	86	4.1	4.1
Umbrina roncador	yellowfin croaker	1	94	9.7	9.7
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	15	25-83	3.6-11.0	103.1
Pachygrapsus crassipes	striped shore crab	3	9-42	0.5-28.0	33.6
Loligo opalescens	market squid	1	52	24.1	24.1
Pugettia spp.	kelp crabs	1	9	0.5	0.5
	Total:	**227**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA027 **Survey Date: December 20 - 21, 2004**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Seriphus politus	queenfish	25	23-95	0.5-11.7	102.4
Anchoa compressa	deepbody anchovy	16	40-112	0.8-14.3	93.7
Leuresthes tenuis	California grunion	10	57-113	1.5-10.3	37.5
Atherinopsis californiensis	jacksmelt	6	62-133	2.4-23.6	37.3
Atherinopsidae	silverside	3	73-105	2.3-8.3	13.5
Sardinops sagax	Pacific sardine	2	80-89	4.5-5.7	10.2
Anchoa delicatissima	slough anchovy	1	68	3.3	3.3
Atractoscion nobilis	white seabass	1	290	265	265.0
Hyperprosopon argenteum	walleye surfperch	1	169	115	115.0
Xenistius califoriensis	salema	1	37	1.0	1.0
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	17	23-61	2.8-19.6	166.1
Cancer spp.	cancer crabs	1	26	28.0	28.0
Pachygrapsus crassipes	striped shore crab	1	15	2.2	2.2
Pugettia spp.	kelp crabs	1	11	1.4	1.4
	Total:	**86**			

Survey: EPSIA028 **Survey Date: December 29 - 30, 2004**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Atherinopsidae	silverside	721	43-145	1.2-28.2	2,746.2
Xenistius californiensis	salema	283	39-59	0.5-3.0	529.6
Anchoa compressa	deepbody anchovy	57	19-105	0.3-10.0	204.5
Cymatogaster aggregata	shiner surfperch	29	70-110	7.9-21.3	409.1
Sardinops sagax	Pacific sardine	21	72-85	2.8-5.2	83.7
Seriphus politus	queenfish	8	40-140	0.9-31.6	67.2
Strongylura exilis	California needlefish	5	400-508	79.4-160	532.0
Paralabrax clathratus	kelp bass	2	45-73	1.7-7.2	8.9
Syngnathus spp.	pipefishes	2	171-194	1.4-2.4	3.8
Atherinops affinis	topsmelt	1	-	-	-
Chub unid.	unid. chub	1	75	7.3	7.3
Citharichthys stigmaeus	speckled sanddab	1	69	4.6	4.6
Hypsopsetta guttulata	diamond turbot	1	225	250	250.0
Lepomis spp.	sunfishes	1	102	29.9	29.9
Micrometrus minimus	dwarf surfperch	1	56	4.5	4.5
Paralichthys californicus	California halibut	1	65	3.0	3.0
Phanerodon furcatus	white surfperch	1	69	9.4	9.4
Porichthys myriaster	specklefin midshipman	1	73	3.3	3.3
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	6	337-478	425-1,100	4,395.0
Myliobatis californica	bat ray	3	321-500	255-500	1,135.0
INVERTEBRATES					
Cancer spp.	cancer crabs	18	16-33	0.1-2.3	18.7
Pachygrapsus crassipes	striped shore crab	8	10-31	0.2-9.5	26.8
Portunus xantusii	Xantus' swimming crab	8	21-58	0.2-24.9	55.4
Pugettia spp.	kelp crabs	5	5-22	0.1-4.1	7.4
Loligo opalescens	market squid	3	78-100	19.4-34.7	80.8
Taliepus nuttallii	globose kelp crab	2	7-8	0.2-0.5	0.7
Brachyuran unid.	unidentified crab	1	-	-	-
	Total:	**1,191**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA029 **Survey Date: January 05 - 06, 2005**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Atherinops affinis	topsmelt	344	48-137	0.9-33.5	2,151.8
Leuresthes tenuis	California grunion	60	53-159	1.2-36.4	361.6
Xenistius californiensis	salema	42	41-55	1.1-3.3	80.9
Cymatogaster aggregata	shiner surfperch	14	78-100	6.5-27.2	240.6
Anchoa delicatissima	slough anchovy	10	55-81	1.6-4.4	24.8
Strongylura exilis	California needlefish	10	408-563	90.0-270	1,620.0
unidentified fish, damaged	unid. damaged fish	10	50-65	0.4-2.4	26.5
Sardinops sagax	Pacific sardine	7	44-88	0.7-4.7	25.1
Anisotremus davidsonii	sargo	4	48-81	2.5-11.6	30.1
Anchoa compressa	deepbody anchovy	3	60-100	2.0-12.2	23.7
Seriphus politus	queenfish	3	44-144	1.2-34.0	40.4
Atractoscion nobilis	white seabass	2	270	85.0-180	265.0
Engraulis mordax	northern anchovy	2	42-45	0.6	1.3
Paralabrax clathratus	kelp bass	2	62-64	2.8-5.1	7.9
Phanerodon furcatus	white surfperch	2	179-224	115-240	355.2
Hyperprosopon argenteum	walleye surfperch	1	98	20.7	20.7
Hyperprosopon spp.	surfperch	1	165	115	115.0
Hypsopsetta guttulata	diamond turbot	1	28	0.5	0.5
Lepomis macrochirus	bluegill	1	114	45.0	45.0
Lepomis spp.	sunfishes	1	106	35.6	35.6
Symphurus atricauda	California tonguefish	1	92	8.1	8.1
Syngnathus spp.	pipefishes	1	248	4.5	4.5
SHARKS/RAYS					
Myliobatis californica	bat ray	2	274-307	320-410	730.0
Ophichthus zophochir	yellow snake eel	2	489-520	120	240.0
Gymnura marmorata	California butterfly ray	1	465	648	648.0
Platyrhinoidis triseriata	thornback	1	-	178.0	177.9
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	22	19-55	2.6-19.7	198.2
Pachygrapsus crassipes	striped shore crab	5	10-31	0.4-10.2	18.7
Pugettia spp.	kelp crabs	3	7-25	1.1-6.1	8.7
Callianassa californiensis	ghost shrimp	2	41-49	1.0-1.9	2.9
Cancer jordani	hairy rock crab	2	21-30	1.3-5.8	7.1
Octopus spp.	octopus	2	-	20.4-114.8	135.2
Cancer antennarius	brown rock crab	1	21	2.3	2.3
Cancer productus	red rock crab	1	37	10.5	10.5
Pugettia producta	northern kelp crab	1	15	1.5	1.5
Taliepus nuttallii	globose kelp crab	1	10	0.5	0.5
	Total:	**568**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA030 **Survey Date: January 12 - 13, 2005**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Atherinops affinis	topsmelt	2,551	35-184	0.5-67.1	23,391.9
Anchoa delicatissima	slough anchovy	861	38-127	0.9-17.0	2,654.2
Hyperprosopon argenteum	walleye surfperch	460	57-195	4.0-128	18,405.7
Anchoa compressa	deepbody anchovy	222	50-122	1.1-20.8	2,131.7
Paralabrax maculatofasciatus	spotted sand bass	181	43-240	1.4-310	1,596.9
Cymatogaster aggregata	shiner surfperch	118	38-136	1.9-54.9	2,175.8
Seriphus politus	queenfish	86	37-225	0.7-165	773.4
Paralabrax clathratus	kelp bass	79	44-154	1.0-70.0	526.4
Micrometrus minimus	dwarf surfperch	47	54-91	4.0-19.8	484.8
Menticirrhus undulatus	California corbina	39	58-341	3.0-580	1,599.6
Phanerodon furcatus	white surfperch	38	83-227	13.9-350	2,830.4
Paralabrax nebulifer	barred sand bass	33	43-88	1.2-35.0	185.7
Amphistichus argenteus	barred surfperch	32	68-195	8.6-220	1,242.5
Paralichthys californicus	California halibut	28	45-255	1.1-261	593.3
Sardinops sagax	Pacific sardine	28	73-180	2.5-65.0	364.7
Xenistius califoriensis	salema	26	36-74	0.6-6.5	45.0
Anisotremus davidsonii	sargo	21	51-244	2.0-370	834.4
Hypsopsetta guttulata	diamond turbot	15	22-240	14.1-310	2,128.0
Roncador stearnsi	spotfin croaker	15	51-421	2.0-1,500	5,531.5
Atractoscion nobilis	white seabass	12	127-316	26.4-350	2,846.4
Fundulus parvipinnis	California killifish	9	49-79	1.8-7.1	48.0
Engraulis mordax	northern anchovy	8	65-86	1.4-5.5	26.7
Umbrina roncador	yellowfin croaker	7	55-298	3.1-355	398.5
Chub unid.	unid. chub	4	62-81	4.5-7.6	24.5
Heterostichus rostratus	giant kelpfish	4	98-161	8.7-28.5	70.9
Citharichthys stigmaeus	speckled sanddab	3	49-65	1.5-3.6	6.6
Hermosilla azurea	zebra perch	3	66-71	7.3-11.9	27.3
Sphyraena argentea	California barracuda	3	198-224	55.4-68.5	181.4
Albula vulpes	bonefish	2	320-340	590-602	1,192.0
Ictaluridae	unid. catfish	2	162-177	55.0-100.5	155.5
Citharichthys sordidus	Pacific sanddab	1	50	0.5	0.5
Cynoscion parvipinnis	shortfin corvina	1	412	900	900.0
Rhacochilus vacca	pile surfperch	1	176	160	160.0
Genyonemus lineatus	white croaker	1	43	1.0	1.0
Hypsoblennius gentilis	bay blenny	1	65	5.0	5.0
Hypsoblennius gilberti	rockpool blenny	1	65	5.0	5.0
Scorpaena guttata	spotted scorpinfish	1	110	38.0	38.0
Strongylura exilis	California needlefish	1	716	90.0	90.0
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	33	275-525	185-1,520	24,459.0
Urolophus halleri	round stingray	10	146-206	180-630	3,834.0
Ophichthus zophochir	yellow snake eel	6	526-800	115-600	1,920.0
Mustelus californicus	gray smoothhound	3	442-687	300-1,100	1,850.0
Myliobatis californica	bat ray	3	355-447	640-1,300	3,240.0
Platyrhinoidis triseriata	thornback	1	186	550	550.0
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	73	13-58	1.5-42.0	492.1
Octopus spp.	octopus	10	-	40.0-700	2,011.5
Pachygrapsus crassipes	striped shore crab	5	11-35	0.5-9.0	25.7
Cancer productus	red rock crab	2	32-33	4.2-6.0	10.2
Cancer antennarius	brown rock crab	1	36	7.2	7.2
Lophopanopeus spp.	black-clawed crabs	1	80	8.0	8.0
Pandalus platyceros	spot shrimp	1	55	1.8	1.8
Pugettia richii	cryptic kelp crab	1	28	11.0	11.0
Sicyonia ingentis	Ridgeback rock shrimp	1	-	16.0	16.0
	Total:	**5,096**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA031
Sample Count: 19

Survey Date: January 19 - 20, 2005

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Atherinops affinis	topsmelt	492	50-179	1.0-30.0	2,256.5
Sardinops sagax	Pacific sardine	32	55-127	2.5-15.5	180.4
Atractoscion nobilis	white seabass	18	80-235	40.0-160	1,521.0
Anchoa delicatissima	slough anchovy	12	55-79	1.0-5.0	29.7
Anchoa compressa	deepbody anchovy	8	60-96	2.5-10.0	36.0
Cymatogaster aggregata	shiner surfperch	6	69-110	9.0-35.0	103.0
Xenistius califoriensis	salema	5	39-55	1.0-3.0	10.0
Hyperprosopon argenteum	walleye surfperch	4	106-141	33.0-72.0	189.0
Paralabrax clathratus	kelp bass	4	53-66	3.0-6.0	20.0
Anisotremus davidsonii	sargo	2	55	2.5-7.0	9.5
Paralabrax maculatofasciatus	spotted sand bass	2	65-79	4.5-9.5	14.0
Paralabrax nebulifer	barred sand bass	2	63-75	4.0-8.0	12.0
Seriphus politus	queenfish	2	47-74	1.0-5.0	6.0
Citharichthys stigmaeus	speckled sanddab	1	38	1.0	1.0
Hypsoblennius spp.	blennies	1	70	7.0	7.0
Hypsopsetta guttulata	diamond turbot	1	253	350	350.0
Leuresthes tenuis	California grunion	1	91	5.0	5.0
Micrometrus minimus	dwarf surfperch	1	67	7.5	7.5
Pleuronichthys ritteri	spotted turbot	1	70	6.5	6.5
SHARKS/RAYS					
Myliobatis californica	bat ray	2	182-404	460-850	1,310.0
Platyrhinoidis triseriata	thornback	2	159-349	200-260	460.0
Gymnura marmorata	California butterfly ray	1	392	380	380.0
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	40	12-60	1.0-22.0	286.0
Pachygrapsus crassipes	striped shore crab	5	12-33	1.0-10.0	24.5
Blepharipoda occidentalis	spiny mole crab	1	24	9.0	9.0
Cancer productus	red rock crab	1	35	7.0	7.0
Octopus bimaculatus	California two-spot octopus	1	80	110	110.0
Pugettia spp.	kelp crabs	1	32	7.5	7.5
	Total:	**649**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA032 | **Survey Date; January 26 - 27, 2005**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Atherinops affinis	topsmelt	243	46-277	1.0-65.0	1,435.4
Anchoa compressa	deepbody anchovy	16	70-111	3.0-15.0	146.9
Seriphus politus	queenfish	11	35-96	1.0-13.0	75.5
Atractoscion nobilis	white seabass	9	159-284	50.0-210	722.0
Cymatogaster aggregata	shiner surfperch	5	62-110	7.0-38.0	86.0
Hypsopsetta guttulata	diamond turbot	3	162-225	85.0-310	615.0
Sardinops sagax	Pacific sardine	3	79-145	5.0-29.0	56.0
Xenistius califoriensis	salema	3	38-52	1.5-3.0	6.5
Phanerodon furcatus	white surfperch	2	87-95	16.0-23.0	39.0
Anchoa delicatissima	slough anchovy	1	61	2.0	2.0
Heterostichus rostratus	giant kelpfish	1	75	3.1	3.1
Hyperprosopon argenteum	walleye surfperch	1	98	21.0	21.0
Micrometrus minimus	dwarf surfperch	1	74	16.0	16.0
Paralabrax clathratus	kelp bass	1	-	0.5	0.5
Paralabrax maculatofasciatus	spotted sand bass	1	65	5.5	5.5
unidentified fish, damaged	unid. damaged fish	1	182	70.0	70.0
SHARKS/RAYS					
Myliobatis californica	bat ray	2	309-395	400-490	890.0
Gymnura marmorata	California butterfly ray	1	365	390	390.0
Torpedo californica	Pacific electric ray	1	311	3,750.0	3,750.0
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	30	24-51	1.5-23.5	325.0
Pachygrapsus crassipes	striped shore crab	4	12-50	2.0-18.0	42.0
Cancer spp.	cancer crabs	2	28-32	2.0-3.0	5.0
Cancer productus	red rock crab	1	35	5.0	5.0
Caridean unid.	unidentified shrimp	1	-	7.0	7.0
Panulirus interruptus	California spiny lobster	1	-	30.0	30.0
	Total:	**345**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA033 **Survey Date: February 20 - 03, 2005**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Atherinops affinis	topsmelt	189	38-325	0.5-270	1,381.3
Sardinops sagax	Pacific sardine	19	66-124	4.8-16.0	153.7
Anchoa compressa	deepbody anchovy	10	62-116	3.0-16.0	70.5
Xenistius californiensis	salema	6	45-59	1.0-4.0	11.5
Hyperprosopon argenteum	walleye surfperch	5	122-165	50.0-100	339.6
Syngnathus spp.	pipefishes	4	162-224	1.1-4.0	9.3
Anisotremus davidsonii	sargo	3	57-69	4.0-7.0	17.5
Micrometrus minimus	dwarf surfperch	2	62-67	7.5-9.0	16.5
Anchoa delicatissima	slough anchovy	1	75	5.0	5.0
Atractoscion nobilis	white seabass	1	307	360	360.0
Cymatogaster aggregata	shiner surfperch	1	77	10.0	10.0
Rhacochilus vacca	pile surfperch	1	214	280	280.0
Paralabrax clathratus	kelp bass	1	65	5.6	5.6
Peprilus simillimus	Pacific butterfish	1	79	11.0	11.0
Phanerodon furcatus	white surfperch	1	87	15.0	15.0
Sarda chiliensis	Pacific bonito	1	362	510	510.0
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	17	20-58	2.0-18.0	137.8
Pugettia spp.	kelp crabs	4	6-23	0.4-9.0	11.9
Cancer jordani	hairy rock crab	1	33	8.5	8.5
Cancer productus	red rock crab	1	56	17.0	17.0
Dosidicus gigas	jumbo squid	1	625	500	500.0
Pachygrapsus crassipes	striped shore crab	1	10	0.2	0.2
Podochela hemphilli	Hemphill's kelp crab	1	20	3.0	3.0
	Total:	**272**			

Survey: EPSIA034 **Survey Date: February 09 - 10, 2005**
Sample Count: 13

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Atherinops affinis	topsmelt	115	58-302	2.0-205	903.8
Anchoa delicatissima	slough anchovy	25	39-98	0.3-9.5	60.9
Anchoa compressa	deepbody anchovy	17	73-112	3.0-17.0	192.2
Seriphus politus	queenfish	16	45-112	1.0-20.0	82.7
Cymatogaster aggregata	shiner surfperch	14	70-113	11.0-31.0	251.6
Umbrina roncador	yellowfin croaker	8	74-96	7.0-14.5	82.5
Atractoscion nobilis	white seabass	5	190-265	70.0-245	675.0
Engraulis mordax	northern anchovy	5	42-89	1.0-5.5	14.4
Xenistius californiensis	salema	5	50-60	2.0-3.5	13.9
Hyperprosopon argenteum	walleye surfperch	4	101-135	45.0-70.0	235.0
Sardinops sagax	Pacific sardine	2	108-111	9.0-12.0	21.0
Hypsopsetta guttulata	diamond turbot	1	206	270	270.0
Paralabrax clathratus	kelp bass	1	65	5.0	5.0
Paralabrax nebulifer	barred sand bass	1	51	2.0	2.0
Paralichthys californicus	California halibut	1	94	13.0	13.0
Roncador stearnsi	spotfin croaker	1	57	3.0	3.0
Syngnathus spp.	pipefishes	1	163	0.6	0.6
unidentified fish, damaged	unid. damaged fish	1	-	100	100.0
SHARKS/RAYS					
Myliobatis californica	bat ray	2	272-530	305-2,000	2,305.0
Ophichthus zophochir	yellow snake eel	1	638	295	295.0
Urolophus halleri	round stingray	1	140	170	170.0
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	14	16-78	3.0-14.0	99.6
Pachygrapsus crassipes	striped shore crab	3	8-18	0.4-3.0	4.9
Cancer productus	red rock crab	2	33-49	12.0-17.0	29.0
	Total:	**246**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA035 **Survey Date: February 16 - 17, 2005**
Sample Count: 13

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Anchoa compressa	deepbody anchovy	5	-	40.2	40.2
Seriphus politus	queenfish	5	44-52	3.0	15.0
Atherinops affinis	topsmelt	4	-	8.7	8.7
Hyperprosopon argenteum	walleye surfperch	2	131-134	45.0-81.0	126.0
Paralabrax maculatofasciatus	spotted sand bass	2	-	14.6	14.6
Paralabrax nebulifer	barred sand bass	2	50-84	3.2-14.0	17.2
Atherinopsis californiensis	jacksmelt	1	273	160	160.0
Hypsoblennius jenkinsi	mussel blenny	1	57	4.3	4.3
Porichthys myriaster	specklefin midshipman	1	380	800	800.0
INVERTEBRATES					
Pachygrapsus spp.	shore crab	417	-	50.0	871.0
Pachygrapsus crassipes	striped shore crab	274	3-37	0.5-21.5	768.5
Cancer productus	red rock crab	13	10-55	1.0-22.0	130.1
Portunus xantusii	Xantus' swimming crab	7	20-35	2.0-7.0	30.0
Brachyuran unid.	unidentified crab	1	-	150-200	350.0
Pugettia producta	northern kelp crab	1	22	3.5	3.5
Pugettia spp.	kelp crabs	1	-	0.5	0.5
	Total:	**737**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA036 | **Survey Date: February 23 - 24, 2005**
Sample Count: 13

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Anchoa compressa	deepbody anchovy	306	54-120	2.0-21.0	3,203.2
Atherinops affinis	topsmelt	304	57-171	1.2-54.7	4,887.9
Cymatogaster aggregata	shiner surfperch	189	72-188	8.9-61.0	5,211.9
Chub unid.	unid. chub	91	62-164	3.0-100	845.5
Paralabrax maculatofasciatus	spotted sand bass	88	43-315	2.0-670	1,318.9
Paralabrax nebulifer	barred sand bass	64	42-94	2.0-15.0	439.8
Hyperprosopon argenteum	walleye surfperch	36	110-164	36.0-116.4	2,564.4
Ictaluridae	unid. catfish	33	124-259	60.0-300	4,123.0
Fundulus parvipinnis	California killifish	31	66-91	4.0-12.0	235.5
Anchoa delicatissima	slough anchovy	24	57-74	2.0-5.0	73.5
Seriphus politus	queenfish	21	49-172	2.0-79.0	410.5
Lepomis macrochirus	bluegill	16	42-135	2.0-86.9	513.7
Lepomis cyanellus	green sunfish	15	47-168	3.0-138	532.0
Anisotremus davidsonii	sargo	10	53-81	3.5-13.0	68.4
Hypsopsetta guttulata	diamond turbot	7	25-233	0.8-260	956.8
Paralichthys californicus	California halibut	6	47-221	1.5-170	200.8
Atractoscion nobilis	white seabass	4	239-432	155-260	775.0
Pylodictis olivaris	flathead catfish	4	158-210	90.0-170	480.0
Chromis punctipinnis	blacksmith	3	55-101	4.0-21.0	32.0
Phanerodon furcatus	white surfperch	3	156-191	85.8-180	385.8
unidentified fish, damaged	unid. damaged fish	3	40-95	1.0-60.0	62.5
Paralabrax clathratus	kelp bass	2	65-90	5.0-14.0	19.0
Ameiurus nebulosus	brown bullhead	1	149	100	100.0
Citharichthys stigmaeus	speckled sanddab	1	45	3.0	3.0
Embiotoca jacksoni	black surfperch	1	225	370	370.0
Heterostichus rostratus	giant kelpfish	1	183	50.0	50.0
Lepomis spp.	sunfishes	1	141	130	130.0
Micrometrus minimus	dwarf surfperch	1	57	5.0	5.0
Micropterus dolomieu	smallmouth bass	1	186	150	150.0
Pleuronectiformes unid.	flatfishes	1	38	0.5	0.5
Syngnathus spp.	pipefishes	1	105	1.0	1.0
Xenistius californiensis	salema	1	48	1.8	1.8
SHARKS/RAYS					
Ophichthus zophochir	yellow snake eel	4	549-769	150-450	1,380.0
INVERTEBRATES					
Octopus spp.	octopus	17	17-117	16.0-520	3,170.0
Portunus xantusii	Xantus' swimming crab	15	11-52	1.3-14.0	73.8
Pachygrapsus crassipes	striped shore crab	6	11-22	1.0-4.0	13.0
Octopus bimaculatus	California two-spot octopus	3	90-95	240-370	940.0
Blepharipoda occidentalis	spiny mole crab	1	18	3.0	3.0
	Total:	**1,316**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA037 **Survey Date; March 02 - 03, 2005**
Sample Count: 13

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Seriphus politus	queenfish	18	47-74	1.2-5.5	45.4
Atherinops affinis	topsmelt	8	65-112	0.4-13.7	55.7
Roncador stearnsi	spotfin croaker	5	70-550	5.5-1,700	3,024.6
Anchoa compressa	deepbody anchovy	3	64-98	3.0-8.6	20.0
Phanerodon furcatus	white surfperch	3	79-175	10.9-130.8	179.1
Citharichthys stigmaeus	speckled sanddab	2	60-68	3.4-4.0	7.4
Anisotremus davidsonii	sargo	1	61	4.5	4.5
Cymatogaster aggregata	shiner surfperch	1	107	26.5	26.5
Dorosoma petenense	threadfin shad	1	69	3.4	3.4
Hypsopsetta guttulata	diamond turbot	1	215	226	226.0
Micrometrus minimus	dwarf surfperch	1	69	7.9	7.9
Paralabrax nebulifer	barred sand bass	1	65	5.7	5.7
Paralichthys californicus	California halibut	1	128	30.3	30.3
Syngnathus spp.	pipefishes	1	127	0.5	0.5
unidentified fish, damaged	unid. damaged fish	1	-	1.2	1.2
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	13	19-48	1.3-15.2	84.2
Pachygrapsus crassipes	striped shore crab	6	8-42	0.6-48.5	73.9
Octopus spp.	octopus	1	95	266.5	266.5
	Total:	**68**			

Survey: EPSIA038 **Survey Date: March 09 - 10, 2005**
Sample Count: 13

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Seriphus politus	queenfish	36	45-80	1.7-7.4	124.6
Atherinops affinis	topsmelt	25	60-152	2.0-33.5	299.9
Cymatogaster aggregata	shiner surfperch	17	76-119	12.0-35.5	350.7
Hypsopsetta guttulata	diamond turbot	10	185-235	160-281	2,126.3
Paralabrax clathratus	kelp bass	6	49-65	2.2-5.6	22.9
Paralabrax maculatofasciatus	spotted sand bass	5	43-80	2.0-11.1	33.2
Paralabrax nebulifer	barred sand bass	4	50-83	2.5-14.1	27.5
Anchoa compressa	deepbody anchovy	3	90-110	9.1-12.8	34.7
Roncador stearnsi	spotfin croaker	3	67-81	4.8-9.5	20.4
Anchoa delicatissima	slough anchovy	2	58-62	2.3-2.8	5.1
Atherinopsis californiensis	jacksmelt	2	110-158	14.8-31.8	46.6
Engraulis mordax	northern anchovy	2	35-38	0.3-0.5	0.8
Anisotremus davidsonii	sargo	1	56	3.9	3.9
Citharichthys stigmaeus	speckled sanddab	1	60	5.2	5.2
Fundulus parvipinnis	California killifish	1	65	4.9	4.9
Gillichthys mirabilis	longjaw mudsucker	1	125	34.4	34.4
Leptocottus armatus	Pacific staghorn sculpin	1	98	15.1	15.1
Micrometrus minimus	dwarf surfperch	1	64	7.3	7.3
Peprilus simillimus	Pacific butterfish	1	85	13.8	13.8
Phanerodon furcatus	white surfperch	1	123	35.9	35.9
Porichthys myriaster	specklefin midshipman	1	330	500	500.0
Sardinops sagax	Pacific sardine	1	114	8.9	8.9
unidentified fish	unid. fish	1	39	0.9	0.9
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	2	347-423	362-671	1,032.7
Platyrhinoidis triseriata	thornback	2	196-395	365-371	735.8
Myliobatis californica	bat ray	1	343	647.0	647.3
Urolophus halleri	round stingray	1	180	448.0	447.7
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	66	16-46	1.1-9.4	260.7
Pachygrapsus crassipes	striped shore crab	5	10-40	0.5-36.8	49.7
Pyromaia tuberculata	tuberculate pea crab	2	5-8	0.2-0.4	`
Octopus spp.	octopus	1	90	319.5	319.5
	Total:	**206**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA039 **Survey Date: March 16 - 17, 2005**
Sample Count: 13

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Atherinops affinis	topsmelt	6	76-138	4.2-28.4	138.6
Anchoa delicatissima	slough anchovy	3	63-72	2.7-3.8	9.5
Cymatogaster aggregata	shiner surfperch	3	40-120	1.4-45.6	83.4
Roncador stearnsi	spotfin croaker	3	57-71	4.7-7.1	17.8
Seriphus politus	queenfish	3	55-65	2.0-3.7	9.3
Hypsopsetta guttulata	diamond turbot	2	210-235	233-281	513.5
Anchoa compressa	deepbody anchovy	1	58	1.7	1.7
Brachyistius frenatus	kelp surfperch	1	80	17.0	17.0
Fundulus parvipinnis	California killifish	1	70	5.4	5.4
Hyperprosopon argenteum	walleye surfperch	1	129	51.2	51.2
Leuresthes tenuis	California grunion	1	74	3.1	3.1
Lyopsetta exilis	slender sole	1	124	25.9	25.9
Paralabrax maculatofasciatus	spotted sand bass	1	54	2.7	2.7
Paralabrax nebulifer	barred sand bass	1	62	3.9	3.9
Syngnathus spp.	pipefishes	1	190	1.8	1.8
Xenistius califoriensis	salema	1	53	2.8	2.8
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	10	21-44	1.0-11.3	30.8
Pachygrapsus crassipes	striped shore crab	6	10-28	1.1-8.4	31.2
	Total:	**46**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA040 **Survey Date: March 23 - 24, 2005**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Atherinops affinis	topsmelt	77	60-155	2.0-50.2	776.2
Cymatogaster aggregata	shiner surfperch	62	33-123	0.8-41.6	1,385.7
Seriphus politus	queenfish	31	35-111	1.3-14.0	155.4
Anchoa compressa	deepbody anchovy	25	54-80	1.6-5.4	73.2
Anchoa delicatissima	slough anchovy	14	55-70	2.3-3.7	40.6
Roncador stearnsi	spotfin croaker	9	64-83	3.0-12.4	57.6
Syngnathus spp.	pipefishes	9	183-235	1.6-3.5	22.0
Strongylura exilis	California needlefish	6	330-538	37.5-181	592.8
Genyonemus lineatus	white croaker	4	31-34	0.6	2.7
Leuresthes tenuis	California grunion	4	70-104	3.3-9.2	20.9
Paralabrax nebulifer	barred sand bass	4	59-64	3.8-5.2	18.3
Hypsopsetta guttulata	diamond turbot	3	205-224	184.4-203.0	574.8
Leptocottus armatus	Pacific staghorn sculpin	3	60-105	3.3-18.8	28.6
Phanerodon furcatus	white surfperch	3	41-166	8.8-87.7	116.2
Anisotremus davidsonii	sargo	2	55-59	4.3-5.0	9.3
Chromis punctipinnis	blacksmith	2	119-125	32.7-35.0	67.7
Hyperprosopon argenteum	walleye surfperch	2	39-177	1.5-190	191.1
Paralabrax clathratus	kelp bass	2	74-76	5.6-8.0	13.6
Pleuronectiformes unid.	flatfishes	2	55-60	3.2-3.7	6.9
Citharichthys stigmaeus	speckled sanddab	1	60	2.9	2.9
Engraulis mordax	northern anchovy	1	87	3.9	3.9
Fundulus parvipinnis	California killifish	1	66	5.2	5.2
Hypsoblennius gilberti	rockpool blenny	1	70	6.3	6.3
Paralabrax maculatofasciatus	spotted sand bass	1	53	2.6	2.6
Peprilus simillimus	Pacific butterfish	1	87	14.3	14.3
Pleuronichthys verticalis	hornyhead turbot	1	138	68.9	68.9
Porichthys myriaster	specklefin midshipman	1	370	350	350.0
Umbrina roncador	yellowfin croaker	1	70	5.4	5.4
unidentified fish	unid. fish	1	156	77.6	77.6
unidentified fish, damaged	unid. damaged fish	1	65	1.6	1.6
Xenistius californiensis	salema	1	51	2.9	2.9
SHARKS/RAYS					
Ophichthus zophochir	yellow snake eel	2	750-752	393-457	849.4
Urolophus halleri	round stingray	2	119-120	95.2-98.0	193.2
Gymnura marmorata	California butterfly ray	1	395	185.0	185.0
Rhinobatos productus	shovelnose guitarfish	1	775	1,800.0	1,800.0
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	56	9-46	0.9-19.0	200.2
Pachygrapsus crassipes	striped shore crab	9	15-40	1.0-31.9	95.6
	Total:	**347**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA041 **Survey Date: March 30 - 31, 2005**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Atherinops affinis	topsmelt	85	58-135	2.5-21.7	552.4
Seriphus politus	queenfish	44	40-130	1.8-33.4	258.7
Cymatogaster aggregata	shiner surfperch	36	32-125	0.6-43.9	798.4
Anchoa compressa	deepbody anchovy	13	65-111	1.6-17.3	98.9
Paralabrax nebulifer	barred sand bass	11	49-75	2.4-8.6	50.9
Hyperprosopon argenteum	walleye surfperch	8	27-43	0.5-1.8	10.8
Anchoa delicatissima	slough anchovy	5	58-69	2.0-3.4	13.3
Anisotremus davidsonii	sargo	5	54-68	3.8-7.0	26.7
Embiotoca jacksoni	black surfperch	5	46-64	3.0-6.8	20.5
Leuresthes tenuis	California grunion	5	64-131	1.2-17.0	43.3
Umbrina roncador	yellowfin croaker	5	65-108	4.8-20.0	45.2
Paralichthys californicus	California halibut	2	70-176	2.2-33.7	35.9
Phanerodon furcatus	white surfperch	2	41-50	1.8-2.5	4.3
Genyonemus lineatus	white croaker	1	45	1.6	1.6
Hypsoblennius gentilis	bay blenny	1	42	1.6	1.6
Menticirrhus undulatus	California corbina	1	262	277.5	277.5
Paralabrax maculatofasciatus	spotted sand bass	1	80	9.6	9.6
Roncador stearnsi	spotfin croaker	1	77	7.5	7.5
Strongylura exilis	California needlefish	1	324	26.3	26.3
Syngnathus spp.	pipefishes	1	207	3.6	3.6
Xenistius califoriensis	salema	1	55	3.1	3.1
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	2	330-398	305-550	855.2
Urolophus halleri	round stingray	2	104-108	56.0-62.1	118.1
Platyrhinoidis triseriata	thornback	1	279	1,500.0	1,500.0
Rhinobatos productus	shovelnose guitarfish	1	1126	4,400.0	4,400.0
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	20	15-58	0.9-16.8	77.1
Pachygrapsus crassipes	striped shore crab	17	5-40	0.3-31.9	85.4
	Total:	**277**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA042 **Survey Date: April 6 - 7, 2005**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Cymatogaster aggregata	shiner surfperch	29	42-131	3.0-65.2	732.7
Atherinops affinis	topsmelt	23	60-127	3.0-24.0	238.0
Seriphus politus	queenfish	17	55-81	4.0-10.0	94.5
Hyperprosopon argenteum	walleye surfperch	6	40-161	2.0-100	204.0
Anchoa compressa	deepbody anchovy	4	68-78	4.0-6.5	19.0
Atherinopsis californiensis	jacksmelt	4	75-252	5.0-140	177.0
Leuresthes tenuis	California grunion	4	78-151	3.8-28.0	58.8
Embiotoca jacksoni	black surfperch	3	53-218	4.5-452	464.0
Porichthys myriaster	specklefin midshipman	3	370-410	800-1,250	2,950.0
Paralabrax nebulifer	barred sand bass	2	50-56	3.0-4.0	7.0
Amphistichus argenteus	barred surfperch	1	42	2.0	2.0
Anchoa delicatissima	slough anchovy	1	63	3.5	3.5
Anisotremus davidsonii	sargo	1	68	8.5	8.5
Chromis punctipinnis	blacksmith	1	95	18.5	18.5
Engraulis mordax	northern anchovy	1	57	2.5	2.5
Genyonemus lineatus	white croaker	1	110	21.0	21.0
Paralabrax maculatofasciatus	spotted sand bass	1	65	7.0	7.0
Sardinops sagax	Pacific sardine	1	128	19.5	19.5
Strongylura exilis	California needlefish	1	345	45.0	45.0
Syngnathus leptorhynchus	bay pipefish	1	208	4.0	4.0
Xenistius califoriensis	salema	1	52	4.0	4.0
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	2	415-462	600-1,050	1,650.0
Urolophus halleri	round stingray	1	168	420	420.0
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	40	17-70	1.5-20.0	300.0
Pachygrapsus crassipes	striped shore crab	8	17-32	3.0-13.5	43.0
Hippolytidae unid.	hippolytid shrimps	1	-	-	-
	Total:	**158**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA043 **Survey Date: April 13 - 14, 2005**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Cymatogaster aggregata	shiner surfperch	93	48-143	6.9-59.8	1,565.9
Atherinops affinis	topsmelt	35	65-155	3.0-39.9	415.6
Anisotremus davidsonii	sargo	13	40-91	3.9-25.2	127.2
Paralabrax maculatofasciatus	spotted sand bass	10	65-263	3.9-259.1	398.9
Anchoa compressa	deepbody anchovy	9	80-120	6.6-22.5	123.9
Leuresthes tenuis	California grunion	6	110-160	7.6-23.1	83.4
Hyperprosopon argenteum	walleye surfperch	5	40-50	1.6-2.5	10.1
Atherinopsis californiensis	jacksmelt	3	194-325	61.4-223	462.1
Paralabrax clathratus	kelp bass	3	65-75	3.2-5.6	12.5
Seriphus politus	queenfish	3	61-84	3.5-7.7	15.2
Chromis punctipinnis	blacksmith	2	154-156	106.6-143.1	249.7
Embiotoca jacksoni	black surfperch	2	56-58	4.3-4.4	8.7
Girella nigricans	opaleye	2	140-190	86.0-260.1	346.1
Hermosilla azurea	zebra perch	2	73-255	10.9-445	455.9
Hypsopsetta guttulata	diamond turbot	2	155-198	107.3-185.1	292.4
Leptocottus armatus	Pacific staghorn sculpin	2	58-66	3.5	7.0
Porichthys myriaster	specklefin midshipman	2	263-352	271-673	943.5
Roncador stearnsi	spotfin croaker	2	80-222	9.5-174.1	183.6
Anchoa delicatissima	slough anchovy	1	70	3.8	3.8
Genyonemus lineatus	white croaker	1	169	92.6	92.6
Heterostichus rostratus	giant kelpfish	1	88	4.9	4.9
Hypsoblennius gentilis	bay blenny	1	58	4.7	4.7
Hypsoblennius jenkinsi	mussel blenny	1	91	13.0	13.0
Paralabrax nebulifer	barred sand bass	1	221	266.7	266.7
Paralichthys californicus	California halibut	1	107	18.2	18.2
Phanerodon furcatus	white surfperch	1	213	215.1	215.1
Umbrina roncador	yellowfin croaker	1	60	4.6	4.6
unidentified fish, damaged	unid. damaged fish	1	-	91.8	91.8
Xenistius califoriensis	salema	1	50	2.4	2.4
SHARKS/RAYS					
Urolophus halleri	round stingray	9	96-198	37.6-521.1	2,298.0
Gymnura marmorata	California butterfly ray	2	365-393	443.8-512.9	956.7
Myliobatis californica	bat ray	2	352-354	673-790	1,463.2
INVERTEBRATES					
Pachygrapsus crassipes	striped shore crab	170	7-31	0.3-14.8	544.1
Portunus xantusii	Xantus' swimming crab	13	18-51	1.5-19.2	85.9
Cancer productus	red rock crab	1	19	-1.4	1.4
	Total:	**404**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA044 **Survey Date: April 20 - 21, 2005**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Cymatogaster aggregata	shiner surfperch	32	43-122	1.9-31.8	477.6
Anchoa compressa	deepbody anchovy	16	65-119	3.2-18.7	159.0
Hyperprosopon argenteum	walleye surfperch	11	41-225	1.7-275.3	465.4
Anisotremus davidsonii	sargo	7	60-75	4.8-9.0	46.8
Atherinops affinis	topsmelt	7	73-133	3.7-23.3	112.1
Seriphus politus	queenfish	6	68-99	4.7-15.7	48.3
Anchoa delicatissima	slough anchovy	4	65-74	2.6-4.9	14.9
Porichthys myriaster	specklefin midshipman	2	270-335	227-482	708.8
Cheilopogon pinnatibarbatus	spotted flyingfish	1	114	2.9	2.9
Leptocottus armatus	Pacific staghorn sculpin	1	65	4.6	4.6
Leuresthes tenuis	California grunion	1	110	11.0	11.0
Paralabrax nebulifer	barred sand bass	1	50	2.3	2.3
Phanerodon furcatus	white surfperch	1	36	1.0	1.0
Porichthys spp.	midshipman	1	-	200	200.0
Roncador stearnsi	spotfin croaker	1	77	8.6	8.6
Strongylura exilis	California needlefish	1	390	57.9	57.9
unidentified fish, damaged	unid. damaged fish	1	-	200	200.0
SHARKS/RAYS					
Urolophus halleri	round stingray	2	100	63.3-150	213.3
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	12	18-40	1.5-13.7	65.9
Pachygrapsus crassipes	striped shore crab	10	4-50	0.2-53.0	82.5
Octopus spp.	octopus	1	-	139.7	139.7
	Total:	**119**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA045 **Survey Date: April 27 - 28, 2005**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Cymatogaster aggregata	shiner surfperch	63	39-122	1.2-42.0	810.1
Atherinops affinis	topsmelt	10	78-136	6.1-23.7	135.0
Hyperprosopon argenteum	walleye surfperch	5	39-115	1.1-49.3	103.2
Leptocottus armatus	Pacific staghorn sculpin	4	70-80	4.9-7.7	27.5
Paralabrax nebulifer	barred sand bass	4	53-91	4.4-14.0	28.4
Anchoa compressa	deepbody anchovy	3	80-100	2.3-13.3	21.9
Anchoa delicatissima	slough anchovy	2	61-97	2.9-9.1	12.0
Anisotremus davidsonii	sargo	2	63-72	5.7-10.3	16.0
Paralabrax clathratus	kelp bass	2	61-76	5.1-8.1	13.2
Mugil cephalus	striped mullet	1	57	3.4	3.4
Paralichthys californicus	California halibut	1	101	14.6	14.6
Peprilus simillimus	Pacific butterfish	1	47	2.2	2.2
Porichthys myriaster	specklefin midshipman	1	252	190.0	189.5
Seriphus politus	queenfish	1	71	6.9	6.9
Xenistius califoriensis	salema	1	70	7.6	7.6
SHARKS/RAYS					
Myliobatis californica	bat ray	1	566	2,500.0	2,500.0
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	6	19-33	1.8-4.9	18.1
Pachygrapsus crassipes	striped shore crab	2	11-12	2.9-3.4	6.3
	Total:	**110**			

Survey: EPSIA046 **Survey Date: May 4 - 5, 2005**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Cymatogaster aggregata	shiner surfperch	169	29-148	0.6-78.6	1,251.5
Anchoa compressa	deepbody anchovy	35	48-100	1.5-13.7	145.2
Atherinops affinis	topsmelt	23	60-126	2.0-26.0	211.4
Hyperprosopon argenteum	walleye surfperch	14	48-157	2.2-94.9	162.4
Seriphus politus	queenfish	6	60-91	2.6-10.3	38.0
Leuresthes tenuis	California grunion	5	71-112	3.5-17.4	37.3
Paralabrax nebulifer	barred sand bass	5	61-80	4.7-11.6	38.1
Paralabrax maculatofasciatus	spotted sand bass	4	75-82	9.1-90.0	122.6
Sebastes atrovirens	kelp rockfish	4	68-90	5.6-16.4	39.8
Paralichthys californicus	California halibut	3	22-80	6.2-9.3	21.9
Citharichthys stigmaeus	speckled sanddab	2	70-79	5.5-6.4	11.9
Leptocottus armatus	Pacific staghorn sculpin	2	73-84	5.3-7.3	12.6
Porichthys myriaster	specklefin midshipman	2	80-82	9.9-12.1	22.0
Anisotremus davidsonii	sargo	1	64	7.4	7.4
Heterostichus rostratus	giant kelpfish	1	85	2.9	2.9
Strongylura exilis	California needlefish	1	400	66.0	66.0
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	1	555	1,508.0	1,508.0
Ophichthus zophochir	yellow snake eel	1	-	17.8	17.8
Urolophus halleri	round stingray	1	204	525	525.0
INVERTEBRATES					
Pachygrapsus crassipes	striped shore crab	4	10-30	1.3-4.8	9.2
Portunus xantusii	Xantus' swimming crab	3	40-50	2.2-11.9	19.4
	Total:	**287**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA047 **Survey Date: May 11 - 12, 2005**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Cymatogaster aggregata	shiner surfperch	89	33-112	0.7-39.2	1,120.1
Phanerodon furcatus	white surfperch	30	30-161	0.7-90.6	179.2
Atherinops affinis	topsmelt	20	45-145	0.7-74.5	232.0
Anchoa compressa	deepbody anchovy	11	75-110	4.1-15.2	103.7
Leptocottus armatus	Pacific staghorn sculpin	9	68-94	5.7-15.7	82.5
Seriphus politus	queenfish	8	71-91	4.6-12.5	64.5
Amphistichus argenteus	barred surfperch	4	53-62	3.7-6.0	18.1
Hyperprosopon argenteum	walleye surfperch	3	50-138	2.8-65.0	72.6
Leuresthes tenuis	California grunion	3	64-140	2.3-17.8	25.7
Porichthys myriaster	specklefin midshipman	3	179-422	258-1,141	1,729.3
Xenistius califoriensis	salema	3	56-70	3.7-7.4	18.1
Anchoa delicatissima	slough anchovy	2	60	2.3-2.4	4.7
Strongylura exilis	California needlefish	2	465-509	105-181	286.0
Anisotremus davidsonii	sargo	1	66	8.7	8.7
Engraulis mordax	northern anchovy	1	40	0.7	0.7
Hypsoblennius gentilis	bay blenny	1	40	1.5	1.5
Paralabrax maculatofasciatus	spotted sand bass	1	73	6.9	6.9
Paralabrax nebulifer	barred sand bass	1	76	8.7	8.7
Syngnathus leptorhynchus	bay pipefish	1	223	2.9	2.9
SHARKS/RAYS					
Urolophus halleri	round stingray	7	119-250	100-541	2,377.5
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	6	15-56	2.1-21.8	43.0
Pachygrapsus crassipes	striped shore crab	4	12-36	1.3-27.9	59.8
Octopus spp.	octopus	1	110	226.0	225.6
	Total:	**211**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA048 | **Survey Date: May 18 - 19, 2005**

Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Cymatogaster aggregata	shiner surfperch	211	30-127	0.5-34.9	782.1
Phanerodon furcatus	white surfperch	21	31-72	0.8-7.1	66.6
Anchoa compressa	deepbody anchovy	11	62-116	2.8-18.1	102.1
Hyperprosopon argenteum	walleye surfperch	11	33-117	0.8-31.2	69.0
Atherinops affinis	topsmelt	9	31-134	7.6-24.5	138.8
Porichthys myriaster	specklefin midshipman	9	245-315	167-392	2,419.8
Paralabrax nebulifer	barred sand bass	4	65-73	4.4-7.2	23.5
Seriphus politus	queenfish	4	70-83	4.8-8.4	25.2
Roncador stearnsi	spotfin croaker	3	59-76	3.5-7.4	16.9
Anchoa delicatissima	slough anchovy	2	65-77	3.4-4.8	8.2
Heterostichus rostratus	giant kelpfish	2	63-87	1.7-4.0	5.7
Leptocottus armatus	Pacific staghorn sculpin	2	68-69	6.2-6.7	12.9
Anchoa spp.	anchovy	1	-	1.8	1.8
Anisotremus davidsonii	sargo	1	74	10.3	10.3
Atractoscion nobilis	white seabass	1	155	37.2	37.2
Citharichthys stigmaeus	speckled sanddab	1	63	3.6	3.6
Hypsopsetta guttulata	diamond turbot	1	53	3.6	3.6
Leuresthes tenuis	California grunion	1	40	0.7	0.7
Paralichthys californicus	California halibut	1	50	1.5	1.5
Strongylura exilis	California needlefish	1	470	145.0	145.2
Syngnathus leptorhynchus	bay pipefish	1	221	1.9	1.9
Umbrina roncador	yellowfin croaker	1	95	14.1	14.1
SHARKS/RAYS					
Urolophus halleri	round stingray	13	74-200	23.7-504	3,456.7
INVERTEBRATES					
Pachygrapsus crassipes	striped shore crab	11	12-24	1.2-9.7	42.6
Portunus xantusii	Xantus' swimming crab	5	25-45	3.9-11.2	40.1
Cancer productus	red rock crab	1	24	2.2	2.2
Loxorhynchus crispatus	moss crab	1	5	0.2	0.2
Pugettia producta	northern kelp crab	1	20	5.2	5.2
Pugettia spp.	kelp crabs	1	23	6.3	6.3
	Total:	**332**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA049 **Survey Date: May 25 - 26, 2005**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Cymatogaster aggregata	shiner surfperch	94	33-110	0.9-30.1	539.1
Seriphus politus	queenfish	20	55-94	2.9-11.8	160.7
Anchoa compressa	deepbody anchovy	18	66-160	2.8-20.5	194.0
Atherinops affinis	topsmelt	14	47-132	1.0-32.8	151.8
Phanerodon furcatus	white surfperch	7	50-75	2.9-6.6	31.8
Hyperprosopon argenteum	walleye surfperch	6	55-147	3.6-88.1	184.8
Porichthys myriaster	specklefin midshipman	6	73-311	5.8-425	994.7
Leptocottus armatus	Pacific staghorn sculpin	5	73-95	7.7-15.4	54.1
Roncador stearnsi	spotfin croaker	5	90-337	13.3-780	840.5
Amphistichus argenteus	barred surfperch	3	54-70	4.7-6.8	18.1
Anchoa delicatissima	slough anchovy	2	61-63	2.7-3.1	5.8
Strongylura exilis	California needlefish	2	281-367	22.8-58.4	81.2
Anisotremus davidsonii	sargo	1	81	11.9	11.9
Rhacochilus vacca	pile surfperch	1	71	10.1	10.1
Embiotoca jacksoni	black surfperch	1	65	7.1	7.1
Engraulis mordax	northern anchovy	1	77	3.3	3.3
Paralabrax clathratus	kelp bass	1	65	4.8	4.8
Paralabrax maculatofasciatus	spotted sand bass	1	62	4.3	4.3
Paralabrax nebulifer	barred sand bass	1	111	30.4	30.4
Paralichthys californicus	California halibut	1	117	22.2	22.2
Sardinops sagax	Pacific sardine	1	165	47.7	47.7
Syngnathus spp.	pipefishes	1	85	0.2	0.2
SHARKS/RAYS					
Urolophus halleri	round stingray	2	119-176	87.3-378	465.1
Gymnura marmorata	California butterfly ray	1	395	581	580.9
INVERTEBRATES					
Pachygrapsus crassipes	striped shore crab	13	10-40	0.4-40.0	82.6
Portunus xantusii	Xantus' swimming crab	5	23-29	1.1-5.7	18.2
Cancer productus	red rock crab	2	26-30	2.5-3.7	6.2
	Total:	**215**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA050 **Survey Date: June 1 - 2, 2005**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Cymatogaster aggregata	shiner surfperch	140	27-110	1.2-29.4	693.4
Phanerodon furcatus	white surfperch	19	51-78	3.1-8.7	115.6
Atherinops affinis	topsmelt	11	86-130	4.6-26.9	105.4
Anchoa compressa	deepbody anchovy	9	76-105	4.8-14.2	90.2
Porichthys myriaster	specklefin midshipman	6	240-280	134-281	1,152.8
Seriphus politus	queenfish	6	38-81	0.7-7.6	17.7
Anchoa delicatissima	slough anchovy	5	35-67	0.8-3.2	8.2
Hyperprosopon argenteum	walleye surfperch	5	51-60	3.6-5.3	22.8
Paralichthys californicus	California halibut	4	40-155	2.9-41.1	106.3
Citharichthys stigmaeus	speckled sanddab	3	41-71	1.0-5.7	10.5
Paralabrax clathratus	kelp bass	3	57-75	3.8-6.2	15.8
Genyonemus lineatus	white croaker	2	82-86	9.0-10.7	19.7
Heterostichus rostratus	giant kelpfish	2	75-122	2.8-12.0	14.8
Paralabrax nebulifer	barred sand bass	2	63	4.2-5.9	10.1
Atractoscion nobilis	white seabass	1	441	980	980.0
Hypsopsetta guttulata	diamond turbot	1	55	3.0	3.0
Leuresthes tenuis	California grunion	1	51	1.1	1.1
Paralabrax maculatofasciatus	spotted sand bass	1	250	293.0	292.5
Sardinops sagax	Pacific sardine	1	40	1.0	1.0
SHARKS/RAYS					
Gymnura marmorata	California butterfly ray	2	226-339	119-274	393.0
Urolophus halleri	round stingray	2	171-297	276-460	735.7
Myliobatis californica	bat ray	1	940	975	975.0
Rhinobatos productus	shovelnose guitarfish	1	374	160.8	160.8
INVERTEBRATES					
Pachygrapsus crassipes	striped shore crab	10	12-25	1.5-3.6	26.9
Pyromaia tuberculata	tuberculate pea crab	4	10-18	1.0-3.3	7.8
Portunus xantusii	Xantus' swimming crab	2	30-37	3.9-8.6	12.5
Cancer spp.	cancer crabs	1	28	3.0	3.0
Majidae	spider crabs	1	13	1.8	1.8
Pugettia spp.	kelp crabs	1	11	0.9	0.9
	Total:	**247**			

Encina Power Station Impingement Abundance: Traveling Screen and Bar Rack Survey Data

Survey: EPSIA051 **Survey Date: June 8 - 9, 2005**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Cymatogaster aggregata	shiner surfperch	129	30-93	1.1-19.1	491.1
Atherinops affinis	topsmelt	28	18-209	0.8-51.2	366.3
Anchoa compressa	deepbody anchovy	14	24-82	0.4-7.3	28.5
Paralichthys californicus	California halibut	11	50-128	2.1-30.3	163.3
Engraulis mordax	northern anchovy	10	36-110	0.2-10.5	19.9
Seriphus politus	queenfish	10	68-110	4.6-19.2	95.4
Porichthys myriaster	specklefin midshipman	7	235-413	156-739	1,796.8
Phanerodon furcatus	white surfperch	4	48-67	3.2-7.6	19.6
Amphistichus argenteus	barred surfperch	3	60-74	5.5-10.9	25.7
Leptocottus armatus	Pacific staghorn sculpin	3	81-85	8.5-13.7	35.3
Strongylura exilis	California needlefish	3	368-534	42.3-225	430.6
Heterostichus rostratus	giant kelpfish	2	80-95	3.6-6.0	9.6
Sardinops sagax	Pacific sardine	2	131-132	23.7-25.6	49.3
Anchoa spp.	anchovy	1	-	8.5	8.5
Hyperprosopon argenteum	walleye surfperch	1	57	4.2	4.2
Hypsoblennius gentilis	bay blenny	1	69	6.4	6.4
Hypsopsetta guttulata	diamond turbot	1	54	3.7	3.7
SHARKS/RAYS					
Myliobatis californica	bat ray	2	206-255	188-290	477.8
Ophichthus zophochir	yellow snake eel	1	787	595.0	594.6
INVERTEBRATES					
Pachygrapsus crassipes	striped shore crab	5	18-20	0.9-5.5	13.0
	Total:	**239**			

Survey: EPSIA052 **Survey Date: June 15 - 16, 2005**
Sample Count: 19

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Cymatogaster aggregata	shiner surfperch	19	45-109	2.2-25.2	105.4
Engraulis mordax	northern anchovy	4	59-67	1.0-2.6	7.4
Porichthys myriaster	specklefin midshipman	3	230-290	142-243	594.3
Atherinops affinis	topsmelt	2	90-95	4.5-5.3	9.8
Heterostichus rostratus	giant kelpfish	2	61-95	1.3-5.6	6.9
Anchoa compressa	deepbody anchovy	1	-	4.2	4.2
Atractoscion nobilis	white seabass	1	340	411	411.0
Citharichthys stigmaeus	speckled sanddab	1	70	4.9	4.9
Paralabrax maculatofasciatus	spotted sand bass	1	300	761.0	761.4
Phanerodon furcatus	white surfperch	1	60	5.8	5.8
Seriphus politus	queenfish	1	50	1.6	1.6
INVERTEBRATES					
Pachygrapsus crassipes	striped shore crab	7	15-27	0.5-6.6	18.4
Portunus xantusii	Xantus' swimming crab	1	35	6.1	6.1
	Total:	**45**			

Encina Power Station Impingement Abundance: Heat Treatment Survey Data

Survey: EPSTS001
Survey Date: July 03-04, 2004

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Cymatogaster aggregata	shiner surfperch	6,554	47-115	2.9-31.1	31,301.3
Anchoa compressa	deepbody anchovy	6,439	65-120	2.2-20.5	61,726.7
Atherinops affinis	topsmelt	5,061	52-108	1.1-15.0	16,090.2
Sardinops sagax	Pacific sardine	4,401	47-106	0.8-8.5	8,798.2
Heterostichus rostratus	giant kelpfish	532	47-122	1.1-19.4	3,587.8
Atractoscion nobilis	white seabass	75	108-366	19.0-650	16,045.0
Girella nigricans	opaleye	72	44-221	3.0-390	6,223.0
Seriphus politus	queenfish	54	83-188	8.0-80.0	2,293.0
Strongylura exilis	California needlefish	53	102-630	1.0-480	806.0
Paralabrax maculatofasciatus	spotted sand bass	49	100-358	30.0-980	8,941.7
Embiotoca jacksoni	black surfperch	39	82-197	17.0-270	1,754.0
Porichthys myriaster	specklefin midshipman	28	124-403	140-820	8,733.0
Chromis punctipinnis	blacksmith	26	65-163	6.0-140	720.0
Hypsoblennius gentilis	bay blenny	26	40-91	3.0-25.0	354.3
Syngnathus spp.	pipefishes	25	128-251	1.0-3.0	29.3
Hypsoblennius spp.	blennies	23	35-54	1.0-3.0	46.7
Ophichthus zophochir	yellow snake eel	14	488-790	110-650	4,750.0
Roncador stearnsi	spotfin croaker	12	80-145	11.0-48.0	395.0
Hyperprosopon argenteum	walleye surfperch	8	78-150	12.0-60.0	366.0
Paralabrax nebulifer	barred sand bass	8	119-252	40.0-320	819.0
Hypsopsetta guttulata	diamond turbot	4	195-228	210-300	980.0
Hypsypops rubicundus	garibaldi	3	122-169	73.0-230	523.0
Trachurus symmetricus	jack mackerel	3	111-142	17.0-40.0	78.0
Umbrina roncador	yellowfin croaker	2	137-150	43.0-61.0	104.0
Xenistius califoriensis	salema	2	88-98	17.0-60.0	77.0
Anisotremus davidsonii	sargo	1	130	44.0	44.0
Cheilotrema saturnum	black croaker	1	48	3.0	3.0
Paraclinus integripinnis	reef finspot	1	49	3.0	3.0
Paralabrax clathratus	kelp bass	1	157	82.0	82.0
Pleuronichthys ritteri	spotted turbot	1	152	98.0	98.0
Scorpaenidae	scorpionfishes	1	122	62.0	62.0
Sphyraena argentea	California barracuda	1	91	5.0	5.0
SHARKS/RAYS					
Urolophus halleri	round stingray	439	125-230	100-700	118,655.1
Myliobatis californica	bat ray	64	221-660	140-4,700	29,566.1
Gymnura marmorata	California butterfly ray	12	240-550	120-950	4,321.8
Mustelus californicus	gray smoothhound	1	575	520	520.0
Triakis semifasciata	leopard shark	1	411	260	260.0
INVERTEBRATES					
Pachygrapsus crassipes	striped shore crab	49	32-46	22.0-45.0	269.0
Octopus spp.	octopus	20	-	2,500.0	2,500.0
Pyromaia tuberculata	tuberculate pea crab	19	-	-	-
Panulirus interruptus	California spiny lobster	1	176	120	120.0
Pugettia spp.	kelp crabs	1	42	26.0	26.0
	Total:	**24,127**			

Encina Power Station Impingement Abundance: Heat Treatment Survey Data

Survey: EPSTS002

Survey Date: August 28, 2004

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Anchoa compressa	deepbody anchovy	5,324	72-120	5.9-20.9	59,754.9
Atherinops affinis	topsmelt	3,201	51-100	1.0-10.6	17,701.4
Cymatogaster aggregata	shiner surfperch	2,801	56-104	5.0-24.5	28,011.1
Sardinops sagax	Pacific sardine	1,206	65-130	1.8-25.0	7,355.5
Leuresthes tenuis	California grunion	998	43-115	0.8-10.4	2,058.8
Heterostichus rostratus	giant kelpfish	299	78-185	2.9-53.6	3,440.4
Seriphus politus	queenfish	265	65-225	2.3-172.3	12,690.8
Atractoscion nobilis	white seabass	64	115-265	40.4-260.7	7,425.4
Cheilotrema saturnum	black croaker	38	64-155	4.8-53.2	617.9
Strongylura exilis	California needlefish	27	109-478	1.0-145.2	1,624.8
Paralabrax maculatofasciatus	spotted sand bass	20	43-335	1.5-925	7,724.0
Hypsoblennius jenkinsi	mussel blenny	18	39-95	0.8-14.7	97.8
Sciaenidae unid.	croaker	17	120-200	32.8-138.0	1,212.0
Chromis punctipinnis	blacksmith	15	55-165	7.0-105	458.8
Girella nigricans	opaleye	14	55-211	4.5-321	1,567.7
Scomber japonicus	Pacific mackerel	14	67-187	14.5-86.8	650.0
Hermosilla azurea	zebra perch	13	35-68	1.1-8.7	41.8
Hypsoblennius gentilis	bay blenny	11	42-95	1.4-15.5	99.5
Paralabrax nebulifer	barred sand bass	11	160-278	82.3-490	2,866.9
Syngnathus spp.	pipefishes	11	154-208	1.0-2.0	16.0
Ophichthus zophochir	yellow snake eel	10	262-900	7.6-750	4,045.4
Hypsoblennius gilberti	rockpool blenny	8	55-101	3.2-29.4	77.1
Paralichthys californicus	California halibut	8	201-322	142-600	2,482.0
Embiotoca jacksoni	black surfperch	7	70-345	15.0-500	1,049.7
Hypsoblennius spp.	blennies	7	45-85	1.3-10.5	20.6
Anisotremus davidsonii	sargo	6	38-180	1.0-142	389.3
Paralabrax spp.	sand bass	6	43-75	1.5-5.8	18.5
Xenistius califoriensis	salema	6	87-132	11.4-34.5	117.0
Atherinopsidae	silverside	5	47-55	1.1-2.9	11.3
Pleuronichthys ritteri	spotted turbot	5	197-220	200-250	1,158.0
Seriola lalandi	yellowtail jack	4	33-99	1.0-32.0	56.0
Sphyraena argentea	California barracuda	4	245-268	55.9-78.2	272.6
Trachurus symmetricus	jack mackerel	4	90-160	7.1-46.8	105.6
Engraulis mordax	northern anchovy	3	64-65	1.8-2.2	5.9
Porichthys myriaster	specklefin midshipman	3	255-328	151-260	586.0
Umbrina roncador	yellowfin croaker	2	150-165	43.9-63.3	107.2
unidentified fish, damaged	unidentified damaged fish	2	165-308	21.6-200	221.6
Hyperprosopon argenteum	walleye surfperch	1	140	64.2	64.2
Menticirrhus undulatus	California corbina	1	510	1,600.0	1,600.0
Paralabrax clathratus	kelp bass	1	138	48.6	48.6
Peprilus simillimus	Pacific butterfish	1	117	33.4	33.4
SHARKS/RAYS					
Urolophus halleri	round stingray	198	198-355	75.0-412	39,361.7
Myliobatis californica	bat ray	31	230-484	200-900	12,310.0
Gymnura marmorata	California butterfly ray	3	265-460	120-700	1,220.0
Mustelus californicus	gray smoothhound	2	805-905	1,400-1,600	3,000.0
Dasyatis dipterura	diamond stingray	1	274	850	850.0

(table continued)

Encina Power Station Impingement Abundance: Heat Treatment Survey Data

Survey: EPSTS002 (continued)
Survey Date: August 28, 2004

Taxon	**Common Name**	**Survey Count**	**Length Range (mm)**	**Weight Range (g)**	**Total Weight (g)**
INVERTEBRATES					
Lophopanopeus spp.	black-clawed crabs	26	10-16	0.3-1.8	27.1
Octopus spp.	octopus	17	27-470	1.1-450	1,851.3
Pachygrapsus crassipes	striped shore crab	15	17-35	2.3-24.1	139.7
Panulirus interruptus	California spiny lobster	6	180-211	125-229	944.9
Cancer spp.	cancer crabs	5	21-32	1.7-6.2	16.9
Pugettia producta	northern kelp crab	2	12.5-25	1.3-8.7	10.0
Pandalus spp.	unidentified shrimp	1	42	0.7	0.7
	Total:	**14,768**			

Encina Power Station Impingement Abundance: Heat Treatment Survey Data

Survey: EPSTS003
Survey Date: October 23, 2004

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Atherinopsis californiensis	jacksmelt	4,450	59-150	1.7-37.9	44,009.9
Leuresthes tenuis	California grunion	4,296	56-124	1.5-22.5	25,732.5
Anchoa compressa	deepbody anchovy	1,694	67-114	3.7-19.8	20,669.4
Xenistius califoriensis	salema	718	40-68	1.4-7.7	1,510.9
Cymatogaster aggregata	shiner surfperch	512	58-96	4.5-20.5	6,092.9
Sardinops sagax	Pacific sardine	507	65-242	3.2-150	6,274.8
Cheilotrema saturnum	black croaker	249	93-132	16.8-61.5	8,408.2
Paralabrax nebulifer	barred sand bass	207	55-173	4.5-160.7	4,308.5
Paralabrax maculatofasciatus	spotted sand bass	188	45-170	2.1-122.3	3,038.3
Anisotremus davidsonii	sargo	185	54-95	2.6-28.8	1,974.4
Paralabrax clathratus	kelp bass	128	28-96	0.6-23.2	876.0
Hyperprosopon argenteum	walleye surfperch	116	90-152	30.6-118.5	8,891.7
Atractoscion nobilis	white seabass	100	140-264	90.0-320	18,017.0
Hypsoblennius spp.	blennies	83	-	-	422.0
Hypsoblennius jenkinsi	mussel blenny	65	30-80	2.0-16.0	332.0
Engraulis mordax	northern anchovy	59	64-82	2.4-4.9	194.9
Heterostichus rostratus	giant kelpfish	58	80-200	5.1-79.4	1,531.1
Medialuna californiensis	halfmoon	49	43-117	2.5-54.6	1,278.5
Seriphus politus	queenfish	43	40-160	1.0-80.0	1,428.0
Hermosilla azurea	zebra perch	36	37-71	1.7-11.4	216.0
Sphyraena argentea	California barracuda	36	135-233	16.9-74.4	1,250.4
Girella nigricans	opaleye	24	49-256	2.8-740	6,270.3
Seriola lalandi	yellowtail jack	17	80-194	7.8-145.7	922.3
Strongylura exilis	California needlefish	17	400-574	80.0-360	2,650.0
Ophichthus zophochir	yellow snake eel	13	560-790	170-520	4,589.0
Phanerodon furcatus	white surfperch	11	69-120	8.6-39.3	195.0
Chromis punctipinnis	blacksmith	10	47-83	6.1-13.1	96.2
Hyperprosopon spp.	surfperch	7	-	-	552.0
Embiotoca jacksoni	black surfperch	6	78-163	13.7-171.1	525.3
Fundulus parvipinnis	California killifish	3	-	-	6.9
Menticirrhus undulatus	California corbina	3	210-340	110-550	860
Amphistichus argenteus	barred surfperch	1	96	25.4	25.4
Hyporhamphus rosae	California halfbeak	1	-	-	-
Mugil cephalus	striped mullet	1	152	53.9	53.9
Pleuronichthys ritteri	spotted turbot	1	185	180	180.0
Sarda chiliensis	Pacific bonito	1	340	540	540.0
Scomber japonicus	Pacific mackerel	1	250	230	230.0
Trachurus symmetricus	jack mackerel	1	144	39.6	39.6
SHARKS/RAYS					
Urolophus halleri	round stingray	55	230-350	130-560	13,610.0
Myliobatis californica	bat ray	4	280-480	320-1,700	2,930.0
Mustelus californicus	gray smoothhound	1	790	1,500.0	1,500.0
INVERTEBRATES					
Pachygrapsus crassipes	striped shore crab	375	20-40	1.5-10.1	2,489.6
Octopus bimaculatus	California two-spot octopus	74	-	2.1-230	2,805.9
Octopus spp.	octopus	36	-	1,562.0	1,562.0
Cancer antennarius	brown rock crab	18	-	18.0	18.0
Cancer productus	red rock crab	11	15-55	1.2-10.5	40.0
Pilumnus spinohirsutus	retiring hairycrab	4	9-23	0.6-2.5	4.6
Pugettia producta	northern kelp crab	4	21-28	1.7-4.3	11.3
Portunus xantusii	Xantus' swimming crab	2	45	4.0-6.1	10.1
Panulirus interruptus	California spiny lobster	1	21	8.1	8.1
	Total:	**14,482**			

Encina Power Station Impingement Abundance: Heat Treatment Survey Data

Survey: EPSTS004
Survey Date: February 13-14, 2005

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Atherinops affinis	topsmelt	3,847	62-151	1.5-90.0	17,444.3
Atherinopsidae	silverside	2,100	-	-	8,650.0
Hyperprosopon argenteum	walleye surfperch	1,828	110-177	34.9-135	80,128.0
Atractoscion nobilis	white seabass	1,375	104-352	65.5-600	289,213.3
Anchoa compressa	deepbody anchovy	643	58-122	1.9-18.8	5,786.5
Xenistius califoriensis	salema	602	43-70	1.4-10.0	2,102.3
Sardinops sagax	Pacific sardine	437	45-184	1.6-71.0	3,190.0
Paralabrax nebulifer	barred sand bass	416	50-127	2.4-43.4	3,323.5
Cymatogaster aggregata	shiner surfperch	343	11-134	1.1-72.8	10,082.7
Leuresthes tenuis	California grunion	330	56-82	1.4-4.8	706.0
Paralabrax clathratus	kelp bass	293	53-102	2.2-20.5	2,397.8
Hypsoblennius gentilis	bay blenny	288	38-102	1.3-23.7	1,334.3
Paralabrax maculatofasciatus	spotted sand bass	271	43-265	1.4-440	3,222.3
Anisotremus davidsonii	sargo	195	49-352	3.4-1,300	33,558.2
Girella nigricans	opaleye	171	28-240	1.6-510	2,674.8
Seriphus politus	queenfish	57	38-292	0.1-225	641.0
Atherinopsis californiensis	jacksmelt	18	112-299	10.9-210	1,142.0
Roncador stearnsi	spotfin croaker	13	238-555	300-3,400	13,831.0
Hypsopsetta guttulata	diamond turbot	12	36-246	1.0-350	2,694.6
Syngnathus spp.	pipefishes	12	146-233	0.3-4.4	20.5
Chromis punctipinnis	blacksmith	11	46-102	2.2-79.5	179.2
Ophichthus zophochir	yellow snake eel	11	394-758	32.7-470	3,222.7
Embiotoca jacksoni	black surfperch	10	105-255	40.9-600	1,403.2
Amphistichus argenteus	barred surfperch	9	96-227	27.3-377.6	680.4
Heterostichus rostratus	giant kelpfish	9	90-225	5.1-110.0	322.1
Genyonemus lineatus	white croaker	8	80-95	8.2-14.3	68.8
Anchoa delicatissima	slough anchovy	7	51-60	0.9-1.9	9.7
Chub, unid.	unid. chub	7	68-81	4.5-7.8	43.7
Hermosilla azurea	zebra perch	7	50-365	2.8-590	2,481.3
Brachyistius frenatus	kelp surfperch	6	76-120	11.0-55.8	198.4
Engraulis mordax	northern anchovy	6	80-125	3.8-15.2	54.1
Pleuronichthys ritteri	spotted turbot	5	200-230	215-250	1,145.0
Mugil cephalus	striped mullet	4	345-400	800-1,100	3,800.0
Phanerodon furcatus	white surfperch	4	112-126	37.7-55.0	190.4
Umbrina roncador	yellowfin croaker	4	185-280	70.0-300	730.0
Paraclinus integripinnis	reef finspot	3	58-70	2.0-4.0	9.2
Paralichthys californicus	California halibut	3	222-350	113-700	1,433.0
Sphyraena argentea	California barracuda	3	167-222	21.9-65.0	127.6
Trachurus symmetricus	jack mackerel	3	95-110	10.0-17.0	42.4
Fundulus parvipinnis	California killifish	2	7.5-7.8	0.4	0.8
Porichthys myriaster	specklefin midshipman	2	395-396	820-900	1,720.0
Strongylura exilis	California needlefish	2	480-490	120-150	270.0
Albula vulpes	bonefish	1	380	900	900.0
Citharichthys spp.	sanddabs	1	-	3.4	3.4
Medialuna californiensis	halfmoon	1	234	410	410.0
Sarda chiliensis	Pacific bonito	1	-	0.1	0.1
Scorpaenidae	scorpionfishes	1	44	1.9	1.9
unidentified fish, damaged	unidentified damaged fish	-	-	-	1,543.2

(table continued)

Encina Power Station Impingement Abundance: Heat Treatment Survey Data

Survey: EPSTS004 (continued)
Survey Date: February 13-14, 2005

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
SHARKS/RAYS					
Urolophus halleri	round stingray	10	135-245	101-530	2,576.1
Myliobatis californica	bat ray	4	335-460	200-1,500	3,130.0
Gymnura marmorata	California butterfly ray	2	430-450	800	1,600.0
INVERTEBRATES					
Portunus xantusii	Xantus' swimming crab	44	20-67	1.1-34.4	337.5
Cancer jordani	hairy rock crab	18	28-47	3.2-16.3	85.5
Octopus bimaculatus	California two-spot octopus	11	19-180	12-590	2,424.3
Pachygrapsus crassipes	striped shore crab	9	13-23	1.0-4.4	16.6
Cancer antennarius	brown rock crab	8	40-50	14.9-27.8	138.2
Cancer magister	dungeness crab	1	50	18.1	18.1
Caridean unid.	unidentified shrimp	1	-	-	-
Octopus spp.	octopus	1	30	300	300.0
Pandalus spp.	unidentified shrimp	1	12	2.3	2.3
Panulirus interruptus	California spiny lobster	1	93	150	150.0
Pugettia producta	northern kelp crab	1	17	1.8	1.8
	Total:	**13,494**			

Encina Power Station Impingement Abundance: Heat Treatment Survey Data

Survey: EPSTS005
Survey Date: April 10, 2005

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Cymatogaster aggregata	shiner surfperch	2,372	90-120	18.0-46.0	93,799.4
Leuresthes tenuis	California grunion	1,443	75-145	3.5-37.9	12,351.6
Anchoa compressa	deepbody anchovy	1,112	58-120	2.0-21.0	10,598.8
Paralabrax nebulifer	barred sand bass	508	54-97	2.6-98.0	4,270.9
Seriphus politus	queenfish	306	56-152	3.1-49.6	2,284.2
Hyperprosopon argenteum	walleye surfperch	298	101-167	30.2-119	19,132.6
Paralabrax clathratus	kelp bass	181	50-94	3.4-18.3	1,546.0
Anisotremus davidsonii	sargo	180	55-100	3.6-30.3	22,582.2
Paralabrax maculatofasciatus	spotted sand bass	139	50-185	3.0-140.3	2,564.2
Hypsoblennius jenkinsi	mussel blenny	92	25-90	1.1-11.6	516.3
Umbrina roncador	yellowfin croaker	90	73-290	7.4-474.2	20,568.5
Xenistius califoriensis	salema	90	50-74	2.1-7.4	409.2
Girella nigricans	opaleye	72	33-197	1.4-309	13,859.1
Hypsopsetta guttulata	diamond turbot	51	75-260	11.2-424	11,199.9
Hypsoblennius gentilis	bay blenny	27	65-105	4.5-23.5	172.7
Porichthys myriaster	specklefin midshipman	24	320-440	100-1,300	20,380.0
Amphistichus argenteus	barred surfperch	19	110-130	26.2-66.4	1,562.7
Chromis punctipinnis	blacksmith	12	60-115	6.4-41.2	294.7
Brachyistius frenatus	kelp surfperch	9	95-145	20.9-65.7	324.9
Strongylura exilis	California needlefish	9	336-490	45.5-148.4	733.3
Engraulis mordax	northern anchovy	7	67-120	2.9-16.5	41.6
Hermosilla azurea	zebra perch	6	104-249	16.2-535	778.7
Syngnathus spp.	pipefishes	5	160-340	1.4-12.5	20.4
Roncador stearnsi	spotfin croaker	4	85-285	10.5-407	574.8
Atractoscion nobilis	white seabass	3	251-320	211-440	1,010.5
Embiotoca jacksoni	black surfperch	3	55-138	5.0-103	199.6
Leptocottus armatus	Pacific staghorn sculpin	3	60-65	3.0-5.0	12.9
Medialuna californiensis	halfmoon	3	117-147	43.6-77.6	175.5
Trachurus symmetricus	jack mackerel	3	115-430	15.9-270	360.5
Ophichthus zophochir	yellow snake eel	2	379-664	29.4-319	348.7
Citharichthys stigmaeus	speckled sanddab	1	115	29.5	29.5
Fundulus parvipinnis	California killifish	1	53	3.2	3.2
Genyonemus lineatus	white croaker	1	79	10.0	10.0
Halichoeres semicinctus	rock wrasse	1	124	32.5	32.5
Heterostichus rostratus	giant kelpfish	1	176	46.1	46.1
Menticirrhus undulatus	California corbina	1	305	430	430.0
Phanerodon furcatus	white surfperch	1	115	56.0	56.0
Pleuronichthys ritteri	spotted turbot	1	175	163.7	163.7
Pleuronichthys verticalis	hornyhead turbot	1	55	3.7	3.7
SHARKS/RAYS					
Urolophus halleri	round stingray	25	100-450	50.0-634	8,199.8
Gymnura marmorata	California butterfly ray	12	256-568	150-1,714	6,682.1
Myliobatis californica	bat ray	6	258-420	230-2,189	5,049.5
Heterodontus francisci	horn shark	1	460	850	850.0
Mustelus californicus	gray smoothhound	1	975	1,800.0	1,800.0

(table continued)

Encina Power Station Impingement Abundance: Heat Treatment Survey Data

Survey: EPSTS005 (continued)
Survey Date: April 10, 2005

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
INVERTEBRATES					
Pachygrapsus crassipes	striped shore crab	38	8-43	0.1-45.1	125.2
Cancer spp.	cancer crabs	31	20-30	1.2-3.4	70.4
Portunus xantusii	Xantus' swimming crab	13	20-50	2.1-18.1	95.4
Octopus bimaculatus	California two-spot octopus	6	25-80	5.6-100	233.7
Pugettia producta	northern kelp crab	2	20-30	4.0-11.5	15.5
Cancer antennarius	brown rock crab	1	46	14.2	14.2
Crangon nigromaculata	spotted bay shrimp	1	60	3.7	3.7
	Total:	**7,219**			

Encina Power Station Impingement Abundance: Heat Treatment Survey Data

Survey: EPSTS006
Survey Date: June 05, 2005

Taxon	Common Name	Survey Count	Length Range (mm)	Weight Range (g)	Total Weight (g)
FISHES					
Anchoa compressa	deepbody anchovy	8,144	29-130	1.3-24.3	95,729.6
Cymatogaster aggregata	shiner surfperch	5,779	37-100	1.1-28.1	50,780.1
Atherinops affinis	topsmelt	3,587	30-105	0.2-12.5	16,261.1
Paralabrax maculatofasciatus	spotted sand bass	869	52-204	3.2-255	82,072.6
Paralabrax nebulifer	barred sand bass	843	60-115	5.4-42.0	17,169.5
Anisotremus davidsonii	sargo	396	44-135	1.2-42.6	9,980.1
Paralabrax clathratus	kelp bass	372	45-136	2.1-63.1	8,328.2
Hyperprosopon argenteum	walleye surfperch	296	20-159	0.3-300	16,851.8
Seriphus politus	queenfish	204	26-170	2.1-105	2,053.4
Porichthys myriaster	specklefin midshipmar	161	190-440	49.3-1,085	35,440.5
Xenistius califoriensis	salema	159	45-175	4.7-60.5	1,937.9
Hypsoblennius gentilis	bay blenny	88	50-100	2.4-19.0	853.0
Chromis punctipinnis	blacksmith	77	60-186	8.0-100	2,682.2
Roncador stearnsi	spotfin croaker	77	85-140	15.1-55.2	2,359.5
Strongylura exilis	California needlefish	50	260-543	28.4-294	5,815.3
Hypsopsetta guttulata	diamond turbot	45	121-300	146-374	9,509.2
Phanerodon furcatus	white surfperch	37	60-100	5.0-23.1	381.5
Umbrina roncador	yellowfin croaker	29	95-125	16.3-42.7	889.7
Sardinops sagax	Pacific sardine	27	70-178	1.8-56.5	648.0
Engraulis mordax	northern anchovy	17	36-129	0.7-19.4	77.5
Menticirrhus undulatus	California corbina	11	125-388	30.4-806	2,034.7
Fundulus parvipinnis	California killifish	10	-	-	30.2
Paralichthys californicus	California halibut	10	72-264	6.7-172	854.2
Heterostichus rostratus	giant kelpfish	9	60-203	1.1-75.2	160.8
Amphistichus argenteus	barred surfperch	5	60-160	6.2-75.2	259.3
Embiotoca jacksoni	black surfperch	4	65-155	15.2-151	435.1
Syngnathus spp.	pipefishes	3	20-217	0.4-1.8	3.8
Brachyistius frenatus	kelp surfperch	2	115-130	23.1-51.9	75.0
Girella nigricans	opaleye	2	160-180	87.6-140.9	228.5
Hypsypops rubicundus	garibaldi	2	222-232	668-705	1,373.7
Leptocottus armatus	Pacific staghorn sculpin	2	75	5.2-8.3	13.5
Sphyraena argentea	California barracuda	2	95-105	4.7-6.6	11.3
Atractoscion nobilis	white seabass	1	252	345.0	344.8
Ophichthus zophochir	yellow snake eel	1	650	347	347.0
Pleuronichthys verticalis	hornyhead turbot	1	197	248.0	247.7
Trachurus symmetricus	jack mackerel	1	200	75.8	75.8
Zoarcidae	eelpouts	1	152	17.1	17.1
SHARKS/RAYS					
Urolophus halleri	round stingray	363	105-239	54.3-800	118,389.8
Gymnura marmorata	California butterfly ray	41	244-609	182-1,629	22,997.3
Myliobatis californica	bat ray	23	226-649	205-1,925	15,585.9
Mustelus californicus	gray smoothhound	17	460-882	225-2,100	13,056.0
Dasyatis dipterura	diamond stingray	1	275	618.0	617.6
Triakis semifasciata	leopard shark	1	455	428.0	428.4
INVERTEBRATES					
Cancer productus	red rock crab	491	10-55	1.8-12.8	2,835.9
Pachygrapsus crassipes	striped shore crab	8	19-29	3.7-10.5	61.3
Majidae	spider crabs	6	10-15	2.1-5.2	20.2
Octopus spp.	octopus	2	20-45	9.7-86.2	95.9
Pugettia producta	northern kelp crab	2	22-30	2.4-5.4	7.8
	Total:	**22,279**			