Southland, L.L.C.

11 October 2006

Mr. Gerard J. Thibeault
Executive Officer
California Regional Water Quality Control Board
Santa Ana Region
3737 Main Street, Suite 500
Riverside, California 92501-3348

Re: **AES Huntington Beach Generating Station**
Proposal for Determination of 316(b) Calculation Baseline

Dear Mr. Thibeault:

The NPDES permit for the AES Huntington Beach Generating Station requires the following:

"By October 14, 2006, the Discharger shall submit for approval by the Executive Officer a proposed methodology to determine the calculation baseline for entrainment and impingement reductions (see VI.C.7.b.) That methodology shall be implemented upon approval." – NPDES permit CA0001163, VI(C)(2)(e).

Per this requirement, we submit the following methodology for determination of the 316(b) Calculation Baseline for the AES Huntington Beach Generating Station. This methodology is consistent with the requirements and language in EPA's 316(b) Phase II Final Regulations.

Entrainment:

Larval fish and invertebrate densities recorded during the 2003-4 AES Huntington Beach Generating Station Entrainment and Impingement Study will be the basis for determination of an entrainment estimate. The average concentration of each taxonomic group from each of the 45 entrainment surveys will be multiplied by the average cooling water flow during 2004-5 for the corresponding survey period to estimate total entrainment for each taxa during each survey period.

The years 2004-5 were chosen since they represent the period after the Units 3&4 retool project. Calculations using cooling water flow prior to that period may underestimate entrainment since Units 3&4 were not operational.

Impingement:

Impingement densities recorded during the 2003-4 AES Huntington Beach Generating Station Entrainment and Impingement Study will be the basis for determination of an impingement estimate. During that study, a total of 52 normal operation and 6 heat treatment impingement surveys were conducted.

Similar to entrainment data analysis, impingement densities will be adjusted based on recent cooling water flow volumes (2004-5). For normal operation impingement samples, the impingement rate for each weekly survey (from 2003-4) will be multiplied by the average

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weekly cooling water flow for the corresponding week from calendar years 2004-5 to estimate total impingement for each taxa during each survey period. Since average cooling water flow during 2004-5 represented 92% of cooling water flow during 2003-4, heat treatment results will be multiplied by 0.92 to reflect current conditions.

The velocity cap on the AES Huntington Beach cooling water intake is recognized by EPA as an impingement control technology. To account for the reduction in impingement mortality provided by the velocity cap, the results of a site-specific study will be used to adjust impingement estimates for the Calculation Baseline. This study was conducted by the University of Washington College of Fisheries, who determined an average reduction in impingement afforded by the velocity cap of approximately 82%. Therefore, the total impingement will be divided by 0.18 to estimate the impingement mortality in the absence of the velocity cap.

Closing:

The proposed methodology for determination of Calculation Baseline, including sample calculations, was submitted to the Santa Ana Regional Water Quality Control Board in August 2006. A copy of that document is attached for your reference. We feel this methodology is consistent with EPA's 316(b) Phase II requirements.

All information required by Section 316(b) will be submitted with the AES Huntington Beach Generating Station's Comprehensive Demonstration Study.

Please let me know if you have any questions.

Respectfully,

Steve Maghy
Environmental Manager
AES Southland LLC

cc: June Martirez
Joanne Schneider
Ken Theisen

:Enclosure

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AES HUNTINGTON BEACH GENERATING STATION IMPINGEMENT MORTALITY AND ENTRAINMENT SUMMARY

August 2006

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EXECUTIVE SUMMARY

AES Huntington Beach LLC submitted the Section 316(b) Proposal for Information Collection (PIC) to the Santa Ana Regional Water Quality Control Board in fall 2005. In the PIC, AES Huntington Beach LLC proposed using data from the 2003-4 Huntington Beach Entrainment and Impingement Study (MBC and Tenera 2005) for both the Impingement Mortality and Entrainment (IM&E) characterization and determination of baseline levels of IM&E required under the new 316(b) rules for existing power plants that were published in July 2004. The IM&E study at HBGS was conducted during 2003 and 2004 with weekly impingement sampling starting in late-July 2003 and continuing through July 2004 and entrainment sampling in the immediate proximity of the cooling water intake occurring twice monthly in September and October 2003, weekly from November 2003 through July 2004, and twice during August 2004. The 2003-4 Huntington Beach Entrainment and Impingement Study was one of the most comprehensive studies of the effects of a coastal generating station ever performed in southern California.

This report presents total impingement estimates calculated using survey-specific impingement rates from the 2003-4 Huntington Beach Entrainment and Impingement Study and average weekly cooling water volumes reported for calendar years 2004-5. Similarly, survey specific entrainment estimates were calculated and used to estimate total entrainment during each survey period. Species-specific impingement and entrainment abundances (and biomass for impingement) were summed across all survey periods. All fish species recorded during the study were included in the calculations, and all macroinvertebrate species meeting the definition of shellfish were included in the calculations for impingement, while a select list of shellfish larvae (selected by a technical working group) were included for entrainment.

Approximately 46,002 fish weighing 1,183.131 kg and 15,123 shellfish weighing 136 kg were estimated to be impinged based on the impingement 2003-4 data and average weekly cooling water volumes reported for calendar years 2004-5. The calculated impingement representative of calendar years 2004-5 was compared against the theoretical no-velocity cap impingement baseline. Data was mathematically transformed according to impingement reductions documented by the Thomas et al. (1980) during experimental evaluations of the velocity cap effect on entrapment at the HBGS. Entrainment estimates from the 2003-4 study, which were calculated assuming maximum cooling water flow, were adjusted for actual flow volumes recorded during 2004-5. An estimated 255,567 fish weighing 6,573 kg would have been impinged without a velocity-capped intake. Shellfish were not included in the Thomas et al. (1980) study, so adjustments based on velocity cap effectiveness were not made.

The total estimated annual entrainment of fish larvae from data collected during the study and using average daily flows from 2004 and 2005 was calculated to be approximately 275 million larvae based on a total cooling water volume of 475 million m^3. The most abundant fish larvae were unidentified gobies, anchovies and several different species of croakers, including spotfin croaker, queenfish, and white croaker. Entrainment abundances were highest in late summer 2004 when densities were approximately five times greater than earlier months. Entrainment samples were also processed for the following shellfish larvae: *Cancer* crab megalops stage larvae, California spiny lobster phyllosome stage larvae, ridgeback shrimp (*Sicyonia*) mysid stage larvae, sand crab megalops stage larvae and squid larvae. Total annual entrainment for the selected shellfish larvae was estimated to be approximately 6.6 million, while annual entrainment of early zoeal-stage sand crab larvae was estimated at almost 370 million.

No baseline calculation adjustments were done for entrainment as no entrainment reduction technologies at the HBGS have been implemented similar to the velocity cap. The final entrainment levels against which the entrainment estimates presented in this report are compared have not been determined.

INTRODUCTION

From July 2003 to September 2004, impingement and entrainment of fishes and shellfishes was monitored at the AES Huntington Beach Generating Station (HBGS) as required by Conditions of Certification from the California Energy Commission (CEC). In July 2004, the United States Environmental Protection Agency published the second phase of new regulations for Section 316(b) of the Federal Clean Water Act (CWA) for existing power plants with once-through cooling systems with flow volumes in excess of 50 million gallons per day (mgd) (Phase II facilities). The Phase II regulations set performance standards for reducing impingement mortality and entrainment (IM&E) due to once-through cooling and provide five options for meeting the IM&E standards. The Phase II regulations also require submittal of a Proposal for Information Collection (PIC) that includes a description of the data or studies that will be used in demonstrating compliance under the new regulations. In the PIC submitted to the Santa Ana Regional Water Quality Control Board in fall 2005, AES Huntington Beach LLC proposed using data from the 2003-4 Huntington Beach Entrainment and Impingement Study (MBC and Tenera 2005) for the IM&E characterization. The 2003-4 Huntington Beach Entrainment and Impingement Study (MBC and Tenera 2005) study was one of the most comprehensive studies on the effects of power plant once-through cooling ever conducted in southern California. The sampling design was based on entrainment and impingement studies conducted at the Diablo Canyon Power Plant, Morro Bay Power Plant, and Moss Landing Power Plant (Tenera 2000a, 2000b, 2001). The study was conducted with the assistance of a Biological Resources Research Team (BRRT), which consisted of AES Huntington Beach L.L.C. representatives and their consultants, and regulatory agency staff and consultants from the California Energy Commission, National Marine Fisheries Service, California Department of Fish and Game, Santa Ana Regional Water Quality Control Board, U.S. Fish and Wildlife Service. This report presents the IM&E characterization using those data.

The PIC also proposed that the data from the 2003-4 study would be used for calculating the baseline levels (“Calculation Baseline”) that will be used for determining compliance with the performance standards set in the new rule. The baseline levels of IM&E are the levels that would occur using a once-through cooling water intake system with the opening located at the shoreline near the surface of the source waterbody with standard vertical 3/8-inch mesh traveling screens and in the absence of any operational controls or technologies implemented in whole or in part for the purposes of reducing IM&E.

Cooling water for the HBGS is withdrawn from the ocean waters directly offshore from the generating station through a submerged, velocity-capped intake. A total of eight circulating water pumps withdraw a maximum of approximately 1,919,000 m^3 (507 mgd) at HBGS Units 1-4. Thomas et al. (1980) examined the effectiveness of the velocity cap in reducing entrapment of juvenile and adult fishes during 1979 and 1980. Shellfish and macroinvertebrates were not included in that study. To simulate a non-velocity-capped intake, the circulating water flow direction was reversed by manipulation of in-plant cross-over gates, resulting in withdrawal of seawater through the offshore discharge structure, which resembles the intake without a velocity cap. Standard operation of the cooling water system, withdrawing water through the velocity-capped intake, was used as the control treatment. Fish densities in the vicinity of the intake were calculated by hydroacoustic surveys in conjunction with lampara sampling to estimate the species composition of the acoustic targets. Simultaneous in-plant sampling involved clearing the forebay every hour. All fish impinged during/after each forebay clearing event were identified to species and weighed to the nearest kilogram (kg). Day and night surveys were conducted to assess diel variation. Surveys in 1979 recorded a mean reduction in entrapment of 72%, while this value rose to 93% in 1980. The mean effectiveness in reducing entrapment was calculated across all surveys.

The objective of this reevaluation of the MBC and Tenera (2005) dataset is to present the IM&E characterization and data for the IM&E Calculation Baseline for the HBGS 316(b) Comprehensive Demonstration Study (CDS).

METHODS

Study Design

The impingement and entrainment study was designed to estimate losses of fishes and shellfish due to operation of the cooling water system of the AES Huntington Beach Generating Station (HBGS). The sampling methodologies and analysis techniques were derived from recent impingement and entrainment studies conducted for the Diablo Canyon Power Plant, Morro Bay Power Plant, and Moss Landing Power Plant (Tenera 2000a, 2000b, 2001). Similar projects were performed nation-wide in the last 25 years to comply with Section 316(b) of the Federal Clean Water Act, including the 1996–1999 study at the Diablo Canyon Power Plant. The study design was developed and the study conducted under a Biological Resources Research Team (BRRT), which consisted of AES Huntington Beach L.L.C. representatives and their consultants, and regulatory agency staff and consultants from the California Energy Commission, National Marine Fisheries Service, California Department of Fish and Game, Santa Ana Regional Water Quality Control Board, U.S. Fish and Wildlife Service. A final study plan that incorporated the comments from the BRRT was published in July 2003.

For the Huntington Beach impingement study, impingement samples were collected from the screening facility within the generating station. For the entrainment study, the numbers of fishes and target invertebrates entrained by the generating station were estimated from plankton samples collected just offshore of the intake structure. Samples collected at the entrainment station and at six other stations extending 4 km upcoast, downcoast, and offshore the intake structure, were used to estimate the source water populations at risk of entrainment.

Target Organisms

All fishes were processed from both impingement and entrainment samples. All macroinvertebrate species meeting the definition of shellfish were processed from impingement, while a select list of shellfish larvae were processed from entrainment samples. The BRRT selected the following organisms for analysis (target organisms):

Vertebrates:

- Fishes (all life stages beyond egg)

Invertebrates:

- *Cancer* spp. (rock crab megalopal life stage)
- *Loligo opalescens* (market squid larvae)
- *Panulirus interruptus* (California spiny lobster phyllosoma larvae)
- *Sicyonia ingentis* (ridgeback rock shrimp phyllosoma larvae)
- *Emerita analoga* (sand crab larvae)

Fishes, rock crabs, and sand crabs were chosen because of their respective ecological roles and because some of them are commercially or recreationally important. Market squid, California spiny lobster, and ridgeback rock shrimp (ridgeback prawn) were selected because of their commercial and/or recreational importance in the area; these three species had the highest combined invertebrate biomass from 1999 through 2001 in the two California Department of Fish and Game (CDFG) catch blocks off Huntington Beach (CDFG 2002).

Impingement Sampling

There were two facets to the impingement study at HBGS: normal operation sampling and heat treatment sampling. Samples collected during normal operations were used to characterize fish loss from the day-to-day operation of the generating station. Normal operations samples were collected over a 24-hr period to determine the daily loss from operation of the CWIS. Samples were also collected during heat treatments, when waters within the CWIS were heated and essentially all fishes and invertebrates succumbed to the high temperatures. Heat treatment procedures were carried out at approximately eight-week intervals to control biofouling within the CWIS. Combined, normal operation and heat treatment samples were used to estimate the annual loss of juvenile and adult fishes and selected macroinvertebrates due to operation of the CWIS.

Normal Operation Impingement Sampling

MBC sampled fishes and macroinvertebrates impinged on traveling screens during normal operation of the HBGS on a weekly basis beginning in late-July 2003 and continuing through July 2004. Once per week, fish impingement samples were collected for one approximately 24-hr period in coordination with generating station operations personnel. Twenty-four hours prior to each survey, the screens were run and the accumulation basket emptied. The following day, traveling screens were operated for approximately 10 minutes, enough time to complete one rotation and sufficient to bring up any impinged organisms from the forebay for identification. Accumulated fishes, invertebrates, algae, and debris from the 24-hr sample were sorted, and fishes and macroinvertebrates were identified to species (whenever possible), enumerated and batch-weighed. Standard length of up to 200 individual fish of each species was measured, and sex of up to 50 individuals of selected species was determined by external morphology or inspection of gonads. Algae and shell debris were identified and batch-weighed by species. Station operation data (number of circulator pumps operating, intake temperature, and discharge temperature) and general weather conditions were recorded during sampling.

Circulating water flow through the plant during the 24-hr sample period was determined by consulting with plant personnel. Results from each weekly 24-hr impingement sample were extrapolated to a weekly impingement total using cooling water flow for the 7-day period (Saturday through Friday). The normal operation impingement total is the sum of the weekly extrapolations based on the cooling water flow of the HBGS.

Heat Treatment Impingement Sampling

MBC sampled fishes and macroinvertebrates impinged on traveling screens during all scheduled heat treatment operations at the HBGS. The results of all six heat treatments are presented in this analysis. Heat treatments are performed periodically (usually once every six to eight weeks) to control growth of fouling organisms in the cooling water system. During these procedures, a portion of the heated discharge water is circulated through the forebay and intake conduits, raising the water temperature to approximately 41°C (106°F), and marine life succumbs to the elevated temperature.

During each survey, traveling screens were run until no more fish were impinged on the traveling screens. Fishes, invertebrates, algae, and debris were sorted, and fish and invertebrates were identified to species (whenever possible), enumerated and batch-weighed. Standard length of up to 200 individual fish of each species was measured, and sex of up to 50 individuals of selected species was determined by external morphology or inspection of gonads. Algae and shell debris were identified and batch-weighed by species. Station operation data (number of circulator pumps operating, intake temperature, and discharge temperature) and general weather conditions were recorded during sampling.

Impingement Data Analysis

Normal operation impingement abundance and biomass (for both fish and shellfish) were standardized to an impingement rate reflecting the abundance (and biomass) per 100 million gallons (mg) of cooling water withdrawn. Equation 1 describes the formula used for deriving the survey-specific impingement rate (abundance per 100 mg). Cooling water flow was determined by multiplying the reported daily flow rate (converted to gallons per minute) by the total survey minutes at that respective flow rate. Often, flow rates changed day to day based on cooling demands dictated by electrical generating requirements. On these occasions, total minutes in each calendar day were calculated and multiplied by the reported cooling water flow volume for that calendar day. Impingement rates for biomass, in kilograms (kg), were derived using the same formula, substituting biomass for abundance.

Equation 1. Derivation of survey-specific impingement rate.

$$Abundance/100mg = \frac{Abundance}{Flow(mg)} X100$$

The impingement rate for each weekly survey derived from MBC and Tenera (2005) was multiplied by the mean weekly cooling water flow for the corresponding week from calendar years 2004-5 to estimate the impinged abundance (biomass) during normal conditions. Years 2004-5 were chosen since they represent the period of time since repowering of Units 3&4 and flows are representative of current and projected future operations; use of flow data prior to then would likely underestimate entrainment and impingement rates. Heat treatment abundance and biomass were adjusted based on differences in flow volumes between 2003-4 and the average annual cooling water flow for calendar years 2004-5. Estimated weekly abundance (biomass) was calculated for each fish and shellfish species, so as to minimize the inherent seasonal variability in species densities surrounding the intake structure. The sum across all weeks for each species approximated the annual species-specific abundance. Summation of all species-specific values estimated the total annual impingement.

Average annual flows during calendar years 2004-5 were 92% of the flow volume reported during the MBC and Tenera (2005) impingement study period. The total heat treatment abundances recorded by MBC and Tenera (2005) were adjusted by multiplying the species-specific abundances (biomass) by 0.92 to approximate current conditions.

All fish recorded by MBC and Tenera (2005) were included in the analysis, for both normal operation and heat treatment surveys, as well as cumulative totals. MBC and Tenera (2005) analyzed all recorded macroinvertebrates inclusively. For the current analysis, shellfish, defined as all crustaceans and cephalopod mollusks, were analyzed.

The velocity cap was in place for the duration of the MBC and Tenera (2005) study. To account for the reduction in fish impingement abundance provided by the velocity cap, the mean percent reduction derived by Thomas et al. (1980) was applied to the estimated fish impingement abundance for calendar years 2004-5. Species-specific impingement abundances (biomass) calculated for 2004-5 were divided by 0.18 (the mean velocity cap:no velocity cap ratio) to approximate the no-velocity-cap baseline abundance. No such adjustments were made to shellfish data.

Entrainment Sample Collection

To determine composition and abundance of ichthyoplankton entrained by the generating station, sampling in the immediate proximity of the cooling water intake was conducted twice monthly in September and October 2003, weekly from November 2003 through July 2004, and twice during August 2004. During each sampling event, two replicate tows at the entrainment station (Figure 1) were collected four times per 24-hr period—once every six hours. Sampling cycles were initiated at approximately 1200 hr, 1800 hr, 2400 hr, and 0600 hr. The second and fourth cycles were initiated to correspond with sunset and sunrise, respectively.

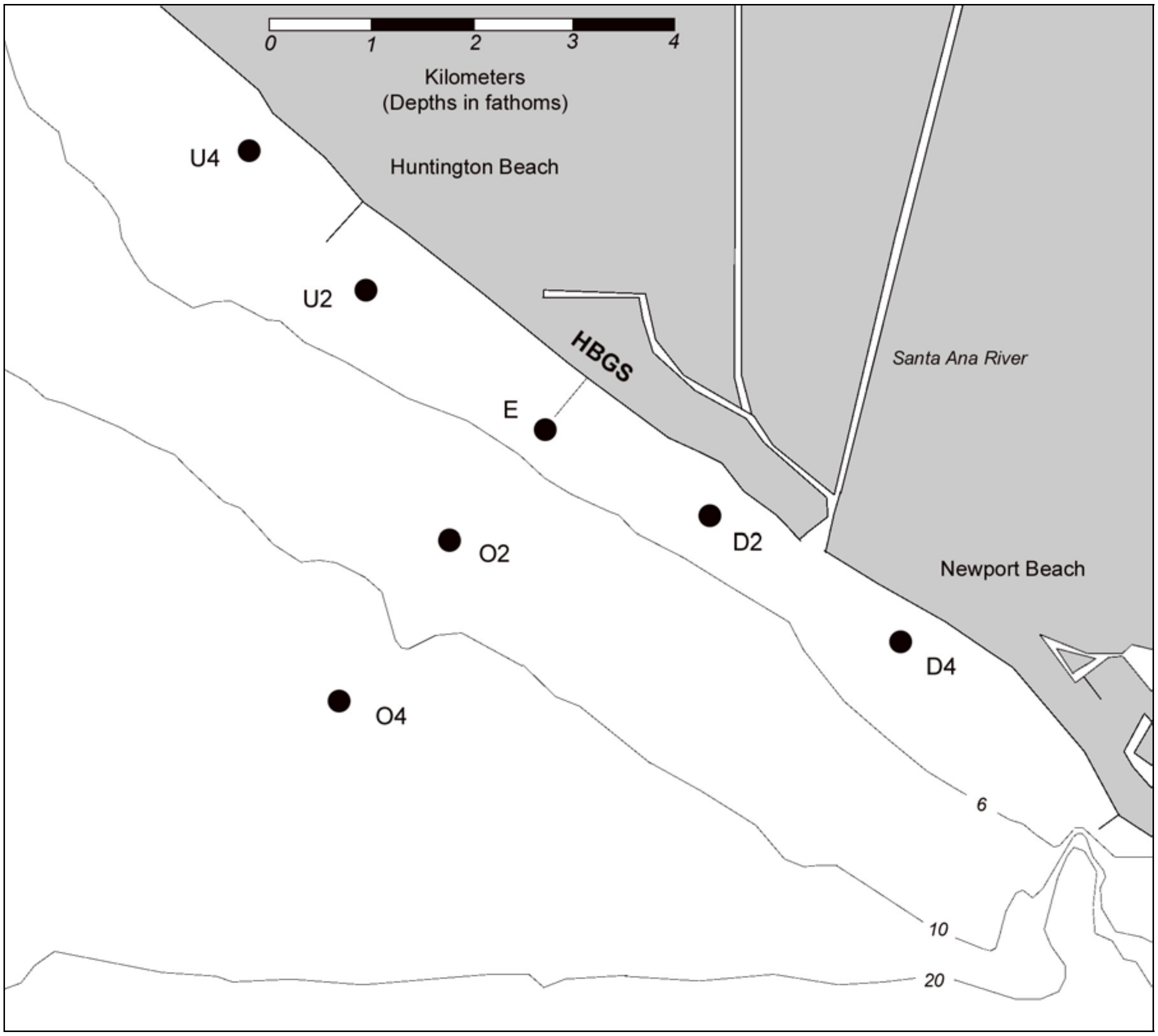

Figure 1. Location of entrainment (E) and source water sampling stations (U4, U2, D2, D4, O2, and O4), where U, D, and O, designates stations upcoast, downcoast, and offshore of the intake, respectively. Also shown are the 6-fathom (11-m), 10- fathom (18-m), and 20-fathom (36-m) isobaths.

Sampling was conducted offshore (within 100 m) of the submerged intake structure (Figure 1) using an oblique tow that sampled the water column from approximately 13 cm off the bottom and then back to the surface. Two replicate tows were taken with a minimum target sample volume of 30 to 40 m^3 for each net on the bongo frame. The net was redeployed if the target volume was not collected during the initial tow.

The wheeled bongo frame was fitted with 60-cm diameter net rings with plankton nets constructed of 333-mm Nitex® nylon mesh, similar to the nets used by the California Cooperative Oceanic Fisheries Investigations (CalCOFI). Each net was fitted with a Dacron sleeve and a cod-end container to retain the organisms. Each net was equipped with a calibrated General Oceanics® flowmeter, allowing the calculation of the amount of water filtered. At the end of each tow, nets were retrieved and the contents of the net gently rinsed into the cod-end with seawater. Contents were washed down from the outside of the net to avoid the introduction of plankton from the wash-down water. Samples were then carefully transferred to prelabeled jars with preprinted internal labels. Samples from one of the two nets were preserved in 4 percent buffered formalin-seawater, while contents of the other net were preserved in 70 to 80 percent ethanol.

Besides the entrainment station, source water sampling occurred at six additional source water stations located upcoast, downcoast, and offshore from the intake structure (Figure 1). Two source water stations were located 2 km and 4 km upcoast and downcoast from the intake on the intake isobath, and two stations were located approximately 1.5 km and 3 km offshore from the intake structure. Water depth at the upcoast and downcoast stations is similar to the depth at the intake (9.5 m) while the depth at the two offshore stations is approximately 14 m and 22 m. Tows were performed in the same manner as the entrainment tows (obliquely).

Entrainment Sample Laboratory Processing

Ichthyoplankton samples were returned to the laboratory, and after approximately 72 hours the samples preserved in 4 percent buffered formalin-seawater were transferred to 70–80 percent ethanol before processing. One net from each replicate was processed from the entrainment surveys. Only the samples initially preserved in formalin from the first of the two bimonthly source water surveys (November through July) were processed, with the samples from the second monthly survey archived for potential future sorting and analysis. Samples were examined under dissecting microscopes and fish larvae and targeted invertebrate larvae were separated from debris and other zooplankton. Larvae were identified to the lowest practical taxonomic level (species for most larvae) and enumerated.

Estimating Entrainment

Estimates of daily larval entrainment for the sampling period from September 2003 through August 2004 at HBGS were calculated from data collected at the entrainment station. The average concentration of each taxonomic group (taxa) from the samples from each survey was used with the average daily plant cooling water flow during 2004 and 2005 for the corresponding survey period to estimate total entrainment for each taxa for each survey period. The number of days within each survey period varied depending upon the sampling frequency and the days that the samples were collected.

RESULTS

Fish Abundance

Based on results from 2003-4 (MBC and Tenera 2005) adjusted for average cooling water flow from 2004 and 2005, a total of 46,002 fish representing 57 fish species were impinged during normal operation and six heat treatments (Table 1). Normal operation impingement accounted for 10,680 fish from 36 species, while heat treatments impinged an additional 35,322 fish representing 55 species. Queenfish (*Seriphus politus*) was the most abundant species in both normal operation and heat treatment surveys. An additional six species each accounted for 1.0% or more of the total, including white croaker (*Genyonemus lineatus*), shiner perch (*Cymatogaster aggregata*), northern anchovy (*Engraulis mordax*), white seaperch (*Phanerodon furcatus*), Pacific pompano (*Peprilus simillimus*), and walleye surfperch (*Hyperprosopon argenteum*). The remaining 50 species individually represented less than 1.0% percent of the total impinged abundance. Queenfish was also the most abundant species observed from just normal operations surveys. Following queenfish, northern anchovy was the next most abundant species observed during normal operation surveys, followed by, in order of decreasing abundance, white croaker, shiner perch, Pacific pompano, and specklefin midshipman (*Porichthys myriaster*) (Table 1). The remaining 30 species observed during normal operation surveys were each represented by less than 100 individuals. During heat treatments, three additional species were observed in abundances greater than 1,000 individuals annually: white croaker (4,259 individuals), shiner perch (3,524 individuals), and northern anchovy (1,259 individuals). The remaining 51 species each accounted for less than 730 individuals collected annually during heat treatments.

Table 1. Estimated fish impingement abundance during normal operations and heat treatments using average cooling water flows from 2004 and 2005. Annual totals reflect operation with and without a velocity cap.

Species	Estimated Normal Operation Abundance	Observed Heat Treatment Abundance	Total Abundance	Percent of Total Abundance	Est. No Velocity Cap Abundance	Est. Difference in Impinged Abundance
queenfish	8,540	23,349	31,889	69.3	177,161	145,272
white croaker	303	4,259	4,562	9.9	25,344	20,782
shiner perch	238	3,524	3,762	8.2	20,900	17,138
northern anchovy	693	1,259	1,952	4.2	10,844	8,892
white seaperch	95	726	821	1.8	4,561	3,740
Pacific pompano	129	432	561	1.2	3,117	2,556
walleye surfperch	31	410	441	1.0	2,450	2,009
jacksmelt	21	284	305	0.7	1,694	1,389
topsmelt	-	213	213	0.5	1,183	970
kelp bass	-	127	127	0.3	706	579
California grunion	32	84	116	0.3	644	528
Pacific sardine	80	35	115	0.2	639	524
specklefin midshipman	103	1	104	0.2	578	474
California scorpionfish	33	69	102	0.2	567	465
round stingray	55	44	99	0.2	550	451
barred sand bass	9	51	60	0.1	333	273
black perch	5	50	55	0.1	306	251
white seabass	9	45	54	0.1	300	246
black croaker	13	40	53	0.1	294	241
spotfin croaker	-	45	45	0.1	250	205
blacksmith	7	36	43	0.1	239	196
salema	9	32	41	0.1	228	187
spotted turbot	32	4	36	0.1	200	164
giant kelpfish	24	8	32	0.1	178	146
California corbina	-	30	30	0.1	167	137
California lizardfish	29	-	29	0.1	161	132
hornyhead turbot	26	1	27	0.1	150	123
bat ray	21	5	26	0.1	144	118
Pacific electric ray	26	-	26	0.1	144	118
California halibut	19	6	25	0.1	139	114
Pacific staghorn sculpin	20	3	23	0.0	128	105
speckled sanddab	14	8	22	0.0	122	100
deepbody anchovy	6	13	19	0.0	106	87
thornback	16	2	18	0.0	100	82
opaleye	6	11	17	0.0	94	77
pile perch	-	17	17	0.0	94	77
sargo	-	16	16	0.0	89	73
rubberlip seaperch	-	16	16	0.0	89	73
Pacific chub mackerel	-	16	16	0.0	89	73
halfmoon	-	12	12	0.0	67	55
plainfin midshipman	11	1	12	0.0	67	55
jack mackerel	7	2	9	0.0	50	41
basketweave cusk-eel	7	1	8	0.0	44	36
yellow snake eel	6	1	7	0.0	39	32
diamond turbot	5	2	7	0.0	39	32
spotted cusk-eel	-	6	6	0.0	33	27
yellowfin croaker	-	6	6	0.0	33	27
rock wrasse	-	4	4	0.0	22	18
rockpool blenny	-	3	3	0.0	17	14
brown rockfish	-	3	3	0.0	17	14
shovelnose guitarfish	-	2	2	0.0	11	9
kelp pipefish	-	2	2	0.0	11	9
leopard shark	-	2	2	0.0	11	9
pygmy poacher	-	1	1	0.0	6	5
spotted sand bass	-	1	1	0.0	6	5
vermillion rockfish	-	1	1	0.0	6	5
California sheephead	-	1	1	0.0	6	5
Total Abundance	10,680	35,322	46,002	100.0	255,567	209,565
Number of Species	36	55	57		57	

Estimated weekly fish impingement abundance was highly variable over the calendar year, with no correlation between cooling water flow and impingement abundance (Pearson Product Correlation, $r^2 = 0.00001$) (Figure 1). Peak abundances were observed during periods of lower circulating water flow in cooler water months in early winter and late fall. Lowest impingement was recorded from late spring through early summer, with a generally increasing trend progressing into early fall.

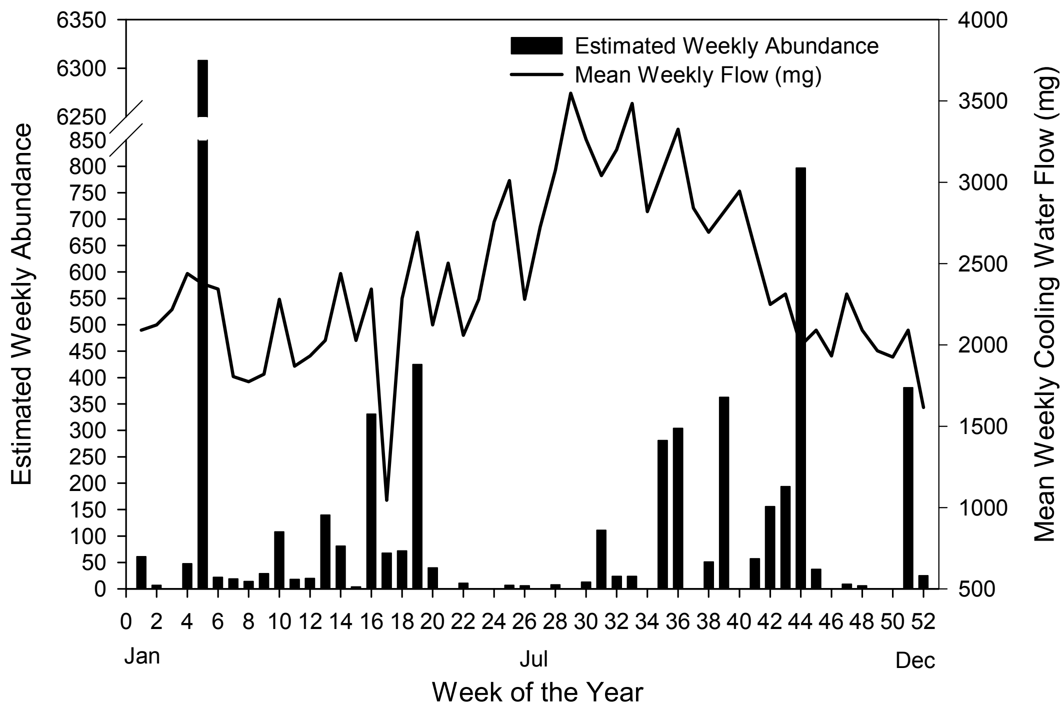

Figure 2. Weekly estimated normal operation fish impingement abundance with a velocity cap and average cooling water flow volume from 2004 and 2005 (million gallons = mg).

Based on the results of Thomas et al. (1980), and the average proportional reduction in fish entrapment provided by the velocity cap, an estimated 255,567 individuals of the same 57 species would have been impinged during an average year (Table 1). This equates to an estimated reduction of 209,565 individuals in annual impingement, or 82%, attributable to the use of the velocity-capped intake structure. Reductions in species-specific impingement abundance among the ten most abundant species ranged from 145,272 individuals for queenfish to 579 kelp bass (*Paralabrax clathratus*).

Fish Biomass

An estimated 1,183.131 kg of fish was impinged based on impingement rates from MBC and Tenera (2005) and average weekly circulating water flow volumes for calendar years 2004-5 (Table 2). Estimated normal operation biomass totaled 261 kg, while heat treatments accounted for an additional 922 kg. Queenfish biomass represented 50% of the total biomass. Heavy-bodied fish species, which were impinged in lower abundances, accounted for substantially larger portions of the impingement biomass. In addition to queenfish, seven species each contributed 2.0% or more to the estimated annual impingement total. In order of decreasing biomass, they were Pacific electric ray (*Torpedo californica*), white croaker, shiner perch, kelp bass, round stingray (*Urobatis halleri*), jacksmelt (*Atherinopsis californiensis*), and California

Table 2. Estimated annual fish impingement biomass (kg) for normal operation and heat treatment surveys using average cooling water flows from 2004 and 2005**. Totals presented for both with and without a velocity cap.**

Species	Estimated Normal Operation Biomass (kg)	Observed Heat Treatment Biomass (kg)	Total Biomass (kg)	Percent of Total Biomass (kg)	Est. No Velocity Cap Biomass (kg)	Est. Difference in Impinged Biomass (kg)
queenfish	49.060	542.930	591.990	50.0	3,288.833	2,696.843
Pacific electric ray	107.373	-	107.373	9.1	596.517	489.144
white croaker	3.637	84.683	88.320	7.5	490.667	402.347
shiner perch	2.259	45.828	48.087	4.1	267.150	219.063
kelp bass	-	43.208	43.208	3.7	240.044	196.836
round stingray	18.612	20.545	39.157	3.3	217.539	178.382
jacksmelt	2.205	25.114	27.319	2.3	151.772	124.453
California scorpionfish	5.416	19.381	24.797	2.1	137.761	112.964
bat ray	13.922	6.686	20.608	1.7	114.489	93.881
white seaperch	0.540	17.101	17.641	1.5	98.006	80.365
thornback	14.489	1.143	15.632	1.3	86.844	71.212
Pacific pompano	2.005	12.720	14.725	1.2	81.806	67.081
walleye surfperch	0.486	14.035	14.521	1.2	80.672	66.151
northern anchovy	4.654	8.596	13.250	1.1	73.611	60.361
opaleye	3.712	7.708	11.420	1.0	63.444	52.024
California halibut	4.986	5.399	10.385	0.9	57.694	47.309
specklefin midshipman	10.373	0.006	10.379	0.9	57.661	47.282
shovelnose guitarfish	-	10.280	10.280	0.9	57.111	46.831
barred sand bass	0.468	8.557	9.025	0.8	50.139	41.114
Pacific sardine	4.342	3.674	8.016	0.7	44.533	36.517
black croaker	0.226	6.147	6.373	0.5	35.406	29.033
black perch	0.882	4.865	5.747	0.5	31.928	26.181
white seabass	0.113	4.410	4.523	0.4	25.128	20.605
pile perch	-	4.351	4.351	0.4	24.172	19.821
plainfin midshipman	3.791	0.003	3.794	0.3	21.078	17.284
topsmelt	-	3.371	3.371	0.3	18.728	15.357
halfmoon	-	3.261	3.261	0.3	18.117	14.856
California corbina	-	2.856	2.856	0.2	15.867	13.011
spotted turbot	2.096	0.006	2.102	0.2	11.678	9.576
blacksmith	0.014	2.062	2.076	0.2	11.533	9.457
yellowfin croaker	-	1.779	1.779	0.2	9.883	8.104
giant kelpfish	1.066	0.651	1.717	0.1	9.539	7.822
spotfin croaker	-	1.625	1.625	0.1	9.028	7.403
yellow snake eel	1.188	0.184	1.372	0.1	7.622	6.250
sargo	-	1.319	1.319	0.1	7.328	6.009
rock wrasse	-	1.280	1.280	0.1	7.111	5.831
brown rockfish	-	1.089	1.089	0.1	6.050	4.961
diamond turbot	0.708	0.329	1.037	0.1	5.761	4.724
California lizardfish	1.016	-	1.016	0.1	5.644	4.628
Pacific staghorn sculpin	0.870	0.095	0.965	0.1	5.361	4.396
spotted sand bass	-	0.828	0.828	0.1	4.600	3.772
leopard shark	-	0.747	0.747	0.1	4.150	3.403
rubberlip seaperch	-	0.685	0.685	0.1	3.806	3.121
California grunion	0.141	0.458	0.599	0.1	3.328	2.729
salema	0.084	0.317	0.401	0.0	2.228	1.827
basketweave cusk-eel	0.388	0.010	0.398	0.0	2.211	1.813
hornyhead turbot	0.258	0.132	0.390	0.0	2.167	1.777
California sheephead	-	0.330	0.330	0.0	1.833	1.503
Pacific chub mackerel	-	0.309	0.309	0.0	1.717	1.408
jack mackerel	0.028	0.233	0.261	0.0	1.450	1.189
deepbody anchovy	0.028	0.132	0.160	0.0	0.889	0.729
spotted cusk-eel	-	0.118	0.118	0.0	0.656	0.538
speckled sanddab	0.041	0.050	0.091	0.0	0.506	0.415
rockpool blenny	-	0.015	0.015	0.0	0.083	0.068
kelp pipefish	-	0.006	0.006	0.0	0.033	0.027
pygmy poacher	-	0.005	0.005	0.0	0.028	0.023
vermillion rockfish	-	0.002	0.002	0.0	0.011	0.009
	261.477	921.654	1,183.131		6,572.951	5,389.820
	36	55	57		57	57

scorpionfish (*Scorpaena guttata*), each with an annual estimated biomass greater than 24.0 kg.

Estimated annual normal operation biomass totaled 261 kg during the analysis period (Table 2). Pacific electric ray biomass accounted for nearly one-half of the total. After queenfish (49.1 kg), four additional species were each recorded with an estimated biomass in excess of 10.0 kg: round stingray, thornback (*Platyrhinoidis triseriata*), bat ray (*Myliobatis californica*), and specklefin midshipman.

Heat treatment biomass was largely influenced by the impingement of queenfish, with nearly 543 kg impinged (Table 2). Following white croaker, three additional species were recorded with impingement weights greater than 25 kg; shiner perch, kelp bass, and jacksmelt were each recorded with total weights ranging from 45.8 kg to 25.1 kg, respectively.

Estimated weekly impingement biomass totals were highly variable, with no significant correlation to the average weekly cooling water flow (Pearson Product Correlation, r^2 = 0.15) (Figure 2). Contrary to abundance, weekly impingement biomass peaked in summer and early fall, with the relative increase in abundance of heavy-bodied species such as rays and basses.

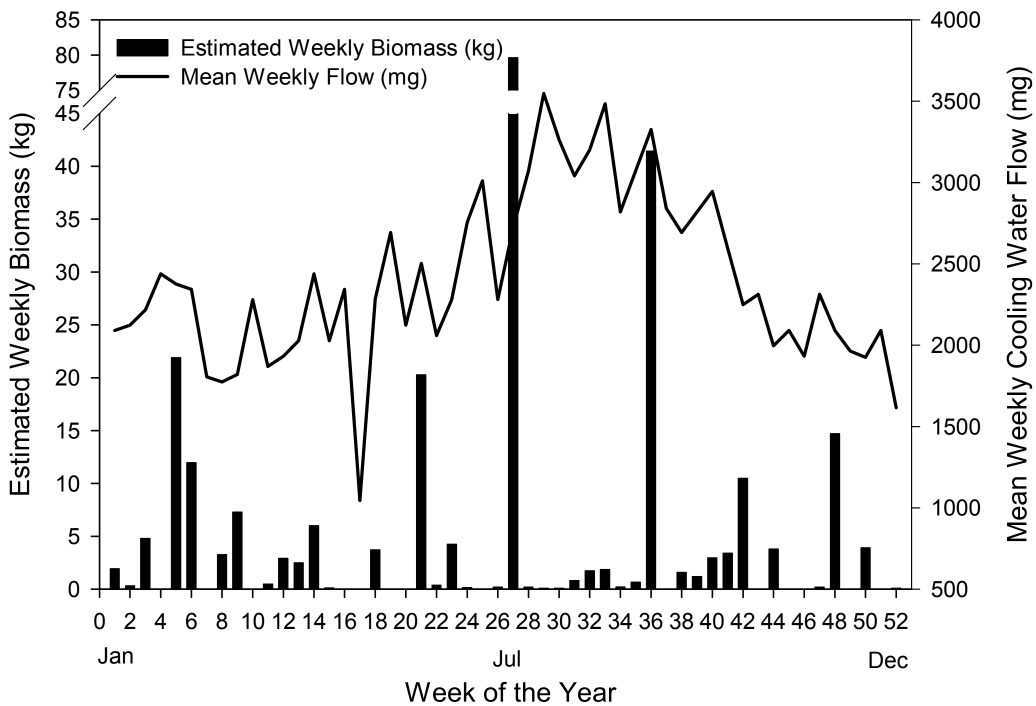

Figure 3. Weekly estimated normal operation fish impingement biomass (kg) with a velocity cap and average weekly cooling water flow volume for 2004 and 2005 (million gallons = mg).

Similar analysis of the effectiveness of the velocity-capped intake was conducted on the dataset for fish biomass (Table 2). Data transformations based on the results of Thomas et al. (1980) indicate an estimated 6,573 kg of fish would have been impinged had the velocity cap not been installed on the intake structure. This equates to an estimated 5,389.820 kg, or 82%, more fish biomass impinged by the operation of the cooling water system at Huntington Beach Generating Station over current impingement with the velocity cap. Among the top ten fish species impinged with highest biomass, the reduction afforded by the use of the velocity cap ranged from 2,697 kg for queenfish to 80 kg for white seaperch.

Shellfish Abundance

An estimated 15,123 shellfish from 21 species were impinged during the analysis period (Table 3). Estimated normal operations of the cooling water system accounted for 14,159 individuals representing 18 species, while heat treatments impinged an additional 964 individuals and 16 species. Graceful crab (*Cancer gracilis*) was the most abundant species collected overall, comprising 31% of the total abundance. An additional four species each accounted for greater than 5.0% of the total abundance: yellow shore crab (*Hemigrapsus oregonensis*), yellow crab (*Cancer anthonyi*), Pacific rock crab (*Cancer antennarius*), and red rock crab (*Cancer productus*). Each of these species were each impinged in estimated abundances in excess of 750 individuals.

Table 3. Estimated annual shellfish impingement for normal operation and heat treatment surveys using average cooling water flows from 2004 and 2005**. No adjustments made for velocity cap effectiveness.**

Species	Estimated Normal Operation Abundance	Observed Heat Treatment Abundance	Total Abundance	Percent of Total Abundance
graceful crab	4,661	10	4,671	30.9
yellow shore crab	3,524	-	3,524	23.3
yellow crab	2,375	139	2,514	16.6
Pacific rock crab	1,362	63	1,425	9.4
red rock crab	776	23	799	5.3
tuberculate pear crab	226	355	581	3.8
red rock shrimp	313	129	442	2.9
blackspotted bay shrimp	376	2	378	2.5
striped shore crab	96	137	233	1.5
two-spot octopus	135	31	166	1.1
California spiny lobster	140	18	158	1.0
intertidal coastal shrimp	70	29	99	0.7
Xantus swimming crab	51	15	66	0.4
northern kelp crab	25	10	35	0.2
bay ghost shrimp	10	-	10	0.1
yellowleg shrimp	7	-	7	0.0
market squid	6	-	6	0.0
moss crab	6	-	6	0.0
sheep crab	-	1	1	0.0
pubescent porcelain crab	-	1	1	0.0
thick-clawed porcelain crab	-	1	1	0.0
	14,159	964	15,123	100.0
	18	16	21	

Graceful crab numerically dominated the estimated normal operation abundance with 4,661 individuals, followed by yellow shore crab, yellow crab, and Pacific rock crab, with each species represented by greater than 1,300 individuals (Table 3). A total of 776 red rock crab was impinged, while the remaining 13 species cumulatively accounted for an estimated 1,461 individuals or approximately 10% of the total normal operation shellfish abundance. Weekly abundance peaked in early fall and winter, although slightly higher median weekly abundances were recorded from spring into early summer (Figure 3).

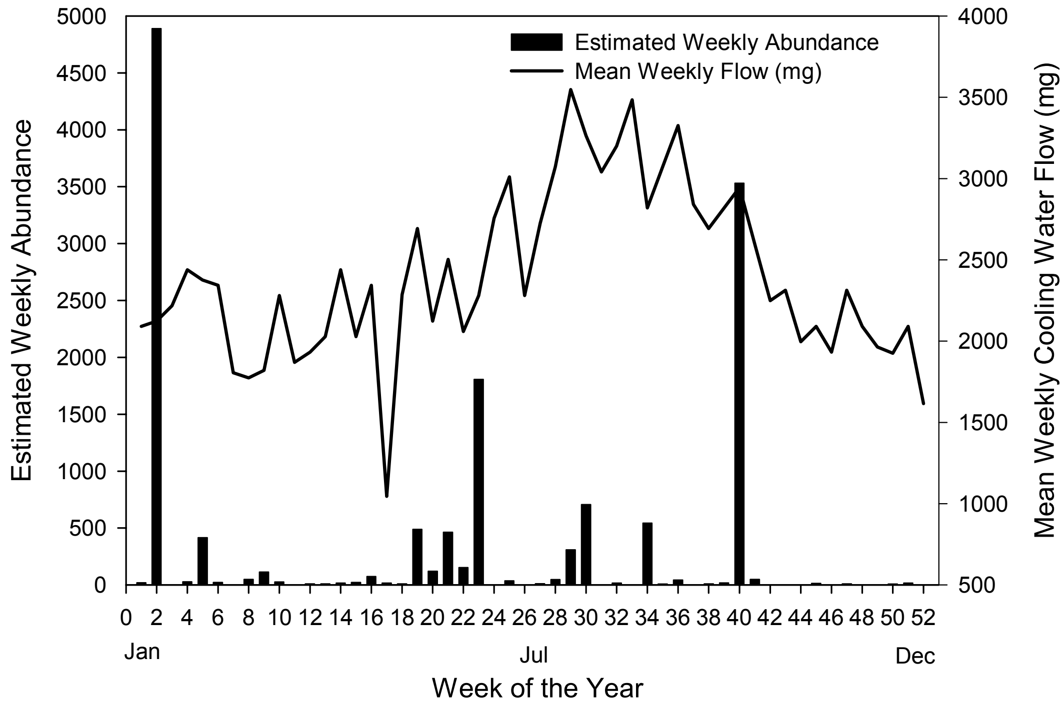

Figure 4. Estimated weekly normal operation shellfish impingement abundance with a velocity cap and average weekly cooling water volume from 2004 and 2005 (million gallons = mg).

Shellfish abundances during heat treatments were dominated by a notably different species assemblage (Table 3). Tuberculate pear crab (*Pyromaia tuberculata*) was the most abundant species collected during heat treatments with 355 individuals. Of the remaining 15 species, only yellow crab, striped shore crab (*Pachygrapsus crassipes*), and red rock shrimp (*Lysmata californica*) were recorded in abundances greater than 100 individuals each.

Shellfish Biomass

Approximately 136.445 kg of shellfish biomass representing 21 species was impinged during the analysis period (Table 5). Normal operation impingement represented a substantial portion (89%) of the overall impingement, with 121.919 kg and 18 species compared to 14.526 kg and 16 species impinged during heat treatments.

Table 4. Estimated shellfish impingement biomass (kg) for normal operation and heat treatment surveys using average cooling water flows from 2004 and 2005**. No adjustments made for velocity cap effectiveness.**

Species	Estimated Normal Operation Biomass (kg)	Observed Heat Treatment Biomass (kg)	Total Biomass (kg)	Percent of Total Biomass (kg)
California spiny lobster	56.065	7.946	64.011	46.9
two-spot octopus	25.292	2.276	27.568	20.2
yellow crab	19.740	1.235	20.975	15.4
Pacific rock crab	9.253	1.085	10.338	7.6
red rock crab	5.433	0.152	5.585	4.1
graceful crab	2.733	0.073	2.806	2.1
tuberculate pear crab	1.012	0.351	1.363	1.0
striped shore crab	0.345	0.369	0.714	0.5
sheep crab	-	0.604	0.604	0.4
blackspotted bay shrimp	0.593	0.004	0.597	0.4
market squid	0.384	-	0.384	0.3
Xantus swimming crab	0.331	0.051	0.382	0.3
northern kelp crab	0.101	0.183	0.284	0.2
red rock shrimp	0.100	0.178	0.278	0.2
yellowleg shrimp	0.236	-	0.236	0.2
moss crab	0.186	-	0.186	0.1
intertidal coastal shrimp	0.063	0.017	0.080	0.1
bay ghost shrimp	0.045	-	0.045	0.0
yellow shore crab	0.007	-	0.007	0.0
pubescent porcelain crab	-	0.001	0.001	0.0
thick-clawed porcelain crab	-	0.001	0.001	0.0
	121.919	14.526	136.445	
	18	16	21	

Unlike abundance, impingement biomass was consistent across survey type with respect to species composition (Table 5). California spiny lobster (*Panulirus interruptus*) dominated the biomass estimates for both normal operation and heat treatment impingement with 56.1 kg and 7.9 kg, respectively (or 64.0 kg total), followed by two-spot octopus (*Octopus bimaculatus/bimaculoides*; 27.6 kg), yellow crab (21.0 kg), Pacific rock crab (10.3 kg), red rock crab (5.6 kg), graceful crab (2.8 kg), and tuberculate pear crab (1.4 kg), with each species representing 1.0% or greater of the total estimated impingement biomass. Weekly impingement biomass peaked in late summer, with high biomass throughout late spring into early fall (Figure 4).

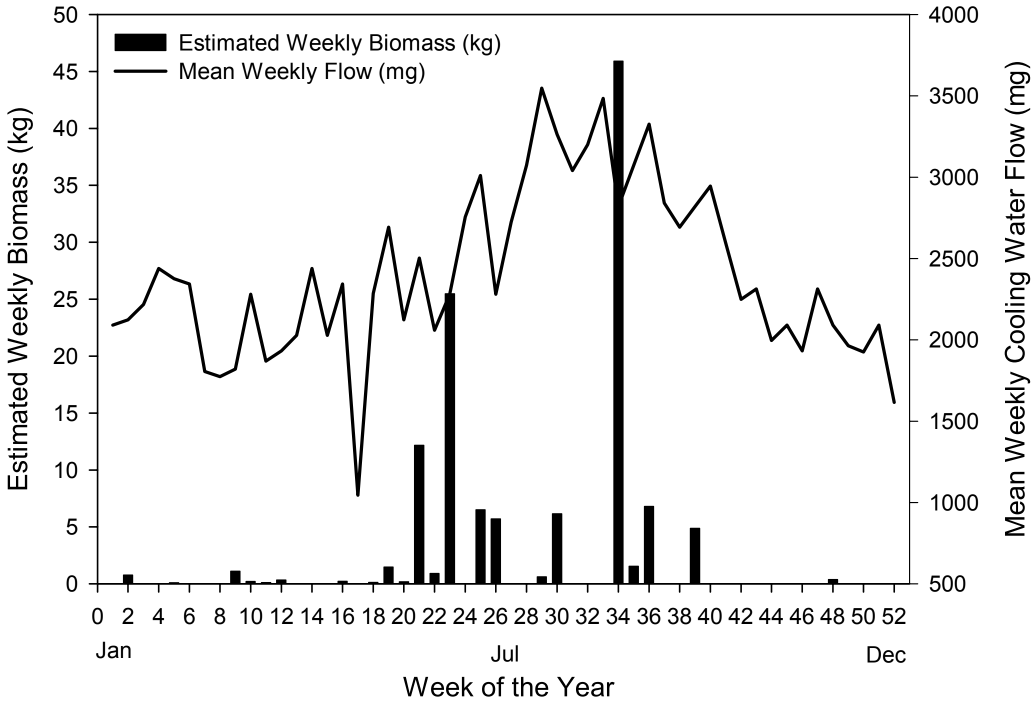

Figure 5. Estimated weekly normal operation shellfish biomass (kg) and average weekly cooling water flow volume for 2004 and 2005 (million gallons = mg).

Entrainment

A total of 6,950 fish larvae in 57 different groups, including 53 taxonomic categories and 4 categories of unidentified or damaged larvae, was collected during the 45 entrainment surveys completed during the September 2003 through August 2004 period (Table 5). Eleven taxa comprised 90% of the total estimated larval entrainment calculated using average cooling water flows from 2004 and 2005: unidentified gobies (mainly of the genera *Clevlandia, Ilypnus*, and *Quietula* [CIQ complex]), spotfin croaker, unidentified anchovies (>95% northern anchovy), queenfish, white croaker, salema, unidentified croakers (newly hatched larvae of several species), black croaker, combtooth blennies, and diamond turbot. Of the five target invertebrate taxa included in the study (Cancer crab megalops, market squid hatchlings, mole crab (sand crab), California spiny lobster, and ridgeback rock shrimp) only mole crab and Cancer crabs were found in the entrainment samples (Table 6). Almost all of the mole crab larvae collected were in the earliest stages of their larval development (Zoea Stage I); only two megalopal stage larvae were collected.

The measured larval densities and average daily intake flows from 2004 and 2005 were used to estimate an annual entrainment of approximately 275 million fish larvae based on a total cooling water volume of 475 million m^3 (Table 5). The composition of HBGS entrainment was characterized by large numbers of gobies, blennies, and several other fishes common in bay environments whose larvae were probably exported into the open ocean by tidal currents from estuarine spawning areas upcoast and downcoast from the HBGS. Some commercially and recreationally important taxa such as California halibut, white seabass, and rockfishes comprised a smaller percentage of the total number of taxa entrained, but others, including northern anchovy and several croaker species, comprised greater than 50% of the total fish larvae collected. The greatest overall abundances occurred in late summer 2004 when densities were approximately five times greater than earlier months (Figure 6). Although gobies and anchovies were abundant throughout the sampling period, high concentrations of spotfin croaker, salema, and queenfish contributed to peak abundances in August 2004. Low concentrations of larvae were measured during some surveys in early February and early March, although abundances generally increased through spring when many fishes start reproducing.

The same calculations described above for fishes were used to estimate a total entrainment of approximately 6.6 million target invertebrate larvae (Table 6). This total does not include the 363 million sand crab zoeal-stage larvae (the earliest larval stage) that were processed from entrainment samples. Zoeal stages of other target invertebrate groups were not processed from the entrainment samples.

Table 5. Larval fishes collected during 45 entrainment surveys from September 2003 through August 2004. Average flows from 2004 and 2005 were used to estimate total entrainment estimates for HBGS Units 1-4. Actual flow totaled 475.2 million m^3 (125.5 billion gal).

Taxon	Common Name	Total Count	Total Estimated Entrainment	Percent of Total	Cumulative Percent	Std. Error Entrainment Estimate
Gobiidae unid.	gobies	2,484	82,909,028	31.05%	31.05%	4,997,566
Roncador stearnsi	spotfin croaker	912	61,063,631	22.87%	53.92%	7,659,603
Engraulidae	anchovies	1,209	39,580,026	14.82%	68.75%	3,134,829
Seriphus politus	queenfish	306	15,770,277	5.91%	74.66%	2,196,195
Genyonemus lineatus	white croaker	446	10,958,915	4.10%	78.76%	944,319
Xenistius californiensis	salema	153	10,393,637	3.89%	82.65%	4,640,088
Sciaenidae unid.	croaker	244	8,234,675	3.08%	85.74%	787,118
Cheilotrema saturnum	black croaker	96	6,120,533	2.29%	88.03%	1,321,487
Hypsoblennius spp.	blennies	166	5,227,431	1.96%	89.99%	419,391
Hypsopsetta guttulata	diamond turbot	87	4,311,897	1.62%	91.60%	406,099
Paralichthys californicus	California halibut	98	3,922,779	1.47%	93.07%	361,252
Menticirrhus undulatus	California corbina	43	2,397,713	0.90%	93.97%	718,360
Paralabrax spp.	sand bass	48	2,330,599	0.87%	94.84%	435,277
Atherinopsidae	silverside	97	2,233,320	0.84%	95.68%	353,434
Citharichthys spp.	sanddabs	31	1,401,729	0.53%	96.20%	246,695
Hypsypops rubicundus	garibaldi	43	1,148,121	0.43%	96.63%	509,477
Sphyraena argentea	California barracuda	14	988,916	0.37%	97.00%	228,390
Oxyjulis californica	senorita	27	829,048	0.31%	97.32%	209,101
Pleuronectidae unid.	flounders	17	775,541	0.29%	97.61%	104,994
Umbrina roncador	yellowfin croaker	24	772,153	0.29%	97.90%	218,477
Gillichthys mirabilis	longjaw mudsucker	20	522,819	0.20%	98.09%	95,897
Pleuronichthys ritteri	spotted turbot	12	460,530	0.17%	98.26%	72,415
Triphoturus mexicanus	Mexican lampfish	8	438,259	0.16%	98.43%	75,935
Diaphus theta	California headlight fish	11	395,677	0.15%	98.58%	89,180
Lepidogobius lepidus	bay goby	18	391,580	0.15%	98.72%	90,313
Syngnathidae unid.	pipefishes	17	381,945	0.14%	98.87%	213,897
Myctophidae unid.	lanternfishes	6	358,746	0.13%	99.00%	80,606
Leptocottus armatus	Pacific staghorn sculpin	16	332,239	0.12%	99.12%	67,529
Haemulidae	grunts	5	326,926	0.12%	99.25%	108,146
Acanthogobius flavimanus	yellowfin goby	15	301,378	0.11%	99.36%	111,599
Atractoscion nobilis	white seabass	5	300,887	0.11%	99.47%	99,800
Gibbonsia spp.	clinid kelpfishes	10	189,461	0.07%	99.54%	47,829
Pleuronichthys verticalis	hornyhead turbot	3	177,561	0.07%	99.61%	47,851
Sardinops sagax	Pacific sardine	4	152,360	0.06%	99.67%	107,982
Peprilus simillimus	Pacific butterfish	2	117,605	0.04%	99.71%	48,126
Semicossyphus pulcher	California sheephead	2	103,088	0.04%	99.75%	41,502
Halichoeres semicinctus	rock wrasse	1	85,156	0.03%	99.78%	40,290
Labrisomidae unid.	labrisomid kelpfishes	3	81,333	0.03%	99.81%	42,724
Stenobrachius leucopsarus	northern lampfish	3	74,045	0.03%	99.84%	31,806
Paralichthyidae unid.	lefteye flounders & sanddabs	2	67,272	0.03%	99.86%	33,237
Medialuna californiensis	halfmoon	2	50,005	0.02%	99.88%	38,293
Scorpaenidae	scorpionfishes	1	40,995	0.02%	99.90%	31,406
Scomber japonicus	Pacific mackerel	2	39,754	0.01%	99.91%	21,648
Symphurus atricauda	California tonguefish	1	34,396	0.01%	99.93%	26,350
Typhlogobius californiensis	blind goby	1	30,036	0.01%	99.94%	23,010
Strongylura exilis	California needlefish	1	26,118	0.01%	99.95%	19,869
Oxylebius pictus	painted greenling	1	24,096	0.01%	99.96%	18,239
Merluccius productus	Pacific hake	1	22,125	0.01%	99.97%	16,766
Coryphopterus nicholsi	blackeye goby	1	21,339	0.01%	99.97%	16,233
Ruscarius creaseri	rouchcheek sculpin	1	19,804	0.01%	99.98%	15,065
Agonidae unid.	poachers	1	18,431	0.01%	99.99%	13,973
Pleuronectiformes unid.	flatfishes	1	16,979	0.01%	99.99%	12,970
Cottidae unid.	sculpins	1	16,820	0.01%	100.00%	12,814
Total Identified Fishes		**6,723**	**266,989,734**			
larvae, unidentified yolksac	unidentified yolksac larvae	136	4,668,434			921,905
larval fish fragment	unidentified larval fishes	51	2,001,380			330,997
larval/post-larval fish unid.	larval fishes	39	1,272,894			192,847
larval fish - damaged	unidentified larval fishes	1	38,090			26,996
Total Unidentified Fishes		**227**	**7,980,797**			
Total Fishes		**6,950**	**274,970,531**			

Table 6. Invertebrate larvae (select taxa) collected during 45 entrainment surveys from September 2003 through August 2004. Average flows from 2004 and 2005 were used to estimate total entrainment estimates. Actual flow totaled 475.2 million m^3.

Taxon	Common Name	Total Count	Total Estimated Entrainment	Percent of Total	Cumulative Percent	Std. Error Entrainment Estimate
Cancer anthonyi (megalops)	yellow crab	77	4,548,723	68.69%	68.69%	1,180,257
Cancer gracilis (megalops)	slender crab	31	982,598	14.84%	83.52%	217,296
Cancer antennarius (megalops)	brown rock crab	18	851,934	12.86%	96.39%	179,954
Cancer productus (megalops)	red rock crab	3	124,857	1.89%	98.27%	42,996
Emerita analoga (megalops)	mole crabs - larva	2	48,843	0.74%	99.01%	37,858
Cancer spp. (megalops)	cancer crabs	2	33,556	0.51%	99.52%	18,735
Cancer spp.	cancer crabs	1	32,032	0.48%	100.00%	24,361
Total Target Invertebrate Larvae		**134**	**6,622,544**			
Emerita analoga (zoea)	mole crabs - larva	10,399	363,033,148			73,186,329
Total Invertebrate Larvae		**10,533**	**369,655,692**			

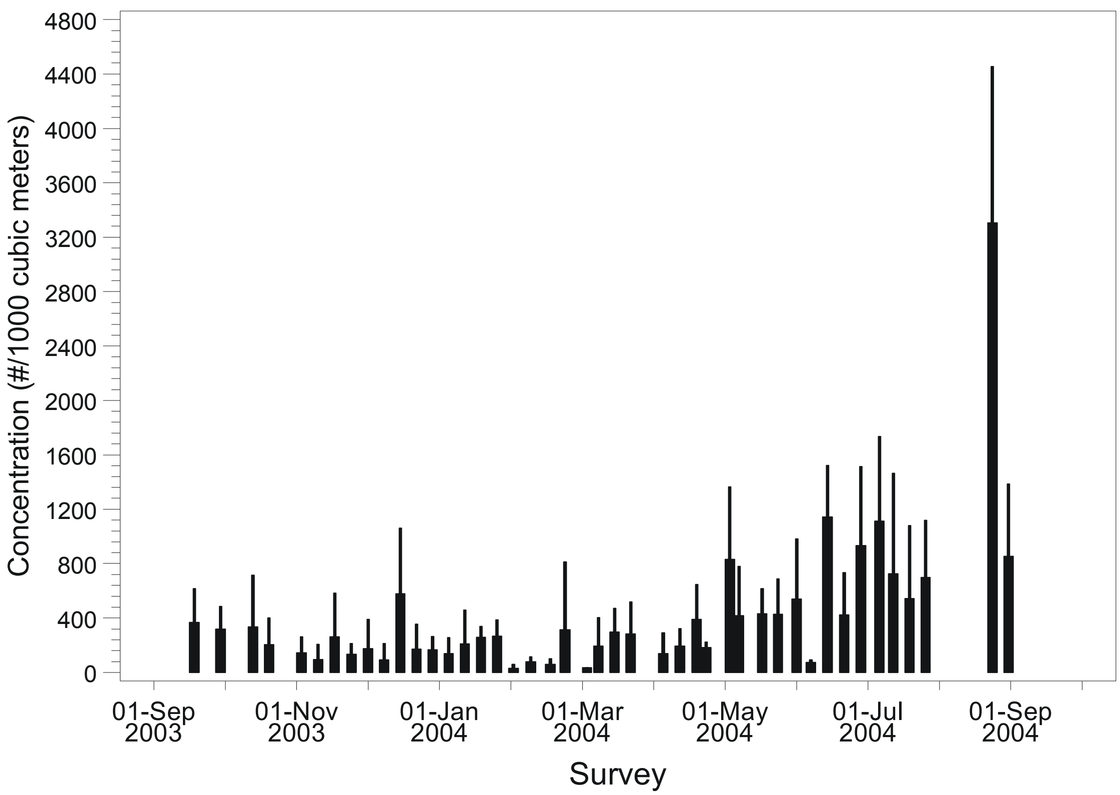

Figure 6. Mean concentrations (#/1000 m^3) and standard error for all larval fishes collected at HBGS entrainment station from September 2003 through August 2004.

DISCUSSION

The reevaluation of the data collected by MBC and Tenera (2005) to represent current operational characteristics at the HBGS indicate approximately 46,002 individual fish weighing 1,183 kg from 57 species are impinged annually by the operation of the cooling water system. An additional 15,123 individual shellfish weighing 136 kg representing 21 species are also impinged. No fish or shellfish observed by MBC and Tenera (2005) was protected under Federal, State, or Tribal Law.

Seven fish species accounted for approximately 96% of the total impingement abundance, while 15 species accounted for 91% of the total impingement biomass. Queenfish was the top-ranked species in both impingement abundance and biomass. No direct correlation was detected between cooling water circulation volumes and impingement abundance/biomass. Fish impingement abundance peaked in winter and fall; conversely, fish impingement biomass peaked during the summer and early fall, notably attributed to the impingement of relatively low abundant, but heavy-bodied, species such as Pacific electric ray.

Eleven of the 21 impinged shellfish species accounted for 98% of the total abundance, while seven species accounted for 97% of the biomass. As was the case with fish impingement, no direct correlation was detected between abundance/biomass and weekly cooling water flow volumes. Weekly impingement abundances peaked in winter and fall, consistent with fish impingement monitoring, but median weekly impingement was highest during the mid-spring to early fall. Shellfish biomass peaked from late spring through early fall, with relatively low values the remainder of the year.

Fish impingement data was adjusted according to Thomas et al. (1980) to determine the estimated reduction in impingement afforded by the use of a submerged, offshore, velocity-capped intake structure. In accordance with the 82% mean annual reduction in entrapment reported by Thomas et al. (1980), impingement was reduced by an estimated 209,565 fish weighing 5,389.8 kg by the use of a velocity-capped intake structure, when compared with a similar structure without the velocity cap.

Annual entrainment based on 2004-5 cooling water volumes was estimated to equal approximately 274 million larval fishes and approximately 6.7 million larval fishes of selected taxonomic groups. Entrainment of zoeal stage sand crabs was estimated at 363 million larvae. Larval fishes were comprised mostly of species spawned in nearshore embayments (CIQ gobies) and coastal nearshore waters (spotfin croaker, queenfish, white croaker, and anchovies).

The estimates presented in this report will be used as the basis for the complete Impingement Mortality and Entrainment Characterization Study to be submitted as part of the HBGS CDS. The compliance alternatives available to AES Huntington Beach are dependent on the outcome of the Phase II litigation. In addition, the State Water Resources Control Board is developing a state-wide 316(b) policy that could effect the contents of the CDS.

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