

Summary

The Washington Department of Ecology (Ecology) submitted the initial documentation for the 2010 Integrated Report (IR) on December 28, 2011 (received January 3, 2012) and the final documentation on June 8, 2012 (received June 13, 2012.) The 2010 IR included the waters of Puget Sound in Category 2, Waters of Concern (as defined in Ecology's Water Quality Policy 1-11, Ecology, 2011), for potential impacts to fish and shellfish habitat from climate change, urbanization, and ocean acidification. This listing is based on narrative criteria (WAC 173-201A-260(2)) intended to protect existing and designated uses. Ecology reached this determination by focusing on studies directly relevant to Washington waters, and in particular, studies directly relevant to Puget Sound. Ecology's basis for including Puget Sound waters in Category 2 is outlined in *Washington's Final 2010 Integrated Water Quality Monitoring and Assessment Report* dated December 27, 2011 and updated on June 8, 2012.

The EPA has conducted a detailed review of Ecology's justification for not placing Puget Sound or other Washington coastal waters on its 2010 303(d) list (Category 5) for impairments associated with water quality standards that could be related to ocean acidification, including marine pH, narrative criteria under aquatic life designated uses, or antidegradation. Based on this review, the EPA has concluded that Ecology has adequately addressed all statutory in CWA section 303(d) and regulatory requirements in 40 C.F.R. 130.7 for excluding these waters from Category 5 of its Integrated Report. As stated in 40 CFR 130.7(b)(6), "Each State shall provide documentation to the Regional Administrator to support the State's determination to list or not to list its waters as required by §130.7(b)(1) and 130.7(b)(2)." Ecology has demonstrated that there is not currently enough evidence to identify Puget Sound or other Washington waters, including Willapa Bay, Gray's Harbor, the Strait of Juan de Fuca or Washington's Pacific Coast waters, on its 2010 303(d) list for not attaining Washington's marine pH, narrative criteria for aquatic life designated uses, or antidegradation requirements.

The EPA's evaluation of Ecology's rationale for not adding these waters to its 2010 303(d) list is detailed below. While this evaluation covers the issues and concerns that the Center for Biological Diversity (CBD) has generally raised in all of their communications with the EPA and Ecology, it specifically evaluates Ecology's response to the comment letter submitted by CBD to Ecology on August 8, 2011 during the public comment period for Ecology's draft 2010 marine water assessment for Washington's waters. An additional letter was also received by the EPA on June 20, 2012, and an email was received on June 22, 2012 and both have been addressed here as well. Additional references that have been sent to the EPA, Ecology and the Makah Tribe have been considered for purposes of reviewing Washington's 2010 303(d) list for its waters. This evaluation does not address Makah Tribal Waters.

Applicable Statute, Regulations and Guidance:

Section 303(d) of the Clean Water Act and regulations at 40 CFR 130.7(b)(1) requires States to identify all waters that are not meeting the applicable water quality standards. The EPA reviews a State's 303(d) list to ensure that the State met the applicable requirements in CWA section 303(d) and 40 CFR part 130.7. States are required to assemble and evaluate all existing and readily available data and information in developing their list of water quality limited waters.

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States must provide documentation to support the State's determination to list or not list water. This documentation must include at a minimum: (1) a description of the methodology used to develop the list; (2) a description of the data and information used to identify waters, including a description of the existing and readily available data and information used; and (3) a rationale for any decision to not use any existing and readily available data and information.

The EPA has encouraged States to assemble "Integrated Reports" (IR) that incorporate the 303(d) list into an overall assessment of State waters required by CWA section 305(b). Washington's IR policy is described in their Water Quality Policy 1-11 (Ecology, 2011), and places State waters into the following categories:

Category 1: Meets tested criteria – not known to be impaired

Category 2: Waters of concern waters--where there is some evidence of a water quality problem, but not enough to require production of a water quality improvement project (TMDL) at this time.

Category 3: Lack of sufficient data to determine if water is impaired

Category 4: The waterbody is determined to be impaired but does not need a Total Maximum Daily Load (TMDL).

4a – Impaired waters with an established and EPA-approved TMDL.

4b – Impaired waters with established "other pollution control requirements" to meet water quality standards.

4c – Impaired waters that fail to meet a water quality standard which is not caused by a pollutant, but instead is caused by other types of pollution.

Category 5: Water quality standards for one or more designated uses are not attained and the waterbody requires a TMDL or recovery plan. Category 5 waters are the Section 303(d) list of impaired waters.

Evaluation

The EPA reviewed Ecology's 2010 303(d) list to determine if it considered all existing and readily available data and information when developing its 2010 303(d) list. Specifically, as related to ocean acidification, the EPA reviewed the data and information that was submitted by CBD to Ecology and Ecology's responses to CBD's comments, as well as data and information CBD submitted in an email to the EPA on January 31, 2012 and a letter from CBD to the EPA dated June 20, 2012 and an email from CBD to the EPA on June 22, 2012. While these communications from CBD to the EPA contained information that was not available to the State at the time of its review, the EPA chose to review them in the interest of thoroughness and transparency. The EPA also reviewed Ecology's documentation supporting its decision not to list Puget Sound waters, or any other Washington waters in Category 5 for impairments associated with water quality standards that could be related to ocean acidification, including marine pH and narrative criteria under aquatic life designated uses, or antidegradation. The EPA's review is organized based on the seven main points CBD outlined in their August 8, 2011 comment letter to Ecology on Washington's draft 2010 303(d) list. The EPA focused its review first on whether any of the submitted data/information from the documents mentioned above were sufficient/appropriate to make a listing decision. If so, EPA then examined whether the data/information demonstrated non-attainment of Washington's marine pH, narrative criteria

related to aquatic life designated uses or antidegradation. Additionally, the EPA's assessment of the individual submitted references from CBD can be found in the Appendix under Table 1 and Table 2.

1. **On its impaired waters list, Washington must include all water bodies that fail to meet “any water quality standard, “ including numeric criteria, narrative criteria, water body uses, and antidegradation requirements.**

Washington's water quality standards are codified in Chapter 173-201A of Washington's Administrative Code (WAC). The waters identified by CBD in their comment letters to Washington are marine waters that, as identified in Table 612 WAC 173-201A-612, are the waters of Puget Sound, the Strait of Juan de Fuca, Willapa Bay, Hood Canal, and Gray's Harbor. The use designations for these waters include extraordinary aquatic life use, shellfish harvesting, primary contact recreation, wildlife habitat, harvesting, commerce and navigation, boating and aesthetics. Below are the water quality standards that CBD asserted were not being attained based on the data and information they submitted:

- WAC 173-201A-210 (1) states that “[i]t is required that all indigenous fish and nonfish aquatic species be protected in waters of the State.” WAC 173-201A-210(1)(a)(i) outlines marine water designated use and criteria for aquatic life uses which requires the protection of indigenous fish and non-fish aquatic species in waters of the State:
 - **Extraordinary quality** salmonid and other fish migration, rearing and spawning; clam, oyster, and mussel rearing and spawning; crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, etc) rearing and spawning.
 - For the protection of extraordinary quality aquatic life use in marine water the pH criteria is as follows: pH must be within the range of 7.0 to 8.5 with a human-caused variation within the above range of less than 0.2 units.
- WAC 173-201A-310 Tier I – Protection and maintenance of existing and designated uses. (1) Existing and designated uses must be maintained and protected. No degradation may be allowed that would interfere with, or become injurious to, existing or designated uses, except as provided for in this chapter. (2) For waters that do not meet assigned criteria, or protect existing or designated uses, the department will take appropriate and definitive steps to bring the water quality back into compliance with the water quality standards. (3) Whenever the natural conditions of a water body are of a lower quality than the assigned criteria, the natural conditions constitute the water quality criteria. Where water quality criteria are not met because of natural conditions, human actions are not allowed to further lower the water quality, except where explicitly allowed in this chapter.
- WAC 173-201A-201(4) requires protection the following: “The miscellaneous marine water uses are wildlife habitat, harvesting, commerce and navigation, boating, and aesthetics.”

- WAC 173-201A-260(2)(a) and Washington narrative standards require that toxic, radioactive, or deleterious material concentrations must be below those which have the potential, either singularly or cumulatively, to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health.

The EPA has conducted a thorough review of all of the comments and information CBD submitted to Ecology, Ecology's responses to CBD's comments as well as comments and information CBD submitted directly to the EPA. Based on this review, the EPA has determined that Ecology's documentation and rationale supporting its decision not to list waters identified by CBD was reasonable and well founded. For the data and information CBD submitted directly to EPA, EPA concluded that such data and information are not sufficient to show non-attainment of any of Washington's water quality standards discussed above, and therefore do not warrant listing any waters as impaired or threatened in Category 5. While the EPA recognizes that there is a growing body of research indicating the seriousness of ocean acidification and its potential impacts to aquatic life, the articles submitted by CBD both to Ecology and EPA do not provide sufficient ambient water quality data, or data that can be reasonably extrapolated, to determine whether these water quality standards are being met. Table 1 and 2 in Appendix A includes the EPA's review and assessment of the individual submitted articles and provides more information about EPA's conclusions.

2. The Northeastern Pacific Ocean is experiencing rapid ocean acidification due to anthropogenic carbon dioxide.

CBD notes the growing body of evidence supporting the relationship between increased levels of atmospheric carbon dioxide and ocean acidification, however many of the articles submitted by CBD reference the great spatial variability in the development of corrosive conditions, due not only to differences in waterbody morphology, but also to differences in anthropogenic and natural inputs. The EPA's review of the articles CBD submitted revealed that many of the papers' authors themselves made reference to data gaps preventing definitive conclusions to be drawn about the causes of corrosive events and the impacts of ocean acidification, as well as the degree to which such information can be extrapolated, as described below.

Feely, *et al.*, 2010, found that, "The coastal region of western North America is strongly influenced by seasonal upwelling." Puget Sound specifically, is prone to natural corrosive episodes, "as an estuary with approximately 4000 km of shoreline, Puget Sound has an extensive land-water interface, with large fluxes of freshwater, sediments, organic matter, nutrients, and pollutants entering the Sound from a variety of natural and urbanized landscapes. As phytoplankton die and sink from euphotic surface water, the organic matter they contain is remineralized back to carbon dioxide by natural respiration processes, consuming oxygen and leading to both potential hypoxia and lower pH and aragonite values in the process. Thus, bottom waters in some areas of the Sound are predisposed to the occasional formation of hypoxic, corrosive conditions because of natural physical and biological processes." They concluded that, "Further study of ocean acidification in estuaries is thus warranted because natural factors including acidic river inputs and restricted circulation can predispose these ecologically and economically important habitats toward corrosive, hypoxic conditions, and anthropogenic

stressors such as nutrient enrichment may compound them.” All of these observations indicate a lack of definitive evidence of the magnitude of anthropogenic impact of ocean acidification on pH and aquatic life and the ability to extrapolate observations from the North Pacific to all coastal waters and Puget Sound.

Ocean acidification can interact with a variety of natural and anthropogenic processes, which can differ significantly by location (Feely, *et al.*, 2010.) Barton *et al.*, 2012 noted that a significant shortcoming in understanding the effects of acidification on natural populations was the prediction of how carbonate conditions will vary in coastal and estuarine environments, and that before predictive models could be developed, high resolution monitoring of carbon dioxide chemistry was still needed. Friedrich *et al.*, 2012, stated that spatial heterogeneity in natural variability is likely to affect the regional impact of ocean acidification on organisms. In Newport, Oregon, there is a distinct seasonal cycle relating to upwelling dynamics (Juraneck *et al.*, 2009.) In Hood Canal, Washington, natural processes and pollution may contribute to low pH values (Langston, May 26, 2011.) Netarts Bay, Oregon is a lagoon-type estuary dominated by ocean inputs, while water exchange between the ocean and the four basins of Puget Sound is limited by bottom morphology at Admiralty Inlet (Barton, *et al.*, 2012 and Feely *et al.*, 2010.) All of these variables make the extrapolation of this data across a large geographic range, for the purposes of determining non-attainment of water quality standards, difficult and inappropriate.

3. Ocean acidification in the Big Eddy: (CBD asserts that the Wootton *et al.*, 2008 study demonstrates non-attainment of Washington waters.)

The EPA reviewed Ecology's analysis of the Wootton article provided by CBD, as well as information from personal communication between CBD and Wootton, and a comment letter submitted by Wootton to Ecology during its public comment period (Wootton *et al.*, 2008; CBD, 2011; Wootton and Pfister, 2011, respectively). Ecology concluded, and further analysis by the EPA confirmed that, for a variety of reasons, including the unique sampling location in the study, information from those documents was insufficient to determine the attainment status of Washington's marine pH criteria and narrative criteria related to aquatic life designated uses, as explained below.

pH

The waters sampled in the Wootton *et al.*, 2008 study are located in Makah Tribal Waters. The State of Washington does not have jurisdiction over waters in Indian Country, therefore such waters are not included in State 303(d) lists. That said, a review of the Tatoosh Island pH data from the Wootton *et al.* 2008 study by Cheryl Brown of the EPA's Pacific Coastal Ecology Branch, Western Ecology Division, Office of Research and Development (Brown, 2012), determined that the observations would not be robust enough to make a marine pH impairment determination for Washington State waters because certain processes, including river discharge effects, were not included in the model (Brown, 2012). Therefore, it is unclear whether the pH changes observed over time in the Wootton *et al.*, 2008 study are due to natural or anthropogenic drivers, which is a necessary part of determining whether the state's marine pH criteria was exceeded.

Overall, Brown's analysis (2012) suggests that the rapid decline in pH that was observed off Tatoosh Island may be related to differences in river discharge, upwelling and chlorophyll *a* levels between the years of the study, and may reflect localized conditions rather than a large-scale decline in nearshore pH due to uptake of atmospheric CO₂. Also, there may be interactions with factors that are not included in the Wootton model. Another source cited by CBD, Feely *et al.*, 2010 also suggested that the decline in pH may be related to local conditions, and could, "probably [be] explained by a combination of factors including enhanced upwelling of waters off the Washington coast resulting from changes in regional ocean circulation as well as a smaller contribution from ocean acidification." All of the above factors make the Tatoosh Island sampling location highly unique.

In order to determine if the pH data from Tatoosh Island were representative of coastal water quality throughout the Pacific Northwest, Brown compared the Tatoosh Island results with those of Yaquina Estuary in Oregon. If the rapid decline in pH observed in the Wootton dataset is an indicator of ocean acidification, the same results would be expected at other locations in the region, such as Yaquina Estuary. In fact, no such correlation existed, indicating that there is something other than the coastal ocean influencing the results from Tatoosh Island.

Aquatic Life

The sampling location in the Wootton *et al.*, 2008 study is highly unique and there is not sufficient information to determine if it is representative of conditions in Washington's state waters. Therefore Ecology determined and EPA confirmed that the Wootton study does not provide a basis for Ecology to conclude that the biological condition in Washington's state waters near Tatoosh Island are not meeting Washington's narrative aquatic life criteria. Further information would be needed on the condition of organisms in State waters in order to determine whether there is an aquatic life use impairment.

Based on Brown's analysis, as well as information from Feely *et al.*, 2010, the EPA agrees with Ecology's conclusion that there is not sufficient information to determine whether the pH decline is due to natural processes or anthropogenic influences. It would also be inappropriate to extrapolate the biology data collected near Tatoosh Island, from the Makah waters, to waters of the State, based on the unique environment of the sampling location.

4. Washington's coastal and Puget Sound waters are not attaining the designated use for aquatic life because of impaired growth, abundance and survival of oysters and other calcifying organisms.

The EPA reviewed Ecology's analysis of data and information regarding attainment of the designated use for aquatic life as part of their response to CBD's first comment. The EPA concurs with Ecology's conclusion that there is insufficient data to determine non-attainment of this standard at this time. Ecology's conclusions are well supported by the record.

CBD submitted a number of laboratory studies, as well as hatchery observations, in support of their assertion of impairment in Washington's waters. In addition to the State's analysis, the EPA noted that those references did not provide evidence of the condition of natural assemblages of organisms in State Waters. Honisch *et al.* 2012, stated that laboratory experiments suffered from

a reduced ecological complexity. The conference proceedings from the Southern California Coastal Water Research Project, 2010, concluded that there was a need for improved linkages between biological and oceanographic data, and recognized that "hatchery operators operate with tendencies that may obscure the relationship between water chemistry and recruitment." Currently, these particular laboratory or hatchery observations do not provide sufficient information to account for the potential adaptation and acclimation of wild assemblages, so it would not be appropriate to apply those findings to an attainment decision in natural waterbodies. As discussed above in the response to Comment 3, other studies, such as Wootton *et al.*, 2008, were conducted in unique locations for which extrapolation of the data to Washington waters was inappropriate. No data or information was presented demonstrating impaired health of wild, natural populations in Washington waters, therefore an impairment determination for the aquatic life designated uses cannot be made at this time. See Appendix A, Tables 1 and 2 for additional information on the EPA's review of ocean acidification references.

5. Washington should evaluate other data to determine ocean acidification's impact on its coastal waters.

CBD asserted that Ecology should use data collected by other agencies to make impairment decisions. Specifically, CBD mentioned data collected in Puget Sound by NOAA. In its response to CBD, Ecology discussed its credible data policy and asserted that all readily available data meeting the requirements of this policy were analyzed. Ecology cited communication from Dr. Feely of NOAA, which validated its decision not to use some existing data sets for Puget Sound for impairment decisions due to the large non-quantifiable error the pH probes used to collect the Puget Sound data are subject to. The EPA finds Ecology's conclusion that some existing data were not valid for making impairment decisions to be reasonable. Therefore, Washington's record demonstrates that it appropriately considered and evaluated all data and information submitted by CBD.

6. Information and data that is not specific to Washington's waters or does not conform to Washington's methods, still merits consideration when determining whether waters are threatened or impaired.

As noted in the EPA's 2006 Integrated Reporting (IR) guidance, the EPA supports the use of predictive modeling and other non-site specific data such as remote sensing data, land use analysis and knowledge about pollutant sources and loadings, to make assessment decisions. (EPA, 2005) In addition, the EPA's 2006 IR guidance lays out data assembly requirements, including establishing reasonable cut-off dates for data solicitation, data quality, data representativeness and data quantity considerations that States should take into consideration in assembling their Integrated Reports and 303(d) lists.

In the November 15, 2010 memo, the EPA supported the use of predictive modeling and other non-site specific data to make impairment decisions when extrapolation of such information to a wider geographic area was appropriate (EPA, 2010). The EPA's review of the articles CBD submitted revealed that many of the papers' authors themselves made reference to data gaps preventing definitive conclusions to be drawn about the impacts of ocean acidification, as well as the degree to which such information can be extrapolated (see the EPA's response under

comment 2; see Appendix A Table 1 and Table 2 for the EPA's review and assessment of the individual submitted articles). Given this, the EPA concurs with Ecology's conclusions.

The EPA agrees that States can utilize data and information not specific to their waters to support attainment or non-attainment decisions. However, in order to make attainment and non-attainment decisions, this data and information must be within an appropriate spatial scale and quality to determine whether the State's water quality standards are being met. Ecology responded to this comment by further explaining the State's credible data policy (Ecology, 2011). Ecology also provided a table which indicated why the references provided by CBD did not lead to an impairment decision. The EPA agrees with Ecology's review.

7. The EPA affirmed that States must consider ocean acidification when developing their Section 303(d) lists under the Clean Water Act.

On November 15, 2010, the EPA issued the *Integrated Reporting and Listing Decisions Related to Ocean Acidification* memorandum which provides information on preparing and reviewing Integrated Reports related to ocean acidification impacts under Sections 303(d), 305(b) and 314 of the Clean Water Act. (EPA, 2010) The ocean acidification memorandum reaffirms that States must list waters not meeting water quality standards where data and assessment methods are available, but also recognizes that information is absent or limited for ocean acidification parameters and impacts in many States.

The EPA's memorandum outlines several ways for States to begin assessing for ocean acidification. In order to assess, States should solicit water quality marine data and information including modeling and other non-site-specific data for marine pH and natural background conditions. The EPA also recommends States solicit biological data that could be used to make attainment decisions. The ocean acidification memorandum encourages coastal States to start developing methods for evaluating marine waters based on ocean acidification impacts using existing marine pH and biological water quality criteria. As part of the assessment process, the EPA notes that identifying the natural conditions, while very important for States to do, is also very hard because most coastal States do not have detailed monitoring protocols, assessment methods, or high-resolution equipment needed to quantify natural conditions within their coastal waters, which is needed to implement criteria.

The EPA believes that Ecology has begun to take steps toward assessing ocean acidification impacts by conducting an extensive review of ocean acidification information during the 2010 Water Quality Assessment. Ecology also responded indirectly to this comment by pointing out the State's commitment to follow this guidance and determine the next steps in understanding ocean acidification through the formation of a Blue Ribbon Panel on Ocean Acidification. The EPA believes that the work of this panel of experts, agencies and stakeholders to determine gaps in science and monitoring, to understand adaptation and mitigation and come up with recommendations on actionable items meets with the memo's directive to begin assessing for ocean acidification. Ecology also indicated in their response to comments that it placed Puget Sound in Category 2, which Washington classifies as "waters of concern" with the intention of helping Ecology and the public to, "be aware of, track and investigate these water quality concerns." This is also a beginning step in assessing for ocean acidification.

Conclusions

The EPA has conducted a thorough review of Ecology's justification for not placing Puget Sound or other Washington waters on its 2010 303(d) list for impairments of water quality standards relevant to ocean acidification impacts. The EPA reviewed comments, data, and information submitted by the CBD to Ecology and Ecology's response to CBD's comments. The EPA determined that Ecology appropriately considered and evaluated such data and information when developing its 303(d) list. In the interest of thoroughness, the EPA also reviewed additional references submitted to the EPA by CBD, which were not available during the State's review. None of these additional references provided any data or information that was inconsistent with Ecology's conclusions. While there were numerous articles presented, few consisted of data/information directly relevant to assess Washington's water quality standards and a vast majority concluded that more data and information is needed to understand the impacts associated with ocean acidification. See Appendix A, Tables 1 and 2 for more information on the EPA's review.

References

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

Brown. C.A. Factors Influencing Trends in pH in the Wootton et al. (2008) Dataset. 2012. U.S. Environmental Protection Agency, Washington, D.C. EPA/600/R/12/676.

Center for Biological Diversity (CBD). Comment letter to Department of Ecology. Re: Comments on draft 2010 assessment of Washington's marine waters. August 8, 2011.

Ecology. Water Quality Policy 1-11, March, 2011.
<http://www.ecy.wa.gov/programs/wq/303d/policy1-11.html>

EPA. *Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act*. US Environmental Protection Agency, July 29, 2005.

EPA. *Integrated Reporting and Listing Decisions Related to Ocean Acidification*. Environmental Protection Agency, November 15, 2010.

Feely *et al.* *Estuarine, Coastal and Shelf Science*, 88 (4): 442-449. The combined effects of ocean acidification, mixing, and respiration on pH and carbonate saturation in an urbanized estuary. 2010.

Freidrich *et al.* *Nature Climate Change* 2 (2): 1-5. Detecting regional anthropogenic trends in ocean acidification against natural variability. 2012.

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Juranek *et al.* *Geophysical Research Letters* 36, no. 24: 1-6. A novel method for determination of aragonite saturation state on the continental shelf of Oregon using multi-parameter relationships with hydrographic data. 2009.

Langston. *Sightline Daily*. Coming to a shore near you. May 26, 2011.

Wootton *et al.* *Proceedings of the National Academy of Sciences*, 105 (48): 18848-18853. Dynamic patterns and ecological impacts of declining ocean pH in a high-resolution multi-year dataset. 2008.

Wootton and Pfister. Comment letter to Department of Ecology. Re Comments on Draft 2010 Assessment of Washington's Marine Waters. 2011.