CENTER for BIOLOGICAL DIVERSITY Because life is good.

February 5, 2015

Jeanine Townsend, Clerk to the Board
State Water Resources Control Board
P.O. Box 100
Sacramento, CA 95812-2000
commentletters@waterboards.ca.gov

Re: Comment Letter—303(d) List portion of the 2012 California Integrated Report

The State Water Resources Control Board has failed to adequately consider ocean acidification in its water quality assessment. The proposed Integrated Report is devoid of any mention of ocean acidification. This runs counter to EPA's recommendations and the requirements of the Clean Water Act.

California has failed to identify waters impaired by ocean acidification, and data submitted by the Center was not evaluated by the State Water Board. California waters are especially vulnerable to ocean acidification, and scientists have already documented corrosive waters and biological impacts off the California coast.

Ocean acidification is caused by increasing carbon dioxide (CO_2) emissions and land use changes. Seawater absorbs CO_2, causing a chemical reaction that reduces seawater pH and makes the oceans more acidic. Anthropogenic sources of carbon dioxide have caused a thirty percent increase in ocean acidity globally. While carbon emissions are the main driver of ocean acidification, regional factors also have significant effects. These local contributions include agricultural runoff, erosion, polluted stormwater, river discharges and local emissions of nitrogen oxides, and sulfur oxides.

Acidified ocean waters seriously harm marine wildlife and the entire ocean ecosystem. When CO_2 concentrations in seawater increase, the availability of carbonate ions decreases, making it more difficult for marine organisms to form, build, and maintain the calcium carbonate shells and skeletons required for their survival. As seawater becomes more corrosive, it can kill fish eggs and inhibit the development of, and essentially dissolve, the shells of small crustaceans, baby shellfish, and other tiny creatures at the base of the food web. Ocean acidification also harms and stresses fish, squid, and other animals that do not build shells. Not only does ocean acidification directly threaten various types of marine animals, it also has implications for the broader marine environment and food web.

Alaska . Arizona . California . Florida . Minnesota . Nevada . New Mexico . New York . Oregon . Vermont . Washington, DC
351 California St., Ste. 600 . San Francisco, CA 94104 tel: (415) 436.9682 fax: (415) 436.9683 www.BiologicalDiversity.org

In previous comments, the Center has provided significant information and supporting materials about the impacts of ocean acidification on the California coast. As shown in the record for this draft integrated report, 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. I was informed that the regional board deferred action on ocean acidification to the State Water Resources Control Board. On June 11, 2008; February 4, 2009, May 28, 2010; August 27, 2010, and April 16, 2014 the Center submitted additional information and comments on ocean acidification for consideration in the water quality assessment. Those comments are incorporated here by reference and are available upon request. Since then, it has become more apparent that ocean acidification poses a serious threat to seawater quality with adverse effects on marine life.

The State Water Resources Control Board must solicit and evaluate data on ocean acidification for its water quality assessment, and it should identify water segments that are violating water quality standards -- including designated uses, numeric, and narrative criteria — as threatened or impaired.

1. California Must Evaluate its Own Data and Solicit it from Research Organizations

California has an independent duty to evaluate ocean acidification during its water quality assessment (Environmental Protection Agency 2010). Specifically, EPA directed states to evaluate ocean acidification data for their 2012 integrated reports (Environmental Protection Agency 2010). The Clean Water Act provides that states must "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). Beyond reviewing the information submitted by the Center, California must also evaluate pH, biological information, and other monitoring data that is available to it and seek out ocean acidification data from state, federal, and academic research institutions. EPA's 2010 memo and Integrated Report Guidance discussed several sources, including the National Oceanic and Atmospheric Administration data (EPA 2010: 7-9; EPA Guidance 30-31). There are now several sources for high resolution ocean acidification data. California must obtain and evaluate data from research institutions, including but not limited to:

- CEDEN, California's Water Quality Repository http://www.ceden.org/
- BCO-DMO, Biological and Chemical Oceanography Data Management Office http://www.bco-dmo.org/data
- California Current Long Term Ecosystem Monitoring http://oceaninformatics.ucsd.edu/datazoo/data/ccelter/datasets
- PMEL NOAA http://www.pmel.noaa.gov/
- National Ocean Data Center http://www.nodc.noaa.gov/
- Integrated Ocean Observing System http://www.ioos.noaa.gov/
- Central & Northern California Ocean Observing System http://www.cencoos.org/
- Monterey Bay Aquarium Research Institute
- Scripps Institution of Oceanography
- West Coast Ocean Acidification and Hypoxia Science Panel http://westcoastoah.org
- California Current Acidification Network http://c-can.msi.ucsb.edu/

For example, the enclosed dataset from the Santa Barbara Channel long term ecological research site must be evaluated (Hoffmann 2014) (available at http://sbc.lternet.edu//data/index.html).

California has failed to meet the Clean Water Act's requirements to evaluate all readily accessible data and information on ocean acidification. To correct its integrated report and 303(d) list, the Board needs to obtain and evaluate all relevant parameters of ocean acidification data available from these sources that serve as clearinghouses for ocean acidification data, especially those that are specific to California's waters.

2. California Should List Ocean Waters as Impaired

The State Water Board must evaluate whether any of California's ocean waters must be included on the 303(d) list because current measures are not stringent enough to prevent ocean acidification and achieve water quality standards. 33 U.S.C. § 1313(d).

The Clean Water Act requires that California protect the water quality for designated uses of its waters. California's Ocean Plan defines the designated uses 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 and 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 (2012). These uses are not being attained by ocean waters off California due to ocean acidification.

California must consider ocean acidification data in light of designated uses and applicable standards. The standards for chemical and biological characteristics require that:

- The pH shall not be changed at any time more than 0.2 units from that which occurs naturally.
- Marine communities, including vertebrate, invertebrate, and plant species, shall not be degraded.
- The natural taste, odor, and color of fish, shellfish, or other marine resources used for human consumption shall not be altered.[1]
- The concentration of organic materials in fish, shellfish or other marine resources used for human consumption shall not bioaccumulate to levels that are harmful to human health.

---

[1] There are also indications that the taste of shellfish is adversely impacted by ocean acidification (Dupont et al. 2014).

Ocean plan at 6 & 10. Finally, California's antidegradation policy requires the maintenance of existing high quality. Resolution 68-16. Ocean acidification is causing violations of these standards in certain waters of California.

While the state has failed to evaluate ocean acidification data, the Center's prior submissions indicate water quality problems and violations of the above standards that warrant listing. Without repeating former comments, I will urge the state to evaluate the Center's submissions as well as publicly available monitoring data on ocean acidification. Moreover, this comment focuses on new scientific data that underscores the fact that these standards are already not being attained.

Shellfish in the California Current large marine ecosystem have experienced massive mortality during this water quality assessment period. Hatcheries and natural shellfish have experienced reproduction failures from California to Washington (Feely et al. 2012). A new study by Waldbusser et al. identified aragonite saturation as the factor causing limited growth and mortality for shellfish (Waldbusser & Hales 2014). Pacific oyster larvae in hatcheries in the Pacific Northwest experienced massive mortality due to ocean acidification (Barton et al. 2012). The Waldbusser follow-up study identifies saturation state as the principal cause of the adverse biological impacts (Waldbusser & Hales 2014). Notably, California already experiences levels of aragonite undersaturation that have been linked to harmful effects in shellfish (Feely et al. 2008; Gruber et al. 2012; Hauri et al. 2013). Such conditions in experiments caused a forty percent increase in deformities and death of rare northern abalone (Crim et al. 2011). Another study of Olympia oysters, a foundation species along the coast, showed that ocean acidification stunted their growth (Hettinger et al. 2012). California mussels also grew thinner and weaker shells that are more vulnerable to mortality, predation, and desiccation (Gaylord et al. 2011).

Off of California's coast, scientists have documented harmful biological consequences in marine communities of plankton. In a recent study of pteropods in the California Current (Bednaršek et al. 2014), scientists found 53% of onshore individuals and 24% of offshore individuals to have severe dissolution damage that was correlated positively with the percentage of undersaturated water with respect to aragonite (*id*.). Further, scientists estimate that shell damage due to ocean acidification has doubled in near shore habitats since pre-industrial conditions and will triple by 2050 (*id*.). Because pteropods form the base of the foodweb, providing food for many species of fish, a decline in pteropods could have far-reaching ecosystem impacts.

Additionally, ocean acidification has likely increased the toxicity of harmful algal blooms in Southern California that have both caused objectionable aquatic growth and concentrated toxins in seafood that are harmful to human health. The toxicity of harmful algal blooms increases with ocean acidification. Ocean acidification conditions can increase toxins as much as five-fold in harmful algae that can poison marine mammals and even cause paralytic shellfish poisoning in people (Fu et al. 2012; Avery O Tatters et al. 2013; Tatters et al. 2012; Avery O. Tatters et al. 2013). The neurotoxin domoic acid in diatom *Pseudo-nitzschia* increased with acidification as did the toxicity of *Alexandrium catenella* (Id.). A -0.5pH change caused toxin production in the diatoms to increase 4.2-fold and a -0.3pH unit change increased the toxicity 2.5-fold (Tatters et al. 2012). The experiments done in these studies were at levels of CO_2 that are already occurring in California, and the increase in the toxicity of harmful algal blooms in Southern California may be consistent with ocean acidification (Id.) Already, these harmful algal blooms have been related to mass mortalities of fish and marine mammals and these studies suggest that the damage will become much worse.

While these are a few new studies highlighted, the body of science previously submitted plus the data sets recommended herein provide ample information on ocean acidification for California to evaluate against its water quality standards. A failure to do so undermines the intent and provisions of the Clean Water Act.

* * *

In conclusion, California must thoroughly evaluate ocean acidification data and identify undersaturated waters and others that are not meeting water quality standards as threatened or impaired. It is imperative that the state take action now on ocean acidification to address this important water quality problem before it has devastating consequences on its fisheries and ecosystems.

Sincerely,

/s/ Miyoko Sakashita
Miyoko Sakashita
miyoko@biologicaldiversity.org

enclosure

Barton, A. et al., 2012. The Pacific oyster, Crassostrea gigas, shows negative correlation to naturally elevated carbon dioxide levels: Implications for near-term ocean acidification effects. *Limnology and Oceanography*, 57(3), pp.698–710.

Bednaršek, N. et al., 2014. Limacina helicina shell dissolution as an indicator of declining habitat suitability owing to ocean acidification in the California Current Ecosystem Limacina helicina shell dissolution as an indicator of declining habitat suitability owing to ocean acidi. *Proc. R. Soc. B*, 281, p.20140123.

Crim, R.N., Sunday, J.M. & Harley, C.D.G., 2011. Elevated seawater CO2 concentrations impair larval development and reduce larval survival in endangered northern abalone (Haliotis kamtschatkana). *Journal of Experimental Marine Biology and Ecology*, 400(1-2), pp.272–277.

Dupont, S. et al., 2014. First Evidence of Altered Sensory Quality in a Shellfish Exposed to Decreased pH Relevant to Ocean Acidification. *Journal of Shellfish Research*, 33(3), pp.857–861.

Environmental Protection Agency, 2010. Memo: Integrated reporting and listing decisions related to ocean acidification.

Feely, R.A. et al., 2008. Evidence for upwelling of corrosive "acidified" water onto the continental shelf. *Science*, 320(5882), pp.1490–2.

Feely, R.A., Klinger, T. & Newton, J.A., 2012. *Scientific Summary of Ocean Acidification in Washington State Marine Waters*,

Fu, F., Tatters, A. & Hutchins, D., 2012. Global change and the future of harmful algal blooms in the ocean. *Marine Ecology Progress Series*, 470, pp.207–233.

Gaylord, B. et al., 2011. Functional impacts of ocean acidification in an ecologically critical foundation species. *The Journal of experimental biology*, 214(Pt 15), pp.2586–94.

Gruber, N. et al., 2012. Rapid progression of ocean acidification in the California Current System. *Science (New York, N.Y.)*, 337(6091), pp.220–3.

Hauri, C. et al., 2013. The intensity, duration, and severity of low aragonite saturation state events on the California continental shelf. *Geophysical Research Letters*, 40(13), pp.3424–3428.

Hettinger, A., Sanford, E. & Hill, T., 2012. Persistent carry-over effects of planktonic exposure to ocean acidification in the Olympia oyster. *Ecology*, In press.

Hofmann, G. E. , C. Blanchette, U. Passow, L. Washburn, J. Lunden, E. Rivest and L. Kapsenberg. 2014. SBC LTER: pH time series: Water-sample pH and CO2 system chemistry, ongoing since 2011. Santa Barbara Coastal LTER. knb-lter-sbc.75.1 (http://metacat.lternet.edu/knb/metacat/knb-lter-sbc.75.1/lter).

Tatters, A.O. et al., 2013. diatom community to acidification and warming Short- and long-term conditioning of a temperate marine diatom community to acidification and warming.

Tatters, A.O. et al., 2013. High CO2 promotes the production of paralytic shellfish poisoning toxins by Alexandrium catenella from Southern California waters. *Harmful Algae*, 30, pp.37–43.

Tatters, A.O., Fu, F.-X. & Hutchins, D. a, 2012. High CO2 and silicate limitation synergistically increase the toxicity of Pseudo-nitzschia fraudulenta. *PloS one*, 7(2), p.e32116.

Waldbusser, G. & Hales, B., 2014. Saturation-state sensitivity of marine bivalve larvae to ocean acidification. *Nature Climate Change*, (December).