Submitted via email

3-7-17 Board Meeting-Item 7
Climate Change
Deadline: 3/3/17 12 noon

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SWRCB Clerk

Jeanine Townsend, Clerk
State Water Resources Control Board
1001 I St
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March 1, 2017

Re: 3/7/17 Board Meeting - Item # 7, Proposed Resolution Adopting a Comprehensive Response to Climate Change

Dear Ms. Townsend,

On behalf of the Center for Biological Diversity (the Center), I encourage the California State Water Resources Control Board (the Board) to adopt the proposed resolution regarding a comprehensive response to climate change, with one modification. I urge the Board to adopt an additional measure to ensure the resolution adequately responds to ocean acidification. Ocean acidification is increasingly affecting California's coastal and estuarine waters and should be more explicitly addressed in the resolution to ensure a truly comprehensive response to this growing concern.

Ocean acidification is altering the chemistry of the world's oceans, and the coast of California will experience some of the earliest, most severe changes in ocean carbon chemistry. These changes threaten the health of our coastal ecosystems and industries that depend upon the marine environment. While carbon dioxide emissions are a major driver of ocean acidification, there are local and state actions which can be taken now to address ocean acidification. Revising water quality criteria is one of those. We urge the Board to include in its resolution a pledge to revise water quality criteria in order to prevent coastal water bodies from experiencing the worst effects of ocean acidification.

Ocean Acidification Is Already Affecting California Waters

The ocean absorbs roughly one third of the carbon dioxide (CO_2) that humans release into the atmosphere, and atmospheric CO_2 interacts with seawater to make it more acidic. Since the beginning of the Industrial Revolution our oceans have become approximately 30% more acidic. This more acidic ocean has begun to dissolve the shells and other hard parts of marine organisms and threatens to change fundamentally the marine ecosystems on which a large fraction of the world depends for sustenance, recreation, and a host of other services. Coastal, estuarine, and bay waters across the California coast are already experiencing the harmful effects of ocean acidification. Increasing

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concentrations of atmospheric carbon dioxide and the contribution of coastal pollution, sedimentation, and inadequate watershed management can substantially amplify the fluctuating pH conditions in waters of the California coast making them more corrosive and highly vulnerable to ocean acidification.

Ocean acidification is already affecting coastal and bay waters of the California region by impairing the capacity of organisms to produce shells and skeletons, altering food webs, and affecting the dynamic of entire ecosystems such as kelp forests (Cooley and Doney 2009, Cheung et al. 2009, 2010, Brown et al. 2014, Ekstrom et al. 2015, Chan et al. 2016, Seijo et al. 2016). Small increases in acidity of coastal and estuarine waters can substantially reduce the ability of marine organisms to produce shells and skeletons. Microscopic algae and calcifying zooplankton are especially at risk and changes in their abundance and survivorship can result in cascading effects that ripple through the food web affecting other marine organisms from fishes to whales. But rising CO_2 in seawater can also directly affect marine fishes by affecting critical behavior such as orientation, predator avoidance, and the ability to locate food and suitable habitat.

California's coastal waters are vulnerable to ocean acidification because two natural phenomena work in concert with anthropogenic CO_2 emissions and coastal pollution: ocean currents and coastal upwelling. Acidification of California waters starts with surface oceanic currents carrying waters throughout the North Pacific from Asia to the West Coast. This water transport takes decades, absorbing atmospheric CO_2 produced through global human activity and accumulating CO_2 by natural respiration. Coastal upwelling along the state brings deep water rich in CO_2 and low in dissolved oxygen to the continental shelf driving chemical conditions that are harmful to marine life (Feely et al. 2004, 2008, 2009, Hauri et al. 2009, 2013, Gruber et al. 2012, Bednaršek et al. 2014). As these processes happen in a multi-decadal time frame, the effects of ocean acidification due the absorption of CO_2 across the North Pacific will become more severe overtime. That is, waters in transit to the West Coast will carry increasingly more anthropogenic CO_2 as they arrive to California and specifically to the California region (Chan et al. 2016). Even if CO_2 emissions are totally halted today the West Coast states have already committed to increasing ocean acidification for the next three to four decades. Meanwhile, coastal upwelling is projected to intensify in response to stronger swings due to global warming, which will only increase the prevalence of waters of acidic and low oxygen conditions (Snyder et al. 2003, Sydeman et al. 2014).

Most importantly for local management, ocean acidification in coastal regions interacts with natural and anthropogenic processes that further reduce pH and carbonate saturation state (Feely et al. 2008, Wootton et al. 2008, Salisbury et al. 2008, Wootton and Pfister 2012, Takeshita et al. 2015). California coastal waters are relatively more acidic because oceanographic processes such as oceanic currents and coastal upwelling (Feely et al. 2004, 2008, 2009, Hauri et al. 2009, 2013). However, surface waters already show undersaturation with respect to aragonite due to anthropogenic ocean acidification independently of upwelling pulses (Feely et al. 2008). In fact, without acidification, undersaturated waters would have been as much as 50 m deeper than they are today (Feely et al. 2008). In addition, recent declines in aragonite saturation states due to anthropogenic ocean acidification have been compounded by changes in the circulation of the California Current (Feely et al. 2012), likely connected to climate change (Bakun 1990, Snyder et al. 2003, Sydeman et al. 2014). Strong coastal upwelling occurs in the spring and summer bringing nutrients and even more CO_2 rich waters from the deep ocean due to ocean acidification (Feely et al. 2008). Upwelling in this region has been intensified in the past decades (Rykaczewski and Checkley 2008) and it is predicted to become stronger with more favorable winds due to climate change (Bakun 1990, Snyder et al. 2003, Sydeman et al. 2014). Models predict that by the mid-century, surface coastal waters in this region would remain undersaturated during the entire summer upwelling season and more than half of nearshore waters throughout the entire year (Gruber et al. 2012, Hauri et al. 2013).

Coastal, bay, and estuarine waters in California are influenced by local variability and ocean acidification can amplify these fluctuations. Daily and seasonal fluctuations in pH are due to changes in upwelling, respiration, salinity, temperature and several local factors such as river discharge, eutrophication, hypoxia, and chemical contamination that amplify the deleterious effects of anthropogenic ocean acidification in coastal and estuarine waters (Fabry et al. 2008, Kelly et al. 2011a, Cai et al. 2011, Waldbusser and Salisbury 2014). For example, ocean acidification combined with eutrophication can alter phytoplankton growth and succession affecting the entire base of food webs (Wu et al. 2014a, Flynn et al. 2015). Studies also show that under ocean acidification conditions heavy metal pollution can be more severe. In more acidic waters, sediments become more toxic as they easily bounds to heavy metals making them more available and thus more toxic for aquatic life (Roberts et al. 2013). For example, ocean acidification increases the toxicity effects of copper in some marine invertebrates (Campbell and Mangan 2014, Lewis et al. 2016).

The Board Should Revise Water Quality Criteria Relevant to Ocean Acidification

The proposed resolution recognizes that mitigation of, and adaption to, climate change are both important in California's response to climate change. While we applaud the Board's recognition of the diverse ways in which actions can be taken to address climate change, there is one at least additional mitigation action the Board can take which will protect our ocean waters and alleviate the worst effects of climate change. The Board can set coastal water quality standards which are specifically tailored to respond to ocean acidification.

The West Coast Panel on Ocean Acidification and Hypoxia (OAH Panel) recently published its seminal report and presented actions that can be taken now to address ocean acidification at a local level (Chan et al. 2016). The OAH Panel specifically recommended that states revise water quality criteria relevant to ocean acidification. According to the 20 leading scientific experts on the OAH Panel, "the existing water quality criteria for pH are not scientifically valid for application to ocean acidification." As the OAH Panel recognized, water quality criteria are the management foundation of the Clean Water Act, and provide water quality managers with a basis for assessing water body condition, determining the level of discharge that will maintain a water body in an ecologically acceptable condition, and objectively determining when a water body is impaired. Water quality criteria can also serve as targets for water body planning and mitigation projects.

The proposed resolution, in the section on adaptive measures, mentions that the Board shall "minimize impacts associated with ocean acidification . . . and . . . shall recommend areas of research needed to improve the Water Boards' ability to support resilient ocean and coastal ecosystems." While admirable, this provision does not go far enough. The Board must commit to revising water quality criteria so that California does not merely adapt to changing ocean chemistry, but mitigates the worst effects of ocean acidification before they are realized.

Updated water quality criteria would alert water quality managers when water bodies, due to acidification, are not meeting their beneficial uses; for example, when oysters and other calcifiers are not producing the shells they need to survive. A violation of an ocean acidification-specific water quality criteria would allow local managers to take steps to limit local pollutants which are amplifying the effects of ocean acidification. These managers could set discharge levels in such a way that curb the local causes, including nutrient runoff, that exacerbate acidification within State waters. Nutrient pollution causes local acidification through feedback loops involving biological growth, metabolism, and decay, over and above that which would occur in the absence of nutrient input from humans. These processes use more oxygen than they produce, causing oxygen minimum zones ("dead zones"), and resulting in locally-acidified waters. California can address local inputs such as nutrient pollution, but in order to effectively do so, it must set water quality criteria that allow managers to identify waters that are experiencing acidification and need our help.

We support the proposed resolution but urge the Board to include a provision regarding updated acidification-specific water quality criteria. Leading scientists have identified this as a priority in combating ocean acidification, and the Board should make it a reality. Please contact me if you have any questions or concerns.

Sincerely,

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Literature cited:

Bednaršek, N., R. A. Feely, J. C. P. Reum, B. Peterson, J. Menkel, S. R. Alin, and B. Hales. 2014. Limacina helicina shell dissolution as an indicator of declining habitat suitability owing to ocean acidification in the California Current Ecosystem. Proceedings of the Royal Society of London B: Biological Sciences 281:20140123.

Brown, M. B., M. S. Edwards, and K. Y. Kim. 2014. Effects of climate change on the physiology of giant kelp, Macrocystis pyrifera, and grazing by purple urchin, Strongylocentrotus purpuratus. Algae 29:203–215.

Campbell, A., and S. Mangan. 2014. Ocean Acidification Increases Copper Toxicity to the Early Life History Stages of the Polychaete Arenicola marina in Artificial Seawater. Environmental science & ….

Chan, F., A. . Boehm, J. . Barth, E. A. Chronesky, A. G. Dickson, R. A. Feely, B. Hales, T. M. Hill, G. Hofmann, D. Ianson, T. Klinger, J. Newton, T. F. Pedersen, G. N. Somero, J. L. Largier, M. Sutula, W. W. Wakefield, G. G. Waldbusser, S. Weisberg, and E. Whiteman. 2016. The West Coast Ocean Acidification and Hypoxia Science Panel: Major Findings, Recommendations, and ctions. Page 40. California Ocean Science Trust, Oakland, California.

Cheung, W. W. L., V. W. Y. Lam, J. L. Sarmiento, K. Kearney, R. Watson, D. Zeller, and D. Pauly. 2010. Large-scale redistribution of maximum fisheries catch potential in the global ocean under climate change. Global Change Biology 16:24–35.

Cooley, S. R., and S. C. Doney. 2009. Anticipating ocean acidification's economic consequences for commercial fisheries. Environmental Research Letters 4:24007.

Ekstrom, J. A., L. Suatoni, S. R. Cooley, L. H. Pendleton, G. G. Waldbusser, J. E. Cinner, J. Ritter, C. Langdon, R. van Hooidonk, D. Gledhill, K. Wellman, M. W. Beck, L. M. Brander, D. Rittschof, C. Doherty, P. E. T. Edwards, and R. Portela. 2015. Vulnerability and adaptation of US shellfisheries to ocean acidification. Nature Climate Change 5:207–214.

Feely, R. A., S. R. Alin, J. Newton, C. L. Sabine, M. Warner, A. Devol, C. Krembs, and C. Maloy. 2010. The combined effects of ocean acidification, mixing, and respiration on pH and carbonate saturation in an urbanized estuary. Estuarine, Coastal and Shelf Science 88:442–449.

Feely, R. A., C. L. Sabine, R. H. Byrne, F. J. Millero, A. G. Dickson, R. Wanninkhof, A. Murata, L. A. Miller, and D. Greeley. 2012. Decadal changes in the aragonite and calcite saturation state of the Pacific Ocean. Global Biogeochemical Cycles 26:GB3001.

Feely, R. A., C. L. Sabine, J. M. Hernandez-Ayon, D. Ianson, and B. Hales. 2008. Evidence for upwelling of corrosive "acidified" water onto the continental shelf. Science 320:1490–1492.

Feely, R. A., C. L. Sabine, K. Lee, W. Berelson, J. Kleypas, V. J. Fabry, and F. J. Millero. 2004. Impact of anthropogenic CO2 on the CaCO3 system in the oceans. Science 305:362–366.

Feely, R., S. Doney, and S. Cooley. 2009. Ocean Acidification: Present Conditions and Future Changes in a High-CO2 World. Oceanography 22:36–47.

Flynn, K. J., D. R. Clark, A. Mitra, H. Fabian, P. J. Hansen, P. M. Glibert, G. L. Wheeler, D. K. Stoecker, J. C. Blackford, and C. Brownlee. 2015. Ocean acidification with (de)eutrophication will alter future phytoplankton growth and succession. Proceedings of the Royal Society of London B: Biological Sciences 282:20142604.

Gruber, N., C. Hauri, Z. Lachkar, D. Loher, T. L. Frölicher, and G.-K. Plattner. 2012. Rapid Progression of Ocean Acidification in the California Current System. Science 337:220–223.

Hauri, C., N. Gruber, G.-K. Plattner, S. Alin, R. A. Feely, B. Hales, and P. A. Wheeler. 2009. Ocean Acidification in the California Current System. Oceanography.

Hauri, C., N. Gruber, M. Vogt, S. C. Doney, R. A. Feely, Z. Lachkar, A. Leinweber, A. M. P. McDonnell, M. Munnich, and G.-K. Plattner. 2013. Spatiotemporal variability and long-term trends of ocean acidification in the California Current System. Biogeosciences 10:193–216.

Lewis, C., R. P. Ellis, E. Vernon, K. Elliot, S. Newbatt, and R. W. Wilson. 2016. Ocean acidification increases copper toxicity differentially in two key marine invertebrates with distinct acid-base responses. Scientific Reports 6.

Salisbury, J., M. Green, C. Hunt, and J. Campbell. 2008. Coastal Acidification by Rivers:A Threat to Shellfish? Eos, Transactions American Geophysical Union 89:513–513.

Seijo, J. C., R. Villanueva-Poot, and A. Charles. 2016. Bioeconomics of ocean acidification effects on fisheries targeting calcifier species: A decision theory approach. Fisheries Research 176:1–14.

Wootton, J. T., and C. A. Pfister. 2012. Carbon System Measurements and Potential Climatic Drivers at a Site of Rapidly Declining Ocean pH. PLOS ONE 7:e53396.

Wootton, J. T., C. A. Pfister, and J. D. Forester. 2008. Dynamic patterns and ecological impacts of declining ocean pH in a high-resolution multi-year dataset. Proceedings of the National Academy of Sciences 105:18848–18853.

Wu, Y., D. A. Campbell, A. J. Irwin, D. J. Suggett, and Z. V. Finkel. 2014a. Ocean acidification enhances the growth rate of larger diatoms. Limnology and Oceanography 59:1027–1034.