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CONTINUING TO LEAD: WASHINGTON STATE'S EFFORTS TO ADDRESS OCEAN ACIDIFICATION[∇]

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*"[O]cean acidification is not a one-time problem with quick and easy solutions. It is a long-term challenge that requires a sustained effort across [multiple] fronts—global and local source reduction, adaptation and remediation, research and monitoring, and public education—and continued engagement by and with governmental and non-governmental entities, industry, and the public. Maintaining a sustainable and coordinated focus on ocean acidification is necessary for ensuring our long-term success."*¹

ABSTRACT: The world's oceans have become approximately thirty percent more acidic since the Industrial Revolution and are currently acidifying at a rate ten times faster than anything the earth has experienced over the last fifty million years. Washington State is undertaking a groundbreaking effort to address ocean acidification, a global issue that has serious implications for the world's oceans, marine ecosystems, and the individuals and communities that depend upon the services that they provide. These localized actions, in isolation,

[∇] The title of this article is derived from a statement by former Washington State Governor Christine Gregoire regarding Washington's ability to address ocean acidification. ERIC SCIGLIANO, SWEETENING THE WATERS: THE FEASIBILITY AND EFFICACY OF STRATEGIES TO PROTECT WASHINGTON'S MARINE RESOURCES FROM OCEAN ACIDIFICATION 7 (Eric Swenson ed. 2012) ("As the first effort of its kind, Washington's initiative—starting with the launch of Governor Gregoire's Blue Ribbon Panel on Ocean Acidification and continuing into the implementation of measures to tackle the problem—is being closely watched around the country and around the world. Governor Gregoire famously summed up the responsibility and the opportunity that come with this mission in a single word. When asked what a small state like Washington could do about a global problem such as ocean acidification, she replied: 'Lead.'").

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1. WASHINGTON STATE BLUE RIBBON PANEL ON OCEAN ACIDIFICATION: FROM KNOWLEDGE TO ACTION, WASHINGTON STATE'S STRATEGIC RESPONSE 20 (H. Adelman & L. Whitely Binder eds., 2012).

will be insufficient to effectively combat and adapt to the acidification of marine waters. While acknowledging this generally accepted premise, Washington has nonetheless determined to become a leader in responding to ocean acidification. This article is an update of the 2013 article *We Can Lead: Washington State's Efforts to Address Ocean Acidification*. Both articles discuss Washington State's reasons for taking action on ocean acidification and the far-reaching influence of those actions, and examines the successes and challenges of, and lessons that can be learned from, Washington's ongoing response.

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I. INTRODUCTION

The oceans' absorption of anthropogenic (human generated) carbon dioxide ("CO₂") causes changes to marine chemistry and biology. Our understanding of the chemical reactions that

result from this absorption is relatively well developed; our understanding of the impacts to the oceans' species and ecosystems is less well developed. The impacts are, however, expected to be severe.

The first signs of these biological impacts occurred within the past decade when commercial shellfish hatcheries in the Pacific Northwest experienced an unprecedented die-off of larval oysters. This prompted hatchery operators to reach out to researchers and request assistance in determining the cause.² Washington's shellfish resources and industry are important to the state, which stands to incur substantial losses in an increasingly acidified marine environment.

Early partnerships on this issue between the shellfish industry and the scientific community served as a catalyst for state action. In 2011, Washington announced a Shellfish Initiative that included a commitment to take a leadership role in investigating the sources of and solutions to ocean acidification.³ Changing the trajectory of ocean acidification will require a global reduction in CO₂ emissions that is largely out of the state's control; nonetheless, Washington's work under its Shellfish Initiative places it at the forefront of efforts to address what is referred to as "the other CO₂ problem" or climate change's "evil twin." Whether and how the national and global communities will effectively address this problem in the long term remains to be seen. What is certain is that we as a state will need to find ways to adapt to the changes ahead.

Part II of this article provides a summary of the sources and anticipated impacts of ocean acidification. It includes an explanation of why Washington's waters are experiencing acidification earlier and more acutely than most other areas of the planet, and what Washington stands to lose if ocean acidification is not addressed. It provides information on how and why Washington's shellfish resources and industry have influenced the state's response to ocean acidification. Part III sets forth the legal avenues available to state and federal governments to address ocean acidification. Part IV provides

2. See WASHINGTON STATE BLUE RIBBON PANEL ON OCEAN ACIDIFICATION: OCEAN ACIDIFICATION: FROM KNOWLEDGE TO ACTION, WASHINGTON STATE'S STRATEGIC RESPONSE xi (H. Adelman & L. Whitely Binder eds., 2012) [hereinafter BLUE RIBBON PANEL REPORT].

3. STATE OF WASHINGTON, WASHINGTON SHELLFISH INITIATIVE (2011) [hereinafter WASHINGTON SHELLFISH INITIATIVE].

an overview of the state's efforts to address ocean acidification over the past five years through the formation of the Blue Ribbon Panel on Ocean Acidification ("Blue Ribbon Panel" or "Panel") under the Washington Shellfish Initiative, and includes a summary of that Panel's recommendations. Part V examines the influence of the Blue Ribbon Panel and the implementation of its recommendations to date. Efforts to address ocean acidification in the areas of law, policy, legislation, research, coordination, education and outreach are occurring at the regional, national, and international levels; this part summarizes a number of these processes and actions and describes how Washington's leadership has influenced them. Part VI discusses lessons that other states can take from Washington's efforts, including the role of public-private partnerships and the importance of localized adaptation. Ultimately, this article explains why taking early and sustained local action is critical even in the face of a problem that clearly requires national and international solutions.

II. WHAT WE KNOW ABOUT OCEAN ACIDIFICATION: CAUSES AND IMPACTS

We have known for some time that the oceans are absorbing a significant amount of human-generated CO₂ emissions. Historically, this was widely considered a beneficial phenomenon; the world's oceans act as a massive carbon sink, removing and storing CO₂ from the atmosphere and slowing the rate of global warming.⁴ We have recently become aware, however, that this valuable mitigation measure results in chemical and biological changes to the ocean and its organisms and ecosystems. This phenomenon is often referred to as "the other CO₂ problem" (climate change, of course, being the "primary" CO₂ problem).⁵ The 550 billion tons of anthropogenic

4. See, e.g., Ben I. McNeil, *Significance of the Oceanic CO₂ Sink for National Carbon Accounts*, 1 CARBON BALANCE MGMT. (2006), <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1550387/> (discussing the inclusion of coastal nations' exclusive economic zones as carbon sinks when calculating a nations' carbon emissions and reductions).

5. Ryan P. Kelly & Margaret R. Caldwell, *Ten Ways States Can Combat Ocean Acidification (and Why They Should)*, 37 HARV. ENVTL. L. REV. 57, 58 (2013); Scott C. Doney et al., *Ocean Acidification: The Other CO₂ Problem*, 1 ANN. REV. MARINE SCI. 169, 170 (2009); *Ocean Acidification*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., <http://www.pmel.noaa.gov/co2/story/Ocean+Acidification> (last visited Feb. 22, 2016). Various commentators have also referred to ocean acidification as climate change's

CO₂ that the world's oceans have already absorbed is anticipated to cause a "profound long-term impact" on marine chemistry and biology.⁶

A. *An Emerging Understanding*

The first sign of trouble appeared in the Pacific Northwest a decade ago. From 2005 to 2009, two commercial shellfish hatcheries in Washington and Oregon suffered massive die-offs of Pacific oyster larvae.⁷ During that same timeframe, wild Pacific oysters in areas of the Pacific Northwest where they have naturalized failed to successfully reproduce.⁸ The failed natural reproduction coupled with significant hatchery production problems in two of the main West Coast shellfish hatcheries threatened the viability of much of the West Coast shellfish industry, which is dependent upon hatcheries and wild reproduction for seed.⁹

Initially, the die-off of larvae in hatcheries was thought to be caused by blooms of a strain of bacteria called *Vibrio tubiashii* flourishing in oxygen-starved dead zones.¹⁰ As hatchery operators, researchers, and others worked to understand the source of the problem, an alternate theory emerged: that the ocean's absorption of anthropogenic CO₂ causes chemical changes to marine waters that has a significant and adverse

ugly or evil twin. See, e.g., Ayana E. Johnson, *Saving Coral Reefs Requires Halting Climate Change*, NAT'L GEOGRAPHIC BLOGS (Dec. 3, 2015, 3:25 PM), <http://voices.nationalgeographic.com/tag/ocean-acidification/feed/>; Bethany Augliere, *Ocean Acidification: 'Evil Twin' of Global Warming Threatens Monterey Bay*, SAN JOSE MERCURY NEWS (Dec. 12, 2015).

6. WASHINGTON STATE BLUE RIBBON PANEL ON OCEAN ACIDIFICATION, SCIENTIFIC SUMMARY OF OCEAN ACIDIFICATION IN WASHINGTON STATE MARINE WATERS 4 (2012) [hereinafter BLUE RIBBON PANEL SCIENTIFIC SUMMARY].

7. BLUE RIBBON PANEL REPORT, *supra* note 2, at xi.

8. Elizabeth Grossman, *Northwest Oyster Die-offs Show Ocean Acidification Has Arrived*, ENV'T 360 (Nov. 23, 2011), http://e360.yale.edu/feature/northwest_oyster_die-offs_show_ocean_acidification_has_arrived/2466/.

9. Craig Welch, *Oysters in Deep Trouble: Is the Pacific Ocean's Chemistry Killing Sea Life?*, SEATTLE TIMES (June 14, 2009), http://seattletimes.com/html/localnews/2009336458_oysters14m.html.

10. Ralph A. Elston et al., *Re-emergence of Vibrio tubiashii in Bivalve Shellfish Aquaculture: Severity, Environmental Drivers, Geographic Extent and Management*, 82 DISEASES OF AQUATIC ORGANISMS 119, 128 (2008); Kenneth R. Weiss, *A Warning from the Sea*, L.A. TIMES (July 13, 2008), <http://articles.latimes.com/2008/jul/13/local/me-oysters13>.

effect on larval oysters' ability to form shells.¹¹

The chemical reactions that cause ocean acidification—a reduction in the pH of the ocean over an extended period, typically decades or longer—are well understood. Scientists have demonstrated that ocean chemistry is changing as a result of anthropogenic CO₂ being released into the earth's atmosphere, and can trace the increased input of CO₂ via radio isotopes to the burning of fossil fuels.¹² When CO₂ enters the ocean, it reacts with water to form carbonic acid, releasing hydrogen ions and lowering the ocean's pH.¹³ A portion of the hydrogen ions released by carbonic acid react with the ocean's reserves of carbonate ions to produce additional bicarbonate.¹⁴ This reaction depletes the ocean's reserves of carbonate ions.¹⁵

Approximately twenty-five percent of the anthropogenic CO₂ produced since the Industrial Revolution has been absorbed by the world's oceans, resulting in a decrease in surface ocean pH

11. George G. Waldbusser et al., *A Developmental and Energetic Basis Linking Larval Oyster Shell Formation to Ocean Acidification Sensitivity*, 40 GEOPHYSICAL RES. LETTERS 2171, 2171 (2013); Press Release, Nat'l Science Foundation, World Oceans Month Brings Mixed News for Oysters (June 11, 2013), http://www.nsf.gov/news/news_summ.jsp?cntn_id=128228; Alan 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, 698–99 (2012); A. Whitman Miller et al., *Shellfish Face Uncertain Future in High CO₂ World: Influence of Acidification on Oyster Larvae Calcification and Growth in Estuaries*, 4 PLOS ONE e5661 (2009); Welch, *supra* note 9. There is some debate regarding the extent to which anthropogenic CO₂ (as compared to natural variability) is contributing to lowered ocean pH and the reproduction problems at Pacific Northwest shellfish hatcheries. See, e.g., Maia Bellon, *Ocean Acidification is Real*, WASH. STATE DEP'T OF ECOLOGY BLOG (September 25, 2014), <http://ecologywa.blogspot.com/2014/09/ocean-acidification-is-real.html>; Cliff Mass, *EPA Takes on the Oyster/Acidification Scaremongers*, CLIFF MASS WEATHER BLOG (September 7, 2014), <http://cliffmass.blogspot.com/2014/09/epa-takes-on-oysteracidification.html>; Cliff Mass, *Ocean Acidification and Shellfish: Did the Seattle Times Get the Story Right?*, CLIFF MASS WEATHER BLOG (Oct. 9, 2013), <http://cliffmass.blogspot.com/2013/10/ocean-acidification-and-northwest.html>.

12. BLUE RIBBON PANEL SCIENTIFIC SUMMARY, *supra* note 6, at xi (while ocean acidification is caused primarily by uptake of CO₂ from the atmosphere, it can also be caused by other chemical additions or subtractions from the ocean). BANKOKU SHINRYOKAN, INT'L PANEL ON CLIMATE CHANGE (IPCC), WORKSHOP REPORT: IMPACTS OF OCEAN ACIDIFICATION ON MARINE BIOLOGY AND ECOSYSTEMS 37 (2011). See also BLUE RIBBON PANEL REPORT, *supra* note 2, at 3.

13. BLUE RIBBON PANEL SCIENTIFIC SUMMARY, *supra* note 6, at 4 (explaining that the concentration of hydrogen ions is measured by the pH scale and the pH scale is the negative log of the hydrogen ion concentration).

14. *Id.*

15. *Id.*

by approximately 0.1 pH units over the past two hundred and fifty years.¹⁶ Although this may not seem like a significant change, it represents an approximately thirty percent increase in acidity over this time period.¹⁷ The rate of change is also alarming: the ocean is acidifying ten times faster today than it has over the last fifty million years. This rate is higher than it has been at any time in the last 100 million years.¹⁸

In contrast to our understanding of the chemical changes that result from the oceans' absorption of anthropogenic CO₂, our awareness and understanding of how ocean acidification is likely to affect marine species and ecosystems is still in its infancy—though evolving rapidly.¹⁹ Much of the early research on ocean acidification's impacts focused on its effects on marine calcifiers.²⁰ Marine calcifiers include oysters, clams, scallops, mussels, abalone, crabs, pteropods, corals, barnacles, sea urchins, sand dollars, sea stars, sea cucumbers, and phytoplankton and zooplankton.²¹ Calcifiers depend on carbonate ions for their survival; these ions are essential “building blocks” calcifiers use to build shells or skeletons.²² Reduced dissolved carbonate ion concentrations leads to a reduction in the saturation states of aragonite and calcite (biologically important forms of calcium carbonate), which compromises these organisms' ability to form shells and skeletons.²³

In addition to impairing calcifiers' ability to build shell or skeleton, ocean acidification is expected to impact a diverse range of biological functions in a multitude of species. For

16. BLUE RIBBON PANEL SCIENTIFIC SUMMARY, *supra* note 6, at xi.

17. *Id.*

18. *Id.*; Jerry Miller & Tom Armstrong, *Study Finds Ocean Acidification Rate is Highest in 300 Million Years, CO₂ is Culprit*, THE WHITE HOUSE BLOG (March 13, 2012, 1:27PM), <http://www.whitehouse.gov/blog/2012/03/13/study-finds-ocean-acidification-rate-highest-300-million-years-co2-culprit>.

19. Ocean acidification research is “among the top three global ocean research priorities” and one of the “fastest growing fields of research in marine science[.]” BIOACID: BIOLOGICAL IMPACTS OF OCEAN ACIDIFICATION, <http://www.bioacid.de> (last visited Feb. 22, 2016).

20. See e.g., Waldbusser et al., *supra* note 11; World Oceans Month Brings Mixed News for Oysters, *supra* note 11; Barton et al., *supra* note 11.

21. BLUE RIBBON PANEL REPORT, *supra* note 2, at xiii.

22. *Id.* at 10.

23. Waldbusser et al., *supra* note 11; World Oceans Month Brings Mixed News for Oysters, *supra* note 11; Barton et al., *supra* note 11.

example, mussels grown in acidified conditions have weaker byssal threads, the mechanism that allows them to attach to rocks, docks, and other hard surfaces.²⁴ Ocean acidification may also impact fish larvae by compromising their ability to hear and respond to sounds during a crucial and short developmental window that would normally lead them from the open ocean, where they hatch, towards protected waters to grow.²⁵ Research on clownfish suggests that this species may lose its hearing and sense of smell, compromising its ability to avoid predators.²⁶ Potential impacts extend to organisms and animals both big and small. At the top of the food chain, ocean acidification may alter shark blood chemistry and behavior patterns, causing the animals to rest less and spend longer periods swimming.²⁷

Because scientists have only recently begun to study the potential impacts, there are limits to our ability to predict how ocean acidification will affect the local and global marine environments—and the people that depend on those environments—at an ecosystem level.²⁸ However, “[g]iven the large number of species for which negative responses to [ocean acidification] have been demonstrated, changes in food web structure and function are likely,”²⁹ potentially resulting in long-term shifts in species composition as early as this century.³⁰ The economic costs are anticipated to be significant

24. Michael J. O'Donnell et al., *Mussel Byssus Attachment Weakened by Ocean Acidification*, 3 NATURE CLIMATE CHANGE 587, 587 (2013); Stephanie P. Ogburn, *Ocean Acidification Weakens Mussels' Grip: Ocean Absorption of CO₂ from Human Activity is Loosening Shellfish's Ability to Cling*, SCI. AM. (March 13, 2013), <http://www.scientificamerican.com/article.cfm?id=ocean-acidification-weakens-mussels-grip>.

25. Tullio Rossi et al., *Ocean Acidification Boosts Larval Fish Development but Reduces the Window of Opportunity for Successful Settlement*, 282 PROC. ROYAL SOC'Y B, no. 1821, at 1, 4, 6 (2015), <http://rsos.royalsocietypublishing.org/content/282/1821/20151954.full.pdf>.

26. Stephen D. Simpson et al., *Ocean Acidification Erodes Crucial Auditory Behavior in a Marine Fish*, BIOLOGY LETTERS (June 1, 2011), <http://rsbl.royalsocietypublishing.org/content/early/2011/05/25/rsbl.2011.0293.full.pdf>.

27. Leon Green and Fredrik Jutfelt, *Elevated Carbon Dioxide Alters the Plasma Composition and Behaviour of a Shark*, 10 BIOLOGY LETTERS, no. 9, at 1 (2014), <http://rsbl.royalsocietypublishing.org/content/roybiolett/10/9/20140538.full.pdf>.

28. Craig Welch, *Sea Changes Harming Ocean Now Could Someday Undermine Marine Food Chain*, SEATTLE TIMES (Nov. 25, 2012); *What is Ocean Acidification?*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., <http://www.pmel.noaa.gov/co2/story/What+is+Ocean+Acidification%3F> (last visited Feb. 22, 2016).

29. BLUE RIBBON PANEL SCIENTIFIC SUMMARY, *supra* note 6, at xii.

30. Astrid C. Wittmann & Hans-O. Pörtner, *Sensitivities of Extant Animal Taxa to*

as well. One analysis estimated that the production loss of mollusks (*e.g.*, clams, mussels, oysters) due alone to ocean acidification would be over \$100 billion worldwide.³¹

Some of the most concerning science already shows potentially profound impacts on organisms that form the building blocks of the food web. Researchers in Sweden have shown that acidification may force ocean bacteria to significantly alter their metabolism; bacteria degrade waste materials, including those produced by algae, and help to release necessary nutrients back into the food chain.³² Other studies have shown that ocean acidification may cause certain species of phytoplankton to die out or migrate while others flourish, potentially causing significant changes in local communities of these organisms.³³ Changes in the phytoplankton assemblage could resonate throughout the food web and have implications for important biogeochemical processes, including carbon cycling.³⁴ More importantly for humans, phytoplankton currently produce approximately half of the oxygen on the planet.³⁵

Acidification, in combination with other stressors including warming ocean water and increased eutrophication, may also contribute to larger and more toxic algal blooms, including of the diatom *Pseudo-nitzschia*, which produces the potent neurotoxin domoic acid.³⁶ In the Spring of 2015, Washington

Ocean Acidification, 3 NATURE CLIMATE CHANGE 995 (2013).

31. Daiju Narita, Katrin Rehdanz & Richard S.J. Tol, *Economic Costs of Ocean Acidification: A Look into the Impacts on Global Shellfish Projection*, 113 CLIMATIC CHANGE 1049, 1061 (2012) (assuming an increasing demand of mollusks with expected income growths combined with a "business-as-usual" emission trend towards the year 2100).

32. Carina Bunse et al., *Response of Marine Bacterioplankton pH Homeostasis Gene Expression to Elevated CO₂*, 6 NATURE CLIMATE CHANGE 2914 (2016).

33. Stephanie Dutkiewicz et al., *Impact of Ocean Acidification on the Structure of Future Phytoplankton Communities*, 5 NATURE CLIMATE CHANGE 1002, 1002 (2015).

34. *Id.* See also Jennifer Chu, *Ocean Acidification May Cause Dramatic Changes to Phytoplankton*, MIT NEWS (July 20, 2015), <http://news.mit.edu/2015/ocean-acidification-phytoplankton-0720>.

35. BLUE RIBBON PANEL SCIENTIFIC SUMMARY, *supra* note 6, at 64.

36. See Kevin J. Flynn et al., Ocean Acidification with (de)eutrophication will alter future phytoplankton growth and succession, 282 PROC. ROYAL SOC'Y B, no. 1804, at 1 (2015), <http://rspb.royalsocietypublishing.org/content/royprsb/282/1804/20142604.full.pdf>; *West Coast Harmful Algal Bloom*, NATIONAL OCEAN SERVICE NEWS (last visited Feb. 22, 2016), <http://oceanservice.noaa.gov/news/sep15/westcoast-habs.html>. Note that science on ocean acidification's contribution to toxic algal blooms is still evolving. Another 2015 study suggests that the diatom response to ocean

State experienced a “massive toxic bloom” of *Pseudo-nitzschia*.³⁷ The bloom stretched from California to as far north as the Alaska Peninsula and resulted in unprecedented closures of recreational and commercial shellfish fisheries; the bloom was also suspected to play a part in an unusual die-off of large whales in the Gulf of Alaska.³⁸

Negative impacts to zooplankton and marine corals, on which multiple other species depend, are also expected.³⁹ A diminishment in coral reefs, and the ecosystem services they provide, could have dramatic effects to reef systems’ composition and diversity. An important breakthrough in ocean acidification science came in late 2012, when researchers demonstrated for the first time the impacts of ocean acidification on a marine species in its natural habitat.⁴⁰ Samples of pteropods (*Limacina helicina antarctica*) taken from the South Ocean showed evidence of shell dissolution caused by ocean acidification.⁴¹ Since those samples were taken, field surveys have also found severe pteropod shell dissolution due to ocean acidification along the Washington–Oregon–California coast.⁴² Pteropods are a vital food source for plankton, fish, birds, and whales.⁴³ Pteropods comprise more than fifty percent of the diet of Pacific Northwest pink salmon during the first year of the salmon’s life in the open ocean.⁴⁴

Ocean acidification may not prove to be dire for all marine

acidification could instead be negative in dynamic light situations, for example in highly mixed systems such as the Southern Ocean. See Clara J.M. Hoppe et al., *Ocean Acidification Decrease the Light-Use Efficiency in an Antarctic Diatom Under Dynamic but not Constant Light*, 207 NEW PHYTOLOGIST 159 (2015).

37. *Id.*

38. *Id.*

39. N. Bednaršek et al., *Extensive Dissolution of Live Pteropods in the Southern Ocean*, 5 NATURE GEOSCIENCE 881 (2012). Compare Hannah C. Barkley et al., *Changes in Coral Reef Communities Across a Natural Gradient in Seawater Ph*, 1 SCI. ADVANCES e1500328 (2015), with Rebecca Albright et al., *Ocean Acidification Compromises Recruitment Success of the Threatened Caribbean Coral Acropora palmate*, 107 PROC. NAT’L ACAD. SCIENCES 20401 (2010).

40. See Bednaršek et al., *supra* note 39.

41. *Id.*

42. 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, no. 1785, at 1 (2014), <http://rspb.royalsocietypublishing.org/content/royprsb/281/1785/20140123.full.pdf>.

43. *Id.* at 3.

44. Welch, *supra* note 28.

animals; some species may benefit from ocean acidification. For example, blue crabs, lobsters, and shrimp may grow bigger shells or skeletons as waters become more acidic.⁴⁵ Seagrasses may also benefit from higher marine levels of CO₂.⁴⁶ Other species like sea corals and sea urchins exhibit variable responses that indicate a potential to be able to adapt to increased ocean acidity.⁴⁷ Some “nuisance species” such as jellyfish may also be ocean acidification winners.⁴⁸

However, focusing on potential impacts to single species or on ocean acidification as an isolated environmental condition tells only part of the story. Whether adverse or beneficial, ocean acidification’s impacts on individual species are likely to contribute to ecosystem-wide effects. Ocean acidification is also occurring at the same time as other “co-stressors” that impact ocean inhabitants and processes, including warming water temperatures and lower levels of dissolved oxygen.⁴⁹ Research into ocean acidification’s impacts on food web dynamics and into ocean acidification’s interactions with other co-stressors is currently being conducted by numerous groups, including the Woods Hole Institute and the German research network BIOACID (Biological Impacts of Ocean Acidification).⁵⁰

45. Justin B. Ries et al., *Marine Calcifiers Exhibit Mixed Response To CO₂-Induced Ocean Acidification*, 37 GEOLOGY 1131 (2009); *Acidic Oceans May Be a Boon for Some Marine Dwellers*, SCIENCE NOW (Dec. 1, 2009), <http://www.sciencemag.org/news/2009/12/acidic-oceans-may-be-boon-some-marine-dwellers>.

46. See ET Apostolaki et al., *Seagrass Ecosystem Response to Long-Term High CO₂ in A Mediterranean Volcanic Event*, 99 MARINE ENV’T RES. (2014); M. Takahashi et al., *The Effects of Long-Term in situ CO₂ Enrichment on Tropical Seagrass Communities at Volcanic Vents*, 73 ICES J. MARINE SCI. 876 (2016).

47. Melissa H. Pespeni et al., *Evolutionary Change During Experimental Ocean Acidification*, 110 PROC. NAT’L ACAD. SCIENCES 6937 (2012); Marcia Malory, *Sea Urchins Cope with Rising CO₂ Levels*, PHYS.ORG (April 9, 2013), <http://phys.org/news/2013-04-sea-urchins-cope-co2.html>.

48. Jason M. Hall-Spencer & Ro Allen, *The Impact of CO₂ Emissions on ‘Nuisance’ Marine Species*, 4 BIODIVERSITY STUD. 33 (2015).

49. Denise L. Breitburg et al., *On Top of All That . . . Coping with Ocean Acidification in the Midst of Many Stressors*, 28 OCEANOGRAPHY 48, 53–54 (2015). See also *Multiple Stressor Considerations: Ocean Acidification in a Deoxygenating Ocean and a Warming Climate*, WEST COAST OCEAN AND HYPOXIA SCIENCE PANEL (July 2015), <http://westcoastoah.org/wp-content/uploads/2015/06/Multistressor-Considerations-FINAL-7.28.15.pdf>.

50. The Woods Hole Institute’s Ocean Acidification Initiative is focused on ocean acidification’s impacts on the marine food web. *Ocean Acidification Initiative*, WOODS HOLE OCEANOGRAPHIC INSTITUTION, <http://www.whoi.edu/main/initiative/ocean-acidification> (last visited March 1, 2016). BIOACID is in the third theme of its research program and is focused on bridging different branches of ocean acidification

B. *Why Ocean Acidification Matters to Washington State*

Although it is a global problem that will require global solutions, ocean acidification is of particular concern to Washington State because of the region's susceptibility to acidification, and the potential impacts on the state's environment, economy, and culture.⁵¹

1. *Regional Contributors to Ocean Acidification*

There are regional differences in susceptibility to ocean acidification; coastal waters in the Pacific Northwest are some of the most vulnerable, as are the polar oceans.⁵² Regional contributors in Washington State include: upwelling of high-CO₂ ocean waters, colder surface waters, respiration and hypoxia, natural and anthropogenic freshwater inputs, and the addition of other acidifying gases and wastes.⁵³

Upwelling, a wind-driven process that occurs along the Pacific coast of the United States, brings water deep in the ocean up to the surface. This deep ocean water is higher in CO₂ than surface waters, in part because colder water holds more CO₂. The effect is an increase in ocean acidification in areas

research. *Scientific Program*, BIOACID, http://www.bioacid.de/front_content.php?idcat=594&idlang=22 (last visited March 2, 2016).

51. BLUE RIBBON PANEL SCIENTIFIC SUMMARY, *supra* note 6, at xi.

52. Lisa L. Robbins et al., *Baseline Monitoring of the Western Arctic Ocean Estimates 20% of Canadian Basin Surface Waters Are Undersaturated with Respect to Aragonite*, 8 PLOS ONE e73796 (2013); Jan Newton & Terrie Klinger, *OA in the Pacific Northwest: What Do We Know About Ocean Acidification in Pacific Northwest Coastal Waters*, U. WASH. COLL. ENVIRONMENT, <https://environment.uw.edu/ocean-acidification-in-the-pacific-northwest> (last visited Feb. 22, 2016). Colder surface waters, particularly those in the Southern and Arctic oceans, take up CO₂ more rapidly than warmer water. Robbins, *supra*, at e73796. In the Arctic Ocean, ocean acidification is also accelerated by a reduction in summer sea ice cover. *Id.*; Lisa Robbins, *Studying Ocean Acidification in the Arctic Ocean*, U.S. GEOLOGICAL SURVEY FACT SHEET NO. 2012-3058 (April 2012), <http://pubs.usgs.gov/fs/2012/3058/pdf/fs20123058.pdf>. Melting sea ice dilutes the ocean's under ice layer with freshwater and exposes the surface mixed layer, allowing an exchange of atmospheric CO₂. Robbins, *Baseline Monitoring*, *supra*, at e73796; Robbins, *Studying Ocean Acidification in the Arctic Ocean*, *supra*. It is estimated that the Arctic Ocean, which covers only 3.9% of the global ocean surface, has taken up as much as 7.5% of the global oceanic CO₂ uptake. Robbins, *Baseline Monitoring*, *supra*, at e73796 (citing N.R. Bates & J.T. Mathis, *The Arctic Ocean Marine Carbon Cycle: Evaluation of Air-Sea CO₂ Exchanges, Ocean Acidification Impacts and Potential Feedbacks*, 6 BIOGEOSCIENCES 2433 (2009)).

53. BLUE RIBBON PANEL SCIENTIFIC SUMMARY, *supra* note 6, at xi-xii; Jan Newton & Terrie Klinger, *supra* note 52.

where upwelling occurs.⁵⁴ In addition, because Pacific Northwest waters were already fresher and colder than the global average, they are naturally at a lower pH than other waters and are therefore closer to harmful thresholds of acidification.⁵⁵ The water upwelled off of Washington's coast today carries with it anthropogenic CO₂ loads from thirty to fifty years ago, when that water was last at the ocean surface. This means that even if humans reduced CO₂ emissions and other contributors today, marine water upwelling to the surface would continue to increase the acidity of surface waters for the next thirty to fifty years.⁵⁶

Respiration and low dissolved oxygen levels can also contribute to ocean acidification. Washington's shallow marine waters contain high levels of nitrogen, which leads to algal blooms.⁵⁷ Organic material from these blooms sinks into deeper waters, where it is remineralized back to CO₂ through a process called microbial respiration.⁵⁸ Respiration releases CO₂ into the water column, affecting pH and aragonite saturation rates in a manner similar to the ocean's absorption of atmospheric CO₂.⁵⁹ Anthropogenic inputs of nutrients (including nitrate, phosphate, and iron) result in eutrophication—an increase in the rate or supply of organic nutrients.⁶⁰ Eutrophication leads to excessive growth of algae and low dissolved oxygen, and has been linked to increased acidification in other areas.⁶¹

Freshwater also brings both natural and anthropogenic acidification to Washington's marine waters. Freshwater is naturally lower in pH than saltwater.⁶² Freshwater also delivers several carbon species including dissolved organic carbon, particulate organic carbon, dissolved inorganic carbon, and total alkalinity, which can contribute to ocean acidification.⁶³

54. BLUE RIBBON PANEL SCIENTIFIC SUMMARY, *supra* note 6, at xi.

55. Jan Newton & Terri Klinger, *supra* note 52.

56. BLUE RIBBON PANEL REPORT, *supra* note 2, at 11, 13.

57. BLUE RIBBON PANEL SCIENTIFIC SUMMARY, *supra* note 6, at 12.

58. *Id.*

59. *Id.*

60. *Id.* at 13–14.

61. *Id.*

62. *Id.* at 15.

63. BLUE RIBBON PANEL SCIENTIFIC SUMMARY, *supra* note 6, at 15.

Local sources of other acidifying gases and wastes include motor vehicles, ships, electric utilities, and agricultural activities.⁶⁴ These sources release CO₂, nitrogen oxide, and sulfur oxide gasses into the atmosphere.⁶⁵ These gases result in nitric acid and sulfuric acid, which when added to marine waters lower pH and increase acidity.⁶⁶

2. *Regional Impacts of Ocean Acidification*

Ocean acidification has the potential to significantly impact Washington State in a number of ways. One notable example is ocean acidification's anticipated effects on mollusks such as clams, mussels, and oysters. Shellfish play a significant role in Washington State's economy, culture, and environment.

People have been farming shellfish in Washington since the mid-1800s.⁶⁷ Today, Washington is the top producer of farmed clams, oysters, and mussels in the nation.⁶⁸ The total revenue of farmed bivalves in Washington was nearly \$150 million in 2013.⁶⁹ In 2010, the state's shellfish industry generated 2,710 jobs and contributed \$184 million to the state's economy.⁷⁰ Shellfish farmers are significant private employers in rural coastal areas of Washington.⁷¹ In Pacific and Mason counties alone, the industry generates over \$27 million annually in payroll.⁷² Although the hope is that this historic industry will be able to employ adaptation measures that allow it to continue to thrive in Washington, the threat of acidification has already led one shellfish company to relocate a portion of its business from Washington to Hawaii as part of its

64. *Id.* at 14.

65. *Id.*

66. *Id.*

67. WASHINGTON SEA GRANT, SMALLISH-SCALE SHELLFISH FARMING FOR PLEASURE AND PROFIT IN WASHINGTON 2 (2002), <http://wsg.washington.edu/mas/pdfs/small-scaleoysterlr.pdf>.

68. WASHINGTON DEPARTMENT OF ECOLOGY AND NOAA FISHERIES, WASHINGTON, A SHELLFISH STATE: THE ENVIRONMENTAL AND ECONOMIC VALUE OF SHELLFISH RESOURCES IN WASHINGTON (2016).

69. *Id.* at 1.

70. *Id.*

71. Shellfish growers are the largest private employer in Pacific County and the second largest in Mason County, according to surveys from the early 2000s. WASHINGTON SHELLFISH INITIATIVE, *supra* note 3, at 1.

72. *Id.*

adaptation strategy.⁷³

Washington's recreational shellfishing activities are also economically and culturally significant.⁷⁴ Over 300,000 licenses are purchased annually to harvest shellfish, providing over \$3.3 million of revenue to the state.⁷⁵ On average 244,000 digger trips are made per season for recreational razor clam harvest on Washington's coast bringing an estimated \$22 million to coastal economies.⁷⁶ In addition, an estimated 125,000 shellfish harvesting trips are made annually to Puget Sound beaches, representing an estimated net economic value of \$5.4 million.⁷⁷

Shellfish have also played a significant role in the diets and economies of western Washington Native American tribes for thousands of years.⁷⁸ Historically, tribes harvested clams, oysters, and other shellfish for consumption, and also traded them across a large regional intertribal network.⁷⁹ Today, Washington tribes engage in commercial, ceremonial, and subsistence harvest of shellfish including Pacific oysters; native littleneck, manila, and geoduck clams; Dungeness crab; and shrimp. All are calcifiers threatened by ocean acidification.⁸⁰

In Washington's marine waters, as with the global marine ecosystem, ocean acidification is expected to significantly impact food web structures and functions, as well as individual species.⁸¹ Over thirty percent of Puget Sound's marine species

73. John Stark, *Bellingham Audience Told Glaciers, Oysters Show Climate Change Impacts*, BELLINGHAM HERALD (November 21, 2013), <http://www.bellinghamherald.com/news/article22219893.html>; Craig Welch, *Sea Change: Oysters Dying as Coast is Hit Hard*, SEATTLE TIMES (September 12, 2013), <http://apps.seattletimes.com/reports/sea-change/2013/sep/11/oysters-hit-hard/>; Craig Welch, *Willapa Bay Oyster Grower Sounds Alarm, Starts Hatchery in Hawaii*, SEATTLE TIMES (June 21, 2012), <http://www.seattletimes.com/seattle-news/willapa-bay-oyster-grower-sounds-alarm-starts-hatchery-in-hawaii/>.

74. WASHINGTON SHELLFISH INITIATIVE, *supra* note 3, at 2.

75. *Id.* at 2.

76. *Id.*

77. *Id.*

78. *Shellfish*, NW. INDIAN FISHERIES COMM'N, <http://nwifc.org/about-us/shellfish/> (last visited Feb. 22, 2016).

79. NW. INDIAN FISHERIES COMM'N, TRIBAL NATURAL RESOURCES MANAGEMENT: A REPORT FROM THE TREATY INDIAN TRIBES IN WESTERN WASHINGTON 7 (2013), <http://nwifc.org/wp-content/uploads/2008/07/NWIFC-Annual-Report-2013.pdf>.

80. *Id.* at 6.

81. BLUE RIBBON PANEL SCIENTIFIC SUMMARY, *supra* note 6, at xii.

are calcifiers including oysters, clams, scallops, mussels, abalone, crabs, geoducks, barnacles, sea urchins, sand dollars, sea stars, sea cucumbers, and some seaweeds.⁸²

III. STATE AND FEDERAL LEGAL AVENUES TO ADDRESS OCEAN ACIDIFICATION

Both the Clean Water Act⁸³ (“CWA”) and the Clean Air Act⁸⁴ (“CAA”) are available to combat the drivers of ocean acidification.⁸⁵ Under these statutes, the federal government sets thresholds for environmental protection while states are invited to enact more stringent regulations.⁸⁶ States also implement, administer, and enforce both acts, though the federal government may step in where a state is delinquent or noncompliant.⁸⁷

The CWA is the primary mechanism available to states and the federal government to regulate and control the direct deposition of pollutants into marine and fresh waters, including pollutants associated with ocean acidification—nutrients, nitrate, phosphate, and iron. In theory, the CWA gives states substantial power to control water pollution.⁸⁸ The

82. BLUE RIBBON PANEL REPORT, *supra* note 2, at 5.

83. 33 U.S.C. §§ 1251–1387 (2012) (congressional goal includes restoration and maintenance of chemical integrity of Nation’s waters).

84. 42 U.S.C. § 7401 (2012) (congressional purpose includes protection and enhancement of Nation’s air resources to promote public health and welfare).

85. Outside of the CWA and the CAA, commentators have also identified creative paths to reducing greenhouse gas emissions and the discharge of pollutants causing ocean acidification at both the state and federal levels. For an excellent discussion of options available to states to combat ocean acidification, see Kelly & Caldwell, *supra* note 5. For a discussion of ways in which the President and the Executive Branch can combat climate change without the participation of Congress, see Chris Wold, *Climate Change, Presidential Power, and Leadership: “We Can’t Wait,”* 45 CASE W. RES. J. INT’L L. 303 (2012).

86. See 33 U.S.C. § 1370; 42 U.S.C. § 7416. To a more limited extent, tribes also have authority to enforce and administer air and water pollution laws within their jurisdictions. See 33 U.S.C. § 1377; 42 U.S.C. § 7601(d). These statutes also provide avenues of engagement for concerned citizens, including citizen suits aimed at forcing state and federal agencies to meet their responsibilities under both acts. For example, the Center for Biological Diversity recently sued the Environmental Protection Agency (“EPA”), alleging that the EPA violated the CWA when it approved Washington’s and Oregon’s lists of impaired water bodies that improperly excluded waters impaired by ocean acidification. Ctr. for Biological Diversity v. EPA, No. 2:13-cv-01866-JLR (W.D. Wash. 2013). See Section V(C), *infra*.

87. See, e.g., 33 U.S.C. § 1313; 42 U.S.C. § 7410.

88. Shell Oil Co. v. Train, 585 F.2d 408, 410 (9th Cir. 1978).

CWA directs states to set water quality standards for bodies of water within their jurisdictions, which includes designating a particular use for the water body and setting water quality criteria to ensure that use goals are met.⁸⁹ Threshold water quality criteria for a subset of pollutants are set out in the Federal Guidelines; states may implement these criteria or may set more protective criteria for particular pollutants.⁹⁰ States may also set criteria for pollutants not covered in the Federal Guidelines, including atmospheric pollutants such as nitrogen oxides and sulphur oxides, which can alter the pH balance and contribute to acidification when deposited in marine waters.⁹¹

States also play a key role in ensuring compliance with water quality standards by issuing National Pollution Discharge Elimination System ("NPDES") permits to individual point sources of pollution such as wastewater treatment plants.⁹² A permitted entity must comply with federally set, technology-based effluent limitations standards.⁹³ As with water quality criteria, states may choose to set technology-based controls for point sources that are more protective than those set by the federal government. States may, for example, target large contributors of pollutants associated with ocean acidification.⁹⁴ If technology-based standards are insufficient to ensure that a water body meets water quality standards, an NPDES permit may incorporate water quality-based discharge limits.⁹⁵

Finally, if a water body is designated as impaired because it does not meet water quality standards, the CWA requires states to set Total Maximum Daily Loads ("TMDLs") for each

89. 33 U.S.C. § 1313(d)(1)(A) (2012); 40 C.F.R. §§ 131.2, 131.6 (2012).

90. 33 U.S.C. § 1314(a).

91. See Anil J. Antony, *Shotguns, Spray, and Smoke: Regulating Atmospheric Deposition of Pollutants Under the Clean Water Act*, 29 UCLA J. ENVTL. L. & POL'Y 215, 268 (2011); EPA, FREQUENTLY ASKED QUESTIONS ABOUT ATMOSPHERIC DEPOSITION: A HANDBOOK FOR WATERSHED MANAGERS 2 (2001), <http://nepis.epa.gov/Exe/ZyPDF.cgi/2000NQU1.PDF?Dockey=2000NQU1.pdf>.

92. 33 U.S.C. § 1342.

93. *Id.* § 1311(b)(1)(C).

94. Kelly & Caldwell, *supra* note 5, at 72–74. For example, Washington State has modified the federal technology standards for combined waste treatment facilities and municipal water treatment plants. WASH. ADMIN. CODE § 173-220-130(1) (2012).

95. 33 U.S.C. § 1312. See also PUD No. 1 of Jefferson Cty. v. Wash. Dep't of Ecology, 511 U.S. 700 (1994).

pollutant contributing to the impairment.⁹⁶ The responsibility for meeting TMDLs is spread between point sources of pollution regulated via the NPDES program and non-point sources of pollution.⁹⁷ The CWA leaves the states with exclusive authority to control nonpoint sources of pollution, though in practice this authority is seldom exercised.⁹⁸ Nevertheless, the control of point and nonpoint sources remains a powerful weapon in state arsenals, and one that could effectively limit pollutants such as nutrients and nitrates, which impact marine pH.

The CAA is the primary existing mechanism available to states and the federal government to combat atmospheric drivers of ocean acidification such as CO₂.⁹⁹ The CAA regulates stationary and mobile sources of air pollutants and sets regional air quality goals through the National Ambient Air Quality Standards (“NAAQS”) program.¹⁰⁰ Responsibility under the NAAQS program is divided between states and the federal government: the Environmental Protection Agency (“EPA”) establishes NAAQS for a list of “criteria pollutants,”¹⁰¹

96. 33 U.S.C. §§ 1311(b)(1)(C), 1313(d); 40 C.F.R. § 130.32(c) (2013). Note that a change in the use designation portion of a water quality standard may move the water body into “impaired” status, triggering the protective TMDL process. Kelly & Caldwell, *supra* note 5, at 80–81.

97. 40 C.F.R. § 130.2(i) (2013); *Friends of Pinto Creek v. EPA*, 504 F.3d 1007, 1014–15 (9th Cir. 2007).

98. *Friends of Pinto Creek*, 504 F.3d at 1014–15; *Pronsolino v. EPA*, 291 F.3d 1123, 1128 (9th Cir. 2002). For a good discussion of the “toothless” TMDL program and the failure of states to regulate nonpoint sources under the CWA, see Oliver A. Houck, *The Clean Water Act Returns (Again): Part I, TMDLs and the Chesapeake Bay*, 41 ENVTL. L. REP. NEWS & ANALYSIS 10208 (2011). It is worth noting that Washington’s Department of Ecology has exercised its authority to control nonpoint sources of pollution under Washington’s Water Pollution Control Act, Chapter 90.48 RCW. This authority was upheld by the Washington State Supreme Court. *Lemire v. Dep’t of Ecology*, 309 P.3d 395, 401–02, 178 Wash. 2d 227, 240–41 (2013) (en banc) (holding that the Department of Ecology acted within its authority in issuing administrative order pursuant to Water Pollution Control Act requiring livestock rancher to address conditions that resulted in substantial potential for nonpoint source pollution on his property).

99. Commentators have argued for and against regulating greenhouse gases under the Clean Air Act. *Compare, e.g.*, Jonathan Miller, *Double Absurdity: Regulating Greenhouse Gas Under the Clean Air Act*, 47 HOUS. L. REV. 1389, 1404 (2011) (against), *with, e.g.*, Scott Schang & Teresa Chan, *Federal Greenhouse Gas Control Options from an Enforcement Perspective*, 2 SAN DIEGO J. CLIMATE & ENERGY L. 88 (2010) (for).

100. 42 U.S.C. §§ 7407–11 (2012); 40 C.F.R. Part 50 (2013).

101. 42 U.S.C. § 7408. The EPA has set NAAQS for six criteria pollutants. *National*

while the authority to regulate polluters' compliance with the NAAQS is left to the states.¹⁰² In places that are designated as attainment areas under NAAQS, major emitting facilities must comply with the Prevention of Serious Deterioration provisions of the Act and employ best available control technology;¹⁰³ in nonattainment areas, new emitters must comply with the EPA's lowest achievable emissions rate technology standards.¹⁰⁴ Outside of the NAAQS program, the CAA also requires new emitters within defined source categories to meet New Source Performance Standards¹⁰⁵ and new motor vehicles to comply with defined emissions standards.¹⁰⁶

CO₂ and other greenhouse gases are not criteria pollutants and until recently were not regulated under the CAA. That changed following the landmark 2009 Supreme Court decision *Massachusetts v. Environmental Protection Agency*,¹⁰⁷ in which the Court held that greenhouse gases fell within the CAA's definition of "air pollutant" and could be regulated under the Act.¹⁰⁸ The Court opined that if the EPA made a determination that greenhouse gases caused or contributed to air pollution detrimental to human health (an "endangerment finding"), the EPA would be required to regulate their emissions.¹⁰⁹ Soon thereafter, the EPA made an endangerment finding for CO₂ and six other greenhouse gases, opening the door to regulating these gases under both mobile and stationary source provisions of the Act.¹¹⁰ The EPA followed its endangerment finding with rules limiting greenhouse gas emissions from new motor vehicles.¹¹¹ At the direction of President Obama, the EPA also

Ambient Air Quality Standards, EPA, <http://www3.epa.gov/ttn/naaqs/criteria.html> (last visited Feb. 22, 2016).

102. 42 U.S.C. § 7410 (requiring states to adopt state implementation plans).

103. *Id.* §§ 7471, 7472, 7479.

104. *Id.* §§ 7502(a)(2)(A), 7503(a).

105. *Id.* § 7411; 40 C.F.R. Part 60 (2013).

106. 42 U.S.C. § 7521.

107. *Massachusetts v. EPA*, 549 U.S. 497 (2009).

108. *Id.* at 528.

109. *Id.* at 533 (opining that if greenhouse gases caused or contributed to air pollution that was detrimental to human health or welfare, the EPA was required to regulate their emissions from new motor vehicles under 42 U.S.C. § 7521(a)(1)).

110. EPA, Endangerment and Cause or Contribute Findings from Greenhouse Gases Under Section 202(a) of the Clean Air Act, 40 C.F.R. Ch. 1 (2009).

111. *See, e.g.*, EPA & Nat'l Highway Traffic Safety Admin, Light-Duty Vehicle

promulgated new rules under CAA Section 111 to limit emissions from new and existing power plants.¹¹² Limitations on existing power plants alone are expected to cut carbon pollution from the United States' power sector by 870 million tons, or thirty-two percent below 2005 levels, by 2030.¹¹³

Outside of the CAA context, Congress also has the authority to enact legislation to control or limit greenhouse gas emissions. Though Congress has entertained numerous pieces of such legislation in recent years, none of the proposed bills passed.¹¹⁴ Where Congress has stumbled, however, state and local governments have to some extent taken up the torch, passing greenhouse gas reduction legislation under their own powers.¹¹⁵ Executive action is also driving the country towards

Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, Final Rule, 40 C.F.R. Parts 85, 86, and 600; 49 C.F.R. Parts 532, 533, 536 (2010).

112. In 2010, President Obama directed the EPA to write new rules to limit emissions from new and existing power plants under Section 111 of the CAA. Memorandum on Power Sector Carbon Pollution Standards, 78 Fed. Reg. 39,533 (June 25, 2013). The first of these rules, applicable to new power plants, was announced on September 20, 2013. News Release, EPA, EPA Proposes Carbon Pollution Standards for New Power Plants (Sept. 20, 2013), <http://yosemite.epa.gov/opa/admpress.nsf/0da9640577ceacd9f85257beb006cb2b6!OpenDocument>. A second rule (the "Clean Power Plan") limiting emissions from existing power plants was announced two years later. 80 Fed. Reg. 64,661 (August 3, 2015). *See also* News Release, EPA, Obama Administration Takes Historic Action on Climate Change/Clean Power Plan to Protect Public Health, Spur Clean Energy Investments and Strengthen U.S. Leadership (Aug. 3, 2015), <http://yosemite.epa.gov/opa/admpress.nsf/bd4379a92ceceac8525735900400c27/c5df9981993c6df785257e96004d4f14!OpenDocument>. On February 9, 2016, the Supreme Court stayed implementation of the Clean Power Plan pending judicial review. *Clean Power Plan for Existing Power Plants*, EPA, <http://www.epa.gov/cleanpowerplan/clean-power-plan-existing-power-plants> (last visited Feb. 22, 2016).

113. Obama Administration Takes Historic Action on Climate Change/Clean Power Plan, *supra* note 112.

114. For example, three prominent bills were introduced in the House and Senate in the 111th Congressional Term alone, none of which passed: The American Clean Energy and Security Act, H.R. 2454, 111th Cong. (2009); the American Power Act, S. Discussion Draft, 111th Cong. (2010); and the Carbon Limits and Energy for America's Renewal Act, S. 2877, 111th Cong. (2009). For an example of a discussion of the legislative tools available to fight climate change, see Scott Schang & Teresa Chan, *Federal Greenhouse Gas Control Options from an Enforcement Perspective*, 2 SAN DIEGO J. CLIMATE & ENERGY L. 87, 90 (2010), and Robert N. Stavins, *A Meaningful U.S. Cap-and-Trade System to Address Climate Change*, 32 HARV. ENVTL. L. REV. 293, 296 (2008).

115. On December 20, 2005, thirteen Northeast and Mid-Atlantic states entered into a Memorandum of Understanding to implement a Regional Greenhouse Gas Initiative, a market-based cap-and-trade program that sets a multi-state cap on CO₂ emissions. *See* REGIONAL GREENHOUSE GAS INITIATIVE, <http://www.rggi.org/> (last visited Feb. 22,

greenhouse gas reduction. In December 2015, the United States signed the Paris Agreement, a historic multinational agreement to limit greenhouse gas emissions under the United Nations Framework Convention on Climate Change.¹¹⁶

Finally, Washington and its cities and counties have the authority pursuant to several state laws to reduce local contributors to ocean acidification such as nitrogen, phosphate, carbon, and iron. Washington's Growth Management Act,¹¹⁷ Shoreline Management Act,¹¹⁸ State Environmental Policy Act,¹¹⁹ Water Pollution Control Act,¹²⁰ Dairy Nutrient Management Act,¹²¹ and Forest Practices Act¹²² all provide avenues for local source reduction.¹²³

IV. WASHINGTON STATE'S RESPONSE

Washington became the first state in the nation to study ocean acidification in depth with the formation of a Blue Ribbon Panel on Ocean Acidification under the 2011

2016). On the West Coast, California passed Assembly Bill 32: Global Warming Solutions Act in 2006, setting economy-wide 2020 emissions reduction targets. Cal. Health & Safety Code § 38500 (2007). For its part, Washington passed legislation limiting greenhouse gas emissions in 2008 and followed with a draft Clean Air Rule in 2016; the rule would cover 60 percent of carbon pollution in the state and would set a cap on carbon pollution. WASH. REV. CODE § 70.235 (2008); News Release, Wash. Dep't of Ecology, Ecology Releases Draft Rule to Cap Carbon Pollution (Jan. 6, 2016), <http://www.ecy.wa.gov/news/2016/002.html>. However, the draft Clean Air Rule was withdrawn on February 26, 2016 in order to allow the Department of Ecology to review the draft and make updates. News Release, Dep't of Ecology, Public Input Spurs Updates to Clean Power Plan (Feb. 26, 2016), <http://www.ecy.wa.gov/news/2016/026.html>. For an overview of state and local government climate change initiatives, see Kirsten H. Engel & Barak Y. Orbach, *Micro-Motives and State and Local Climate Change Initiatives*, 2 HARV. L. & POL'Y REV. 119 (2008).

116. Paris Protocol to the United Nations Framework Convention on Climate Change, Dec. 12, 2015.

117. WASH. REV. CODE § 36.70A (2012).

118. *Id.* § 90.58.

119. *Id.* § 43.21C.

120. *Id.* § 90.48 (2012).

121. *Id.* § 90.64.

122. *Id.* § 76.09.

123. For a detailed analysis of legal avenues available to Washington to address ocean acidification, see RYAN KELLY & JENNY GROTE STOUTENBURG, WASHINGTON STATE'S LEGAL AND POLICY OPTIONS FOR COMBATING OCEAN ACIDIFICATION IN STATE WATERS (2012), prepared at the request of the Blue Ribbon Panel to assist in its deliberations and included as Appendix 8 to the BLUE RIBBON PANEL REPORT, *supra* note 2.

Washington Shellfish Initiative.¹²⁴ Washington took action primarily because ocean acidification was already visibly impacting shellfish, an economically, culturally, and environmentally significant resource to the state. In doing so, it recognized that global CO₂ emissions were the largest contributor to ocean acidification, and that effectively addressing ocean acidification necessitated a global reduction in those emissions. Washington's efforts, outlined below, have focused on adaptation, remediation, research, outreach, and local source reduction. The state has also assumed a leadership role in the reduction of local CO₂ emissions.¹²⁵

A. *Washington Shellfish Initiative*

Washington State's coordinated efforts to address ocean acidification arose out of the Washington Shellfish Initiative. Launched by then Washington State Governor Christine Gregoire in late 2011, the Washington Shellfish Initiative is a cooperative effort among Washington State government, federal government, tribes, the shellfish industry, and shellfish restoration practitioners.¹²⁶ It is a regional implementation of a National Shellfish Initiative that the National Oceanic and Atmospheric Administration ("NOAA") released in June 2011 concurrent with its National Aquaculture Policy.¹²⁷ Washington was the first state in the country to respond to the National Shellfish Initiative with a regionally focused effort.¹²⁸

124. WASH. STATE DEP'T OF ECOLOGY, PUB. NO. 13-01-002, FOCUS ON: OCEAN ACIDIFICATION IN WASHINGTON'S WATERS (2013) [hereinafter FOCUS ON OCEAN ACIDIFICATION].

125. *See supra* note 115.

126. Press Release, Office of the Governor, Governor Gregoire Announces New Initiative to Create Jobs, Restore Puget Sound: Washington Shellfish Initiative Promotes Clean Water and Creation of Jobs in State's Aquaculture Industry (Dec. 9, 2011), http://www.ecy.wa.gov/news/2011/gov_20111209.html [hereinafter Shellfish Initiative Press Release].

127. The purpose of NOAA's Aquaculture Policy is to enable the development of sustainable marine aquaculture within the context of NOAA's multiple stewardship missions and broader social and economic goals. Concurrent with its Aquaculture Policy, NOAA launched a National Shellfish Initiative to increase domestic populations of bivalve shellfish through commercial production and conservation activities.

128. NOAA FISHERIES, IMPLEMENTATION OF THE NATIONAL SHELLFISH INITIATIVE: CURRENT ACCOMPLISHMENTS AND KEY ACTIONS FOR FY'13 (2013), http://www.nmfs.noaa.gov/aquaculture/docs/policy/shellfish_init_accomp_04_13.pdf. To date, NOAA has now partnered with five states (Washington, Maryland, Louisiana, Alabama, and

The Washington Shellfish Initiative's goals are to restore and expand Washington's commercial, tribal, and native shellfish resources, and create green and family wage jobs in Washington State.¹²⁹ The Washington Shellfish Initiative recognizes that "shellfish aquaculture and commercial and tribal harvest of wild shellfish resources are water-dependent uses that rely on excellent water quality" and that shellfish can be "part of the solution to restore and protect endangered waters," and renews the state's shellfish protection, restoration and enhancement efforts in order to increase recreation and clean water jobs, and to create a healthier Puget Sound and coastal marine waters.¹³⁰

The Washington Shellfish Initiative creates public/private partnerships for shellfish aquaculture through several objectives: focus on furthering shellfish aquaculture research and streamlining aquaculture permitting; promote native shellfish restoration and recreational shellfish harvest; and take specific actions to ensure clean water to protect and enhance shellfish beds.¹³¹ One such action was the convening of a Blue Ribbon Panel on Ocean Acidification, announced as part of the Washington Shellfish Initiative and formally convened in February 2012.¹³²

B. *Blue Ribbon Panel on Ocean Acidification*

Governor Gregoire convened the Blue Ribbon Panel because of ocean acidification's threat to shellfish, which in turn posed a threat to Washington's economy, culture, and environment.¹³³ Shellfish provide to the state "thousands of jobs, literally hundreds of millions of dollars in commercial and recreational benefits, and . . . a deep cultural heritage."¹³⁴

The Blue Ribbon Panel was charged with developing "clear,

California) to expand opportunities for shellfish farming and restoration under the National Shellfish Initiative. *Id.*

129. *Id.*

130. WASHINGTON SHELLFISH INITIATIVE, *supra* note 3, at 1.

131. *See generally id.*

132. BLUE RIBBON PANEL REPORT, *supra* note 2, at xvi.

133. *Governor's Blue Ribbon Panel on Ocean Acidification: Remarks of Keith Phillips* (TVW television broadcast March 30, 2012), http://tvw.org/index.php?option=com_tvwpayer&eventID=2012030125A.

134. *Id.*

actionable recommendations on understanding, monitoring, adapting and mitigating ocean acidification in Puget Sound and Washington waters.”¹³⁵ Governor Gregoire outlined four key science and policy objectives for the Blue Ribbon Panel:

- (1) Review and summarize the current state of scientific knowledge of ocean acidification pertinent to Washington State.¹³⁶ (The Blue Ribbon Panel was specifically directed to include existing scientific knowledge of the anticipated consequences of ocean acidification on shellfish and other marine species.)¹³⁷
- (2) Identify additional research and monitoring needed in Washington to increase scientific understanding and facilitate connections between science and management actions.¹³⁸
- (3) Develop recommended state actions to respond to ocean acidification, with a focus on using existing laws, regulations, policies, programs, and activities. (These actions were to include ways to reduce ocean acidification’s harmful effects on Washington’s shellfish industry and other marine resources.)¹³⁹
- (4) Identify opportunities to improve and expand coordination among levels of government, non-profit organizations, and private businesses, and enhance public awareness and understanding of ocean acidification and how to address it.¹⁴⁰

The Blue Ribbon Panel’s two co-chairs and twenty-six members were comprised of state, federal, local, and tribal government representatives, scientists, nonprofits, public opinion leaders, shellfish industry, and other private industry representatives, and restoration representatives.¹⁴¹ The Panel

135. WASHINGTON SHELLFISH INITIATIVE, *supra* note 3, at 5.

136. WASHINGTON SHELLFISH INITIATIVE: OCEAN ACIDIFICATION BLUE RIBBON PANEL CHARTER (2012) [hereinafter BLUE RIBBON PANEL CHARTER]. This review was intended to build on the work presented at the 2011 Washington Sea Grant Ocean Acidification Symposium. *See id.*

137. *See id.*

138. *See id.*

139. *See id.*

140. *See id.*

141. BLUE RIBBON PANEL REPORT, *supra* note 2, at iii. The Blue Ribbon Panel was co-chaired by William D. Ruckelshaus, Madrona Venture Group, and Jay J. Manning, Cascadia Law Group. *Id.* The Washington Department of Ecology and Washington Sea Grant provided administrative management and support. *See* BLUE RIBBON PANEL

met seven times over the course of 2012.¹⁴²

The Blue Ribbon Panel presented its findings and recommendations in a report to Governor Gregoire in November 2012. The Panel recommended a list of forty-two actions categorized into six “Action Areas”: (1) reduce emissions of carbon dioxide; (2) reduce local land-based contributions to ocean acidification; (3) increase our ability to adapt to and remediate the impacts of ocean acidification; (4) invest in Washington’s ability to monitor and investigate the causes and effects of ocean acidification; (5) inform, educate and engage stakeholders, the public, and decision makers in addressing ocean acidification; and (6) maintain a sustainable and coordinated focus on ocean acidification.¹⁴³

In addition to the forty-two recommended actions, the Panel’s scientific advisors prepared a technical summary of ocean acidification that includes a literature review and summary of research and monitoring capabilities relevant to Washington State, identifies gaps in research and capacity, and sets forth recommended actions on the scientific front.¹⁴⁴ The report also provides a technical analysis of region-specific ocean acidification issues in three different areas of Washington: Washington’s Outer Coast,¹⁴⁵ Puget Sound and the Strait of Juan de Fuca,¹⁴⁶ and the Columbia River Estuary and other Washington shallow estuaries.¹⁴⁷ The report’s overarching recommendation was to “[c]reate an ocean acidification science coordination team to promote scientific collaboration across agencies and organizations and connect

CHARTER, *supra* note 136. Funding for the Blue Ribbon Panel was provided by NOAA, Rockefeller Brothers Funds, the Stanford University Center for Ocean Solutions, Sustainable Fisheries Partnership, the Bullitt Foundation, Ocean Conservancy, the EPA, the University of Washington Climate Impacts Group, the University of Washington College of the Environment, the Washington Department of Ecology, the Washington Department of Natural Resources, and Washington Sea Grant. BLUE RIBBON PANEL REPORT, *supra* note 2, at iv. For a summary of Blue Ribbon Panel meetings, see *2012 Panel Members and Meetings*, WASH. STATE DEPT’ OF ECOLOGY, <http://www.ecy.wa.gov/water/marine/oa/panel.html> (last visited Feb. 22, 2016).

142. BLUE RIBBON PANEL REPORT, *supra* note 2, at iii.

143. *Id.* at 9.

144. BLUE RIBBON PANEL SCIENTIFIC SUMMARY, *supra* note 6, at 101–02.

145. *Id.* at 17–26.

146. *Id.* at 27–44.

147. *Id.* at 45–56.

ocean acidification science to adaptation and policy needs.”¹⁴⁸

Two key reports that informed the Blue Ribbon Panel’s deliberations were included as appendices to its final report. The first, *Washington State’s Legal and Policy Options for Combating Ocean Acidification in State Waters*,¹⁴⁹ was drafted to provide Blue Ribbon Panel members with information about the legal and policy tools available to Washington State to address ocean acidification.¹⁵⁰ The report sets forth a toolbox of existing and potential options for the state, focusing on existing policy tools, but, at the direction of the Blue Ribbon Panel, does not make any specific recommendations.¹⁵¹ Options are categorized by type of input—terrestrial, governed by land use laws; atmospheric, governed by air quality laws; and marine and aquatic, governed by water quality laws.¹⁵² The report also examines the option of voluntary incentive programs as well as civil and criminal nuisance laws.¹⁵³

The second report, *Sweetening the Waters: The Feasibility and Efficacy of Strategies to Protect Washington’s Marine Resources from Ocean Acidification*,¹⁵⁴ analyzes the feasibility, efficacy, benefits, and other consequences of a variety of strategies for addressing ocean acidification.¹⁵⁵ The report looks at options for adaptation (with a focus on shellfish production systems), mitigation (reduction of anthropogenic inputs), and remediation (local and regional scale measures to restore healthy ocean chemistry).¹⁵⁶

148. *Id.* at 102.

149. KELLY & STOUTENBURG, *supra* note 123. The Center for Ocean Solutions has also published a similar report for California. RYAN P. KELLY & MARGARET R. CALDWELL, WHY OCEAN ACIDIFICATION MATTERS TO CALIFORNIA, AND WHAT CALIFORNIA CAN DO ABOUT IT (2012), <https://woods.stanford.edu/sites/default/files/files/OceanAcidification.pdf>.

150. BLUE RIBBON PANEL REPORT, *supra* note 2, at 51.

151. KELLY & STOUTENBURG, *supra* note 123, at 3.

152. *Id.* at 8.

153. *Id.*

154. ERIC SCIGLIANO, SWEETENING THE WATERS: THE FEASIBILITY AND EFFICACY OF STRATEGIES TO PROTECT WASHINGTON’S MARINE RESOURCES FROM OCEAN ACIDIFICATION 7 (Eric Swenson ed., 2012).

155. *Id.*

156. *Id.* at 5, 7.

C. *The Panel's Recommendations: Key Early Actions*

Recognizing the urgent need for source reduction of CO₂ emissions on a global scale, as well as Washington State's limitations in achieving such reduction, the Blue Ribbon Panel recommended that the state provide leadership in regional, national, and international forums to advocate for such reductions. The Panel also recommended taking local mitigation, adaptation, and remediation actions to "buy time" until a global reduction in emissions is achieved.¹⁵⁷

Washington's shellfish industry and native ecosystems cannot rely on emissions reductions alone, however. Our marine waters are continuing to acidify, and reducing carbon dioxide emissions takes time. To rely solely on those reductions would result in significant—and in some cases irreversible—economic, cultural, and environmental impacts.¹⁵⁸

Out of its forty-two recommended actions, the Blue Ribbon Panel identified eighteen "key early actions" ("KEAs"), based on the level of urgency and relative importance.¹⁵⁹ Implementation of these KEAs is "necessary to ensure the continued viability of native and commercial shellfish species [in Washington] and to make real progress against the threat of ocean acidification to [Washington's] marine resources, [Washington's] economy, and jobs that depend on these resources."¹⁶⁰ These eighteen KEAs are set forth below, organized by six action areas in the same manner they are categorized by the Blue Ribbon Panel.¹⁶¹

Action Area 1: Reduce emissions of carbon dioxide. CO₂ emissions are universally recognized as the largest anthropogenic contributor to ocean acidification.¹⁶² The Panel recommended that

157. BLUE RIBBON PANEL REPORT, *supra* note 2, at xvii.

158. *Id.*

159. *Id.* at xx–xxi, Table S-1.

160. WASH. STATE DEP'T OF ECOLOGY, OCEAN ACIDIFICATION IN WASHINGTON STATE: FROM KNOWLEDGE TO ACTION, GOVERNOR'S PROPOSED 2013-15 BUDGET, PUB. NO. 12-01-018 (2012), <https://fortress.wa.gov/ecy/publications/publications/1201018.pdf> [hereinafter WASH. OCEAN ACIDIFICATION BUDGET].

161. This article discusses only the eighteen KEAs. For a comprehensive list and detailed discussion of the Blue Ribbon Panel's forty-two recommended actions, see RIBBON PANEL REPORT, *supra* note 2, at 228–91 app. 1.

162. *Id.* at 35.

Washington continue ongoing efforts to reduce emissions at the state level; work with federal and regional partners on emissions reduction; and raise awareness nationally and internationally about the sources of ocean acidification such as CO₂, as well as its consequences.¹⁶³

- **KEA 1: Work with international, national, and regional partners to advocate for a comprehensive strategy to reduce carbon dioxide emissions.** Form partnerships to protect marine waters from the threat of acidification, such as agreements to cooperate in scientific initiatives and agreements on pollution reduction.¹⁶⁴ Share knowledge, data, scientific expertise, and potential policy initiatives, and engage in joint outreach to build public awareness.¹⁶⁵

- **KEA 2: Enlist key leaders and policymakers to act as ambassadors advocating for carbon dioxide emissions reductions and protection of Washington's marine resources from acidification.** Panel members, elected state officials and other leaders can all serve as ambassadors.¹⁶⁶ Develop communications materials and periodically brief ambassadors to ensure that they are conveying up to date information.¹⁶⁷

Action Area 2: Reduce local land-based contributions to ocean acidification. Nutrients from point and nonpoint sources (such as discharges from municipal and industrial wastewater treatment facilities, large stormwater outfalls, runoff from on-site septic systems, farms, and grazing lands) and organic carbon from living or decaying organic matter release CO₂ into marine waters, lowering pH and contributing to ocean acidification.¹⁶⁸ While the Blue Ribbon Panel recognized that these inputs of nutrients and organic carbon into Washington's waters contributed to ocean acidification, it was unable to ascertain the extent of that contribution.¹⁶⁹ The Panel's recommendations

163. *Id.* at 36.

164. *Id.* at 37.

165. *Id.*

166. *Id.*

167. RIBBON PANEL REPORT, *supra* note 2, at 39.

168. *Id.* at 43.

169. *Id.* at 44.

therefore focused on determining the relative influence of local sources on ocean acidification, rather than actually reducing that influence.¹⁷⁰ The Panel also recommended strengthening and enhancing existing nutrient and organic carbon reduction programs.¹⁷¹ The Panel's report does include two recommended actions to impose stricter controls of nutrients and organic carbon, but does not identify any of these as KEAs, stating that they "should be implemented only if research finds that more substantial reductions . . . are necessary to address ocean acidification."¹⁷²

- **KEA 3: Implement effective nutrient and organic carbon reduction programs in locations where these pollutants are causing or contributing to multiple water quality problems.** Direct increased resources and political support to strengthen two existing nutrient reduction programs: a stakeholder group in Samish Bay working to reduce pollutant sources that caused a downgrade of commercial shellfish beds in 2011, and a nitrogen removal effort by the LOTT (Lacey, Olympia, Tumwater, and Thurston County) sewage treatment plant designed to reduce nutrient loading into Budd Inlet in South Puget Sound.¹⁷³ Implement programs in other areas where nutrient loading is determined to be contributing to ocean acidification, through implementation of best management practices, improved technologies, and innovative approaches such as nutrient trading.¹⁷⁴ Initiate a stakeholder process to evaluate and, if deemed appropriate, design a nutrient trading program for Washington State.¹⁷⁵

- **KEA 4: Support and reinforce current planning efforts and programs that address the impacts of nutrients and organic carbon.** Utilize existing regulatory and voluntary programs such as the Growth Management Act, the Shoreline Management Act, Washington State Voluntary Stewardship Program, and the Puget Sound Partnership Action Agenda to reduce nutrients from

170. *Id.*

171. *Id.* at 44–45.

172. *Id.* at 45.

173. RIBBON PANEL REPORT, *supra* note 2, at 46–47.

174. *Id.* at 47, 47–48.

175. *Id.* at 47–48.

nonpoint sources, conserve forest and agricultural land uses to remove nutrients and sequester carbon, and take other measures to manage and reduce nutrients and organic carbon.¹⁷⁶

Action Area 3: Increase our ability to adapt to and remediate the impacts of ocean acidification. Both adaptation and remediation actions will be necessary to reduce ocean acidification's impacts on native and cultivated shellfish in Washington State.¹⁷⁷ The Panel recommended that the science coordination team establish a formal process for soliciting, evaluating, and recommending adaptation and remediation measures.¹⁷⁸

- **KEA 5: Develop vegetation-based systems of remediation for use in upland habitats and in shellfish areas.** Develop phytoremediation techniques to change the chemistry of seawater, either using vegetation to remove nutrients before they enter marine waters or using vegetation in shellfish beds to absorb CO₂ from the water column.¹⁷⁹ Further develop phytoremediation techniques through experiments, field trials, and monitoring to better understand their mitigation potential.¹⁸⁰

- **KEA 6: Ensure continued water quality monitoring at the six existing shellfish hatcheries and rearing areas to enable real-time management of hatcheries under changing pH conditions.** Secure funding to maintain and improve current monitoring of pH, pCO₂, salinity, temperature, and dissolved oxygen at intake lines at two shellfish hatcheries in Washington and a third shellfish hatchery in Oregon, and three sites in Willapa Bay on Washington's Coast.¹⁸¹ As a result of this monitoring, hatcheries are able to conduct operations when CO₂ levels are lower and pH levels are higher, helping to ensure successful operations.¹⁸² This monitoring also helps inform

176. *Id.* at 48.

177. *Id.* at 55.

178. BLUE RIBBON PANEL SCIENTIFIC SUMMARY, *supra* note 6, at 102.

179. RIBBON PANEL REPORT, *supra* note 2, at 56.

180. *Id.*

181. *Id.* at 58.

182. *Id.*

scientific understanding of ocean acidification and its impacts.¹⁸³

- **KEA 7: Investigate and develop commercial-scale water treatment methods or hatchery designs to protect larvae from corrosive seawater.** Overcome “significant engineering, design, and research hurdles” and develop (i) a means of changing marine water chemistry as it enters the hatchery in a manner that reduces its harmful effects, and (ii) close-loop hatchery systems.¹⁸⁴

- **KEA 8: Identify, protect, and manage refuges for organisms vulnerable to ocean acidification and other stressors.** Locate such refuges in areas that currently, or have the potential to, protect vulnerable species such as shellfish from ocean acidification.¹⁸⁵ Preserve them so they can be utilized to address future needs, and use them to test shellfish adaptation and remediation methods.¹⁸⁶

Action Area 4: Invest in Washington’s ability to monitor and investigate the causes and effects of ocean acidification. The Blue Ribbon Panel concluded that significant research is needed to understand the sources and impacts of ocean acidification before decisions can be made about where to expend limited resources.¹⁸⁷ The Panel called for research in four key areas: (1) understand the status of and trends in ocean acidification in Washington’s marine waters; (2) quantify the relative contribution of different [global and local] acidifying factors to ocean acidification in Washington’s marine waters; (3) understand the biological responses of local species to ocean acidification and associated stressors; and (4) develop capabilities to identify real-time corrosive seawater conditions, as well as short-term forecasts and long-term predictions of global and local acidification effects.¹⁸⁸

183. *Id.*

184. *Id.* at 60.

185. RIBBON PANEL REPORT, *supra* note 2, at 62.

186. *Id.*

187. *Id.* at 67.

188. *Id.* at 67–68.

• **KEA 9: Establish an expanded and sustained ocean acidification monitoring network to measure trends in local acidification conditions and related biological responses.** Expand the state's existing monitoring sites to form a sustained monitoring network in a manner that will allow scientists to "discern trends across space and over time" and "evaluate the relationships between changing chemical conditions and biological responses" ¹⁸⁹

• **KEA 10: Quantify key natural and human-influenced processes that contribute to acidification based on estimates of sources, sinks, and transfer rates for carbon and nitrogen.** Develop a budget that shows the degree to which various sources of carbon and nitrogen contribute to regional ocean acidification, and what role these sources can be anticipated to play in the future. ¹⁹⁰

• **KEA 11: Determine the associations between water and sediment chemistry and shellfish production in hatcheries and in the natural environment.** Conduct research to better understand how water and sediment chemistry affect shellfish growth and survival to allow improved management and cultivation of shellfish as acidification increases and enable farmers to change cultivation practice or location; identify particularly adaptable stocks or strains; and enable or increase survival. ¹⁹¹

• **KEA 12: Conduct laboratory studies to assess the direct effects of ocean acidification, alone and in combination with other stressors, on local species and ecosystems.** Prioritize studies of "species of ecological, economic, or cultural significance, species of concern, and species that can influence human health and well-being" to inform management and adaptation actions. ¹⁹²

• **KEA 13: Establish the ability to make short-term forecasts of corrosive conditions for application to shellfish hatcheries, growing areas, and other areas of concern.** The

189. *Id.* at 69. The Panel also provided additional recommendations for data collection, data quality provisions and training, data preservation, and public access.

190. *Id.* at 72.

191. RIBBON PANEL REPORT, *supra* note 2, at 74.

192. *Id.* at 75.

chemistry of marine waters that hatcheries utilize varies seasonally as well as with the tidal cycle and the time of day.¹⁹³ If shellfish farmers are able to forecast when conditions (for example, pH levels) will be more favorable to cultivation activities, they can plan for operations to occur during these times.¹⁹⁴ Farmers could use real-time monitoring and modeling to forecast when conditions will be particularly favorable and unfavorable, and then provide online access to this information so that it can be accessed and tracked by shellfish farmers.¹⁹⁵

Action Area 5: Inform, educate, and engage stakeholders, the public, and decision makers in responding to ocean acidification. Although the global and regional implications of this issue are significant, at the time the Panel was deliberating, public awareness of ocean acidification was very low.¹⁹⁶ Polling conducted in 2012 resulted in a US composite score of 14 out of 100 when participants were asked if they had heard of the issue of ocean acidification.¹⁹⁷ This number dropped to 10 out of 100 when participants were asked if they were “familiar with” or “informed about” ocean acidification.¹⁹⁸ Similar polling put these numbers even lower, with only seven percent of Americans having even heard of the issue.¹⁹⁹ When prompted with a brief explanation of ocean acidification, there was a dramatic increase in levels of concern about the issue among polling participants.²⁰⁰ This research suggests that increased public awareness

193. Press Release 12-070, National Science Foundation, Ocean Acidification Linked with Larval Oyster Failure in Hatcheries, (April 11, 2012), http://www.nsf.gov/news/news_summ.jsp?cntn_id=123822.

194. BLUE RIBBON PANEL REPORT, *supra* note 2, at 76 (Action 7.4.1.).

195. *Id.*

196. THE OCEAN PROJECT, AMERICA AND THE OCEAN: OCEAN ACIDIFICATION, SUMMER 2012 SPECIAL REPORT: PUBLIC AWARENESS OF OCEAN ACIDIFICATION (2012), http://theoceanproject.org/wp-content/uploads/2012/09/Special_Report_Summer_2012_Public_Awareness_of_Ocean_Acidification.pdf [hereinafter THE OCEAN PROJECT, AMERICA AND THE OCEAN].

197. Based on a sample of 1,817 responses from adults in the United States to an online survey between March and April 2012. Respondents were screened, certified, and paid. The overall confidence level is 99 percent. *Id.*

198. *Id.*

199. BLUE RIBBON PANEL REPORT, *supra* note 2, at 81.

200. THE OCEAN PROJECT, AMERICA AND THE OCEAN, *supra* note 196.

is a critical component of addressing the issue. The Panel recommended educating the general public as well as elected officials, resource managers, business and industry leaders, and youth.²⁰¹ The Panel further identified four key messages that should be conveyed regarding ocean acidification: (i) that ocean acidification is affecting jobs and resources in Washington; (ii) the importance of oceans to human health and well-being and coastal economies; (iii) the pace at which Washington's marine waters are acidifying and the potential impacts on marine and human life in Washington; and (iv) what Washingtonians can do about the issue, and the importance of early action.²⁰²

• **KEA 14: Identify key findings for use by the Governor, Panel members, and others who will act as ambassadors on ocean acidification.**

Develop communication materials that draw the connections between human activity and ocean acidification; explain the significance of natural resources, especially shellfish, to the economy and the environment; and share examples of Washingtonians impacted by acidification.²⁰³

• **KEA 15: Increase understanding of ocean acidification among key stakeholders, target audiences, and local communities to help implement the Panel's recommendations.**

Conduct a public opinion survey and engage key stakeholders to inform the preparation of education and outreach "toolkits" related to ocean acidification. Toolkits should include specific actions that members of the public can take to address ocean acidification, and provide examples of actions others are taking as well as resources at risk from ocean acidification.²⁰⁴

• **KEA 16: Provide a forum for agricultural, business, and other stakeholders to engage with coastal resource users and managers in developing and implementing solutions.** The Panel identified a need for these stakeholders to reduce nutrient inputs into the marine system in order to maintain shellfish production and address

201. BLUE RIBBON PANEL REPORT, *supra* note 2, at 81.

202. *Id.*

203. *Id.* at 81–82.

204. *Id.* at 82.

ocean acidification.²⁰⁵

Action Area 6: Maintain a sustainable and coordinated focus on ocean acidification at all levels of government. The report recognized the need for sustained leadership in order to ensure implementation of the Panel's recommendations.²⁰⁶

- **KEA 17: Charge, by gubernatorial action, a person in the Governor's Office or an existing or new organization to coordinate implementation of the Panel's recommendations with other ocean and coastal actions.** Ensure that the coordinating person or entity: (i) has full support of the Governor; (ii) supports the Governor's ocean policies; (iii) has full support of and partnership with state agencies with responsibility over oceans; and (iv) is adequately resourced.²⁰⁷ Charge this person or entity with the following responsibilities: (i) advance the Panel's recommendations; (ii) seek and ensure effective expenditure of funding; (iii) lead future efforts to update recommendations; (iv) work with tribal, federal, state, and local governments, organizations, and the private sector; (v) continue to bridge science and policy needs related to ocean acidification; and (vi) build public awareness, support, and engagement on ocean issues.²⁰⁸

- **KEA 18: Create an ocean acidification science coordination team to promote scientific collaboration across agencies and organizations and connect ocean acidification science to adaptation and policy needs.** Once created, this team should focus on acidification-related research in Washington, ensure that implementation of the Panel's recommended actions are as coordinated and efficient as possible, and connect science and policy needs.²⁰⁹

205. *Id.* at 83–84.

206. *Id.* at 89 (“The state’s effectiveness in addressing the impacts of changing ocean chemistry on our marine ecosystems and coastal communities requires sustained leadership and support by the Governor and other state officials and a coordinating mechanism to facilitate implementation of the Panel’s recommendations.”).

207. BLUE RIBBON PANEL REPORT, *supra* note 2, at 89–91.

208. *Id.* at 90; *id.* app. 3 at 115–18.

209. *Id.* at 91.

V. THE REACH OF THE BLUE RIBBON PANEL

In the years since the Blue Ribbon Panel issued its report, the state, the Panel's members, and others have worked to implement the Panel's recommendations. Washington has taken further steps by following the panel's recommendations in the areas of education and outreach, research, monitoring, and adaptation, and to reduce local CO₂ emissions. Complementary individual, local, regional, national, and international efforts to address ocean acidification have also progressed. The influence of the Blue Ribbon Panel is evident in many of these actions. Other states and regions have followed Washington's lead and are building off of the Panel's work. At least partially in response to a request from the Panel, the EPA initiated an investigation into the assessment of water quality criteria relevant to ocean acidification. The Blue Ribbon Panel and its members have successfully elevated awareness of ocean acidification's risks and early signs of impacts to Washington's shellfish resource to other states, the EPA, non-governmental organizations, and the United Nations, among others. This section examines some of these efforts to address ocean acidification and the impact of the Blue Ribbon Panel and its members.

A. *State Implementation of the Blue Ribbon Panel's Recommendations*

Many of the Blue Ribbon Panel's recommendations focused on monitoring, research, education, and outreach. With regard to reducing local CO₂ emissions, the state experiences political challenges in enforcing existing laws and passing new laws to reduce emissions and other contributors to ocean acidification. However, in recent years, Washington has undertaken a suite of actions designed to reduce emissions.

As the Blue Ribbon Panel acknowledged in its report, responses to ocean acidification are hamstrung by significant information gaps. Without a better understanding of the relative significance of regional contributors, it is difficult to determine where to best allocate limited resources. Thus, efforts are primarily falling into the arenas of research, monitoring, outreach, and education, as well as the formation of advisory bodies and work groups to implement the Blue Ribbon Panel's recommendations.

1. *Governor's Executive Order 12-07 and Budget*

Concurrent with the Blue Ribbon Panel's issuance of its recommendations, Governor Gregoire issued an Executive Order entitled, "Washington's Response to Ocean Acidification."²¹⁰ The Executive Order recognizes that Washington's waters are particularly vulnerable to acidification and that the increasing acidification of these waters poses "serious and immediate threats" to the shellfish industry and resource as well as important implications for Washington's tribal communities and fishermen and the broader marine ecosystem.²¹¹

The Order charges the Director of Washington's Department of Ecology ("Department of Ecology") with nine specific tasks:

1. Coordinate implementation of the Blue Ribbon Panel's recommendations;
2. Work with the University of Washington and state agencies to establish a mechanism that ensures coordination between scientists and decision makers that will enhance the state's ability to respond to ocean acidification;
3. Develop an agreement among state and federal agencies to support data sharing, collaboration, and leveraging and prioritizing of funds;
4. Conduct a technical analysis of local sources of contributors to ocean acidification in partnership with the University of Washington;
5. Reduce nutrients and organic carbon where those pollutants are causing or contributing to marine water quality problems;
6. Formally request that the EPA begin the assessment of water quality criteria relevant to ocean acidification;
7. Review unimplemented actions recommended by the Climate Action Team and identified in the State Energy Strategy and propose implementation of additional actions to reduce atmospheric carbon dioxide where appropriate;

²¹⁰ Exec. Order No. 12-07, Washington's Response to Ocean Acidification (Nov. 27, 2012).

²¹¹ *Id.*

8. Increase policymakers, interested organizations, and the public's understanding of ocean acidification and its consequences;
9. Work with stakeholders to develop and implement local solutions; and
10. Provide a progress report on the Order's implementation to the Governor by December 31, 2013.²¹²

The Order also directs the Governor's Office and cabinet agencies to advocate for reductions in CO₂ emissions at global, national, and regional levels and orders the Puget Sound Partnership²¹³ to incorporate the Blue Ribbon Panel's scientific findings, strategies, and actions into existing documents, programs, and plans.²¹⁴

Both Governor Gregoire's and Governor Jay Inslee's proposed budgets for the 2013–2015 biennium included \$3.31 million to begin implementation of the Blue Ribbon Panel's KEAs.²¹⁵ \$1.82 million of these funds was directed to the University of Washington for a new ocean acidification impacts

212. *Id.*

213. The Puget Sound Partnership, created in 2007 by the Washington State legislature, is a community effort of public and private stakeholders to restore and protect Puget Sound. PUGET SOUND PARTNERSHIP, <http://www.psp.wa.gov/puget-sound-partnership.php> (last visited Feb. 22, 2016); *Puget Sound*, EPA, <http://www.epa.gov/pugetsound/partnerships/> (last visited Feb. 22, 2016).

214. Exec. Order No. 12-07, *supra* note 210. The Governor's order to take regional steps to reduce CO₂ emissions built on existing strategies. From 2005 to 2012, Washington State took the following steps toward this goal: (1) adopted clean cars and alternative fuel standards, (2) established a standard for renewable energy in Washington, (3) adopted changes in the energy code to achieve a 70 percent reduction in building energy by 2030 compared to 2006, (4) invested in green building and energy efficiency projects for public buildings and low-income properties (5) expanded its fleet of hybrid, all-electric and alternative-fuel vehicles, and (6) adopted legislation to end the burning of coal for power generation at the TransAlta power plant, which will lead to large reductions in CO₂ and other harmful gases. FOCUS ON OCEAN ACIDIFICATION *supra* note 124. Governor Inslee has taken additional efforts toward local emissions reduction since his election into office in 2012. *See generally supra* note 115.

215. WASH. OCEAN ACIDIFICATION BUDGET, *supra* note 160; WASH. OFFICE OF FIN. MGMT., WORKING WASHINGTON BUDGET PRIORITIES 2013–15: CLIMATE, ENERGY AND NATURAL RES. at 17–19 (2013), http://www.ofm.wa.gov/budget13inslee/climate_energy_naturalresources.pdf (“Implement the priority recommendations of the blue-ribbon Ocean Acidification Panel to monitor and reduce impacts of acidic water on the state's shellfish industry and native shellfish. (\$3.3 million total: \$2.0 million State Toxics Control Account; \$820,000 Aquatic Lands Enhancement Account; \$510,000 Resource Management Cost Account”).

and adaptation center.²¹⁶ An additional \$1 million was proposed for the Department of Ecology and \$510,000 to the Department of Natural Resources for the implementation of additional specific KEAs.²¹⁷

The final 2013–15 Operating Budget included \$1.82 million for a Center for Ocean Acidification at the University of Washington, but did not include the requested \$1.51 million for the Departments of Ecology and Natural Resources.²¹⁸ In addition, the University of Washington received only \$1.55 million in funds for the center and for “ocean acidification monitoring, forecasting and research” in the state’s 2015–17 budget.²¹⁹

2. *Washington Ocean Acidification Center*

Consistent with the Panel’s recommendations, the Washington Ocean Acidification Center (“WOAC”) was modeled after the University of Washington’s Climate Impacts Group (“CIG”).²²⁰ WOAC was created and funded to implement the recommendations of the Blue Ribbon Panel.²²¹ The creation of WOAC itself is an implementation of KEA 18 (“Create an ocean acidification science coordination team to promote scientific collaboration across agencies and organizations and

216. WASH. OCEAN ACIDIFICATION BUDGET, *supra* note 160

217. *Id.* at 3. The additional KEAs were: “for the Department of Ecology, Implement effective nutrient and organic carbon reduction programs in locations where these pollutants are causing or contributing to multiple water quality problems. (Action 5.1.1); Quantify key natural and human-influenced processes that contribute to acidification based on estimates of sources, sinks, and transfer rates for carbon and nitrogen. (Action 7.2.1); Increase understanding of ocean acidification among key stakeholders, target audiences, and local communities to help implement the Panel’s recommendations. (Action 8.1.2). For the Department of Natural Resources: Provide a forum for agricultural, business, and other stakeholders to engage with coastal resource users and managers in developing and implementing solutions. (Action 8.1.4); Develop vegetation-based systems of remediation for use in upland habitats and in shellfish areas. (Action 6.1.1); Identify, protect, and manage potential refuges for organisms vulnerable to ocean acidification and other stressors. (Action 6.3.2); Determine the association between water and sediment chemistry and shellfish production in hatcheries and in the natural environment. (Action 7.3.1).” *Id.*

218. Operating Budget, June 30, 2013 Wash. Sess. Laws ch. 4 § 606(7) (2013).

219. E.S.S.B. 6052 §606(5), 64th Legislature, 3d Spec. Sess. (Wa. 2015).

220. Press Release, Univ. of Wash., Ocean Acidification Center Another Example of State Leading the Nation (Aug. 8, 2013), <http://www.washington.edu/news/2013/08/08/ocean-acidification-center-another-example-of-state-leading-the-nation/>.

221. Act effective Jun. 30, 2013, 2013 Wash. Laws ch. 4.

connect ocean acidification science to adaptation and policy needs.”).²²² In addition, WOAC was charged with implementing the following specific Blue Ribbon Panel KEAs; each KEA received a separate funding allocation:

1. Ensure continued water quality monitoring at the six existing shellfish hatcheries and rearing areas to enable real-time management of hatcheries under changing pH conditions.²²³
2. Investigate and develop commercial-scale water treatment methods or hatchery designs to protect larvae from corrosive seawater.²²⁴
3. Establish an expanded and sustained ocean acidification monitoring network to measure trends in local acidification conditions and related biological responses.²²⁵
4. Conduct laboratory studies to assess the direct causes and effects of ocean acidification, alone and in combination with other stressors, on Washington’s species and ecosystems.²²⁶
5. Establish the ability to make short-term forecasts of corrosive conditions for application to shellfish hatcheries, growing areas, and other areas of concern.²²⁷

The Center’s Co-Directors, Dr. Terrie Klinger and Dr. Jan Newton, both served on the Blue Ribbon Panel.²²⁸ Several of the KEAs that WOAC is charged with implementing are targeted toward shellfish hatcheries, ensuring that ocean acidification-related collaboration and open information exchange between researchers and shellfish hatchery operators continues to occur. WOAC coordinates closely with the Marine Resources Advisory Council, see V.A.3., on research regarding the effects and sources of ocean

222. BLUE RIBBON PANEL REPORT, *supra* note 2, at xxi (Action 9.1.2).

223. *Id.* at 58 (Action 6.2.1.).

224. *Id.* at 60 (Action 6.2.3.).

225. *Id.* at 69 (Action 7.1.1.).

226. *Id.* at 75 (Action 7.3.2.).

227. *Id.* at 76 (Action 7.4.1.).

228. Press Release, Univ. of Wash., Klinger & Newton Named as co-Directors of New Ocean Acidification Center (Aug. 15, 2013, 9:38 a.m.), <http://depts.washington.edu/smea/news/archive/klinger-newton-named-co-directors-new-ocean-acidification-center>.

acidification.²²⁹ In carrying out its charge to implement the KEAs identified above includes, among other efforts, continued water quality monitoring at shellfish hatcheries and developing a daily forecast model for Washington's marine waters, both of which facilitate adaptation; biological experiments on species including plankton, crabs, shellfish, fish, forams, Dungeness crab, geoducks, Olympia oysters, and krill; and the creation of an integrated ocean acidification monitoring network in Washington's marine waters.²³⁰

3. *Marine Resources Advisory Council (SB 5603)*

Two bills significant to climate change and ocean acidification were enacted in Washington during the 2012–2013 legislative session. The first, SB 5603, passed into law on May 21, 2013, created the Washington Marine Resources Advisory Council (“MRAC”) within the Office of the Governor to make recommendations and take actions related to ocean acidification.²³¹ MRAC's members include governmental, private, tribal, academic, and nongovernmental representatives.

It is charged with maintaining “a sustainable coordinated focus, including the involvement of and the collaboration among all levels of government” and other sectors to increase the state's ability to address ocean acidification through monitoring, research, analysis and other response efforts, including working with the University of Washington to study the sources and effects of ocean acidification, seeking public and private funding necessary for ongoing technical analysis, and delivering recommendations to the governor and appropriate house and senate committees.²³²

229. See *Ocean Acidification and Washington State*, WASH. STATE DEP'T OF ECOLOGY, <http://www.ecy.wa.gov/water/marine/oceanacidification.html> (last visited Feb. 22, 2016).

230. Terrie Klinger & Jan Newton, *Science Update*, UNIV. OF WASH. COLL. OF THE ENV'T, WASH. OCEAN ACIDIFICATION CTR. (Oct. 13, 2015), <http://www.ecy.wa.gov/water/marine/oa/20151013MRACwoacupdates.pdf>; *Washington Ocean Acidification Center*, UNIV. OF WASH. COLL. OF THE ENV'T, <https://environment.uw.edu/research/major-initiatives/ocean-acidification/washington-ocean-acidification-center/> (last visited Feb. 22, 2016).

231. Act effective July 28, 2013, 2013 Wash. Laws, ch. 318 at § 4.

232. *Id.* § 4(8)(a)–(d). MRAC's implementing legislation is scheduled to expire on June 30, 2017; legislation has been introduced in the 2016 Regular Session to extend this expiration to June 30, 2022. SB 6633, 64th Leg. (Wa. 2016).

MRAC has assumed a coordination role over implementation of the Blue Ribbon Panel's recommendations, as well as implementation of many of the tasks set forth in Executive Order 12-07.²³³ It has reviewed, evaluated, and prioritized the Panel's 42 recommendations, and developed a list of the following priority actions, which it is working to implement:

- Continue and expand monitoring efforts that directly contribute to marine industries taking action against ocean acidification conditions.
- Provide ocean acidification forecasts to inform shellfish growers and resource manager actions.
- Study how ocean acidification affects vital commercial and managed species such as salmon, rockfish, razor clams, geoduck, and fish.
- Investigate the capacity of species to genetically adapt to ocean acidification.
- Complete research on how local sources of nutrients exacerbate acidic conditions.
- Investigate various strategies to adapt to and alleviate the impacts of ocean acidification, including: (i) Developing a seaweed cultivation program; (ii) Restoring native oyster populations (iii) Supporting the creation of a shell recycling program; (iv) Establishing and managing refuges for species vulnerable to ocean acidification.
- Continue to educate and raise awareness of ocean acidification to potentially impacted industries, stakeholders, and the general public.
- Seek public and private funding to support these efforts including: (i) A 2015-17 biennium state funding request in the Governor's budget of \$1.7 million for continued ocean acidification research and coordination; (ii)

233. See *Ocean Acidification and Washington State*, WASH. STATE DEP'T OF ECOLOGY, <http://www.ecy.wa.gov/water/marine/oceanacidification.html> (last visited Feb. 22, 2016); WASH. STATE DEP'T OF ECOLOGY, STATUS BLUE RIBBON PANEL RECOMMENDATIONS (Nov. 21, 2013), <http://www.ecy.wa.gov/water/marine/oa/20131121BRPrecommendations.pdf>; WASH. STATE DEP'T OF ECOLOGY, MARINE RES. ADVISORY COUNCIL, 2015 STATUS OF BLUE RIBBON PANEL RECOMMENDATIONS (2015), <http://www.ecy.wa.gov/water/marine/oa/20150331MRACstatusBRP.pdf>; WASH. STATE DEP'T OF ECOLOGY, MARINE RES. ADVISORY COUNCIL, STATE OF OCEAN ACIDIFICATION IN WASHINGTON (2015), <http://www.ecy.wa.gov/water/marine/oa/20150331MRACstatusOA.pdf>.

Working to identify federal funding opportunities that can be used in conjunction with state funding to improve monitoring and adaptation efforts.

- Track the results of this work through the Puget Sound Partnership.²³⁴

Washington State's initial leadership efforts in addressing ocean acidification were born out of a state-led partnership effort to protect and enhance the state's shellfish resources and its continued leadership in addressing ocean acidification includes efforts specific to the Washington Shellfish Initiative's original goals.²³⁵ On January 15, 2016, Governor Inslee launched Phase II of the Washington Shellfish Initiative ("Phase II").²³⁶ A continuation of the federal, tribal, shellfish industry, and non-profit partnership that was formed under the initial Washington Shellfish Initiative in 2011,²³⁷ Phase II includes further efforts to address ocean acidification's effects on shellfish, identifying specific actions that MRAC will take over the next few years to implement the Blue Ribbon Panel's recommendations.²³⁸

4. *Greenhouse Gas Emissions Reduction (SB 5802)*

The second bill, SB 5802, was introduced at the request of Governor Inslee and addressed CO₂ emission reduction.²³⁹ As enacted, Section 1 of SB 5802 commissioned a study of climate change mitigation alternatives while Section 2 of the Bill created a bipartisan climate legislative and executive work group ("Workgroup").²⁴⁰ The Workgroup was charged with recommending a state program of actions and policies to

234. STATE OF OCEAN ACIDIFICATION IN WASHINGTON, *supra* note 233.

235. See WASHINGTON SHELLFISH INITIATIVE, *supra* note 3, at 2–6.

236. Press Release, Wash. Governor Jay Inslee, Inslee Launches Next Phase of Washington Shellfish Initiative (Jan. 15, 2016), <http://www.governor.wa.gov/news-media/gov-jay-inslee-launches-next-phase-washington-shellfish-initiative>.

237. WASHINGTON SHELLFISH INITIATIVE, *supra* note 3, at 2.

238. *Gov. Inslee's Shellfish Initiative*, GOVERNOR.WA, <http://www.governor.wa.gov/issues/issues/energy-environment/gov-inslee%E2%80%99s-shellfish-initiative> (last visited Feb. 22, 2016); GOVERNOR'S LEG. & POL'Y OFFICE, WASHINGTON SHELLFISH INITIATIVE—PHASE II WORK PLAN, 5–7 (Jan. 2016), <http://www.governor.wa.gov/sites/default/files/ShellfishWorkPlan.pdf>.

239. Engrossed Second Substitute Senate Bill 5802, Act effective April 2, 2013, 2013 Wash. Laws ch. 6, 63rd Leg.

240. *Id.*

reduce greenhouse gas emissions that, if implemented, would ensure achievement of the state's emissions targets as set forth in RCW 70.235.020.²⁴¹

As reflected in its final report to the legislature in January 2014, the Workgroup was unable to reach agreement on formal recommendations.²⁴² Governor Inslee, along with Senator Ranker and Representative Fitzgibbon, made one set of findings and conclusions and Senator Ericksen and Representative Short another.²⁴³ The recommendations championed by Governor Inslee include a cap on carbon pollution emissions along with measures to reduce dependence on coal-fired power plants and to encourage clean energy and smart building.²⁴⁴ In line with these recommendations, Governor Inslee directed the Department of Ecology to develop a regulatory cap on carbon emissions in July 2015.²⁴⁵

The recommendations proposed by Senator Ericksen and Representative Short proposed incentives for hydroelectric and nuclear energy generation and allowance for renewable energy credit banking.²⁴⁶ This second set of recommendations emphasized the high cost of implementing climate change-related policies, and the likelihood that Washington's actions would not affect the impacts of global CO₂ emissions, including ocean acidification.²⁴⁷

The Department of Ecology released its draft Clean Air Rule in January 2016.²⁴⁸ As drafted, the rule would cover 60

241. *Id.* § 2(b)(4).

242. CLIMATE LEGISLATIVE AND EXECUTIVE WORKGROUP, A REPORT TO THE LEGISLATURE ON THE WORK OF THE CLIMATE LEGISLATIVE AND EXECUTIVE WORKGROUP 4 (2014) [hereinafter CLIMATE WORKGROUP REPORT], <http://www.governor.wa.gov/sites/default/files/documents/CLEWfinalCombinedReport20140130.pdf>.

243. *Id.* at 2 (Report from Governor Inslee and Senators Ranker and Representative Fitzgibbons), 28 (Report from Senator Ericksen and Representative Short).

244. *Id.* at 13.

245. Press Release, Wash. Governor Jay Inslee, Inslee Directing Ecology to Develop Regulatory Cap on Carbon Emissions (July 28, 2015), <http://www.governor.wa.gov/news-media/inslee-directing-ecology-develop-regulatory-cap-carbon-emissions>.

246. CLIMATE WORKGROUP REPORT, *supra* note 242, at 28.

247. *Id.* at 32–33.

248. Wash. State Dep't of Ecology, Notice of Proposed Rule Making A0 #15-10 (Jan. 5, 2016), <http://www.ecy.wa.gov/laws-rules/WAC173442/p1510.pdf>; Wash. State Dep't of Ecology, Proposed Chapter 173-441 WAC, <http://www.ecy.wa.gov/laws-rules/WAC173442/p1510a.pdf>; Wash. State Dep't of Ecology, Proposed Chapter 173-442 WAC, <http://www.ecy.wa.gov/laws-rules/WAC173442/p1510b.pdf>

percent of carbon pollution in the state and would set a cap on carbon pollution.²⁴⁹ However, the Department withdrew the Rule shortly thereafter to allow for further feedback, review and revision.²⁵⁰

B. Other States' Efforts

Following Washington's lead, other states have initiated regional efforts to address ocean acidification, challenging the premise that ocean acidification can only be addressed through national and international levels. States and regions have recognized that ocean acidification poses threats to local environments and natural-resource-dependent economies and communities, and have taken action in response.

In August 2013, Oregon and California jointly convened the West Coast Ocean Acidification and Hypoxia Science Panel ("OAH Panel"),²⁵¹ which was assembled to "complement" the work of the Blue Ribbon Panel.²⁵² The OAH Panel is comprised of scientists from British Columbia, Washington, Oregon, and California in the fields of chemical and physical oceanography,

249. WASH. REV. CODE § 70.235 (2008). See News Release, Wash. Dep't of Ecology, Ecology Releases Draft Rule to Cap Carbon Pollution (Jan. 6, 2016), <http://www.ecy.wa.gov/news/2016/002.html>.

250. News Release, Dep't of Ecology, Public Input Spurs Updates to Clean Power Plan (Feb. 26, 2016), <http://www.ecy.wa.gov/news/2016/026.html>.

251. *The West Coast Ocean Acidification and Hypoxia Science Panel*, CAL. OCEAN SCI. TRUST, <http://calost.org/science-advising/?page=ocean-acidification-and-hypoxia-panel> (last visited Nov. 17, 2013) ("California and Oregon have identified ocean acidification as an issue of which the states would benefit from improved scientific understanding. More broadly, the West Coast Governors Alliance on Ocean Health recently signed an agreement citing ocean acidification as a priority ocean and coastal health issue. All this comes on the heels of the State of Washington's Blue Ribbon Panel on Ocean Acidification, which released its final report on November 27, 2012. The knowledge base established in Washington will provide a robust foundation for the work of the OAH Panel, resulting in a West Coast-wide understanding of ocean acidification and hypoxia that will inform multiple levels of government."); *West Coast Scientists Team up on Ocean Acidification Panel*, EARTHFIX (Oregon Public Broadcasting, Aug. 28, 2013), <http://www.opb.org/news/article/west-coast-scientists-team-up-on-acidification-panel/>; Press Release, OREGON.GOV, Governor Kitzhaber Announces West Coast Ocean Acidification and Hypoxia Science Panel (Aug. 28, 2013); Memorandum of Understanding Between the State of Cal. Natural Res. Agency and the State of Or. Governor's Natural Res. Office to Establish the W. Coast Ocean Acidification and Hypoxia Science Panel (Aug. 27, 2013), http://westcoastcoah.org/wp-content/uploads/2013/12/082013_MOU_OA-and-OH_CA-and-OR_executed.pdf [hereinafter Science Panel Memorandum].

252. Science Panel Memorandum, *supra* note 251.

biogeochemistry, marine biology, ecology, and physiology. Among its charges is an examination of what ocean acidification means for West Coast fisheries, natural resources, and coastal communities. The OAH Panel is expected to release a final report in early 2016 that details the state of the science, identifies additional research needs, provides technical guidance and sets forth key findings and recommendations.

Other collaborative West Coast approaches to ocean acidification include the California Current Acidification Network and the West Coast Governors Alliance on Ocean Health.²⁵³ The Pacific Coast Collaborative (“PCC”), a partnership between Alaska, British Columbia, California, and Oregon, has also made ocean conservation and climate change ongoing priorities.²⁵⁴ The PCC penned an open letter to President Obama and Canadian Prime Minister Harper in 2013 requesting continued funding for ocean acidification research and a collaborative approach for moving forward.²⁵⁵

State governments have followed suit, as has Congress. Maine and Maryland both passed legislation establishing special commissions to study the effects of ocean acidification in 2014.²⁵⁶ A bill to create a similar task force was introduced and rejected in New Hampshire in 2015 and another is currently before the Massachusetts legislature.²⁵⁷ At the federal level, several bills and resolutions aimed at spurring ocean acidification research were introduced in the 114th Congress alone.²⁵⁸

253. CAL. CURRENT ACIDIFICATION NETWORK, <http://c-can.msi.ucsb.edu/> (last visited May 4, 2016); WEST COAST GOVERNOR'S ALLIANCE ON OCEAN HEALTH, <http://www.westcoastoceans.org/> (last visited May 4, 2016).

254. *Ongoing Priorities*, PAC. COAST COLLABORATIVE, <http://www.pacificcoastcollaborative.org/priorities/Pages/OngoingPriorities.aspx> (last visited March 2, 2016).

255. Letter from Pacific Coast Collaborative to Barack Obama, President of the U.S., and Stephen Harper, Prime Minister of Can. (Dec. 12, 2013), http://www.ecy.wa.gov/water/marine/oa/20131212_PacificCoastCollaborative_letter.pdf.

256. Resolve, Establishing the Commission to Study the Effects of Coastal Ocean Acidification and Its Existing and Potential Effects on Species That Are Commercially Harvested and Grown along the Maine Coast, H.P. 1174, Leg. Doc. 1602, Resolve 2013, Ch. 110, 126th Leg. (Me. 2014); Task Force to Study the Impact of Ocean Acidification on State Waters, H.B. 118, Ch. 383, Acts of 2014 (Md. May 5, 2014).

257. H.B. 379, 2015 Sess. (N.H. 2015); H. 716, 189th Gen. Court (Ma. 2015).

258. Ocean Acidification Research Partnerships Act, H.R. 1277, 114th Cong. (2015); Ocean Acidification Innovation Act of 2015, H.R. 1967, 114th Cong. (2015); Coastal Communities Ocean Acidification Act of 2015, H.R. 2553, 114th Cong. (2015); Federal Ocean Acidification Research and Monitoring Act of 2015, H.R. 2717, 114th Cong.

C. *EPA Assessment of Water Quality Criteria Relevant to Ocean Acidification*

On December 24, 2012, Department of Ecology Director Ted Sturdevant sent a letter to the EPA requesting that the agency begin an assessment of water quality criteria relevant to ocean acidification.²⁵⁹ The request was in response to the Blue Ribbon Panel's recommended Action 5.1.3²⁶⁰ and Governor Gregoire's Executive Order 12-07.²⁶¹ EPA Acting Administrator Nancy Stoner sent a formal response stating that EPA planned to convene a technical workgroup in the near future to assess the possibility of water quality parameters to address ocean acidification.²⁶²

Shortly thereafter, EPA made a similar commitment in response to a petition submitted by the Center for Biological Diversity ("CBD").²⁶³ On April 17, 2013, CBD submitted a petition for nondiscretionary action to EPA requesting that EPA promulgate water quality criteria for ocean acidification under the CWA.²⁶⁴ On May 17, 2013, EPA responded to CBD

(2015).

259. Letter from Ted Sturdevant, Dir., Wash. State Dep't of Ecology, to Nancy Stoner, Acting Assistant Adm'r, EPA Office of Water (Dec. 24, 2012), <http://www.ecy.wa.gov/programs/wq/303d/ECYLtr-USEPAHQOceanAcidification122412.pdf>.

260. BLUE RIBBON PANEL REPORT, *supra* note 2, at 49 (Action 5.1.3) ("Assess the need for water quality criteria relevant to ocean acidification.").

261. Exec. Order No. 12-07, Washington's Response to Ocean Acidification (Nov. 27, 2012).

262. Letter from Nancy Stoner, Acting Assistant Adm'r. EPA, to Maia Bellon, Dir., Wash. State Dep't of Ecology (April 19, 2013) [hereinafter Stoner Letter].

263. CBD has a history of active engagement on ocean acidification issues. Between 2007 and 2009, CBD petitioned every coastal state to designate their coastal waters as threatened by ocean acidification. In 2007, CBD petitioned the EPA to strengthen water quality standards for ocean pH. In 2009, the CBD petitioned the National Marine Fisheries Service to list 83 species of coral as threatened or endangered. In the same year, CBD issued a notice of intent to sue the EPA for its failure to protect coastal waters by strengthening water quality standards for pH. CBD has also initiated three lawsuits against the EPA; the first, in 2009, for the EPA's failure to address ocean acidification on the coast of Washington State; the second in 2010 to protect endangered black abalone habitat; and the third in 2013 for EPA's approval of Washington's and Oregon's lists of impaired water bodies, which do not include ocean acidification-impaired marine waters. *Ctr. for Biological Diversity v. EPA*, Case No. 2:13-cv-01866 (W.D. Wash. 2013).

264. *CTR. FOR BIOLOGICAL DIVERSITY, 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 (2013), http://www.biologicaldiversity.org/campaigns/ocean_acidification/pdfs/EPA_OA_petition_2013.pdf [hereinafter CBD

by letter, agreeing to convene a technical workgroup to evaluate data and research regarding water quality and ocean acidification.²⁶⁵

CBD's April 17, 2013 petition ("Petition") was designed to move EPA to produce new water quality standards to address ocean acidification. In the Petition, CBD argued that current water quality criteria for pH in marine waters, which rely on measuring changes in pH from baseline pH levels, are insufficient to protect against ocean acidification.²⁶⁶ The Petition named seawater chemistry parameters (minimum aragonite saturation levels) and biological criteria (no measurable decline in calcification rates for target calcifiers) as appropriate indicators of ocean acidification that may be integrated into water quality criteria and that do not rely on changes in baseline pH.²⁶⁷ The Petition also argued for the adoption of biological criteria specifying that there be no measurable decline in calcification rates for target calcifiers.²⁶⁸

The Petition also requested that EPA publish information to provide guidance on ocean acidification pursuant to Section 304(a)(2) of the CWA. The Petition pointed to the Blue Ribbon Panel to demonstrate that states are waiting for federal guidance on water quality criteria relevant to ocean acidification.²⁶⁹ The Petition highlighted the steep increase in research and information on ocean acidification in the last several years, providing a wealth of information to "serve as a foundation for EPA's guidance."²⁷⁰ Specifically, CBD requested that EPA include a discussion of: "(1) the impact of carbon

PETITION]. CBD based its right to petition on the First Amendment to the U.S. Constitution and the Administrative Procedures Act, 5 U.S.C. § 553(e).

265. Letter from Nancy Stoner, Acting Assistant Adm'r, EPA, to Miyoko Sakashita, Senior Attorney & Oceans Dir., Ctr. for Biological Diversity (May 17, 2013), http://www.eenews.net/assets/2013/05/30/document_pm_02.pdf.

266. CBD PETITION, *supra* note 264, at 32. Reliance on baseline measurements is also problematic because data is often missing or unreliable. *Id.* at 32, 34. These facts, CBD argued, are supported by the "latest scientific knowledge" and derogate the EPA's sole reliance on ocean pH as a measurement of ocean acidification, triggering EPA's nondiscretionary duty to act under the CWA. *Id.* at 33, 34 ("In light of recent information demonstrating that marine pH alone is a less effective metric to evaluate the impacts of ocean acidification, EPA must promulgate criteria on alternative ocean acidification parameters.") (relying on 33 U.S.C. § 1314(a)(1)(b)-(c)).

267. CBD PETITION, *supra* note 264, at 32-33, 40.

268. *Id.* at 32.

269. *Id.* at 35.

270. *Id.* at 45.

dioxide on seawater chemistry; (2) the impacts of ocean acidification on fish, shellfish and wildlife; (3) the recommended methods for measuring ocean acidification parameters and considering data and information on ocean acidification; and (4) recommendations for developing and implementing total maximum daily loads for ocean acidification.”²⁷¹

EPA responded by letter to CBD one month after CBD submitted its petition to EPA, and committed to convening a technical workgroup to study water quality criteria relevant to ocean acidification.²⁷²

In addition to petitioning EPA to amend water quality criteria to address ocean acidification, CBD has actively engaged with coastal states in an effort to encourage inclusion of marine waters in state 303(d) lists of impaired waters.²⁷³ Between 2007 and 2009, CBD petitioned every coastal state to designate their coastal waters as threatened by ocean acidification. When EPA approved Washington’s 303(d) list, which failed to include any marine waters as impaired by ocean acidification, CBD sued EPA.²⁷⁴ After that case settled, EPA determined that inclusion of waters impaired by ocean acidification on state 303(d) lists was appropriate. However, in 2012 EPA again approved a 303(d) list from Washington that failed to list any marine waters as impaired by ocean acidification.²⁷⁵ EPA additionally approved Oregon’s 303(d) list, which similarly failed to list any marine waters as impaired.²⁷⁶ On October 16, 2013, CBD again filed suit, alleging that EPA’s approval of Washington’s and Oregon’s 303(d) lists, and its failure to identify Washington and Oregon marine waters as impaired by ocean acidification, was arbitrary, capricious and in violation of law.²⁷⁷ The lawsuit was dismissed on summary judgment in 2015, in an opinion that extensively cited the Blue Ribbon Panel’s work and

271. *Id.* at 43.

272. Stoner Letter, *supra* note 262.

273. *See* note 263, *supra*.

274. *See* Complaint for Declaratory and Injunctive Relief at 9, Ctr. for Biological Diversity v. Env’tl. Protection Agency, No. 2:13-cv-01866-JLR (W.D. Wash. filed Oct. 16, 2013).

275. *Id.* at 9–10.

276. *Id.* at 10–11.

277. *Id.*

recommendations.²⁷⁸

CBD has, however, continued undeterred in pushing lawmakers to use existing legal tools to address ocean acidification. In December 2014, CBD signed an open letter to Governor Inslee asking him to “bring the Department of Ecology along” with him in his “bold leadership” on climate change and ocean acidification.²⁷⁹ In 2015, the organization also petitioned EPA to regulate CO₂ under the Toxic Substances Control Act based in part on its ability to alter ocean chemistry.²⁸⁰

VI. WHAT OTHER STATES CAN LEARN FROM WASHINGTON’S EFFORTS

States can learn much from the Blue Ribbon Panel’s deliberations and recommendations, as well as actions Washington State has taken to ensure the implementation of those recommendations. Unquestionably, the Panel and its members have made great strides in raising public and stakeholder awareness of ocean acidification, securing additional research funding, enhancing networks and exchanges of valuable information, facilitating adaptation, and advancing local priorities. Several years out, efforts to implement the Blue Ribbon Panel’s recommendations have survived a change in administration and has persisted, and continues to gain momentum. However, Washington has also dealt with some predictable challenges other states are also likely to face in undertaking similar efforts. This Part discusses the Panel’s successes and roadblocks, and makes the case for other states that have not already done so to follow Washington’s lead in addressing ocean acidification.

278. *Ctr. For Biological Diversity v. Env’tl. Protection Agency*, 90 F. Supp. 3d 1177, 1209 (W.D. Wash. 2015) (“[T]his court will not second guess EPA’s decision to require more conclusive evidence before identifying coastal waters as acidified-impaired.”), *amending and superseding* 88 F. Supp. 3d 1231 (W.D. Wash. 2015).

279. Open Letter from Ctr. For Biological Diversity et al. to Jay Inslee, Gov. of Wash., Concerning Action on Ocean Acidification (Dec. 9, 2014), http://www.biologicaldiversity.org/campaigns/ocean_acidification/pdfs/Open_letter_to_Governor_Jay_Inslee_2014_.pdf.

280. *CTR. FOR BIOLOGICAL DIVERSITY, PETITION FOR RULEMAKING PURSUANT TO SECTION 21 OF THE TOXIC SUBSTANCES CONTROL ACT, 15 U.S.C. § 2620, CONCERNING THE REGULATION OF CARBON DIOXIDE 2* (2015), https://www.biologicaldiversity.org/campaigns/ocean_acidification/pdfs/Petition_OA_TSCA.pdf.

A. *Successes*

Washington's leadership in addressing ocean acidification has met with success in many areas. The role of public-private partnerships in the formation of the Panel and the implementation of its recommendations has greatly enhanced this success. Shellfish hatcheries were the first to observe the impacts of ocean acidification. Although they did not know ocean acidification to be the cause of shellfish larval die-offs, hatchery operators quickly collaborated with scientists, worked to secure funding, and undertook their own efforts to determine the source of the problem. Shellfish growers shared knowledge, observations, and resources with researchers, enabling them to understand more about the issue and inform their scientific process and understanding. These partnerships were further enhanced by the addition of state and federal government, non-profit, and tribal stakeholders in the Blue Ribbon Panel and MRAC.

These public-private partnerships have resulted in great strides toward identifying adaptation measures that will allow shellfish farming and restoration efforts to continue in the Pacific Northwest. Researchers have readily shared their findings with hatchery operators and designed their research so that the findings will have practical utility. State funds utilized for monitoring have built off of privately funded industry research on adaptation methods, and existing federal data networks have been leveraged to allow for efficient data sharing. Since the formation of the Blue Ribbon Panel, scientists have discovered the chemical and biological processes that cause larval mortality in hatcheries, greatly enhancing shellfish growers' ability to adapt to an increasingly acidified environment. These discoveries have not only benefitted those that work with shellfish, however; they have also furthered the scientific community's understanding of ocean acidification and its impacts. This will lead to an improved ability for communities and governments to adapt to ocean acidification.

Ultimately, having an impacted economic interest serve as the "canary in the coal mine" elevated ocean acidification to the attention of legislators, policymakers, government, researchers, and private foundations in a way that likely would not have been possible by the scientific community alone. The Blue Ribbon Panel and WOAC are prime examples of this influence. Formed under the Washington Shellfish

Initiative, the Panel was charged to examine scientific knowledge and recommend responses that include a focus on shellfish. MRAC implements specific Blue Ribbon Panel KEAs intended to enhance shellfish hatcheries' ability to adapt to ocean acidification as well as further scientific understanding of ocean acidification through monitoring and laboratory studies.

This win-win approach of multi-stakeholder collaboration is one that other states can adopt as a model for responding to ocean acidification. Coastal communities will be affected by ocean acidification in a myriad of ways. For example, Alaska's red king crab fishery is projected to be particularly affected by ocean acidification.²⁸¹ Maryland estimates that its industries that may experience some of the earliest effects of ocean acidification, including tourism and recreation dependent on healthy, functional ecosystems, translates to approximately forty-four percent of its estimated Gross Domestic Product ("GDP").²⁸² States should identify vulnerable economic interests and communities, engage them on the issue, and work collectively towards adaptation efforts that will help ensure that these industries and communities are able to continue into the future. Given Washington's success, industries and communities at risk should also consider turning to their state governments for assistance in addition to lobbying their federal representatives.

Washington's efforts have also been greatly furthered by "ambassadors" who have worked to raise awareness of ocean acidification locally, nationally, and internationally. Deliberately or not, many individual Panel members have worked to carry out the Panel's recommendations to inform, educate, and engage stakeholders, the public, and decision makers in responding to ocean acidification and reducing CO₂ emissions. For example, Panel members have given dozens of

281. William C. Long et al., *Effects of Ocean Acidification on Juvenile Red King Crab (Paralithodes camtschaticus) and Tanner Crab (Chionoecetes bairdi) Growth, Condition, Calcification, and Survival*, 8 PLOS ONE e60959 (2013); Craig Welch, *SeaChange: Lucrative Crab Industry in Danger*, SEATTLE TIMES (Sept. 12, 2013), <http://apps.seattletimes.com/reports/sea-change/2013/sep/11/alaska-crab-industry/>.

282. TASK FORCE TO STUDY THE IMPACT OF OCEAN ACIDIFICATION ON STATE WATERS REPORT TO THE GOVERNOR AND THE MARYLAND GENERAL ASSEMBLY 15 (2015), <http://msa.maryland.gov/megafile/msa/speccol/sc5300/sc5339/000113/020000/020877/unrestricted/20150253e.pdf>.

presentations at conferences, to organizations, the public, law and policy makers, and in international fora.²⁸³ As mentioned, at the time the Panel was deliberating in 2012, public awareness of ocean acidification was very low.²⁸⁴ Although data is not available to determine how the Panel and its members' outreach efforts have changed awareness of ocean acidification, it is clear that public awareness is increasing, in the Pacific Northwest and nationwide. The Panel's work has also inspired other outreach efforts. For example, *The Seattle Times* undertook the first in-depth analysis by a major news organization of ocean acidification and its consequences.²⁸⁵

Researchers, non-governmental organizations, policymakers, governments, and others can look to the Blue Ribbon Panel and its recommendations as a roadmap for addressing ocean acidification. Individuals working to secure funding for research and development efforts can now use the Panel's report to articulate the significance and implications of the issue. This has led to increased interest, awareness, and research funding. For example, the OAH Panel is using the Blue Ribbon Panel's work as a robust foundation for its efforts, which are designed to complement the work of the Panel. The Panel has also influenced efforts to address ocean acidification through existing legal and regulatory frameworks. For example, CBD's April 17, 2013, petition points to the Blue Ribbon Panel to demonstrate the need for federal guidance on water quality criteria relevant to ocean acidification. The CBD also referenced the work of the Blue Ribbon Panel in its 2013 lawsuit against the EPA for approving Washington and Oregon's lists of impaired waters, which do not include waters

283. See, e.g., *List of Panelists for the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea*, http://www.un.org/depts/los/consultative_process/ICP14_Presentations/ICP_Panellist_Table.pdf (last visited Feb. 22, 2016) (presentations by Panel members Richard A. Feely and Bill Dewey); *Scientific Forum: The Blue Planet – Nuclear Applications for a Sustainable Marine Environment 2013*, INT'L ATOMIC ENERGY AGENCY, <https://www.iaea.org/About/Policy/GC/GC57/ScientificForum/presentations.html> (presentation by Bill Dewey); Press Release, Pac. Coast Collaborative, Pacific Coast Action Plan on Climate and Energy (Oct. 28, 2013), <http://www.pacificcoastcollaborative.org/Documents/PCC%20NR%20-%20October%2028%202013.pdf> (presentation by Bill Dewey).

284. THE OCEAN PROJECT, AMERICA AND THE OCEAN, *supra* note 196.

285. Craig Welch, *SeaChange: The Pacific's Perilous Turn*, SEATTLE TIMES (Sept. 12, 2013), <http://apps.seattletimes.com/reports/sea-change/2013/sep/11/pacific-ocean-perilous-turn-overview/>.

impaired by ocean acidification.²⁸⁶ Further efforts at the state level can build off of these early efforts, using them as a guide while tailoring them to the individual needs of each states' coastal communities and industries that depend upon the natural resources threatened by ocean acidification.

Another area where Washington's efforts have met with success is in implementation of the Blue Ribbon Panel's recommendations. The formation of WOAC and MRAC have proven key to ensuring that the Panel's recommendations are implemented, by providing accountability, funding, and a structure that facilitates continued multi-stakeholder collaboration and information exchange. It is not enough for a state to investigate the sources of and risks posed by ocean acidification; states must commit to sustained investment of resources and ensure that any recommendations developed are actually implemented, and periodically re-evaluated, in order to successfully address ocean acidification. As the Blue Ribbon Panel itself recognized:

“[O]cean acidification is not a one-time problem with quick and easy solutions. It is a long-term challenge that requires a sustained effort across [multiple] fronts—global and local source reduction, adaptation and remediation, research and monitoring, and public education—and continued engagement by and with governmental and non-governmental entities, industry, and the public. Maintaining a sustainable and coordinated focus on ocean acidification is necessary for ensuring our long-term success.”²⁸⁷

B. *Challenges and Limitations*

The most significant limitation states face in addressing ocean acidification is the inability to reduce CO₂ emissions on a global scale.²⁸⁸ The Blue Ribbon Panel recognized this

286. It is notable, however, that while the reviewing court cited extensively to the Blue Ribbon Panel, it upheld the EPA's decision to approve Washington's and Oregon's decisions not to list state waters as impaired due to ocean acidification.

287. BLUE RIBBON PANEL REPORT, *supra* note 2, at 20.

288. BLUE RIBBON PANEL REPORT, *supra* note 2, at xvii (“Additional local actions, including local source reduction and adaptation and remediation, are necessary to ‘buy time’ while society collectively works to reduce global carbon dioxide emissions.”). See also Kelly & Caldwell, *supra* note 5, at 61 (recognizing that state efforts alone will be

limitation, but did not disregard the issue altogether, identifying ways that the state could contribute to emissions reduction.²⁸⁹ Indeed, the first action area and the first two KEAs in the Panel's report address ways in which Washington and its leaders can most effectively engage on this issue: by acting as advocates and "ambassadors" for CO₂ emissions reductions. At the same time, recognizing that Washington cannot rely on emissions reductions alone, the Panel developed recommendations in the areas of research, adaptation, coordination and public outreach that focus on local priorities and solutions. In addressing ocean acidification, other states can look to the recommendations and reports of the Blue Ribbon Panel to help define the legal and policy tools available to states to address the issue.

Sustained funding for implementation can also pose a challenge. Although Washington has been able to authorize and secure funding for MRAC and WOAC to date, state funds are typically only secured for a short period of time, leading to uncertainty regarding the ability to finance long-term efforts as well as vulnerability to changes in administrations or legislatures. This is the case in Washington: MRAC's implementing legislation is scheduled to expire on June 30, 2017.²⁹⁰ Over Governor Inslee's veto, Washington passed legislation in 2016 to extend this expiration to June 30, 2022; the legislation was passed by a two-thirds majority.²⁹¹

Another challenge is that the extent to which each local source contributes to ocean acidification is limited and in some cases nonexistent. If a state cannot ascertain the extent to

insufficient to solve the global CO₂ problem).

289. Washington State is a leader in reducing greenhouse gas emissions. Currently, the State's Climate Legislative and Executive Workgroup (discussed earlier in this Article) created under E2SSB 5802 during the 2013 legislative session is developing recommendations to ensure achievement of Washington's emissions reduction limits. For more information about Washington's efforts to reduce greenhouse gas emissions, see *Climate Change*, WASH. STATE DEPT OF ECOLOGY, <http://www.ecy.wa.gov/climatechange/> (last visited Nov. 23, 2013).

290. 2013 Wash. Sess. Laws, ch. 318, § 4(9).

291. Marine Resources Advisory Council—Expiration, 2016 Wash Sess. Laws., ch. 27. Governor Inslee vetoed 27 bills in order to encourage lawmakers to pass a supplemental budget; his veto did not represent disagreement with the substance of the bill and he welcomed the veto override on this and other bills. Walker Orenstein, *Senate Overrides Governor's Vetoes*, THE WASHINGTON TIMES (March 28, 2016), <http://www.washingtontimes.com/news/2016/mar/28/senate-overrides-governors-vetoes/?page=all>.

which a reduction in certain types of local inputs will affect local acidification, if at all, it usually does not make sense to expend significant resources and political will to change practices that may not have an ultimate impact on reducing the problem. For this and other reasons, the Blue Ribbon Panel recommended an initial step of quantifying the relative contribution of different acidifying factors to ocean acidification in Washington's marine waters, rather than starting with reduction actions themselves. The Department of Ecology is undertaking an effort to identify these local sources and the extent to which each contributes to local acidification levels. Thus, states looking to reduce localized contributors should prepare for the likelihood of needing to: (i) quantify the relative influence of different local inputs prior to taking reduction actions, (ii) prioritize where to expend likely limited resources, and (iii) engage stakeholders early on in the process.

VII. CONCLUSION

Washington State's efforts in the areas of research, monitoring, education, and outreach have resulted in increased awareness of ocean acidification, directed additional resources toward ocean-acidification related research, inspired other jurisdictions to take further action, and drawn the attention of organizations from the Center for Biological Diversity to the United Nations. And, notably, the state has established itself as a geographic leader in ocean acidification research, with a focus on bridging research and policy, which is likely to lead to increased federal and private funds being directed toward research directly applicable to Washington State's remediation and adaptation needs. Washington's Blue Ribbon Panel on Ocean Acidification, while not solely responsible for these efforts, deserves much of the credit for galvanizing and furthering many ongoing efforts to address the issue, and developing a blueprint for action that has the support of and input from numerous critical stakeholders. The Panel's efforts have been greatly furthered by the work of individual Panel members and by critical multi-stakeholder partnerships between the shellfish industry, researchers, tribes, nongovernmental organizations, and state and federal governments.

As the Panel recognized, addressing ocean acidification requires sustained efforts in the areas of global and local source reduction, adaptation and remediation, research and

monitoring, public education, and continued engagement by and with stakeholders. Several years after the Blue Ribbon Panel issued its recommendations, Washington State has been able to initiate and sustain efforts to implement those recommendations, largely through the formation and funding of WOAC and MRAC. That Washington's momentum toward addressing ocean acidification has continued through a change in administration makes its efforts that much more impressive.

Whether Washington will be able to enact or enforce existing measures that demonstrably reduce localized contributors to ocean acidification remains to be seen, but in many ways Washington has succeeded in its first steps as a leader addressing this significant issue. The anthropogenic CO₂ being absorbed by the world's oceans and the chemical and biological impacts that result make clear that ocean acidification is a problem beyond Washington's borders, impacting marine waters throughout the United States and the world. Other states—as well as the federal government and other nations—have much to learn from Washington's response, and can and should take actions that build off of and complement Washington's early efforts.