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Using the Clean Water Act to Tackle Ocean Acidification: When Carbon Dioxide Pollutes the Oceans

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USING THE CLEAN WATER ACT TO TACKLE OCEAN ACIDIFICATION: WHEN CARBON DIOXIDE POLLUTES THE OCEANS

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ABSTRACT: Carbon dioxide is an invisible pollutant that threatens water quality and entire marine ecosystems. The oceans absorb carbon pollution from the atmosphere, which reacts with seawater causing it to become more acidic. Ocean acidification impairs the growth, survival and reproduction of marine animals, and if unabated will massively disrupt entire ecosystems. One of the most powerful tools that we have to combat ocean acidification is the Clean Water Act—a law that has successfully solved difficult water pollution problems for decades. This article will discuss how the Clean Water Act can be leveraged to address ocean acidification and to protect our oceans.

I. OCEAN ACIDIFICATION THREATENS MARINE ECOSYSTEMS

The oceans are undergoing a fundamental change because carbon dioxide pollution is causing them to become more acidic. The oceans have become about thirty percent more acidic since the beginning of the industrial revolution,[1] and by the end of

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1. James C. Orr, et al., *Anthropogenic Ocean Acidification over the Twenty-First Century and Its Impact on Calcifying Organisms*, 437 NATURE 681, 681 (2005).

the century they will become 170 percent more acidic.[2] Ocean acidification is causing seawater chemistry changes so profound that our oceans will lose their biological diversity and the most vulnerable species will face extinction.[3]

As the oceans absorb carbon dioxide pollution, a chemical reaction strips the seawater of chemicals needed to build the protective shells and skeletons that animals need to survive.[4] The harmful consequences of ocean acidification are already being observed along the West Coast of the United States.

Billions of oyster larvae have perished in the corrosive coastal waters of Oregon and Washington.[5] Hatcheries in the Pacific Northwest experienced multi-year failures beginning in about 2005. Scientists discovered that along the entire West Coast surface waters are corrosive to sea life during certain seasons,[6] and models predict that there will be year-round corrosive conditions by 2050.[7] Acidified waters have already eroded plankton shells, and fifty-three percent of pteropods near the shores of California have severely dissolved shells.[8] In studies, corals, coralline algae, plankton, mollusks, and other shellfish exposed to future levels of ocean acidification have all

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2. INT'L GEOSPHERE-BIOSPHERE PROGRAMME, OCEAN ACIDIFICATION SUMMARY FOR POLICYMAKERS: THIRD SYMPOSIUM ON THE OCEAN IN A HIGH-CO_2 WORLD (2013) [hereinafter INT'L GEOSPHERE-BIOSPHERE PROGRAMME], http://www.igbp.net/download/18.30566fc6142425d6c91140a/1385975160621/OA_spm2-full-lorez.pdf.

3. K.L. Denman et al., *Couplings Between Changes in the Climate System and Biogeochemistry*, *in* CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS 499 (S. Solomon ed., 2007), https://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4_wg1_full_report.pdf; J.M. Hall-Spencer et al., *Volcanic Carbon Dioxide Vents Show Ecosystem Effects of Ocean Acidification*, 454 NATURE 96 (2008); Katharina E. Fabricius et al., *Losers and Winners in Coral Reefs Acclimatized to Elevated Carbon Dioxide Concentrations*, 1 NATURE CLIMATE CHANGE 165 (2011).

4. J.A. KLEYPAS ET AL., IMPACTS OF OCEAN ACIDIFICATION ON CORAL REEFS AND OTHER MARINE CALCIFIERS 3 (2006).

5. WASH. STATE BLUE RIBBON PANEL ON OCEAN ACIDIFICATION, OCEAN ACIDIFICATION: FROM KNOWLEDGE TO ACTION xi (2012); *see also* RICHARD A. FEELY ET AL., NOAA, SCIENTIFIC SUMMARY OF OCEAN ACIDIFICATION IN WASHINGTON STATE MARINE WATERS (2012).

6. Richard A. Feely et al., *Evidence for Upwelling of Corrosive 'Acidified' Water onto the Continental Shelf*, 320 SCIENCE 1490 (2008).

7. C. Hauri et al., *The Intensity, Duration, and Severity of Low Aragonite Saturation State Events on the California Continental Shelf,* 40 GEOPHYSICAL RES. LETTERS 3424 (2013).

8. N. Bednaršek et al., *Limacina Helicina Shell Dissolution as an Indicator of Declining Habitat Suitability Owing to Ocean Acidification in the California Current Ecosystem*, 281 PROC. ROYAL SOC'Y B 20140123 (2014).

experienced problems.[9]

Even animals that do not have shells are at risk because ocean acidification disrupts other biological functions. For example, when exposed to acidification, orange clownfish suffer a type of brain malfunction that interferes with their homing abilities and makes them five to nine times more likely to swim toward a predator.[10]

Ocean acidification also increases the toxicity of harmful algal blooms. Scientists found that at levels of ocean acidification already observed off the California Coast, pseudonitzia is five times more toxic.[11] These harmful algal blooms have been particularly severe in recent years and can poison fish, marine mammals, and even humans.[12]

These impacts of ocean acidification are already being observed in our waters, and the biological consequences will become more severe. Carbon dioxide emissions continue to grow, making seawater conditions even more stressful for

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9. *See generally* Joan A. Kleypas et al., *Coral Reefs and Ocean Acidification*, 22 OCEANOGRAPHY 108 (2009); KLEYPAS, *supra* note 4; Ilsa Kuffner et al., *Decreased Abundance of* Crustose Coralline *Algae Due to Ocean Acidification,* 1 NATURE GEOSCIENCE 114 (2007); A. Barton et al., *The Pacific Oyster,* Crassostrea Gigas*, Shows Negative Correlation to Naturally Elevated Carbon Dioxide Levels: Implications for Near-Term Ocean Acidification Effects*, 57 LIMNOLOGY & OCEANOGRAPHY 698 (2012); Stephanie C. Talmage et al., *Effects of Elevated Temperature and Carbon Dioxide on the Growth and Survival of Larvae and Juveniles of Three Species of Northwest Atlantic Bivalves*, 6 PLOS ONE 10 (2011); Stephanie C. Talmage et al., *The Effects of Elevated Carbon Dioxide Concentrations on the Metamorphosis, Size, and Survival of Larval Hard Clams (*Mercenaria Mercenaria*), Bay Scallops (*Argopecten Irradians*), and Eastern Oysters (*Crassostrea Virginica*)*, 54 LIMNOLOGY & OCEANOGRAPHY 2072 (2009); Orr et al., *supra* note 1; Ulf Riebesell et al., *Reduced Calcification of Marine Plankton in Response to Increased Atmospheric* CO_2, 407 NATURE 364 (2000).

10. P.L. Munday et al., *Ocean Acidification Impairs Olfactory Discrimination and Homing Ability of a Marine Fish*, 106 PROC. NAT. ACAD. SCIENCES 1848 (2009); Stephen D. Simpson et al., *Ocean Acidification Erodes Crucial Auditory Behaviour in a Marine Fish,* 7 BIOLOGY LETTERS 917 (2011); Maud C. O. Ferrari et al., *Intrageneric Variation in Antipredator Responses of Coral Reef Fishes Affected by Ocean Acidification: Implications for Climate Change Projections on Marine Communities*, 17 GLOBAL CHANGE BIOLOGY 2980 (2011).

11. Fei-Xue Fu et al., *Global Change and the Future of Harmful Algal Blooms in the Ocean*, 470 MARINE ECOLOGY PROGRESS SERIES 207 (2012); Avery O. Tatters et al., *High* CO_2 *and Silicate Limitation Synergistically Increase the Toxicity of* Pseudo-Nitzschia Fraudulenta, 7 PLOS ONE 1 (2012); Avery O. Tatters et. al., *Short- and Long-Term Conditioning of a Temperate Marine Diatom Community to Acidification and Warming*, 368 PHIL. TRANSACTIONS ROYAL SOC'Y B. 437 (2013).

12. *See, e.g.*, Michael Milstein, *NOAA Fisheries Mobilizes to Gauge Unprecedented West Coast Toxic Algal Bloom,* NOAA (2015), http://www.nwfsc.noaa.gov/news/features/west_coast_algal_bloom/index.cfm.

marine animals. Atmospheric carbon dioxide levels exceeded 400 parts per million in 2015, and under business-as-usual emissions scenarios the acidity of the oceans will double before the end of the century.[13] Furthermore, due to the long atmospheric lifetime of carbon dioxide, ocean acidification is long-lasting and irreversible on human timescales.[14]

While harm from ocean acidification is already happening, the worst consequences are predicted for the future. Because these changes in seawater chemistry are impossible to reverse, robust action is needed to stop ocean acidification now, before it is too late.

II. USING WATER POLLUTION LAWS TO ADDRESS OCEAN ACIDIFICATION

A. Background on the Clean Water Act Section 303

The Clean Water Act is the nation's strongest law protecting water quality. Congress enacted the Clean Water Act[15] with the "express purpose of "restor[ing] and maintain[ing] the chemical, physical, and biological integrity of the Nation's waters" and promptly eliminating water pollution.[16] Section 303(c) of the Clean Water Act requires each state to establish water quality standards for bodies of water within the state's boundaries.[17] Water quality standards set goals for enhancing water quality and should "provide water quality for the protection and propagation of fish, shellfish and wildlife and for recreation."[18]

Water quality standards form the basis for water pollution controls under the Act. There are several water quality standards that are relevant to ocean acidification. For

13. *See Recent Monthly Average Mauna Loa CO_2*, NOAA, http://www.esrl.noaa.gov/gmd/ccgg/trends (last updated April 5, 2016) (showing a concentration of 401.85 ppm); INT'L GEOSPHERE-BIOSPHERE PROGRAMME, *supra* note 2.

14. D. Archer et al., The Millennial Atmospheric Lifetime of Anthropogenic CO2, 90 CLIMATIC CHANGE 283 (2008); S. Solomon et al., *Irreversible Climate Change Due to Carbon Dioxide Emissions*, 106 PROC. NAT'L ACAD. SCI. U.S. 1704–9 (2009); THE ROYAL SOCIETY, OCEAN ACIDIFICATION DUE TO INCREASING ATMOSPHERIC CARBON DIOXIDE vi (2005).

15. 33 U.S.C. §§ 1251 *et seq.* (2012).

16. *Id.* § 1251(a).

17. *Id.* § 1313(a)–(c); 40 C.F.R. § 130.3 (2011).

18. 40 C.F.R. § 130.3.

example, all states have water quality standards for marine pH and standards that protect aquatic life uses.[19] Water quality standards designate specific uses for each water body and set narrative or numeric criteria for the water that will support those designated uses.[20] For example, Hawaii protects reefs and reef communities, including mollusks and corals;[21] and Washington protects marine waters for extraordinary or excellent quality salmon and shellfish rearing and spawning.[22]

State water quality standards are the foundation of the Clean Water Act and are at the heart of each strategy of pollution control under the Act.[23] State water quality standards are important in developing regulatory controls on the discharge or release of pollutants. For example, water quality standards inform individual point source obligations through NPDES discharge permits, which may require effluent limitations and technology controls.[24] Section 401 requires applicants for any federal permit or license to obtain state certification that the permitted activity will comply with state water quality standards.[25]

State water quality standards are also used to determine whether a water body is "impaired" for failing to meet an applicable standard. Every two years, 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 ensure "any water quality standard applicable" will be met.[26] This submission is known as a section 303(d), or impaired waters, list. The Environmental Protection Agency (EPA) has promulgated regulations under section 303(d) that require the list to be compiled using "all existing and readily available water quality-related data and information."[27] The list must include all water bodies that fail to meet "any water quality

19. 33 U.S.C. § 1313.
20. *Id.* § 131.3(b), (f).
21. HAW. REV. STAT. § 11-54-7 (2014).
22. WASH. ADMIN. CODE § 173-201A-210(1) (2011).
23. Pronsolino v. Nastri, 291 F.3d 1123, 1127 (9th Cir. 2002).
24. 33 U.S.C. §§ 1342, 1311.
25. *Id.* § 1341.
26. *Id.* § 1313(d).
27. 40 C.F.R. § 130.7(b)(5) (2011).

standard."[28]

Once a state develops its impaired waters list, the state submits the list to the EPA, and the EPA must approve, disapprove, or partially disapprove the list.[29] The EPA may approve a list only if it meets the full requirements of the Clean Water Act and its regulations and accordingly identifies all waters failing to meet any water quality standard. If the EPA does not approve a state's list, then within thirty days EPA must identify waters that should have been listed as impaired.[30]

After a water body is listed as impaired pursuant to section 303(d), the state has the authority and duty to control pollutants from all sources that are causing the impairment. Specifically, the state or the EPA must establish total maximum daily loads (TMDL) of pollutants that a water body can receive and still attain water quality standards.[31] States implement the maximum loads by incorporating them into the state's water quality management plan and by controlling pollution from point sources (via National Pollution Discharge Elimination System (NPDES) permits) and nonpoint sources.[32]

B. Water quality standards evolve to gauge biological thresholds for ocean acidification

While all states already have water quality standards that can be used to assess problems associated with ocean acidification, the EPA should promulgate more exacting standards to improve the efficacy of monitoring and measuring the adverse effects of acidification.

Congress intended the EPA to keep standards updated to meet the demands of new water pollution problems and new information about the impacts of water pollution. The Clean Water Act requires that the EPA publish and "from time to time thereafter revise" criteria for water quality to accurately reflect the latest scientific knowledge on water pollution and its effects on wildlife and water quality.[33] The national water

28. *Id.* §§ 130.7(b)(1), (b)(3), (d)(2).
29. 33 U.S.C. § 1313(d)(2).
30. *Id.*; 40 C.F.R. § 130.7(d)(2).
31. 33 U.S.C. § 1313(d).
32. *Id.* § 1313(e); *Pronsolino*, 291 F.3d at 1128–29; 40 C.F.R. §§ 130.6, 130.7(d)(2).
33. 33 U.S.C. § 1314(a)(1).

quality criteria and information required by section 304 establish a baseline for nationwide implementation of the Clean Water Act.[34] States must either adopt the national recommended water quality criteria in their water quality standards or provide a science-based explanation for their alternate criteria.[35]

At present, all states have pH standards and aquatic life standards that can be used to assess ocean acidification. For example, the EPA's recommended criterion provides that marine pH "should not be changed more than 0.2 units outside the naturally occurring variation or in any case outside the range of 6.5 to 8.5."[36] However, states have adopted variations of this standard, and at least fifteen coastal states have standards that allow a wider range of pH change in marine waters.[37] For comparison, New York states that "the normal range shall not be extended by more than one-tenth (0.1) of a pH unit;"[38] while the marine pH standard for Oregon allows a wide range of pH values between 7.0 and 8.5.[39] At the time when these pH standards were adopted (i.e., 1976 for the EPA's criteria) such variation may have been scientifically defensible because scientists only recently recognized that ocean acidification is a water quality threat. Now it is well established that pH levels above EPA's lower threshold of 6.5 harm marine life.[40] This means that waters in some regions will become so corrosive that certain sea life can no longer survive even though the seawater attains state water quality

34. *Pronsolino*, 291 F.3d at 1127.

35. 40 C.F.R. § 131.11(a)–(b).

36. EPA, QUALITY CRITERIA FOR WATER, EPA NO. 440/9-76-023 342–43 (1976), http://www.epa.gov/wqc/national-recommended-water-quality-criteria.

37. The Clean Water Act regulations allow states to adopt standards that vary from EPA guidance if they are derived from other scientifically defensible methods. 40 C.F.R. § 131.11(b). In 2013, the Center for Biological Diversity petitioned EPA to revise all of these state water quality standards to conform to EPA's marine pH criterion. *See infra* note 42.

38. N.Y. COMP. CODES R. & REGS. tit. 6, § 703.3 (2015).

39. OR. ADMIN. R. 340-041-0021 (2015).

40. George G. Waldbusser et al., *Ocean Acidification in the Coastal Zone from an Organism's Perspective: Multiple System Parameters, Frequency Domains, and Habitats*, 6 ANNU. REV. MARINE SCI. 221 (2014); Kristy J. Kroeker et al., *Impacts of Ocean Acidification on Marine Organisms: Quantifying Sensitivities and Interaction with Warming*, 19 GLOBAL CHANGE BIOLOGY 1884 (2013).

standards.[41]

In 2013, the Center for Biological Diversity petitioned the EPA to adopt new water quality criteria for ocean acidification.[42] Specifically, the petition recommended that the EPA initiate rulemaking and develop water quality criteria that includes an aragonite saturation state threshold and biological criteria to measure ocean acidification. Water quality criteria that are specific to ocean acidification can help states and the EPA develop appropriate monitoring programs. The National Research Council recommends monitoring of several seawater chemistry parameters as well as biological indicators.[43] By defining new water quality criteria specific to ocean acidification, states will be better informed about which parameters they should be monitoring to understand how ocean acidification is affecting seawater quality. In 2013, the EPA committed to examining whether additional standards should be adopted to measure ocean acidification.[44] The EPA responded:

> The EPA agrees with the Center for Biological Diversity (CBD) and other experts in the field that recent scientific research indicates that other ocean chemistry indicators and biological parameters, beyond pH, may be relevant for ocean acidification. Such research indicates that data on carbonate system parameters (e.g., pC02, dissolved inorganic carbon, total alkalinity) and biological metrics of effects may be needed to evaluate ocean acidification. Additionally, the EPA agrees that calcium carbonate (e.g., aragonite and calcite) saturation state is an important parameter related to shell-building of calcareous marine organisms.

At that time in 2013, the EPA stated that it would convene a

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41. Stephen B. Weisberg et al., *Water Quality Criteria for an Acidifying Ocean: Challenges & Opportunities for Improvement*, 126 OCEAN & COASTAL MGMT. 31, 38 (2016).

42. Petition for Additional Water Quality Criteria and Guidance under section 304 of the Clean Water Act, 33 U.S.C. § 1314, to Address Ocean Acidification, CTR. FOR BIOLOGICAL DIVERSITY (Apr. 17, 2013), http://www.biologicaldiversity.org/campaigns/ocean_acidification/pdfs/EPA_OA_petition_2013.pdf.

43. NAT'L RESEARCH COUNCIL, OCEAN ACIDIFICATION: A NATIONAL STRATEGY TO MEET THE CHALLENGES OF A CHANGING OCEAN 6 (2010), http://www.nap.edu/catalog/12904/ocean-acidification-a-national-strategy-to-meet-the-challenges-of.

44. Letter from Nancy Stoner, Acting Adm'r, EPA, to Miyoko Sakashita, Center for Biological Diversity (May 17, 2013) (on file with author).

technical workgroup tasked "to identify water quality parameters related to ocean acidification" and later respond to the petition.[45] To date, EPA has not answered the Center for Biological Diversity's petition.

C. States must identify waters impaired by ocean acidification

The Clean Water Act can directly address ocean acidification as a water quality threat. In 2010, the EPA issued a decision memorandum recognizing the seriousness of ocean acidification, concluding "that States should list waters not meeting water quality standards, including marine pH [water quality criteria], on their 2012 303(d) lists, and should also solicit existing and readily available information on [ocean acidification] using the current 303(d) listing program framework."[46]

The EPA's memorandum came as the result of legal advocacy. In 2009, the Center for Biological Diversity filed a lawsuit challenging the EPA's approval of Washington State's impaired waters list for failing to identify waters impaired by ocean acidification.[47] Under a settlement agreement, the EPA solicited public comment about ocean acidification and the 303(d) program and agreed to make a determination about how to proceed with its section 303(d) program in light of ocean acidification. In its decision memorandum, the EPA confirmed that the Clean Water Act has the breadth to address ocean acidification.[48] Subsequently, EPA provided the memo to states concerning the need to include ocean acidification in their water quality assessments.

Every two years, states conduct water quality assessments, and now coastal states must consider whether seawaters are meeting standards in light of ocean acidification. While the

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45. *Id.*

46. Memorandum from Denise Keehner, Dir. of Office of Wetlands, EPA, on Integrated Reporting and Listing Decisions Related to Ocean Acidification to Water Division Dirs., Regions 1–10 (Nov. 15, 2010), http://www.epa.gov/sites/production/files/2016-01/documents/memo_integrated_reporting_and_listing_decisions_related_to_ocean_acidfication.pdf.

47. Complaint at 2, Ctr. for Biological Diversity v. EPA, No. 2:09-cv-00670-JCC (W.D. Wash. 2009) ("dismissed").

48. Memorandum from Denise Keehner, *supra* note 46.

body of scientific evidence is building that some West Coast surface waters are already dangerously corrosive to sea life during certain seasons,[49] to date the EPA has declined to identify any water bodies as impaired by ocean acidification based on available information. The EPA reiterated its position in *Center for Biological Diversity v. EPA*,[50] a case that challenged the EPA's failure to take action on ocean acidification under the Clean Water Act.

In *Center for Biological Diversity*, the environmental plaintiff challenged EPA's approval of Oregon and Washington's 303(d) lists for failing to identify waters impaired by ocean acidification.[51] While the EPA conceded that ocean acidification is a serious problem, it considered the evidence before it insufficient to support a listing decision.[52] The court deferred to the EPA's reasoned explanations for finding the data insufficient. For example, it accepted the agency's rationale to exclude scientific data linking the massive die-off of oyster larvae in a hatchery to acidified waters taken from an Oregon bay because adverse impacts on the Bay's biological community were missing.[53] Given the discretion afforded to agency decisions, the federal court held that the EPA's approvals of the Washington and Oregon lists were not arbitrary and capricious.[54] The court held that the plaintiff had standing to bring the claim based on concrete injuries to its members that harvest shellfish and use and enjoy areas affected by ocean acidification, and because the relief sought in the case could redress the injuries through mitigation of local sources of acidification.[55]

Overall, *Center for Biological Diversity* highlighted the need for site-specific ocean acidification information and monitoring data. Stronger evidence and certainty of biological impacts from ocean acidification would provide a path for future water

49. *See* Feely et al., *supra* note 6; Barton et al., *supra* note 9; FEELY ET AL., *supra* note 5; J. Timothy Wootton et al., *Dynamic patterns and ecological impacts of declining ocean pH in a high-resolution multi-year dataset*, 105 PROC. NAT'L ACAD. OF SCIENCES 18848 (2008).

50. Ctr. for Biological Diversity v. EPA, 90 F. Supp. 3d 1177 (W.D. Wash. 2015).

51. *Id.* at 1181–82.

52. *Id.* at 1184–85.

53. *Id.* at 1206–07.

54. *Id.* at 1216–17.

55. *Id.* at 1186–96.

quality assessments of ocean acidification. Improved monitoring of pH and biological responses to chemical changes in coastal waters would help provide baseline data and ways to measure the impacts of ocean acidification. Unless carbon dioxide emissions are rapidly abated, water quality conditions will continue to decline because of ocean acidification. It is a matter of when, not if, there will be clear violations of water quality standards that require the identification of acidification impaired seawaters. As the body of scientific evidence of ocean acidification grows, we can expect it will become undeniable that waters warrant 303(d) listing.

D. Toward a TMDL for ocean acidification

Once a water body is listed as impaired for ocean acidification, a requirement will kick in to develop a total maximum daily load (TMDL).[56] There is a viable path for a TMDL for ocean acidification to have a beneficial impact by reducing the speed and severity of ocean acidification.

A TMDL puts into place a plan for reducing the pollution that is causing the water quality impairment. According to the Ninth Circuit Court of Appeals, "[a maximum load] defines the specified maximum amount of a pollutant which can be discharged or 'loaded' into the water at issue from all combined sources."[57] It acts "as a link in an implementation chain" that seeks to attain water quality goals through all Clean Water Act programs from permits to nonpoint-source pollution plans.[58] As a part of the process, the sources of pollution are identified and then each source is allocated a proportion of the allowable load.[59]

Not only can a TMDL reduce local stressors that contribute to regional hot spots for acidification, but it can also work to reduce carbon dioxide pollution that is at the root of the problem. On the local level, section 303(d) and other programs under the Clean Water Act can reduce such pollution by mandating prevention of stormwater surges, coastal and riparian vegetation buffers, wetland restoration, and improved

56. 33 U.S.C. § 1313(d)(1)(C)–(D) (2012).

57. Dioxin/Organochlorine Ctr. v. Clarke, 57 F.3d 1517, 1520 (9th Cir. 1995).

58. *Pronsolino*, 291 F.3d at 1129.

59. 33 U.S.C. § 1313(d).

treatment of runoff.[60] The Clean Water Act has a role beyond mitigating local stressors that amplify the impacts of ocean acidification; it can also assist in reducing carbon dioxide pollution.

On the national level, the EPA can leverage our powerful water pollution law to address carbon dioxide pollution. There are three central recommendations for an ocean acidification TMDL: (1) it should be national or regional; (2) it should complement existing regulation of carbon dioxide under the Clean Air Act and state laws; and (3) it should be consistent with reaching atmospheric carbon dioxide goals that are needed to prevent the worst impacts of ocean acidification.

The sources of ocean acidification are not confined to a single state, but this is not unique for water pollution, and the Clean Water Act has already grappled with downstream and cross-border pollution.[61] Indeed, Clean Water Act section 303(d) has been used for other atmospheric pollutants such as mercury and acid rain that cause water quality problems.[62] Like carbon dioxide pollution, mercury pollution originates from global sources; nonetheless, there is a well-established program under the Clean Water Act to address waterbodies impaired by mercury, and there is a far-reaching seven-state regional TMDL.[63] Even absent a national or regional approach, however, individual state programs could be an important step toward reducing a portion of carbon dioxide emissions.

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60. Ryan P. Kelly et al., *Mitigating Local Causes of Ocean Acidification with Existing Laws*, 332 SCIENCE 1036, 1036 (2011).

61. *See, e.g.*, Milwaukee v. Illinois, 451 U.S. 304 (1981) (concerning Milwaukee's battle with Illinois over sewage discharges into Lake Michigan); Gulf Restoration Network v. Jackson, No. 12-677, LEXIS 134811 (E.D. La. 2013), *vacated*, 783 F.3d 227 (2015) (concerning EPA authority to set water quality standards for multiple states whose runoff contributes to the Gulf of Mexico dead zone).

62 EPA, FREQUENTLY ASKED QUESTIONS ABOUT ATMOSPHERIC DEPOSITION: A HANDBOOK FOR WATERSHED MANAGERS (2001).

63. Memorandum from Craig Hooks, Dir., Office of Wetlands, EPA, on Listing Waters Impaired by Atmospheric Mercury Under Clean Water Act Section 303(d): Voluntary Subcategory 5m for States with Comprehensive Mercury Reduction Programs to Regions I-X Water Div. Dirs. 3 (Mar. 8, 2007), http://www.epa.gov/sites/production/files/2015-09/documents/2007_03_08_tmdl_mercury5m_mercury5m.pdf. *See, e.g.*, Northeast Regional Mercury TMDL, http://www.neiwpcc.org/mercury/mercuryTMDL.asp (last visited Feb. 3, 2016).

III. CONCLUSION

There are key advantages of using the Clean Water Act to address ocean acidification. First, there is no need to wait for new legislation to address ocean acidification because our nation's strong water pollution law already has the breadth to deal with this emerging problem. Second, federal and state agencies already have the expertise and structure in place to implement this science-based law. Therefore, this expertise can be brought to bear on efforts to mitigate and avoid the worst consequences of ocean acidification. Although we have only recently come to recognize carbon dioxide as a form of water pollution, the Clean Water Act, properly applied, is an essential tool in preventing ocean acidification.