Public Hearing (9/16/09)
Once Through Cooling
Deadline: 9/30/09 by 12 noon

September 29, 2009

Ms. Jeanine Townsend
Clerk to the Board
State Water Resources Control Board
1001 "I" Street, 24^{th} Floor
Sacramento, CA 95814

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SWRCB EXECUTIVE

Comment Letter – OTC Policy

Dear Ms. Townsend:

MBC *Applied Environmental Sciences* (MBC) appreciates the opportunity to participate in the scoping process for the State Water Resource Control Board's (SWRCB's) proposed once-through cooling (OTC) policy. MBC is an environmental consulting firm that recently assisted with §316(b) entrainment/impingement compliance activities for eight coastal generating stations in southern California. Our recent 316(b) experience includes design and implementation of Impingement Mortality and Entrainment (IM&E) Characterization Studies, data analysis/report preparation, and compliance planning and support. Our experience with 316(b) spans three decades, as MBC biologists worked with representatives from state and federal resource agencies to design and conduct 316(b) demonstrations at California's coastal generating stations in the late 1970s.

In September 2006 we submitted comments to the SWRCB on the first proposed statewide 316(b) policy. Since that time, IM&E Characterization Study reports have been submitted for almost all of the coastal generating stations in southern California. In January 2008, complete 316(b) Comprehensive Demonstration Study (CDS) reports were submitted to the Santa Ana Regional Water Quality Control Board for the AES Huntington Beach Generating Station, and to the San Diego Regional Water Quality Control Board for Southern California Edison's San Onofre Nuclear Generating Station.

In May 2008 we submitted comments to the SWRCB on the scoping document and draft policy released in March 2008. Many of our comments are reiterated herein since they still apply to data and text contained in the latest draft policy and Substitute Environmental Document (SED).

Two Track Approach

The proposed policy requires either a reduction in flow commensurate to that achieved by a closed-cycle cooling system (Track 1), or use of operational measures and/or structural controls to reduce impingement mortality and entrainment of all life stages of marine life to a comparable level to that which would be achieved by implementation of Track 1 (Track 2). As stated in previous comment letters, no technologies have been identified that would provide the entrainment reductions sought by the proposed statewide policy. The proposed policy also requires a reduction in entrainment of zooplankton. We note that there are no known technologies currently available that would exclude zooplankton from entrainment other than retrofit closed-cycle cooling.

The rationale for the requirement to collect and analyze all zooplankton in entrainment samples, and to provide for their protection, is unclear. Zooplankton are generally excluded from entrainment assessments since the potential for detectable impacts to these organisms is minimal. Reasons for this low potential of impact to zooplankton include: (1) the widespread distributions (spanning large oceanic areas) of most taxa, (2) the relatively short reproductive times of most taxa, and (3) their ability to withstand physical entrainment stresses compared to ichthyoplankton. Studies performed for the Marine Review Committee at San Onofre Nuclear Generating Station, which accounts for approximately one-fourth of permitted cooling water withdrawal in southern California, determined that "in fact no substantial changes have occurred in the zooplankton..." due to plant operations.

No Presentation of Environmental Benefits

As in the previous two scoping documents, the SWRCB has not presented any quantitative technical information to describe the nature of fishery improvements that would be achieved by the proposed policy. A recent analysis of cooling water system effects on California's nearshore fisheries determined that a large-scale conversion to closed-cycle cooling may result in no measurable benefit to California fish populations (EPRI 2007). Multiple investigations into nearshore fish populations in southern California have demonstrated that population sizes fluctuate independently of power plant operations, and population trends are better explained by changes in oceanographic conditions, commercial/recreational fishing pressure, or both.

At the public workshop held in Sacramento on September 16, 2009, Chair Hoppin posed a question in response to the raw entrainment and impingement totals presented in the draft SED. He asked the Staff to put the raw totals into context (i.e., What does the entrainment of millions of larvae really translate into?).

MBC, in collaboration with other scientists, has published several documents in the last two years that provide some context for the entrainment and impingement estimates presented in the draft SED. These include:

- 316(b) Impingement Mortality and Entrainment Characterization Studies for eight coastal generating stations submitted in 2007-8. See:

  http://www.swrcb.ca.gov/santaana/water_issues/programs/aes/index.shtml and

  http://www.waterboards.ca.gov/losangeles/water_issues/programs/power_plants/

- *Assessment of Cooling Water Intake Structure Impacts to California Coastal Fisheries*, submitted to the SWRCB in December 2007; See:

  http://www.swrcb.ca.gov/water_issues/programs/npdes/cwa316.shtml

- Several peer-reviewed, scientific papers analyzing trends in coastal fish populations in relation to climatic/oceanographic changes, as well as trends in cooling water flow at coastal power plants (see Miller et al. [2009 and in review]).

The 316(b) IM&E Characterization Studies included impact assessments, which specifically attempted to address Chair Hoppin's underlying question of IM&E impacts. Where possible, numbers of larvae were expressed in terms of (1) the numbers of adult fishes they would represent had they survived entrainment, (2) the reproductive output of female fishes lost as a result of entrainment, and (3) proportional entrainment, or the fraction of the source population at risk of entrainment that was lost due to operation of cooling water withdrawals. In many cases, losses were compared to long-term monitoring efforts to determine if there were detectable effects due to operation of cooling water intake systems. Losses were also compared with regional and/or statewide commercial and recreational fishing landings. All of this information is available to the SWRCB, yet none of it appears to have been considered in drafting the proposed policy.

The fish communities of the Southern California Bight have clearly responded, mostly negatively, to the 1977 regime shift (see attachment). Primary and secondary productivity in the California Current decreased substantially after the regime shift of 1976-77. The subsequent shift in oceanographic conditions led to reduced plankton biomass (Roemmich and McGowan 1995), which resulted in effects cascading up the marine food web. Planktivorous species, such as queenfish, have markedly declined in response. Furthermore, the general ocean warming associated with climate change (McGowan et al. 1998) has resulted in a faunal shift where historically abundant, cooler water species common to southern California have declined in abundance, while more southern species have increased. This pattern is generally consistent with the heavily cited northern anchovy/Pacific sardine cycle (Chavez et al. 2003).

The fishes offshore southern California are exhibiting a faunal shift related to climate change, with many populations unable to recover from the damage caused by the nearshore gill net fishery. Throughout these times with changing oceanographic conditions and fishing pressure, however, we have witnessed some populations increase more than a thousand-fold. Yellowfin croaker have increased by over 3,000%, on average, during the post gill net period (1995-2008) over their levels prior to the gill net fishery (1972-1982). This increase in abundance was accomplished while cooling water systems throughout southern California continued to operate. Yellowfin croaker are also among the top species impinged at San Onofre, ranking second in impingement abundance during the 316(b) demonstration in 2006-7.

Cost-Benefit analysis was recently performed for the AES Huntington Beach Generating Station (available online at the Santa Ana RWQCB web site). In that study, compliance with the IM&E reductions specified in the facility's NPDES permit would result in annualized benefits ranging between $4,719 and $12,700, with a mean estimate of $7,928. The 20-year discounted value of these benefits ranged from $94,000 to $254,000, with a mean estimate of $158,600. By comparison, the cost to comply with NPDES permit requirements was roughly $76 million.

Past Mitigation Efforts

Mitigation is discussed briefly on pages 75-76 of the proposed policy, but never taken into account when discussing IM&E impacts. While the Staff summarize some of the mitigation efforts undertaken to offset IM&E losses, the IM&E losses presented in the document are never presented in this context. Entrainment at San Onofre accounts for nearly 40 percent of the statewide total listed in the draft SED, yet the fact that these losses have been mitigated as required by another state agency is never mentioned.

Cumulative Impacts

The Staff has misrepresented the cumulative impacts analysis performed by MBC and Tenera (2005). We again reiterate our objections to Staff's use of this data out of context from its original presentation.

The proposed policy states that MBC and Tenera (2005) "*estimated that, for 12 coastal power plants in the Southern California Bight, there is an overall cumulative entrainment mortality of 1.4 percent of the larval fishes in the Bight.*" As stated in our previous comment letters, the 1.4 percent mortality was not based on empirical biological data, but several assumptions, including an assumed source water and maximum cooling water flow at the power plants. As illustrated in the draft SED, actual statewide cooling water flows are only about one-half of the permitted maximum. One other assumption in the analysis prepared for the CEC included a relatively long larval duration (exposure to entrainment) of 40 days.

The Staff also cite MBC and Tenera's estimation of Bight-wide impingement, which was required by the California Energy Commission. It is unclear why these estimations from 2005 are cited since there is now empirical impingement data for every power plant in southern California (as presented in Table 3 of the draft SED). The comparison of impingement and recreational fish landings is also reported out of context, since there is a large disparity between the fish species impinged and those targeted by recreational anglers.

Wholly Disproportionate Demonstration

As part of a Wholly Disproportionate Demonstration, the owner/operator of a power plant is required to quantify the environmental benefits of compliance, including (1) the reduction in entrainment expressed as Habitat Production Foregone, (2) the reduction in impingement mortality, and (3) the improvement in receiving water quality due to reduction of thermal discharge. It is not clear how these different metrics would eventually be analyzed.

Findings of Significance

Staff do not indicate what their significance criteria are, or how they arrived at findings of significance. The policy could result in a 14% increase in CO_2 emissions, and an 18% increase in NO_2 emissions. However, "*staff expects the actual net increase in greenhouse gas emissions will fall somewhere in between these extremes (0-5 percent increase).*" The findings of no significance for water quality are also questionable, particularly since the significance criteria are never spelled out.

Greenhouse gas levels have been linked to climate change by the scientific community. Climate change is resulting in gradually increasing sea and air temperatures globally, glacial melting, sea level rise, and poleward shifts in population distributions. Increases in aerial CO_2 levels are leading to increased ocean acidification, which has been linked to reduced calcification in primary producers, such as pteropods. Such effects will ultimately manifest themselves in the upper trophic levels. McGowan et al. (2003) reported on reduced zooplankton size, which may partially be the root cause of many of these upper trophic level declines.

With the growing body of knowledge regarding climate change, the effects of greenhouse gas emissions, and long-term trends in marine resources, it is unclear how a policy that will increase such emissions can be seriously considered without a more rigorous effort to estimate potential impacts from various compliance strategies. It is difficult to fathom how implementation of the proposed policy could not result in any significant effects, particularly with respect to air quality.

Cumulative and Long-Term Impacts

There is a section titled 'Cumulative and Long-Term Impacts'. However, no cumulative or long-term impacts are even identified. It is unclear how a policy that would affect the state's power supply and distribution for the foreseeable future could not result in any cumulative or long-term impacts.

Other Comments

The relationship between cooling water flow and power generation are plotted in Figure 10, but there are only six data points. The statement is made that cooling water flow and power production are linearly correlated. It is unclear why there are only six data points in this graph.

The titles for Tables 16 and 17 are incorrect, since many mammals and sea turtles are never 'impinged'. It should be clarified that marine mammal and turtle "impingement" is rare. Instead, animals are usually entrapped and subsequently removed from circulating water systems.

The title for Table 18, for example, is "*Existing IM/E controls and Mitigation Efforts at the OTC Facilities*". However, no mitigation information is listed.

Conclusion

Thank you again for the opportunity to comment. If you have any questions regarding this letter please feel free to contact me at (714) 850-4830 or sbeck@mbcnet.net.

Respectfully,

MBC *Applied Environmental Sciences*

Shane Beck
President

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ATTACHMENT

A REVIEW OF THE PATTERNS IN SOUTHERN CALIFORNIA MARINE ZOOPLANKTNON AND FISH POPULATIONS IN RELATION TO OCEANOGRAPHIC CONDITIONS WITH CONSIDERATIONS OF ONCE THROUGH COOLING.

Eric F. Miller
MBC *Applied Environmental Sciences*

Implicit in the current Draft Substitute Environmental Document supporting the State Water Resources Control Board's Water Quality Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling (Policy) is the assumption that cessation of once through cooling by California power plants will result in increases in local marine populations. To this end, two declarations made by Board staff require further examination to better estimate the net effect of the proposed policy. These declarations include:

1) Once through cooling causes an adverse environmental impact (AEI) on coastal populations (Pg. 28), and

2) The increased emission of greenhouse gases (GHG) such as carbon dioxide will have a "less than significant impact" (Pg. 101).

Item 1 is supported by two staff reports (CEC 2005; USEPA 2004). Neither document included reviews of long-term data on population trends in coastal fish populations that would have provided insights both into prior AEI and the potential benefits to be realized through the implementation of the State's proposed policy. Previous trends in fish populations are critical to this evaluation in light of climactic forcing, especially the effects of climate change, anthropogenic GHG emissions, and the ultimate effects of these factors on the rate of change (OPC 2007; WCGA 2008; CANRA 2009; AB32).

HISTORIC REVIEW OF PATTERNS IN COASTAL POPULATIONS - Critical to this discussion is the state of the nearshore zooplankton communities along the California coastline. Previous authors have documented a marked decline in the plankton biomass along the California coastline (Roemmich and McGowan 1995; Rebstock 2002; McGowan et al. 2003; Ware and Thomson 2005; Miller et al. 2009). This decline directly links to shifts in productivity realized since the 1977 oceanographic regime shift in the Northeast Pacific (Roemmich and McGowan 1995; Mantua et al. 1997; Ware and Thomson 2005). Within the Southern California Bight, zooplankton biomass has declined to a lower stable state since circa 1977 (Figure 1). When viewed in relation to OTC flow across the five facilities examined by Miller et al. (2009), no relationship was detected between flow and plankton biomass. Furthermore, after the startup of San Onofre Nuclear Generating Station Units 2&3 in the early 1980s, the source of the marked increase observed in Figure 1, OTC flow and zooplankton biomass indices have shown similar declines. This indicates that the operation of OTC and zooplankton community dynamics were unrelated. A lack of any prior relationship between zooplankton and OTC suggests that any future alterations to OTC use, such as its cessation, will not result in a corresponding change in the zooplankton community. Given that all prior analyses of zooplankton in the Northeast Pacific have linked its population dynamics to oceanographic forcing, including those parameters most closely monitored in relation to climate change, it appears that the future of zooplankton communities in the area are contingent upon future climate change factors. Such factors include ocean acidification, which may be the cause of the perceived declines in the mean individual copepod size (McGowan et al. 2003) as the species composition has remained relatively stable (Rebstock 2001) and the populations of various copepod species have varied (Rebstock 2002) while the plankton biomass has declined. Historic patterns in zooplankton communities, both nearshore and throughout the Northeast Pacific are critical to this evaluation in light of their dependence on oceanographic forcing, specifically climate change impacts, especially the effect of anthropogenic GHG emissions and their effect on the rate of change (OPC 2007; WCGA 2008; CANRA 2009; AB32). Their past relationship to OTC and climactic forcing are the best indicators of what can be expected with the passage of the State's draft policy.

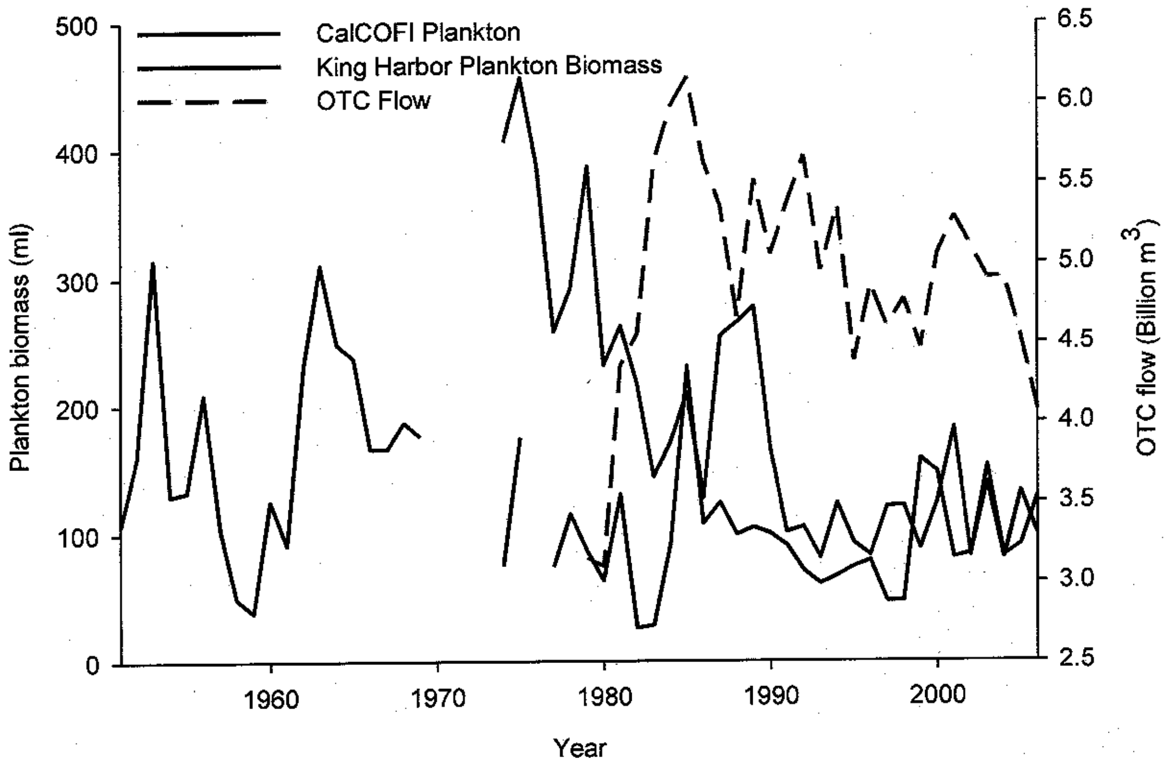

Figure 1. Plankton volumetric biomass (ml) recorded by California Cooperative Oceanic Fisheries Investigations (CalCOFI) cruises; in King Harbor, Redondo Beach adjacent to the Redondo Beach Generating Station Units 7&8 intake structure; and the total OTC flow in billion cubic meters for the five facilities analyzed by Miller et al. (2009).

Previous studies by Daniels et al. (2005) on the long-term trends in the Hudson River fish assemblage, the site of much of the founding arguments regarding environmental impacts of OTC, are insightful for this process. Their analysis recorded shifts in the species common to the assemblage. Changes were attributed to a suite of factors, including: invasive species, such as the zebra mussel and non-native fishes; effects of land-use practices; urbanization; non-point source pollution; and global warming (climate change). Many of the Hudson River fishes that declined were typically associated with cooler waters and/or had a more northern biogeographic distribution. Those species that were increasing were the opposite, preferring warmer waters. The effect of urbanization, land-use practices, and global warming had lead to warmer waters that were presumably less suitable to the traditional, cooler water affinity species. Prior reports in California have identified AEI based on brief studies lasting less than a decade, anecdotal evaluation, and expert opinion (Foster 2005; CEC 2005). All lacked a review of empirical datasets with greater than 10 years of consistent monitoring. The most robust study cited by CEC (2005) was the Marine Review Committee studies of San Onofre Nuclear Generating Station (SONGS) during the planning and construction of Units 2 and 3. These studies occurred in the late 1970s through the early 1980s. This was a period marked by dramatic oceanographic change, most important of these being the 1977 oceanographic regime shift (Roemmich and McGowan 1995; McGowan et al. 2003) and the 1982-1983 El Niño. The regime shift was unidentified until the mid-1990s. Its biological impacts are still being evaluated, but it caused demonstrable changes in the marine communities, especially the plankton assemblages that form the base of the marine food web.

A review of fish populations based on power plant impingement monitoring, and comparison to other available fishery-independent data such as the California Cooperative Oceanic Fisheries Investigation (CalCOFI) plankton surveys, establishes a 37-year timeline of fish populations along the southern California coastline. The impingement data is derived from five facilities with open coast, velocity-capped intakes ranging from Ventura to San Clemente, California. Details on the analysis techniques are available in Miller et al. (2009). Analysis of this dataset provides keen insight into the principle stressors acting upon the coastal marine fish populations. Miller et al. (2009) found queenfish abundances to vary spatially among several sites repeatedly sampled over an 11-year period within the Southern California Bight. The pattern exhibited by queenfish populations were found to significantly follow that observed in nearshore plankton biomass, which has been previously described (Roemmich and McGowan 1995) as a clear indicator of oceanographic conditions. The decline in both communities, queenfish and plankton, has been in response to the environmental conditions present after the 1977 regime shift. Moreover, the pattern in each community shows no indication of any alteration in the area due to OTC, such as the startup of San Onofre Nuclear Generating Station Units 2&3 or the progressive decline in OTC water flow in southern California. Lastly, while entrainment has been frequently identified as a principle vector for the reported impact of OTC, the queenfish larval densities have continued to decline in King Harbor in samples taken adjacent to the Redondo Beach Generating Station Units 7&8 OTC intake structure (Miller et al. 2009; Figure 2). In fact, there is a positive significant relationship between cooling water withdrawals and larval queenfish densities. All of these patterns described for queenfish were further consistent with the CalCOFI results across their entire sampling area. These empirical data demonstrate that queenfish populations are variable and susceptible to environmental forcing, specifically factors that impact coastal productivity in the zooplankton community, the major prey source for queenfish. Given that previous changes in OTC use in California were not evident in the queenfish population indices, it is unlikely that any future cessation of OTC would measurably benefit the population dynamics. Furthermore, any procedures that would accelerate the alterations to oceanographic conditions currently observed would further weaken the queenfish populations.

While the analysis of queenfish is demonstrable, investigation of a greater array of species reveals further insights. The croakers, of which queenfish is included, provide an even greater overview of the population patterns, including analysis in relation to oceanographic conditions and commercial fishing effort. This amounts to a cumulative impact study in a more true sense since it encompasses OTC as well as other potential significant sources of variation. All seven croaker species are impinged by the five coastal plants analyzed, but in highly variable numbers. The population indices range from 905.1, on average, for queenfish to 0.8 for white seabass. Entrainment sampling, recent and historic, has recorded few croakers other than white croaker and queenfish, although spotfin croaker and black croaker were both abundant offshore of Huntington Beach Generating Station in 2004. Cumulatively, the croakers accounted for 6% of all entrainment recorded at four of the five power plants analyzed by Miller et al. (in review). While the differences in the impingement abundances vary by greater than three orders of magnitude, on average, the species exhibited remarkable similarity in their historic patterns, consistent with oceanographic forces and commercial fishing practices regulating their populations (Figure 3). Most notably was the depressed period in nearly all species circa 1982-1995, or the period during which the nearshore white croaker gill-net fishery operated (Miller et al. in review). The data suggests this fishery, as either bycatch or the targeted species (queenfish and white croaker), influenced all seven species' population. After the fishery's closure in 1995, most species remained depressed while spotfin croaker and yellowfin croaker increased. Comparisons with sea temperature, or a similar index such as the Pacific

Decadal Oscillation or North Pacific Gyre Oscillation, recorded significantly negative relationships between a temperature index and four of the seven species while spotfin croaker and yellowfin croaker

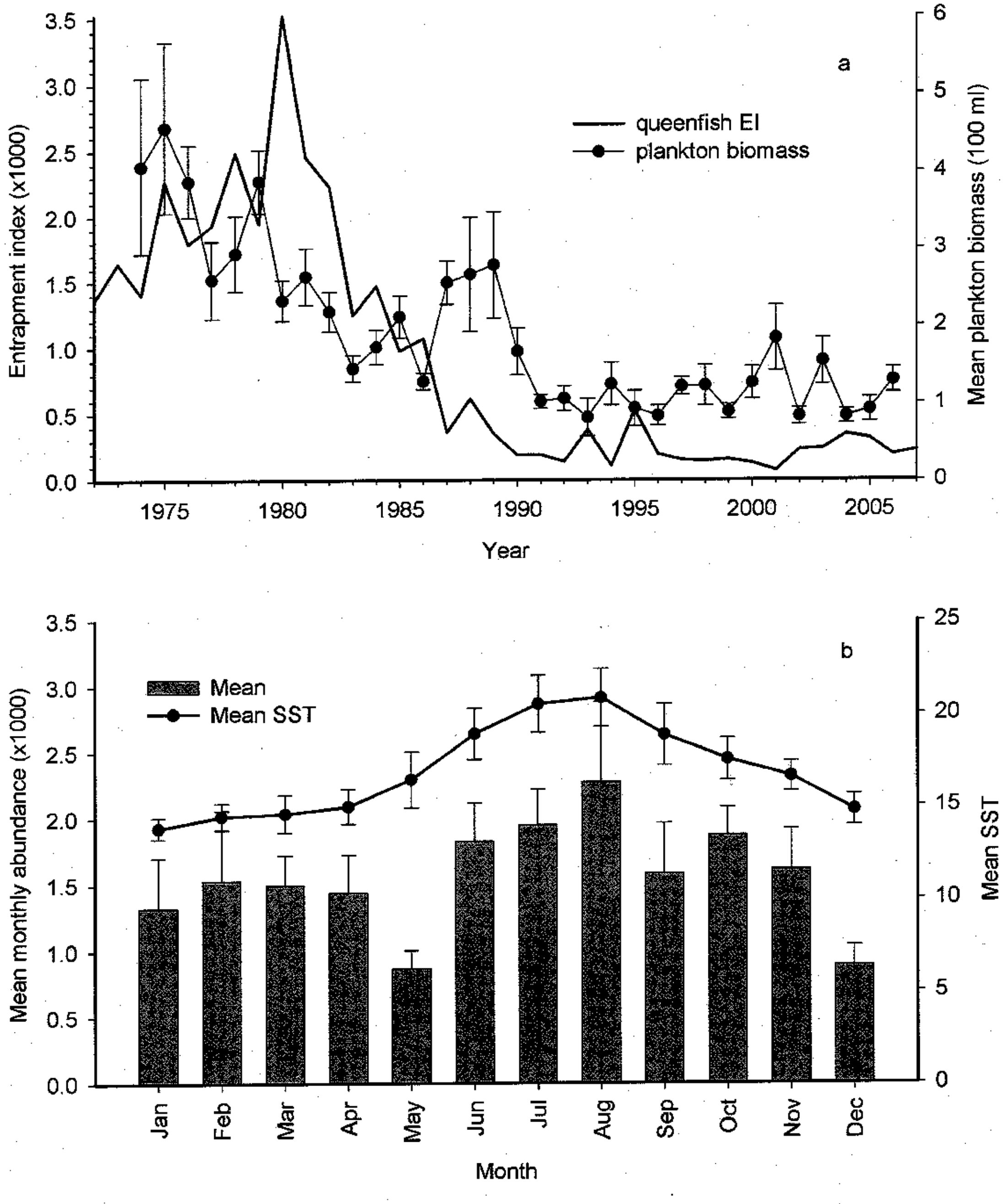

Figure 2. a) Queenfish standardized entrapment abundance at Ormond Beach Generating Station (OBGS), El Segundo Generating Station (ESGS), Redondo Beach Generating Station (RBGS), Huntington Beach Generating Station (HBGS) and San Onofre Nuclear Generating Station (SONGS). Ormond Beach Generating Station sampling period (1979-2007) was shorter than the remaining sites (1972-2007). b) Mean monthly entrapped abundance at SONGS (1984-2007) and mean monthly sea surface temperature (SST) recorded at Newport Beach Pier (1984-2007). (Figure from Miller et al. 2009).

were positively related to the temperature parameters. White seabass was not related but was also heavily impacted by the commercial gill-net fishery (Allen et al. 2007). Seawater temperatures worldwide, and especially along the west coast of North America (McGowan et al. 1998), have been increasing over time with most researchers linking this increase to anthropogenically-forced (GHG emissions) climate change (Bindoff et al. 2007; OPC 2007). Additionally, several researchers have observed poleward biogeographic shifts in populations (Murawski 1993; Genner et al. 2004; Perry et al. 2005), including marine bird and fish species from California (Veit et al. 1996; WCGA 2008; CANRA 2009; Hsieh et al. 2009). The southern California croakers are clearly following this pattern with the cooler-water species such as queenfish and white croaker declining in local abundance to less than 15% of their 1970's levels while yellowfin croaker and spotfin croaker increasing to 3,553% and 355%, respectively, of their 1970's level (Miller et al. in review; Figure 3). In addition to the significant relationships observed with temperature indices, four of the seven species were significantly related to the nearshore plankton biomass trend described in Figures 1 and 2 as well as Miller et al. (2009).

Patterns in the croaker populations observed over the last 37 years, especially their similarities to oceanographic conditions and zooplankton biomass, provides further insight into what may be expected from the implementation of the State's draft policy. Like the queenfish analysis, changes in OTC were not evident in the croaker population analysis. Furthermore, the correspondence between the populations and oceanographic conditions, specifically seawater temperature, pose the greatest concern. The observed shifts from cool water croakers (white croaker and queenfish) to more warm water species (yellowfin croaker and spotfin croaker) indicate that further acceleration of climate change impacts, such as rising seawater temperature, will allow for the increase in the warm water croakers while the cool water species become much more rare, if not extinct, in the area. A lack of prior indications of OTC change evidenced in the croaker dynamics indicates that no future changes to OTC, such as it cessation, will result in a measurable change in the population. Increased GHG emissions, however, will contribute to accelerating climate change which has already had a pronounced effect on the croaker populations.

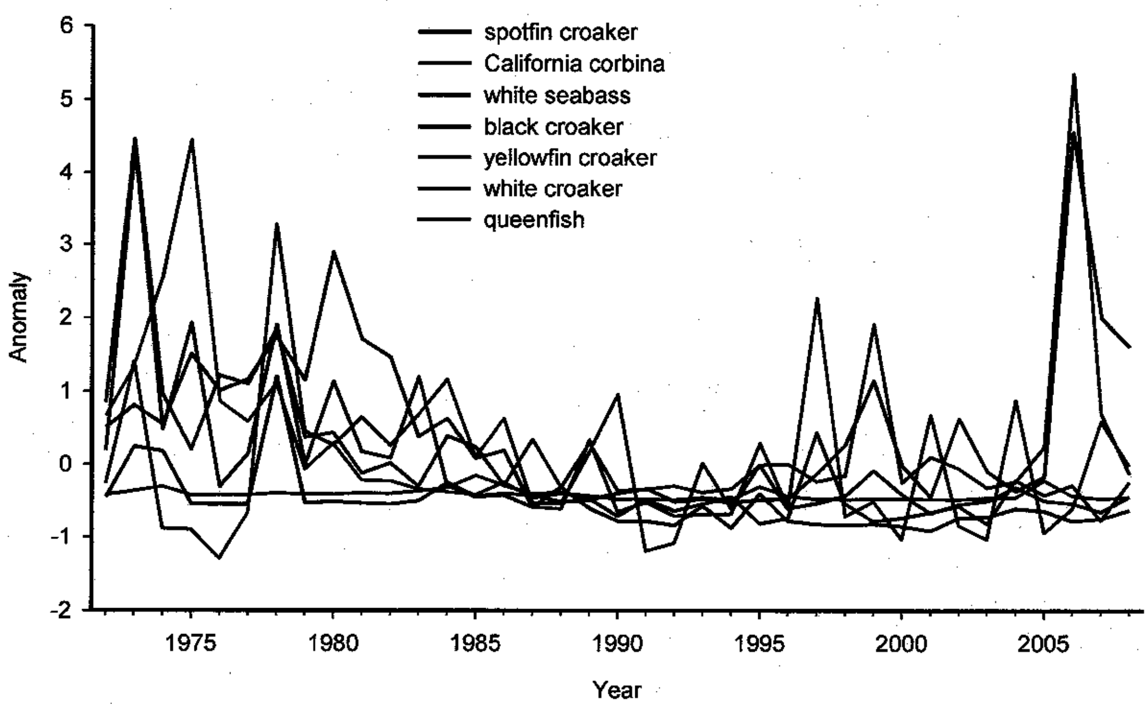

Figure 3. Index anomaly (z-score; deviation from the mean ± 1 standard deviation) by sciaenid species for the entrapment index (EI; 1972-2008). (From Miller et al. in review).

To ensure as complete coverage to all marine fish species, evaluation of a wider selection of species should illustrate the more comprehensive dynamics of the interaction between OTC and the coastal environment. Twenty-one species cumulatively represent 98% of all impinged fishes recorded at the five facilities examined. These include both forage and fished species (recreational and/or commercial). Their patterns further illustrate a defining pattern of oceanographic forcing with no clear relationship to changes in OTC use. These observed patterns are consistent with more extensive longer term studies, such as the CalCOFI program, which further support their use as an index of the population parameters. Each of the 21 species were compared to a suite of oceanographic indices, all of which have some indication to coastal productivity and/or temperature, including: sea surface temperature, seafloor temperature, Pacific Decadal Oscillation, North Pacific Gyre Oscillation, and nearshore plankton biomass. Of these 21 species, nine peaked during or before 1980, three from 1981-1990, while 10 have increased since 1990 (Figure 4). Furthermore, nearly all those species with declining patterns prefercooler-water conditions (Miller 2007) or have biogeographic ranges extending further into more northern latitudes. Those species that are increasing have warmer thermal tolerances and preferences and/or are geographically distributed across more southerly latitudes. A specific example is the decline observed in northern anchovy and corresponding increases in Pacific sardine. This dynamic has been well documented, most recently by Chavez et al. (2003), and has been indicative of the oceanographic climate for millennia, based on analysis of sediments from the Santa Barbara Basin. Northern anchovy is common in cooler water periods in southern California, while Pacific sardine is more common in warm water regimes, such as that beginning in 1977. These data clearly show that while the rising seawater temperatures, and associated effects of climactic forcing, has driven down the abundance of cool water-affinity species, a corresponding rise in warm water affinity species has occurred. The overall community has declined due to the significant proportion of the historic catch constituted by white croaker and queenfish. As with the croakers previously discussed, there is no representation in the population trends of these 21 species to indicate that any changes related to OTC use have occurred since 1972. The lack of such an indication in the past suggests that any future changes, such as cessation of OTC use, will not result in a positive response on the part of these species, including those targeted by recreational or commercial fisheries. A cessation of OTC use in California will not result in greater fishery yields. Moreover, the consistent relationship between these species and oceanographic indictors of climate change, namely seawater temperature, clearly indicate that the nearshore fish populations will continue to shift towards a warm-water fauna. Increased GHG emissions will continue to accelerate climate change, and thus the transition from the fauna common to the Southern California Bight since at least 1972 towards a fauna more common to the Baja California coastline, and further south. This includes most commonly targeted fishery species, such as barred and kelp bass, white seabass, northern anchovy, etc.

The empirical results depicted in Figure 4 correspond with annual larval densities recorded by CalCOFI for all red and blue colored species, where data is available (Moser et al. 2001). This confirms that the patterns observed in Figure 4 are, in fact, representative of the overall population patterns. As stated previously, past performance is the best predictor of the future. In this case, the lack of an OTC-effect on the coastal populations in the past indicates that cessation of its use in the future will not result in a net population increase.

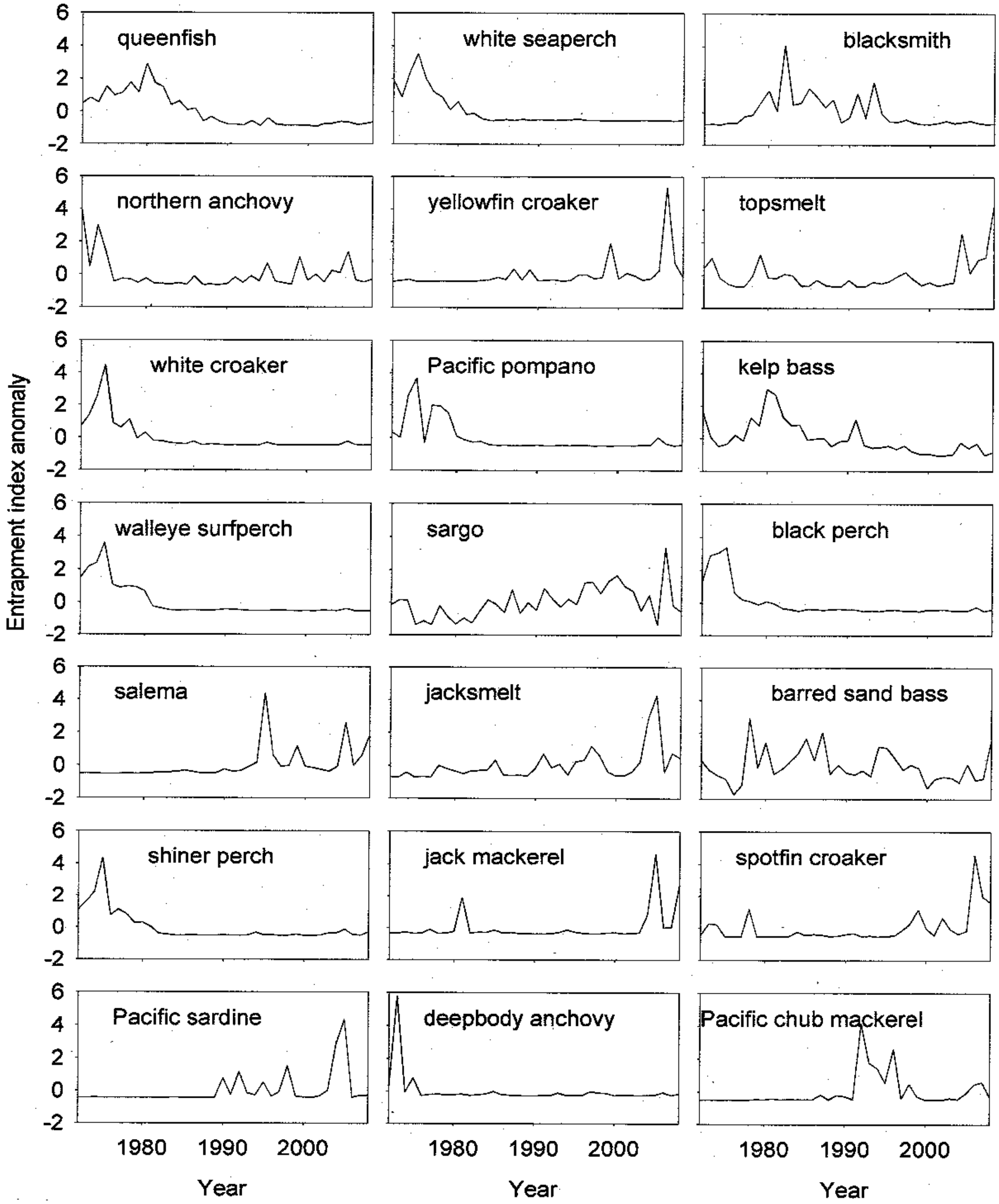

Figure 4. Anomaly (deviation from the mean ± 1 standard deviation) in the populations of 21 common southern California marine fishes which represent 98% of all fishes impinged. Blue color represents a significant ($p < 0.05$) negative correlation with seawater indices. Red color indicates a significant positive correlation with seawater indices. Black indicates no correlation at the $p = 0.05$ significance level.

EFFECT OF INCREASED GREENHOUSE GAS EMISSIONS - As shown in Figures 3 and 4, a substantial portion of the species interacting with OTC have responded to changing water temperatures in the Northeast Pacific. Previous reports from numerous authors (Murawski 1993; Veit et al. 1996; Genner et al. 2004; Perry et al. 2005; Hsieh et al. 2009; Noakes and Beamish 2009) have documented similar responses to rising seawater temperatures throughout the world's oceans. Furthermore, the connection between rising seawater temperatures and anthropogenic GHG emissions has also been well documented by both State (OPC 2007; WCGA 2008; CANRA 2009; AB32) and Federal (USGCRP 2009a,b) agencies as well as international bodies (IPCC 2004; Bindoff et al. 2007). Ultimately, recent reports (CANRA 2009; USGCRP 2009b) unequivocally link the currently accelerating climate change to anthropogenic GHG emissions. In light of these robust findings, the policy's finding of "less than significant" for an increase in GHG emissions from the second largest emitting sector in the state without any supporting data is scientifically questionable. The empirical data on fish population patterns and their response to rising seawater temperatures, which are ultimately driven, in part, by anthropogenic GHG emissions clearly indicate that the policy will likely result in further depressed populations of species associated with cooler water conditions (blue in Figure 3) while the species associated with warmer conditions (red in Figure 3) will continue to increase in the southern California area. The increase in warmer water species, however, cannot be sustained with ever-increasing seawater temperatures as their poleward expansion continues. The "less than significant" finding is not consistent with the scientific information currently available. Nor is it consistent with recent government reports on climate change and its effect on coastal resources as well as adaptation and management plans designed to alleviate or mitigate these climate change effects.

Ultimately, the State's draft policy is designed to reduce the impact of power plant operations on the coastal marine species. It is assumed that the loss of marine life to OTC use is causing an AEI which can most be readily alleviated by the cessation of OTC use. Whether or not an AEI is occurring as a result of OTC use, the direct loss of marine life by the cessation of OTC use will occur. The principle question is will the State's draft policy result in a net benefit to the coastal marine resources. When evaluated in total, the answer is no due to the dramatic increase in GHG emissions that will result from the conversion to a less efficient technology. As previously stated, various regulatory and scientific agencies have determined that anthropogenic GHG emissions, including that from power plants, are accelerating climate change to previously unseen rates. These changes are felt by the marine species through the variety of modifications to oceanographic conditions, specifically water temperature, upwelling, nutrient concentration, ocean acidification, etc. All of these impact primary productivity which directly influences all subsequent parts of the marine food web. The empirical data clearly shows the marine resources of California, and the world, are shifting poleward in response to rising seawater temperatures. As written, the State's draft policy on once through cooling will force significant increases in GHG emissions statewide. This, especially in light of AB32 and other pending State and Federal legislation, cannot be considered "less than significant".

SUMMARY – Analysis of 37 years of fish monitoring, and its comparison to more prevalent studies such as CalCOFI, have clearly illustrated the patterns exhibited by California's coastal marine species. These communities have consistently responded to oceanographic forcing, often factors indicative of anthropogenically-accelerated climate change. Examination of the past population patterns has not revealed a relationship to OTC use in California. This lack of a demonstrable relationship to past operations clearly raises doubt as to the benefit of OTC cessation in the State. There is no empirical evidence that cessation of OTC will result in any change, positive or negative, in the nearshore populations. While cessation of OTC will not affect the populations, the Policy will increase GHG emissions State-wide. Based on the past relationship between populations and climate change-driven oceanographic conditions, such as seawater temperature, any benefit resulting from OTC cessation will be overwhelmed by the negative impact of the increased GHG emissions. The effect of these increased emissions will impair all marine populations, likely driving species such as white croaker and white seaperch to near extinction in the Southern California Bight. The net benefit of the State's policy will be a substantial contribution to the systematic decline of marine resources in California and around the world.

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