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Re: California's 2008 List of Impaired Water Bodies under Clean Water Act § 303(d)

On behalf of the Center for Biological Diversity, these comments are submitted in for consideration in California's 303(d) List of Impaired Water Bodies. This comment letter supports the inclusion of ocean waters impaired by ocean acidification on the list.

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. The regional Water Quality Control Boards have deferred action on ocean acidification to the State Water Resources Control Board. For example, in response to comments on the San Francisco Bay Area's proposed list, the Region relied on the State Water Resources Control Board's review of the Center's data on ocean acidification.

In a letter dated January 16, 2009, the U.S. Environmental Protection Agency ("EPA") acknowledged the threat that ocean acidification presents to water quality. The EPA has now committed to evaluate its water quality criterion for pH under the Clean Water Act. This important step by EPA recognizes that changes in pH caused by carbon dioxide are appropriate for consideration under the Clean Water Act. The Boards are urged to include ocean waters on their impaired waters list. California is a leader when it comes to actions on climate change and should seize the opportunity to take decisive action on ocean acidification. The Clean Water Act gives California the authority and duty to address ocean acidification.

The overwhelming scientific evidence supports the inclusion of ocean waters on the 303(d) List because of impairment caused by ocean acidification. This letter and its source documents should be taken under consideration in support of listing ocean waters, and the Center's previous letters and documents are incorporated by reference.

The Regional and State Water Resources Control Boards are urged to take ocean acidification seriously and to take prompt steps to halt this threat to our ocean ecosystems. The Boards should place California's ocean water segments on the 303(d) List and develop a TMDL for carbon dioxide pollution that is impairing our seawater quality.

The Clean Water Act Requires California to Include Ocean Waters Impaired by Ocean Acidification on Its 303(d) List

Under the Clean Water Act, each state must establish water quality standards that take into account the water's "use and value for public water supplies, propagation of fish and wildlife, recreational purposes, and agricultural, industrial, and other purposes." 33 U.S.C. § 1313(c)(2). The Clean Water Act's section 303(d) requires each state to identify waters for which existing regulations are inadequate to protect water quality—resulting in a "303(d) List." 33 U.S.C. § 1313(d). "Each state shall identify those waters within its boundaries for which the effluent limitations … are not stringent enough to implement any water quality standard applicable to such waters." 33 U.S.C. § 1313(d)(1)(a). A water body failing to meet any numeric criteria, narrative criteria, waterbody uses, or antidegradation requirements shall be included as a water-quality limited segment on the 303(d) List. 40 C.F.R. § 130.7(b)(3). Relevant here, one of the conventional pollutants recognized under the Clean Water Act is pH. 33 U.S.C. §

1314(a)(4). Consequently, an unacceptable change in pH constitutes a basis for inclusion in the 303(d) List.

The Clean Water Act's 303(d) List was intended as a mechanism to address problems such as ocean acidification, and the 303(d) List is an effective mechanism to address atmospheric deposition. EPA's *Information Concerning 2008 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions* acknowledges that atmospheric deposition must be a factor considered by states during their water quality assessments (available at http://www.epa.gov/owow/tmdl/2008_ir_memorandum.html). Moreover, 303(d) listing and the establishment of total maximum daily loads has been an approach applied to parallel air deposition pollutants causing water quality problems such as mercury and acid rain.

Ocean Waters Should Have Been Included in the San Francisco Bay Area's 303(d) List

California's ocean waters meet one or more of the 303(d) listing factors enumerated in California's Water Quality Control Policy ("WQCP"). First, California's ocean waters are experiencing a trend of declining water quality for pH. Second, ocean acidification is causing degradation of marine communities.

Ocean pH has already changed by over 0.1 pH units on average. Thus, the ocean is on a declining trend and must be listed as impaired. Recent studies show that the magnitude of ocean acidification is among the highest off the coast of northern California (Feely et al. 2008). Thus, ocean waters should be listed as impaired because ocean acidification threatens the aquatic life uses, and it violates the antidegradation policy.

In the Pacific, the "saturation horizon" for aragonite and calcite has already shifted toward the surface by 50 to 200 m. This means that calcareous organisms cannot survive at the same depths they once could. The depth of water in which they can survive will continue to become shallower in the coming decades (Feely 2004). New data on ocean acidification on the west coast of the United States demonstrates that the problem of ocean acidification is much worse than previously thought. Feely et al. (2008) conducted hydrographic surveys along the continental shelf of western North America from central Canada to northern Mexico in May-June 2007 and calculated aragonite and calcite saturation from water samples at depth. This study found that seawater undersaturated in aragonite, with pH values less than 7.75, was upwelling onto large portions of the continental shelf from Canada to Mexico, reaching mid-shelf depths of 40-120 m along most of the surveyed areas (Figure 1) (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 being exposed to corrosive water during the upwelling season.

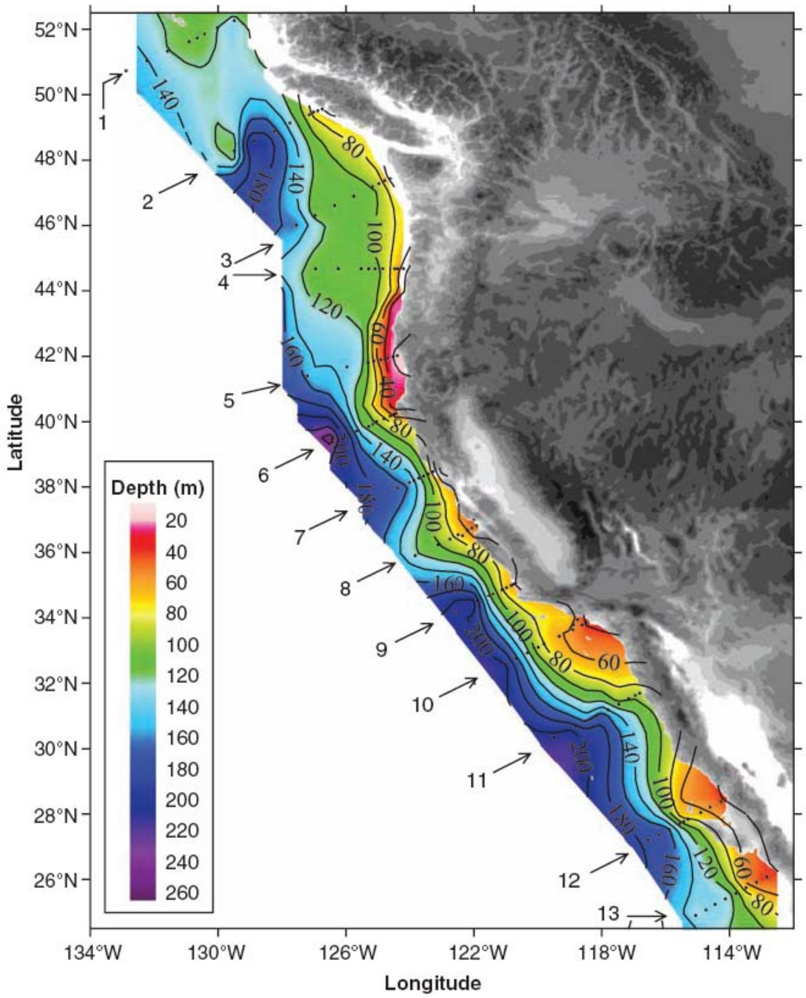

Figure 1. Distribution of the depths of water undersaturated with respect to aragonite on the continental shelf of western North America from Queen Charlotte Sound, Canada, to San Gregorio, Baja California Sur, Mexico. On transect line 5, corrosive water reaches all the way to the surface in inshore waters near the coast. The black dots represent station locations.
Source: Feely et al. (2008): Figure 1.

The findings of Feely et al. (2008) add to the evidence that ocean acidification poses a significant threat to marine life. First, Feely et al. (2008) highlight that ocean acidification is impacting the continental shelf of western North America much earlier than predicted. They note that the occurrence at the surface of open-ocean water undersaturated in aragonite was not predicted to occur until 2050 (under a IS92a business-as-usual emissions scenario where atmospheric CO_2 concentration reached 550 ppmv) and only in the Southern Ocean—not along the west coast of North America (Feely et al. 2008). Secondly, the researchers calculated that *without the anthropogenic signal of CO_2,* the equilibrium aragonite saturation level would be deeper by about 50 m across the shelf and no undersaturated waters would reach the surface. The aragonite and calcite saturation depths in the North Pacific are already among the shallowest in the global ocean (Feely et al. 2004: Figure 2). The uptake of anthropogenic CO_2 has caused aragonite saturation depths in the North Pacific to migrate upwards by 50-100 m since pre-industrial times, with current upward migration occurring at a rate of 1-2 meters per year, while calcite saturation depths have moved upwards by 40-100 m since pre-industrial times (Feely et al. 2004, Fabry et al. 2008, Feely et al. 2008). Seasonal upwelling is enhancing the advancement of the corrosive deep water into broad regions of the California Current System with large predicted impacts on marine species (Feely et al. 2008).

Another study by Wootton et al., provides further evidence that ocean acidification is progressing much faster than expected. In an extensive study on the coast of Washington, Wootton et al. found that pH declined by -0.045 annually (Wootton et al. 2008). The authors stated:

> This rate of decline is more than an order of magnitude higher than predicted by simulation models (0.0019; ref. 3), suggesting that ocean acidification may be a more urgent issue than previously predicted, at least in some areas of the ocean.

(Wootton et al. 2008: 18849). The study examined 24,519 measurements of coastal ocean pH spanning 8 years. It found that pH declined strongly when atmospheric carbon dioxide increased. The study considered all variables known to have an impact on ocean pH and found that atmospheric carbon dioxide was the only factor that could explain the persistent decline in pH.

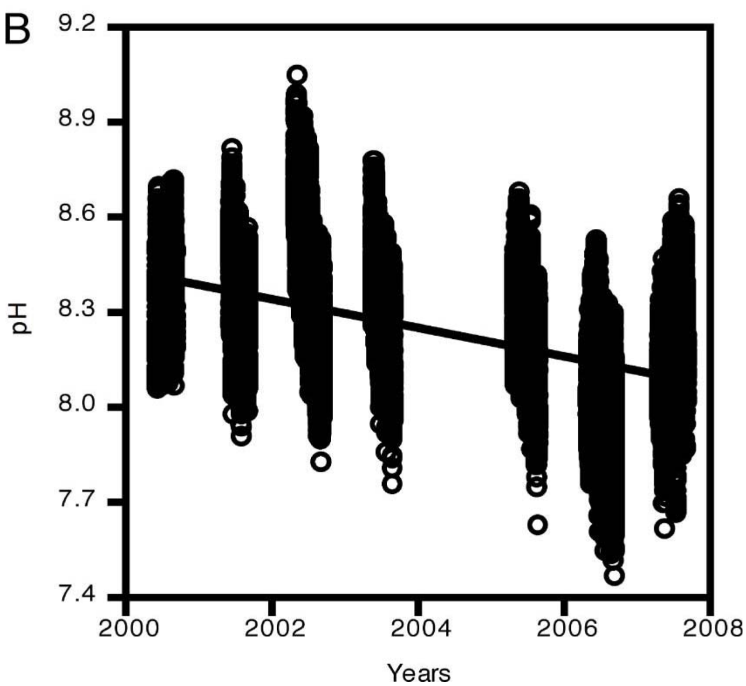

Figure 2. Patterns of ocean pH through time at Tatoosh Island (*N*_24,519). pH readings as a function of date and time taken between 2000 and 2007. The decline is significant (*P* _ 0.05).

Source: Wootton et al. 2008

The study also found that ocean acidification led to species shifts in habitats that showed declining fitness of calcifying organisms. Specifically, calcifying organisms exhibited increasing probabilities of replacement by other species as pH decreased and decreasing probabilities of displacing other species. Notably, the abundance of California mussels, which provide important food and structure for various species on the Pacific's rocky coast, declined with declining pH.

Other recent scientific studies on ocean acidification further highlight the adverse consequences of ocean acidification that is degrading California's water quality:

- Ocean acidification can increase noise pollution with impacts on marine mammals and other species sensitive to sound as carbon dioxide invasion and reduced ventilation will result in significant decreases in ocean sound absorption (Hester et al. 2008).

- Ocean acidification can disrupt the ability of larvae to detect olfactory cues from adult habitats, larval clownfish lost the ability to respond to olfactory cues that guide their behavior when reared in reared in conditions simulating CO2-induced ocean acidification (Munday et al. 2009).

- Increasing water temperatures and acidity lead to increased methylation of mercury and greater uptake by fish and mammals (Booth et al. 2005, McMichael et al. 2006).

- Corals in the Great Barrier Reef have experienced declining calcification greater than 14 percent since 1990 (De'ath et al. 2008).

- 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).

These studies demonstrate that ocean acidification is impairing and will further impair the aquatic life uses of coastal waters, including those in California.

Zeebe et al. (2008) highlighted the importance of establishing lower greenhouse gas emissions targets in order to avoid negative consequences of ocean acidification on marine species and ecosystems and noted the inadequacy of existing regulatory mechanisms, such as the 0.2 water quality standard adopted by California, to regulate ocean acidification:

> 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).

This outdated pH criterion will soon be reviewed by EPA to determine its relevance to ocean acidification. California should also review its numeric criterion in light of new information about ocean acidification.

The problem of ocean acidification is imminent and swift action is needed to address this problem that cannot be reversed within human timescales.

California Is Required to Consider Scientific Evidence of Ocean Acidification Submitted by the Center for Biological Diversity.

In preparing its 2008 303(d) List, California has a duty to consider the information submitted by the Center for Biological Diversity. 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 (11^{th} Cir. 2007).

Conclusion

The materials submitted with previous letters and this letter support a finding that California's oceans are impaired. Ocean pH has decreased by 0.11 units since the industrial age and will continue to decrease at an accelerated rate if carbon dioxide emissions continue to increase as predicted. California waters which are reached by the California Current's upwelling are experiencing even more severe pH changes warranting prompt action to list them as impaired. The decrease in ocean pH has already begun to impair the calcification of some aquatic organisms, and catastrophic effects are predicted for the next decades.

The purpose of water quality standards is to protect the biological diversity of California's waters as well as recreational and commercial uses. Ocean acidification will have significant negative impacts on the survival of calcareous organisms as well as fish and other marine species. Commercial and recreational uses will be harmed as a result, which will particularly affect the shellfish and fishing industries that are so important to California's residents.

The coastal waters must be listed as impaired under section 303(d) now so that TMDLs can be established to protect California's coastal waters.

Respectfully submitted,

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