August 8, 2016

Scott Maloni
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Carlsbad, CA 92008

Re: **Technical Memorandum: Comparison of Existing Offshore Ichthyoplankton Data for the Huntington Beach Desalination Plant**

Dear Mr. Maloni,

I am pleased to submit HDR and MBC's final technical memorandum which offers a comparison of the ichthyoplankton densities near the intake for the Huntington Beach Desalination Plant. We look forward to discussing our findings with you at your earliest convenience.

Sincerely,
HDR Engineering, Inc.

Timothy M. Hogan

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Technical Memorandum

Comparison of Existing Offshore Ichthyoplankton Data for the Huntington Beach Desalination Plant

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Introduction

The Huntington Beach Desalination Plant (HBDP) is proposing to modify the existing Huntington Beach Generating Station (HBGS) intake. The offshore portion of the existing HBGS intake structure would be modified to include 1-mm cylindrical wedgewire screens (WWS). The array would be installed on the existing HBGS intake tower located 1,840 ft offshore (depth of 31.2 feet.).

At the request of the Santa Ana Regional Water Quality Control Board ("Regional Board") staff, Poseidon previously evaluated whether relocating the intake withdrawal point farther offshore could potentially minimize entrainment effects (see memo titled "Evaluation of a Long-distance Offshore Intake for the Huntington Beach Desalination Plant", dated April 29, 2016).

Poseidon received a letter form the Regional Board's staff (dated July 29, 2016) which included a request for additional ecological data on alternative intake sites. The Regional Board staff provided a table ("Information Requests for Huntington Beach Desalination Project (HBDP) Related to Analysis of Alternative Sites") containing specific information requests. The instructions provided state:

> *Please provide local ecological data (e.g., from the Southern California Bight Monitoring Program) on population density and diversity for all forms of marine life as a function of depth and also distance from the Orange County shoreline. Additionally, based on Poseidon's technical memo titled "Evaluation of a Long-distance Offshore Intake for the Huntington Beach Desalination Plant" (dated April 29, 2016), the location with the least intake mortality is 1.2 miles offshore. If you disagree with this conclusion, please provide any other studies or information that may refute this. This information can be provided separately from the table below.*

The statement above in the Regional Board staff's letter appears to misinterpret the April 29, 2016 MBC/HDR memo to conclude that the "*the location with the least intake mortality is 1.2 miles offshore*" of the proposed Huntington Beach site. This technical memorandum (memo) is provided to answer the questions posed above by the Regional Board staff (separate from the table, as suggested by the Regional Board staff) and to provide further clarification on why the Regional Board staff misinterpreted the conclusions of the previous memo.

This memo will clearly demonstrate that there would be no biological benefit to moving the existing intake withdrawal point to 1.2 miles offshore because the concentration of ichthyoplankton is not statistically lower. Moreover, since the density of fish larvae at the station located 1.2 miles offshore was statistically indistinguishable from the existing intake location, the impacts of extending the pipeline outweigh the potential benefits and would not justify the extensive construction related-impacts to the benthic environment.

Additional Local Ecological Data

The potential operational impact of the proposed offshore HBDP intake can be estimated using existing data that characterize the populations of organisms that are at risk of entrainment. There are two available datasets that characterize the populations of organisms that are at risk of entrainment depending on the distance offshore. Based on the method of sampling, these two datasets (Table 1) can be used to draw meaningful conclusions about the densities of entrainable-sized organisms at various distances offshore. The previous memo used these data to evaluate the biological value in moving the intake withdrawal point farther offshore.

Table 1. Data Sources Used in the Biological Analysis.

SOURCE	SAMPLING PERIOD	DEPTH RANGE	SOURCE
HBGS CEC	2003–2004	9.5–21.9 m	MBC and Tenera 2005
CalCOFI	2004–2005	10–80 m	Watson et al. 2005

1. HBGS CEC = Huntington Beach Generating Station California Energy Commission
2. CalCOFI = California Cooperative Oceanic Fisheries Investigations

The Regional Board staff has suggested, as an example, that data from the Southern California Bight Monitoring Program be used to further describe the densities of fish eggs and larvae offshore of the HBDP. To clarify, using this data is not scientifically appropriate for the purpose described by the Regional Board staff as the Southern California Bight Monitoring Program (Bight) has not included an ichthyoplankton component during the five iterations thus far (1994, 1998, 2003, 2008, and 2013). Biological sampling has focused on juvenile and adult marine organisms either burrowing or living in close association with the seafloor sediments (SCCWRP 2012). Presence of these organisms as juveniles or adults does not directly translate to their presence in the area's plankton. For instance, some of the fish can migrate into the area as a result of spawning, feeding, or sometimes induced by age-related changes in habitat preference (Miller and Schiff 2012). Furthermore, the area in question offshore of Huntington Beach was not frequently sampled during any of the four completed Bight surveys. The Bight categorizes the continental shelf by depth. The inner shelf category includes depths ranging from five to 30 meters water depth, or the areas suggested for the intake. Typically, only 30-40 stations were sampled in this depth category across the entire Southern California Bight, which extends from Point Conception to the United States-Mexico border (Miller and Schiff 2012). For these reasons, it is not scientifically appropriate for the Bight data to be used in this analysis of potential entrainment effects offshore of Huntington Beach.

An exhaustive search was made to uncover any and all data available relevant to the fish larvae densities offshore of Huntington Beach, California. There are two existing data sources relevant to potential entrainment by the desalination facility as a function of distance offshore; these are presented in Table 1. Fortunately, both data sources reported data collected during a similar period of time, therefore supporting each other in documenting the conditions occurring at the time. As such, these existing data are biologically sufficient for addressing the Regional Board staff's information request. The HBGS study used the methods outlined in the Desalination Amendment to the Ocean Plan. A larger net mesh was used by the CalCOFI sampling, but this data set provides greater spatial coverage both onshore and offshore as well as along the coast in areas with similar ecology as Huntington Beach. The CalCOFI program has been conducted for over 60 years by a joint effort of the National Marine Fisheries Service, California Department of Fish and Wildlife, and Scripps Institution of Oceanography. Over this time, the sampling design has garnered worldwide recognition and has been replicated repeatedly by researchers and government agencies the world over.

Using the larger mesh net focuses the CalCOFI survey on those larvae with greater potential to complete the larval period and transform into juveniles and, later, adults (Houde 2008). This is a result of the 99+% natural mortality rate suffered by larval marine fish. This mortality rate declines with size as the larvae ages (McGurk 1986; Houde 2008). Therefore, while differing in technique from the prescribed methods in the Ocean Plan, the CalCOFI sampling more accurately predicts population-level impacts of entrainment than the HBGS data; hence its inclusion in this analysis.

Location with Least Potential for Intake Mortality

MBC and HDR disagree with the Regional Board staff's initial representation that the location with the least intake mortality is 1.2 miles offshore because it is not supported by the prudent statistical analysis of the ecological data available. Sokal and Rohlf (1995) define statistics as *the scientific study of data describing natural variation*. As stated in the previous memo, and per Sokal and Rohlf's definition, the fish larvae density was ecologically indiscernible between the E sampling station (0.5 km offshore and 9.5-m deep) and the O2 sampling station (1.9 km offshore and 14.9-m deep) (Figure 1 and Figure 2). The means differed by only 15.9 larvae. The standard error bars shown in Figure 2 illustrate that there is inherent variability in the data and that the very small absolute difference between the mean fish larvae density between stations E (368.5 larvae/1,000 m^3) and O2 (352.6 larvae/1,000 m^3) are not statistically different (i.e., the error bars overlap).

To use the means without considering the standard error misrepresents the precision of the mean. As described by a popular data analysis software package (http://support.minitab.com/en-us/minitab/17/topic-library/basic-statistics-and-graphs/hypothesis-tests/tests-of-means/what-is-the-standard-error-of-the-mean/), the standard error of the mean is used to determine:

> *…how precisely the mean of the sample estimates the population mean. Lower values of the standard error of the mean indicate more precise estimates of the population mean. Usually, a larger standard deviation will result in a larger standard error of the mean and a less precise estimate. A larger sample size will result in a smaller standard error of the mean and a more precise estimate.*

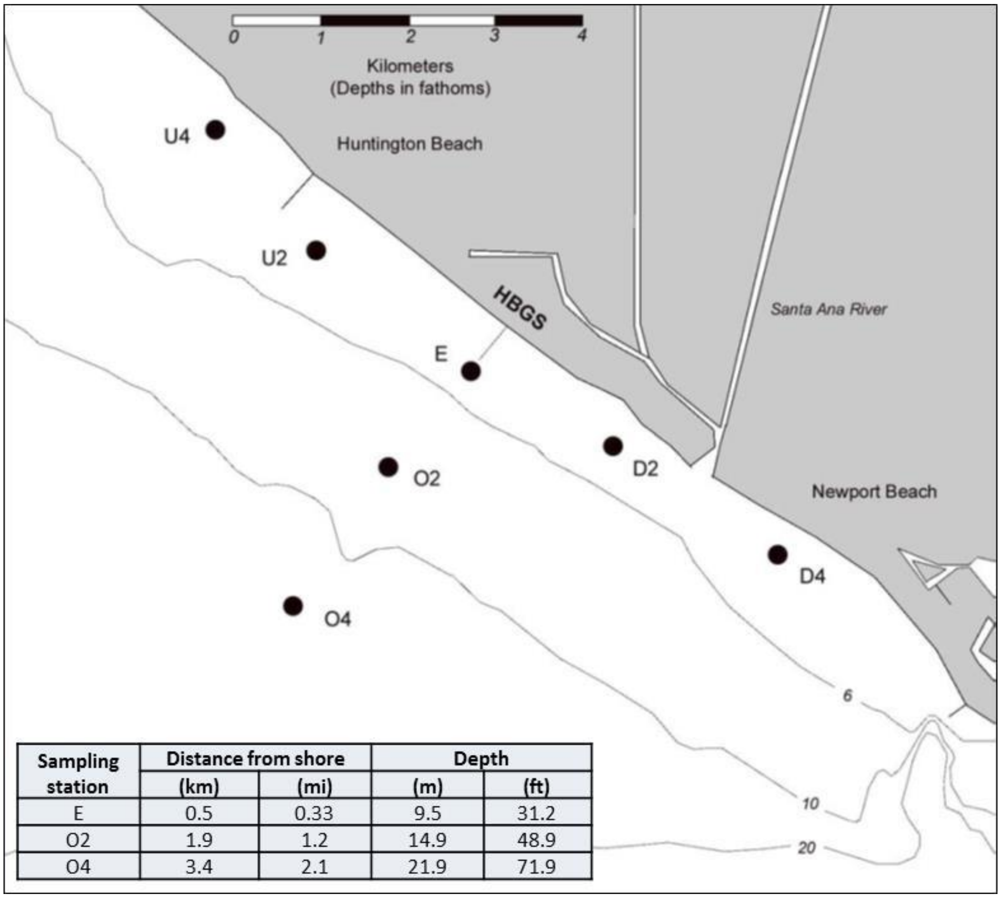
Although standard error decreases with increased sample size, large samples sizes are not always feasible due to time and expense. Additionally, there is often a great deal of inherent patchiness (variability) with biological organisms such as fish larvae (Wiebe and Holland 1968);

even with large samples sizes, it may not be possible to realize lower standard error. Between September 2003 and August 2004, 12 monthly samples were taken at the three stations offshore HBGS using a paired bongo frame fitted with 333-µm mesh nets. At each station, two replicate oblique tows with the bongo frame were made from near the seafloor to the water's surface with a target volume of 30–40 m^3 passing through each net on each tow. Each 24-hour sampling period was divided into four 6-hr blocks with one sampling event at each station per period. This resulted in 96 samples per station for the year from which all fish larvae were identified and counted.

The data analysis for the HBGS CEC data (MBC and Tenera 2005) was both descriptive (mean with standard error) and analytical (Kruskal Wallis analysis of variance with a Dunn's multiple comparison test). This analysis was used to determine if the fish larvae densities were significantly different at various depths/distances from shore. As stated in the previous memo, no significant differences were detected among the three depths sampled (Figure 4; KW, H=0.569, df = 2, p=0.752). More specifically, there were no significant differences between densities at the 9.5-m (31.2-foot) deep station located 0.5 km (0.3 miles) offshore and the 14.9-m (48.9-foot) deep station located 1.9 km (1.2 miles) offshore. Although the means may have differed slightly, the variability around each mean (indicated by the standard error bars) was high and overlapped, indicating that there is no statistically significant difference in fish larvae densities between/among these depth-specific densities.

The CALCOFI data are applicable to this exercise because the data clearly indicate that larval densities generally increase with greater distance offshore (Figure 3 and Table 2). As such, there is no scientifically justifiable analysis to assert that there is a statistically significant reduction in larval densities when comparing the 9.5-m (31.2-foot), 0.5 km (0.3 miles) offshore location and the 14.9-m (48.9-foot), 1.9 km (1.2 miles) offshore location knowing that as distance from shore increases (up to 10 miles, the extent of the CalCOFI data used), density of larvae increases.

MBC and HDR, therefore, disagree with the conclusion that the location with the least intake mortality is 1.2 miles offshore. Based on the descriptive and analytical analysis completed for the HBGS CEC data, the densities of fish larvae 0.3 miles and 1.2 miles offshore are scientifically indistinguishable.



Sampling station	Distance from shore		Depth	
	(km)	(mi)	(m)	(ft)
E	0.5	0.33	9.5	31.2
O2	1.9	1.2	14.9	48.9
O4	3.4	2.1	21.9	71.9

Figure 1. Map of stations sampled during the Huntington Beach Generating Station California Energy Commission entrainment study, 2003–2004. Source: MBC and Tenera 2005.

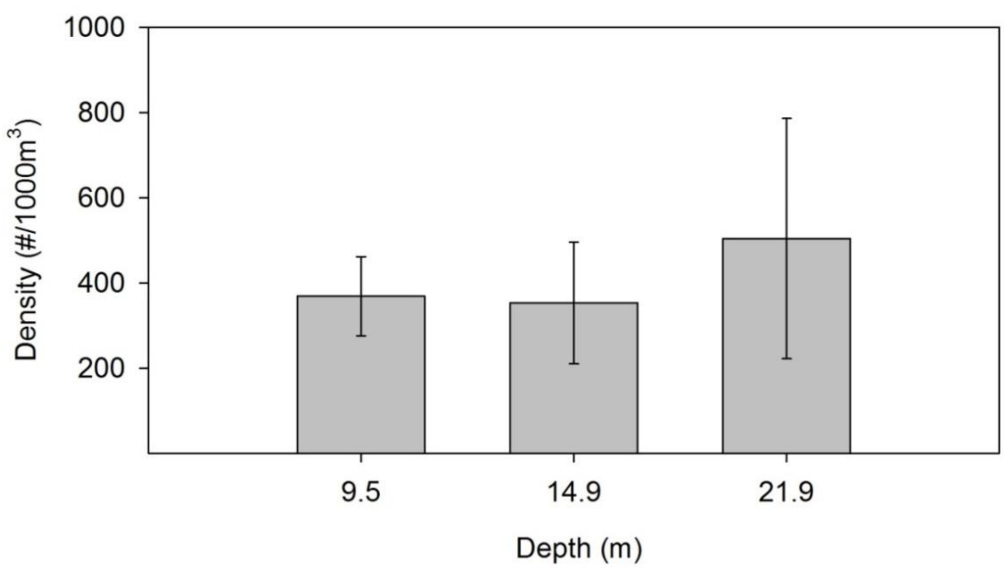


Figure 2. Mean total fish larvae densities (with standard error bars) for sampling at Stations E (9.5 m deep), O2 (14.9 m), and O4 (21.9 m) during the Huntington Beach Generating Station California Energy Commission entrainment study, 2003–2004.

The CalCOFI sampling recorded a similar pattern of generally increasing larval fish densities with increasing depth (Figure 3 and Figure 4). Sampling at Seal Beach was the most representative of the Huntington Beach area. Seal Beach lies approximately 10 miles northeast of Huntington Beach, and the CalCOFI stations range from 0.7 to 10 miles offshore. Offshore Seal Beach, there was no statistical difference between the larval fish densities by depth (KW, H =3.981, df=4, p=0.409).

In addition to Seal Beach, three other areas were sampled: Ormond Beach in Ventura County, Playa del Rey in the Santa Monica Bay, and San Onofre in northern San Diego County. Similar depths were sampled in all areas, but the distance offshore varied as a function of the slope of the continental shelf. As Figure 3 shows, the continental shelf ranged from relatively wide offshore Seal Beach to narrow offshore San Onofre. Despite spanning >110 miles of the Southern California Bight coastline, the pattern of generally increasing larval fish densities with increasing depth occurred at all CalCOFI sites. Combining the data from all four areas to increase the sample size revealed that in the Southern California Bight larval fish density significantly increased with increasing depth (KW, H=14.148, df=4, p=0.007).

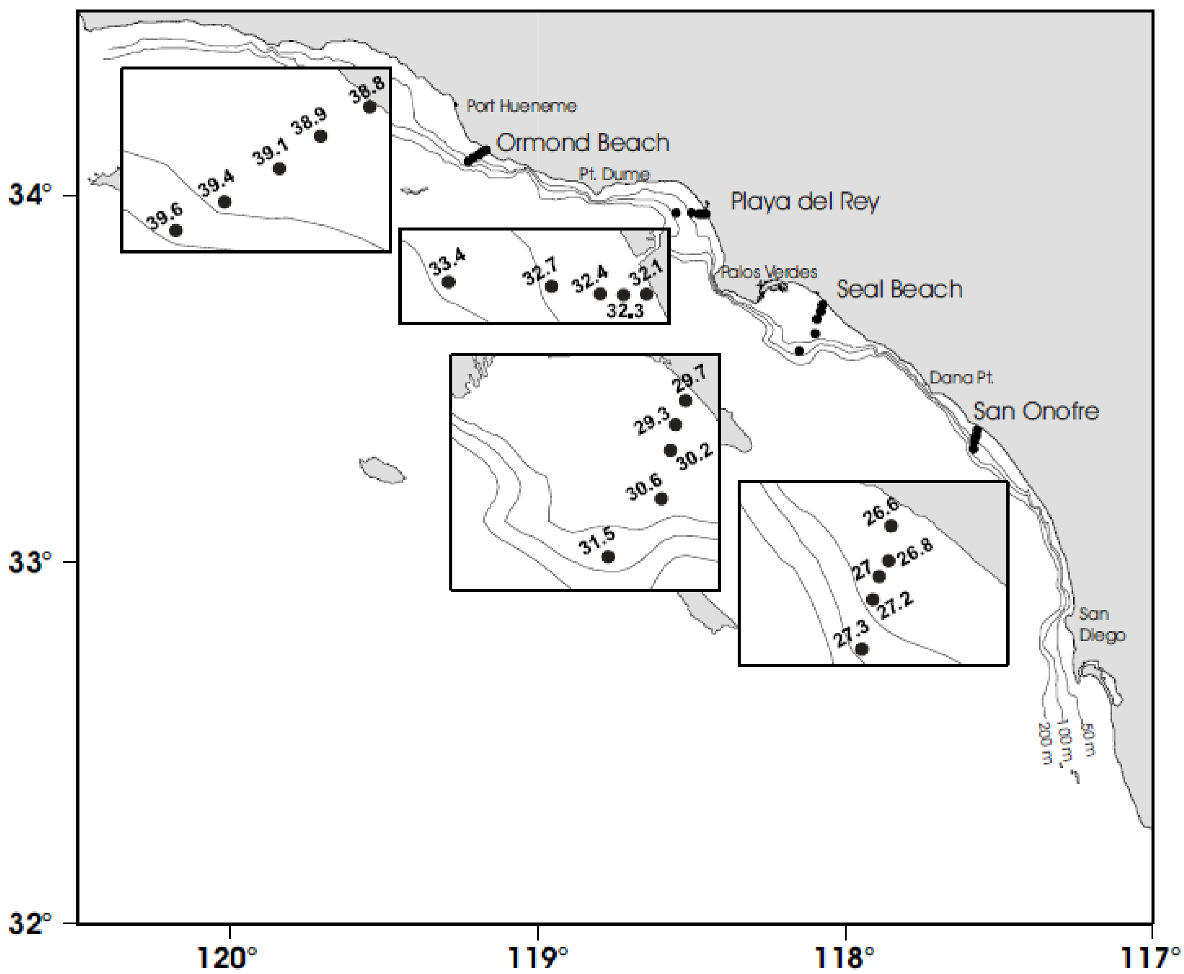


Figure 3. Map of the stations sampled during the California Cooperative Oceanic Fisheries Investigations; numbers indicate sampling stations. Source: Watson et al. 2007.

Table 2. Distance from shore and depth for CalCOFI sampling stations show in Figure 3.

Station	Distance from shore		Depth (m)	
	(km)	(mi)	(m)	(ft)
Ormond Beach	0.5	0.3	10	32.8
Ormond Beach	1.7	1.1	20	65.6
Ormond Beach	3	1.9	30	98.4
Ormond Beach	5	3.1	40	131.2
Ormond Beach	6.6	4.1	80	262.5
Playa del Rey	0.6	0.4	10	32.8
Playa del Rey	1.8	1.1	20	65.6
Playa del Rey	2.7	1.7	30	98.4
Playa del Rey	5	3.1	40	131.2
Playa del Rey	10.9	6.8	80	262.5
Seal Beach	1.2	0.7	10	32.8
Seal Beach	3	1.9	20	65.6
Seal Beach	5.9	3.7	30	98.4
Seal Beach	10.1	6.3	40	131.2
Seal Beach	16.7	10.4	80	262.5
San Onofre	1.3	0.8	10	32.8
San Onofre	2.9	1.8	20	65.6
San Onofre	3.8	2.4	30	98.4
San Onofre	5.1	3.2	40	131.2
San Onofre	7.5	4.7	80	262.5

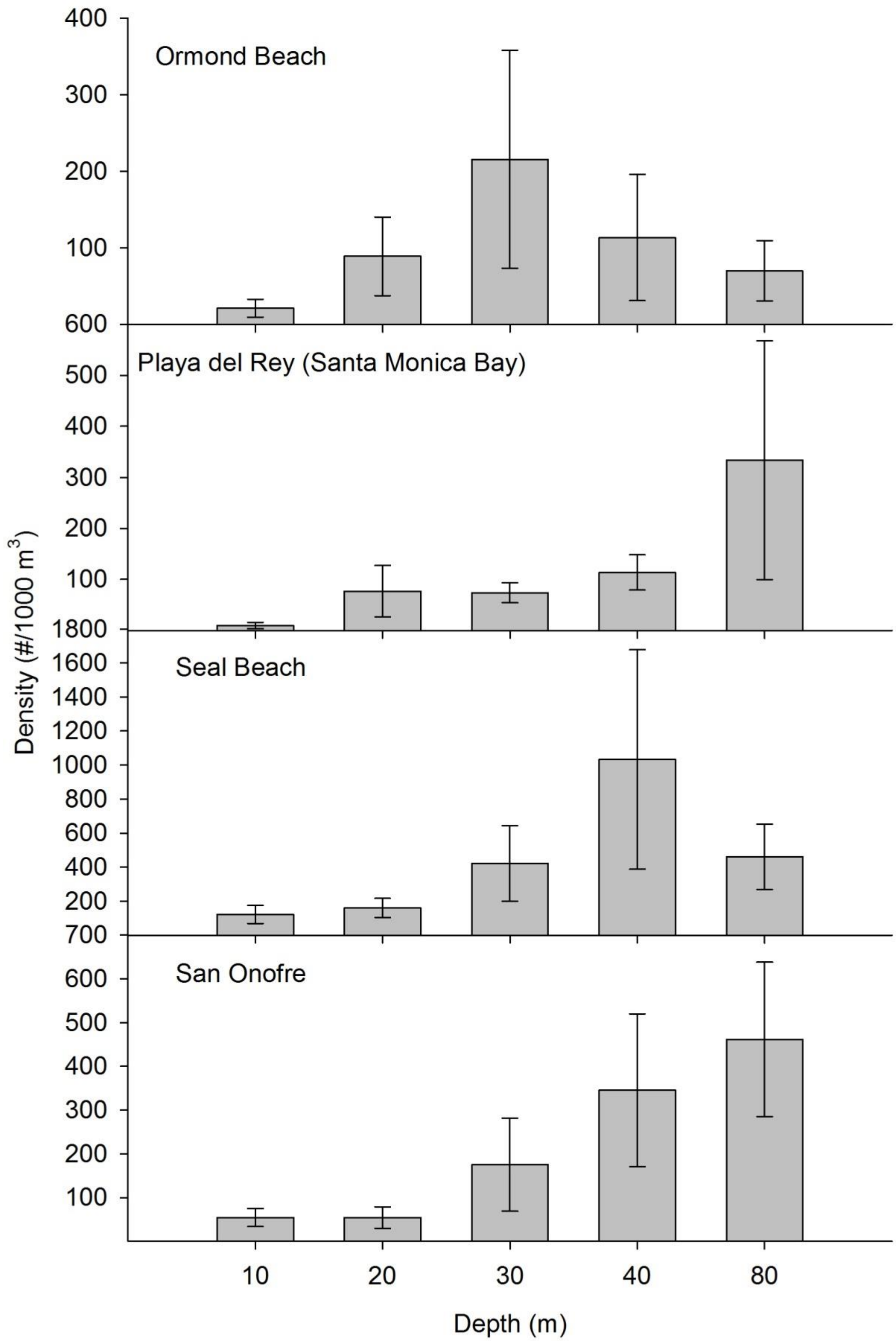


Figure 4. Mean total fish larvae densities (with standard error bars) for sampling at each isobath sampled by the California Cooperative Oceanic Fisheries Investigations offshore of Ormond Beach, Playa del Rey, Seal Beach, and San Onofre.

Conclusion

Based on these existing data, there would be no biological benefit to moving the existing intake withdrawal point to 1.2 miles offshore because the concentration of ichthyoplankton is not statistically lower. The feasibility analysis provided in the previous memo was intended to outline the technical, social, economic, and scheduling aspects of a potential extension of the intake pipeline *if* there were a scientifically justified reason to do so. Therefore, *if* the data had demonstrated that operational impacts of the intake would be reduced by extending the pipeline, then the feasibility considerations discussed in the previous memo would come into play. Those considerations indicated that the pipeline extension would result in substantial construction-related impacts and, in concert with the associated economic and scheduling aspects of the pipeline modification (e.g., permitting, design, financing, construction, maintenance, mitigation, project management, and energy consumption), the current intake withdrawal point is best.

Moreover, since the density of fish larvae at the station located 1.2 miles offshore was statistically indistinguishable from the existing intake location, the impacts of extending the pipeline outweigh the potential benefits and would not justify the extensive construction related-impacts to the benthic environment.

References

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