6/15/10 Board Meeting
2010 Integrated Report 303(d)
Deadline: 5/28/10 by 12 noon

CENTER *for* BIOLOGICAL DIVERSITY *Because life is good.*

May 28, 2010

Sent via electronic mail and hand delivered with CD

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Re: Comment Letter – 2010 Integrated Report / Section 303(d) List.

On behalf of the Center for Biological Diversity, these comments are submitted in response to California's draft 2010 Integrated Report / Section 303(d) List to urge the State Water Resources Control Board to:

Designate coastal and ocean waters as threatened or impaired by ocean acidification pursuant to section 303(d) of the Clean Water Act.

The ocean absorbs carbon dioxide causing seawater to become more acidic. Among various adverse impacts to marine life, this process—termed ocean acidification—impairs the ability of calcifying organisms to build their protective structures. Already ocean pH has changed significantly due to human sources of carbon dioxide. Recent surveys of the west coast by Feely et al., showed that northern California is being exposed to some of the most acidic waters due to ocean acidification. On the current trajectory, ocean ecosystems are likely to become severely degraded due to ocean acidification.

On February 27, 2007, the Center for Biological Diversity submitted scientific information supporting the inclusion of ocean waters on California's 303(d) list to each of the coastal regional water boards. Since then, it has only become more apparent that ocean acidification poses a serious threat to seawater quality with adverse effects on marine life. On June 11, 2008, the Center for Biological Diversity submitted additional scientific information concerning the latest findings on ocean acidification. Apparently, the regional Water Quality Control Boards have deferred action on ocean acidification to the State Water Resources Control Board. Nonetheless, the Center submitted comments with updated information concerning ocean acidification during each of the coastal regional water board's public comment period. Additionally on February 4, 2009, I submitted additional information for consideration to the State Water Resources Control Board.

Nonetheless, California's draft 303(d) list failed to include any ocean segments threatened or impaired by ocean acidification and the Integrated Report did not even mention ocean acidification. The overwhelming scientific evidence supports the inclusion of ocean waters on the 303(d) list because ocean acidification is causing degradation of seawater quality in violation of California's water quality standards and threatens to become worse. Since the Center originally requested in 2007 that California designate ocean waters as threatened or impaired the problem of ocean acidification has become more severe, it has accelerated, the scientific knowledge about ocean acidification has grown more certain, and EPA has acknowledged the reach of section 303(d) of the Clean Water Act to ocean acidification. California not only has the authority to designate ocean waters as threatened or impaired, but it also has a duty to do so. This letter and its source documents should be taken under consideration in support of including ocean waters as threatened or impaired on California's 303(d) list, and the Center's previous letters and supporting documents are incorporated by reference.

1. Clean Water Act Background

Congress enacted the Clean Water Act, 33 U.S.C. §§ 1251 et seq., with the express purpose of "restor[ing] and maintain[ing] the chemical, physical, and biological integrity of the Nation's waters." 33 U.S.C. § 1251(a) (2008). The goals of the Clean Water Act are to guarantee "water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation" and to promptly eliminate water pollution. 33 U.S.C. § 1251(a).

Toward those goals, the Clean Water Act requires states to establish water quality standards that serve as a basis for regulation of water pollution. 33 U.S.C. § 1313(a)-(c); 40 C.F.R. § 130.3. These standards set out water quality goals for each water body by designating uses and setting criteria necessary to protect those uses. 40 C.F.R. § 130.3. Water quality standards should "provide water quality for the protection and propagation of fish, shellfish and wildlife and for recreation." 40 C.F.R. § 130.3.

In turn, section 303(d) of the Clean Water Act requires states to establish a list of impaired water bodies within their boundaries for which existing pollution controls "are not stringent enough to implement any water quality standard applicable to such waters." 33 U.S.C. § 1313(d). Water quality standards include all numeric criteria, narrative criteria, waterbody uses, and antidegradation requirements. 40 C.F.R. § 130.7(b)(3).

Once a state develops its impaired waters list, EPA provides oversight and must either approve, disapprove, or partially disapprove the impaired waters list. 33 U.S.C. § 1313(d)(2). EPA regulations mandate that a list shall be approved only if it meets the requirements that existing pollution control requirements are stringent enough to ensure waters meet all water quality standards. 40 C.F.R. § 130.7(b)(1) & (d)(2). If EPA does not approve a state's list, then it must identify those waters that should be included. 33 U.S.C. § 1313(d)(2); 40 C.F.R. § 130.7(d)(2).

Once a water body is listed as impaired pursuant to Clean Water Act § 303(d), the state has the authority and duty to control pollutants from all sources that are causing the impairment. Specifically, the state or EPA must establish total maximum daily loads of pollutants that a water body can receive and still attain water quality standards. 33 U.S.C. § 1313(d). States then implement the maximum loads by controlling pollution from point sources and nonpoint sources. The goal of section 303(d) is to ensure that our nation's waters attain water quality standards whatever the source of pollution.

2. California Must List Ocean Waters as Impaired or Threatened

California must list its coastal waters as impaired or threatened water bodies as required by section 303(d) of the Clean Water Act because existing pollution controls are insufficient for ocean waters to meet the state's water quality standards. 33 U.S.C. § 1313(d). Moreover, pH is already considered a conventional pollutant under the Clean Water Act, and accordingly, an unacceptable change in pH constitutes a basis for regulation.

Recent actions of EPA underscore the authority that states have to address ocean acidification pursuant to the Clean Water Act. EPA announced that it will review the aquatic life criterion for marine pH under the Clean Water Act to determine if a revision is necessary to protect designated uses from the threat of ocean acidification (EPA 2009). On April 15, 2009, EPA issued a notice of data availability in the Federal Register that calls for information and data on ocean acidification that the agency will use to evaluate water-quality criteria under the Clean Water Act. In the notice, EPA acknowledged the threat that ocean acidification poses to marine ecosystems:

> Preliminary projections indicate that oceans will become more acidic over time and overall, the net effect is likely to disrupt the normal functioning of many marine and coastal ecosystems.

(EPA 2009: 17485). On March 22, 2010, EPA took another step by soliciting information on what the agency should consider to determine if coastal waters are threatened or impaired by ocean acidification, how ocean acidification can be monitored, and how to develop a TMDL for ocean acidification (EPA 2010). EPA's action aims toward issuing guidance for states on how to approach ocean acidification under the Clean Water Act. EPA's notice is the result of a settlement of a suit brought by the Center for Biological Diversity under the Clean Water Act, which challenged EPA's failure to address ocean acidification off the coast of Washington. Despite the approach EPA ultimately decides to take on ocean acidification, California has an independent obligation under the Clean Water Act to list is ocean waters as threatened or impaired and establish a total maximum daily load.

Section 303(d) of the Clean Water Act requires states to establish a list of impaired water bodies within their boundaries for which existing pollution controls "are not stringent enough to implement any water quality standard applicable to such waters." 33 U.S.C. § 1313(d). California therefore must use *all* existing water quality standards, including marine pH, general criteria, narrative criteria, waterbody uses, and antidegradation standards to support threatened or impaired water listing for coastal waters due to ocean acidification. 40 C.F.R. § 130.7(b)(3).

California's Ocean Plan defines the <u>designated uses</u> of ocean waters:

> The beneficial uses of the ocean waters of the State that shall be protected include industrial water supply; water contact and non-contact recreation, including aesthetic enjoyment; navigation; commercial and sport fishing; mariculture; preservation an enhancement of designated Areas of Special Biological Significance (ASBS); rare and endangered species; marine habitat; fish migration; fish spawning and shellfish harvesting.

California Ocean Plan at 3 (2005). As described below, ocean acidification, which harms marine life by impairing growth and other biological functions, impairs these designated uses for aquatic life, marine habitat, fish and shellfish.

At present, California's ocean segments are also threatening non-attainment of the numeric water quality standard for marine pH. California's water quality standard for the ocean states, "the pH shall not be changed at any time more than 0.2 units from that which occurs naturally." California Ocean Plan 6 (2005). As demonstrated by Feely et al., all along the California coast waters affected by ocean acidification are upwelling during certain seasons and bathing marine life in corrosive waters (Feely et al. 2008). California's marine pH standard, however, may be inadequate to protect marine fauna and flora and the designated uses of waters. Zeebe et al. (2008) highlighted the importance of addressing ocean acidification before seawater pH change exceeds the 0.2 unit water quality criterion recommended by the EPA, and adopted by California:

> Thus, although the response of different organisms is expected to be inhomogeneous (*9*), current evidence suggests that large and rapid changes in ocean pH will have adverse effects on a number of marine organisms. Yet, environmental standards for tolerable pH changes have not been updated in decades. For example, the seawater quality criteria of the U.S. Environmental Protection Agency date back to 1976 and state that for marine aquatic life, pH should not be changed by more than 0.2 units outside of the normally occurring range (*10*). These standards must be reevaluated based on the latest research on pH effects on marine organisms. Once new ranges of tolerable pH are adopted, CO_2 emission targets must be established to meet those requirements in terms of future seawater chemistry changes.

(Zeebe et al. 2008: 52). In light of this insufficiency, California must gauge the need to list waters due to ocean acidification on the 303(d) list by the impacts on water quality and marine life. It should also revise its water quality standards in light of the most recent information on ocean acidification.

Ocean acidification also violates the state's antidegradation policy which requires that high quality waters be maintained to the maximum extent possible. Res. No. 68 68-16. This is because carbon dioxide pollution is degrading high quality waters and causing them to compromise their designated uses.

Information included herein and the enclosed scientific information demonstrate that the water quality standards described above are not being attained by California's ocean waters due to ocean acidification. Specifically, ocean acidification impairs the use of coastal waters for shellfish, fish, and wildlife habitat because it changes ocean chemistry with adverse effects on calcifying species and other marine animals.

3. The Scientific Background of Ocean Acidification

a. Ocean acidification threatens marine life and ocean ecosystems.

1. Carbon dioxide is causing the oceans to become more acidic

The ocean absorbs carbon dioxide from the atmosphere, which alters seawater chemistry causing slightly alkaline waters to become more acidic. This process, ocean acidification, is advancing rapidly as humans release carbon dioxide into the atmosphere, and the changes in ocean chemistry are unlike anything experienced for millions of years.

Carbon dioxide reacts with seawater to form carbonic acid, which dissociates to form bicarbonate and releases hydrogen ions. This reaction reduces the amount of carbonate ions and decreases pH.[1] Ocean acidification has caused seawater pH to decrease by 0.11 units on average, which is equivalent to a 30 percent change in acidity and a decrease in carbonate concentration of 10 percent (Caldeira & Wickett 2003; Orr et al. 2005; Caldeira et al. 2007; Feely et al. 2008).

The current atmospheric carbon dioxide concentration is at 386 ppm (parts per million) and it continues to increase by 2 ppm annually (EPA 2009). This is a 38 percent increase from preindustrial levels, which is almost all attributable to anthropogenic sources (EPA 2009). Three-quarters of carbon dioxide pollution is from fossil fuel use, with most emitted from electricity generation followed by the transportation sector (Denman et al. 2007; EPA 2009). Most of the remaining emissions are from land use changes, primarily deforestation (Denman et al. 2007).

About half of the carbon dioxide released into the atmosphere from human activities will be absorbed by the ocean (EPA 2009). Right now the ocean absorbs about 22 million tons of carbon dioxide each day (Feely et al. 2006).

By the end of this century, carbon dioxide is predicted to reach 788 ppm and the pH of the ocean will to drop by another 0.3 or 0.4 units, amounting to a 100–150 percent change in acidity (Orr et al. 2005, Meehl et al. 2007). A pH change of this magnitude has not occurred for more than 20 million years (Feely et al. 2004). Scientists tell us that carbon dioxide emissions will need to be stabilized below 350 ppm to avoid perilous biological consequences of ocean acidification (McNeil & Matear 2008; Steinacher et al. 2009; Hansen et al. 2008; Cao & Caldeira 2008).

Changing marine pH and carbonate concentrations are fundamentally altering ocean chemistry. Carbonate is an important constituent of seawater because many organisms form their shells and skeletons by complexing calcium and carbonate. Calcium carbonate is present in the ocean in two common forms, calcite and aragonite. When seawaters become undersaturated with respect to calcium carbonate they are corrosive to organisms that produce calcium carbonate shells, liths, and skeletons. Modeling predicts that by the end of the century global aragonite production will be reduced by 29% and total calcium carbonate production by 19% relative to preindustrial levels (Ganstø et al. 2008).

A recent survey of the Pacific Coast revealed that the effects of ocean acidification are occurring more rapidly there than predicted (Feely et al. 2008). See figure 1. Researchers found seawater undersaturated with respect to aragonite upwelling onto large portions of the continental shelf, reaching shallow depths of 40 to 120 meters (Feely et al. 2008). As a result, marine organisms in surface waters, in the water column, and on the sea floor along the West Coast are already being exposed to corrosive water during the upwelling season. Although the East Coast has different oceanographic conditions than the West Coast, monitoring of the Atlantic Ocean reveals that pH is declining in step with rising carbon dioxide in the atmosphere. Recently, a survey in the Pacific revealed that ocean acidification from anthropogenic sources is already significantly affecting surface waters (Bryne et al. 2009). The Byrne study calculated that surface ocean waters in the North Pacific Ocean have experienced an annual decline

[1] Acidity is the concentration of H^+ ions, and it is measured in pH units. A pH decrease of 1 unit means a 10-fold increase in the concentration of H+, or acidity.

of 0.0017 pH units between 1991 and 2006, and that this rate of change is accelerating (Byrne et al. 2009).

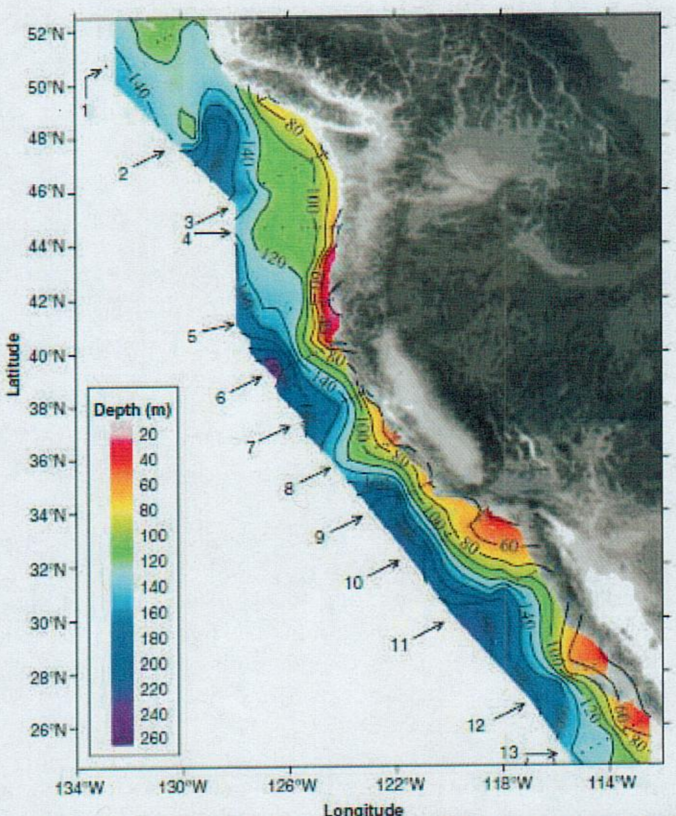

Fig. 1. Distribution of the depths of the undersaturated water (aragonite saturation < 1.0; pH < 7.75) on the continental shelf of western North America from Queen Charlotte Sound, Canada, to San Gregorio Baja California Sur, Mexico. On transect line 5, the corrosive water reaches all the way to the surface in the inshore waters near the coast The black dots represent station locations.

A survey in Washington found that corrosive waters have developed in the Puget Sound shifting from being saturated with respect to aragonite to being undersaturated (Feely et al. 2010). Upwelling of acidified waters, as well as other factors, have contributed to this change. Feely et al. estimated that ocean acidification can account for 24-49 percent of the pH decrease already observed and will account for 49-82 percent of the pH decrease over time when carbon dioxide in the atmosphere reaches 560 ppm (*Id.*).

At present, the effects of ocean acidification are greatest in surface waters (< 1000 m) where carbon dioxide exchange occurs with the air, but the decline in aragonite and calcite saturation will extend throughout the water column in the foreseeable future (Orr et al. 2005). This is important because calcifying organisms form their shells from calcium carbonate, and can not do so when carbonate is not available to complex with calcium. Consequently, ocean acidification threatens the biological, chemical, and physical integrity of marine waters and impairs the ability of ocean waters to sustain the health and vitality of aquatic life.

The science is undisputable that carbon dioxide is causing our oceans to become more acidic. Not only is the scientific understanding of ocean acidification well established, but also the magnitude of the problem and likely effects are predictable with a high degree of certainty (Secretariat of the Convention on Biological Diversity 2009). The key question remaining is whether we will be able to reduce carbon dioxide emissions quickly enough to avoid the worst consequences of ocean acidification on marine ecosystems.

2. *Biological and ecological consequences of ocean acidification*

One of the major impacts of ocean acidification is that it impairs the ability of marine organisms to build protective shells and skeletons. The uptake of carbon dioxide by the ocean impairs calcification in animals because carbonate minerals, calcite and aragonite, become unavailable in seawater. Nearly all calcifying organisms studied, including species from the major marine calcifying groups, have shown an adverse response of reduced calcification in response to elevated carbon dioxide. EPA acknowledges that:

> As more CO^2 dissolves in the ocean, it reduces ocean pH, which changes the chemistry of water. These changes present potential risks across a broad spectrum of marine ecosystems...For instance, ocean acidification related reductions in pH is forecast to reduce calcification rates in corals and may affect economically important shellfish species including oysters, scallops, mussels, clams, sea urchins, and lobsters...Impacts to shellfish and other calcifying organisms that represent the base of the food web may have implications for larger organisms that depend on shellfish and other calcifying organisms for prey.

(EPA 2009: 17485)

Plankton, which comprise the basis of the marine food web, are among the calcifying organisms likely to be adversely affected by ocean acidification. Studies of coccolithophorids showed that carbon dioxide related changes to seawater caused reduced calcification, resulting in malformed and incomplete shells (Riebesell 2000). Pteropods similarly experience reduced calcification under elevated carbon dioxide levels (Comeau et al. 2009). Experiments also show that the shells of pteropods dissolve as seawater becomes undersaturated with aragonite (Orr et al. 2005). Elevated carbon dioxide concentrations also reduce the shell mass of foraminifera (Kleypas et al. 2006). Modern shell weights of foraminifera in the Southern Ocean are 30–35 percent lower than those from preindustrial sediments, which is consistent with reduced calcification induced by ocean acidification (Moy et al. 2009). While some species of plankton react differently under high concentrations of carbon dioxide, most calcareous plankton studied thus far exhibit reduced calcification (Guinotte & Fabry 2008). Ocean acidification's impact on calcifying plankton is especially troublesome because most of the ocean's primary production is from such plankton and effects will extend up the entire food chain.

Ocean acidification also decreases the calcification of corals, including cold-water corals. Calcification rates of reef-building corals are expected to decrease 30-40 percent with a doubling of atmospheric carbon dioxide (Kleypas et al. 2006; Hoegh-Guldberg et al. 2007; Guinotte and Fabry 2008). Scientists predict that ocean acidification coupled with increasing ocean temperatures will destroy the world's reefs by mid-century (Hoegh-Guldberg et al. 2007). Scientists warn that at current levels of CO^2 (387 ppm), the world's coral reefs are committed to an irreversible decline due to warming and acidifying waters, and that due to ocean acidification at 450 ppm coralline algae will cease to calcify and coral calcification will decline by about 50 percent (Veron et al. 2009). There is growing evidence that ocean acidification has already impacted saturation rates in areas with corals causing adverse effects, and if CO^2 levels are allowed to reach 560 ppm only a few areas of the Pacific will have conditions suitable for coral growth (*Id.*). Within the past decade, scientists have observed a significant decrease in the saturation state of a calcium carbonate mineral, aragonite, in the greater Caribbean region (Gledhill et al. 2008). In the Australian Great Barrier Reef, scientists investigated 328 colonies of massive Porites corals and found that calcification has declined by 14.2% since 1990, predominantly because linear extension has declined by 13.3%. (De'ath et al. 2009; Cooper 2008). Atlantic golf ball coral (*Favia fragum*) recruits were tested under undersaturated aragonite states and were found to have significant delays and impairment of skeletal growth (Cohen et al. 2009). See figure 2. Research shows that coral calcification will decline by 10-50 percent by mid-century, and consequently reefs are at risk as well as the services they provide for biodiversity and shoreline protection (Kleypas et al. 2009). Ocean acidification also causes a decrease in crustose coralline algae, an important plant for coral reef building. Experiments at pH levels expected within the century caused crustose coralline algae to decrease by 92 percent (Kuffner et al. 2008). Cold-water corals may be even more sensitive to reduced carbonate saturation because they already live in conditions less favorable to calcification, and 70 percent of scleractinian cold-water corals could be in water undersaturated with respect to aragonite by the end of the century (Royal Society 2005; Guinotte & Fabry 2008).

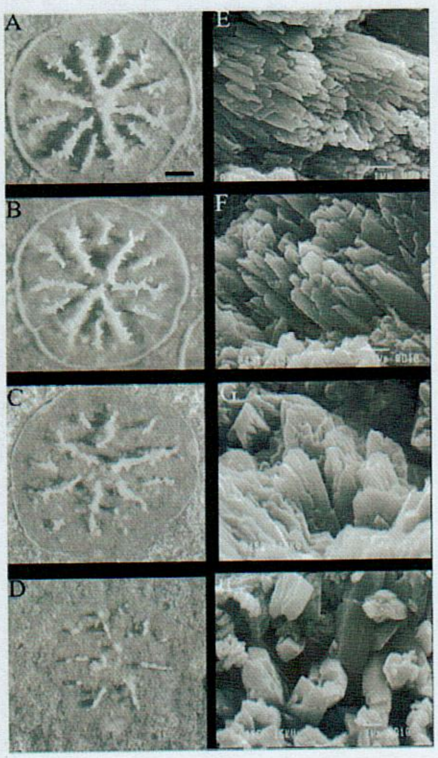

Fig. 2(a–d) Progressive changes in the mesoscale skeletal development, including distortion of basal plate and retardation of septal development, of 8-day-old corallites of Favia fragum with decreasing seawater saturation state. Visible changes in the amount of aragonite produced by the corals are quantified by cross-sectional area analysis and weighing of individual corallites. (e–h) Progressive changes in the morphology and orientation of crystals within the corallites are documented by scanning electron microscopy imaging of broken faces of primary septa. In Figures 2a and 2e, W = 3.71 (control); in Figures 2b and 2f, W = 2.40; in Figures 2c and 2g, W = 1.03; and in Figures 2d and 2h, W = 0.22. In Figure 2a, scale bar is 200 mm. (Cohen et al. 2009).

Cold water corals provide shelter and feeding grounds for a variety of organisms, including commercially valuable fish species (Secretariat of the Convention on Biological Diversity 2009: 39). "An estimated 40% of current fishing grounds are located in waters hosting cold-water coral communities," which have been theorized to serve as nurseries for juveniles (*Id.*). Cold water corals generally inhabit waters with naturally elevated pH levels, being "restricted to high latitudes and deeper depths, which exhibit lower saturation state of calcium carbonate" (Maier et al. 2009). While their natural tolerance to heightened pH levels might at first appear to give cold water corals an advantage in increasingly acidified oceans, their specialized habitat actually renders cold water corals particularly vulnerable. "[M]ore than 95% of cold-water coral communities occur in waters that are supersaturated with respect to aragonite, confining their global distribution to ocean basins where the aragonite saturation horizon remains relatively deep" (Secretariat of the Convention on Biological Diversity 2009: 39). Cold water corals reside in areas where the water is both sufficiently cold and unusually saturated with aragonite. The aragonite saturation horizon, or the depth below which ocean water becomes under saturated with aragonite, is predicted to become dramatically shallower as oceanic CO^2 concentrations increase (Maier et al. 2009, Secretariat of the Convention on Biological Diversity 2009). Studies indicate that over 70% of cold water coral communities will be exposed to waters undersaturated with aragonite by the end of this century, making many areas uninhabitable for cold water corals even sooner than corals living in warmer, shallower areas (Maier et al. 2009, Secretariat of the Convention on Biological Diversity 2009). Cold water corals are relatively difficult to study because of the depths at which they grow (Secretariat of the Convention on Biological Diversity 2009). The loss of these corals would be especially tragic because the full extent of their ecological significance has yet to be determined.

Scientists predict that ocean acidification will also decrease calcification in shellfish significantly by the end of the century (Gazeau et al. 2007). For example, a recent study found that the calcification rates of the edible mussel and Pacific oyster decrease with increases in carbon dioxide (Gazeau et al. 2007). Experiments revealed that moderate increases in atmospheric carbon dioxide had significant effects on the survival and growth of sea urchins and snails (Shirayama 2005). Another study of clams, scallops, and oysters showed that levels of CO^2 expected to be absorbed this century by oceans worldwide "are capable of significantly decreasing the size, rates of metamorphosis, and survivorship of larvae from three species of commercially and ecologically valuable shellfish (*M. mercenaria, A. irradians, and C. virginica*)" (Talmage & Gobler 2009: 2076). Under CO^2 conditions expected later this century, the shellfish experienced dramatic declines in survivorship and impaired growth (*Id.*). Already, ocean acidification may have contributed to global declines in shellfish (*Id.*). The impacts of ocean acidification from loss of calcifying organisms or alterations in marine food webs are estimated at about $160 billion annually (Cooley et al. 2009). Annual harvests of the three species in the Talmage study in states on the east coast of United States alone are estimated to be worth hundreds of millions of dollars (Talmage & Gobler 2009). Ecosystem services provided by these species have been valued even more highly than their harvest (*Id.*). Pacific Coast oyster hatcheries are already experiencing difficulties associated with increasing ocean acidification. Two of the largest hatcheries report production rates down by as much as 80% (Miller et al. 2009). The oyster failures in recent years may foreshadow the widespread effects that increasingly acidic waters will have on the shellfishing and fishing industry. Assuming business as usual projections for carbon emissions and a corresponding decline in ocean pH and mollusk harvests, ocean acidification's broader economic losses for the United States would range from $1.5–6.4 billion through 2060 (Cooley et al. 2009).

Ocean acidification also disrupts metabolism and other biological functions in marine life. Changes in the ocean's carbon dioxide concentration result in accumulation of carbon dioxide in the tissues and fluids of fish and other marine animals, called hypercapnia, and increased acidity in the body fluids, called acidosis. These impacts can cause a variety of problems for marine animals including difficulty with acid-base regulation, calcification, growth, respiration, energy turnover, and mode of metabolism (Pörtner et al.2004). Squid, for example, show a very high sensitivity to pH because of their energy intensive manner of swimming (Pörtner et al. 2004; Royal Society 2005). Because of their energy demand, even under a moderate 0.15 pH change squid have reduced capacity to carry oxygen and higher carbon dioxide pressures are likely to be lethal (Pörtner et al. 2004). Studies have shown that squid under elevated carbon dioxide have a slowed metabolic activity and impaired behaviors, and researchers say warming waters will mean that the oxygen-poor zones the squid inhabit at night will be shallower reducing squid habitat and increasing their vulnerability to predators (Rosa et al. 2008). In fish, high concentrations of carbon dioxide in seawater can lead to cardiac failure (Ishimatsu et al. 2004).

Some studies show that juvenile marine organisms are particularly susceptible to ocean acidification (Ishimatsu et al. 2004; Kurihara & Shirayama 2004). In conditions simulating future seawater with elevated carbon dioxide, larval clownfish lost their detection and homing abilities to find suitable habitat (Munday et al. 2009). Ocean acidification can also decrease the sound absorption of seawater causing sounds to travel further with potential impacts on marine mammals and other marine life that may be sensitive to noise of vessel traffic, seismic surveys, and other noise pollution (Hester et al. 2008). Already sound travels 10-15 percent further with a change of 0.1 pH, and it is predicted to increase about 40 percent by mid century with corresponding ocean acidification (Hester et al. 2008). Additionally, a decline of 0.3 pH united causes a 40 percent decrease in the sound absorption of surface seawater and sound may travel 70 percent farther, thus noise from vessels, military, and other human sources may adversely affect sensitive marine mammals (Brewer et al. 2009). Moreover, ocean acidification may also enhance the mobility of mercury in the environment resulting in increased accumulation of mercury in fish, marine mammals, and humans (USGS 2000).

Entire ecosystems are likely to be altered by the changes caused by ocean acidification. Scientists have already observed changes in species distribution that are likely the result of ocean acidification. Calcifying organisms off the coast of Washington State exhibited increasing probabilities of replacement by other species as pH decreased substantially between 2000 and 2008 (Wootton et al. 2008). The consequences of ocean acidification on marine life are complex, but they could disrupt the marine food web with potentially detrimental consequences. Already some of the biological effects of ocean acidification are occurring in our ocean waters (Moy et al. 2009). Additionally, ocean acidification coupled with other environmental changes such as global warming can have cumulative and synergistic adverse impacts on ocean biodiversity (Guinotte & Fabry 2008).

4. Data Quality and Consideration

The regulations governing implementation of the Clean Water Act's section 303(d) *require* that California "evaluate all existing and readily available water quality-related data and information to develop the list." 40 C.F.R. § 130.7(b)(5); *see also Sierra Club v. Leavitt*, 488 F.3d 904 (11th Cir. 2007)

The enclosed peer-reviewed scientific literature meets data quality standards. The data and information is of high quality and credibility using methods and parameters to control for errors. Moreover, EPA's guidance states that the "[l]ack of a State-approved QAPP should not, however, be used as the basis for summarily rejecting data and information submitted by such organizations, or assuming it is of low quality, regardless of the actual QA/QC protocols employed during the gathering, storage, and analysis of these data" (EPA, Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act at 33 (2005) ("EPA 2006")(EPA advised states to prepare their 2010 303(d) lists consistent with the 2006 Guidance).

EPA's guidance for listing of impaired waters emphasizes that states should evaluate all data, and that listings may be based on small data sets, data other than site specific monitoring, and data from the public (EPA 2006 Guidance). Here, the absence of site specific monitoring should not obviate the need to list California's ocean waters as impaired, rather it demonstrates a need for additional coastal monitoring. Recognizing the limited monitoring data available, EPA encourages states to consider a more expansive versus cautious approach to monitoring data (EPA 2006 Guidance). Site-specific monitoring data is not required for impaired water listing. EPA regulations require that "reports from dilution calculations and predictive modeling" be included in the data and information that a state considers in its assessment process for section 303(d) listing purposes. 40 CFR 130.7(b)(5)(ii)). EPA guides states to consider even very small sample sets to ascertain the attainment status of waters. Moreover, states should use information about observed effects, predictive modeling, and knowledge about pollutant sources and loadings when making its listing determinations (EPA 2006 Guidance).

Furthermore, EPA regulations and guidance require states to seek public participation in the impaired waters listing process. EPA regulations require that states actively solicit data and information from organizations and individuals, including conservation organizations. 40 C.F.R. 130.7(b)(5)(iii); EPA 2006 Guidance. Here, the Center for Biological Diversity presents well-documented and highly credible scientific evidence that California ocean waters are threatened or impaired from ocean acidification.

6. Conclusion

In summary, California has an obligation to list its ocean waters as threatened or impaired under section 303(d) of the Clean Water Act. The scientific evidence summarized here and enclosed with this letter documents that the addition of carbon dioxide to our coastal waters from human sources is significantly changing ocean chemistry and harming marine life. Ocean acidification is a threat to seawater quality, and the Clean Water Act requires the state to list waters and create a TMDL.

While the worst effects of ocean acidification are forecasted for the future, the adverse changes to California's ocean waters from ocean acidification are already underway. These changes will, if not addressed, have serious, and likely catastrophic effects on ocean biodiversity, productivity, and ultimately, economy. The goals of the Clean Water Act can only be met by taking steps to slow ocean acidification, and action under the Clean Water Act can complement other efforts to regulate carbon dioxide emissions.

Sincerely,

/s/ Miyoko Sakashita
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Staff Attorney
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enclosure

References

The following articles are enclosed on a compact disc to support listing waters as threatened or impaired under section 303(d) of the Clean Water Act.

Balch, W.M. and P.E. Utgoff. 2009. Potential Interactions Among Ocean Acidification, Coccolithophores, and the Optical Properties of Seawater. Oceanography 22:146-159.

Barry, J. P., K. R. Buck, C. Lovera, L. Kuhnz, and P. J. Whaling. 2005. Utility of deep sea CO^2 release experiments in understanding the biology of a high-CO^2 ocean: Effects of hypercapnia on deep sea meiofauna, J. Geophys. Res., 110, C09S12

Beesley, A., Lowe, D.M., Pascoe, C.K., Widdicombe, S. 2008. Effects of CO^2-induced seawater acidification on the health of Mytilus edulis. Climate Research 37:215-225.

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