Ocean Acidification:
National and International Regimes to Address a Difficult Policy Problem

By: Rebecca Davis

I. INTRODUCTION

Everyone in the world depends on the oceans for resources, transportation of goods, tourism, food, climate regulation, and natural beauty. Yet within a few decades, our oceans may be devastated by a human-created environmental problem that has been called "global warming's evil twin" - ocean acidification.[1] Carbon dioxide is thought of mainly as an atmospheric pollutant, but it is also polluting the earth's waters. As CO_2 in the atmosphere increases, and more is absorbed by the oceans, the pH of the sea becomes more acidic. Increased ocean acidity poses a threat to marine ecosystems, and to the people around the world who depend on the oceans.

While the scientific community has only recently begun understanding the dangers posed by ocean acidification, the one fact that everyone agrees on is the need for immediate action. Actions addressing ocean acidification will require a comprehensive assortment of domestic and international laws. This paper starts with a discussion of the science behind ocean acidification and its potential ecological, social, and economic impacts. It will then discuss what makes ocean acidification such a difficult problem to deal with from a policy perspective. Finally, it will outline various types of policy regime responses that are possible in the face of the challenge of ocean acidification. Specifically, this paper will outline three different policy regimes: a biodiversity regime, a marine pollution regime, and a climate change regime. Within each policy regime, this paper will analyze several laws available in the United States and internationally,

[1] *See e.g.,* <http://cop15post.com/2009/12/15/news/acid-oceans-global-warming's-'evil-twin'/> The COP15 Post (Dec. 15, 2009).

and the actions being taken to abate this environmental problem. This paper is meant to show policy makers and readers the broad array of policy tools that are already available to address ocean acidification, and the progress that is already being made, but also to warn about the dangers of inaction.

II. OCEAN ACIDIFICATION AND ITS EFFECTS

The oceans play a fundamental role in the global carbon cycle, acting as a sink for carbon dioxide emissions.[2] Scientists estimate that that the oceans absorb 25-30% of cumulative anthropogenic CO_2 emissions each year.[3] On the one hand, this has greatly reduced the impact of greenhouse gases on climate change, but on the other hand, our emissions are changing the ocean's chemistry.[4] The pH levels of the ocean has dropped by 0.1 already,[5] which equates to an increase in acidity of 30% since the beginning of the industrial revolution.[6] When carbon dioxide from the atmosphere is absorbed into the oceans, it reacts with the seawater and forms a carbonic acid (H_2CO_3).[7] Some of the carbonic acid dissociates in ocean waters, producing hydrogen ions (H+).[8] As the number of hydrogen ions increase, the pH of the ocean decreases, and the water becomes more acidic.[9] As a result of the decrease in pH, there is also a decrease in the availability of chemical building blocks that marine organisms need to produce shells and

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[2] U.N. Dept. of Economic and Social Affairs [UN-DESA], U.N.-DESA Policy Brief No. 26, *Ocean Acidification: A Hidden Risk for Sustainable Development*, at 1 (Dec. 2009).
[3] UN-DESA, *supra* note 2.
[4] *Id.*
[5] Richard A. Feely, Christopher L. Sabine & Victoria J. Fabry, *Carbon Dioxide and Our Ocean Legacy*, at 2 (April 2006) (PEW Ctr. On Global Climate Change).
[6] UN-DESA, *supra* note 2; Ocean Acidification Reference User Group, *Ocean Acidification: The Facts. A Special Introductory Guide for Policy Advisers and Decisions Makers*, at 3 (D. d'A. Laffoley & J.M. Baxter eds., European Project on Ocean Acidification [EPOCA] (2009).

[7] *Id*.
[8] *Id*.
[9] *Id.*

skeletons made of calcium carbonate.[10] The process of ocean acidification dissolves the shells and skeletons of key marine species, and threatens to destroy the entire marine ecosystem.[11]

It is important to understand that ocean acidification and climate change are both effects of excessive amounts of CO_2 in the atmosphere, but ocean acidification is a direct result of CO_2 emissions, not climate change.[12] Ocean acidification is a direct chemical reaction to CO_2 emissions dissolving into the water.[13]

A. Effects of Ocean Acidification

Before examining strategies to address ocean acidification, it is important to understand the immense benefits that the oceans provide, and the far–reaching impacts that the destruction of marine ecosystems will have globally. A healthy ocean is a key part of the ecological system of the earth. Even people that live hundreds of miles inland are affected by the oceans everyday. The oceans have an important role both economically and ecologically, and ocean acidification's consequences threaten to reach billions of people. While the details of the effects of ocean acidification are not completely understood, one thing that is certain is that the effects will be widespread.

The biggest concern about ocean acidification is that it reduces the amount of carbonate available in the oceans, which is a substance that is used by tens of thousands of marine life forms to produce shells and skeletons.[14] Increased acidity in the oceans has been found to result

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[10] Feely et al., *supra* note 5, at 2.
[11] Louis Gray, *Copenhagen Climate Conference: Ocean Acidification Could Leave One Billion Hungry*, U.K. Telegraph (Dec. 19, 2009) *available at* http://www.telegraph.co.uk/earth/copenhagen-climate-change-confe/6811984/Copenhagen-climate-conference-ocean-acidification-could-leave-one-billion-hungry.html.
[12] Feely et al., *supra* note 5, at 1.
[13] *Id.*
[14] Natural Resources Defense Council (NRDC), *Ocean Acidification: The Other CO_2 Problem*, at 1 (August, 2009).

in slower growth rates and weaker shells and threatens to damage corals and other shell forming species.[15] With a high enough acidity, ocean water can actually become corrosive, and dissolve an organisms shell, which may in turn lead to extinction.[16] Marine organisms have adapted to the current pH levels over millions of years, and scientists do not know if they will be able to adapt to the rapid increase in acidity over a period of decades, rather than millennia.[17] Ocean acidification will damage key species in the food web, which threatens species all the way up the food chain, reaching fish, birds, and mammals.[18] Scientists have seen a measurable decrease in the weights in shells of both pteropods and foraminifera, two species that play an important role in the ocean food chain.[19] Pteropods[20] are eaten by animals all along the marine food chain, from tiny krill to gigantic whales.[21] With weakened shells, pteropods are at risk, and this could affect the health and biodiversity of the entire marine ecosystem.[22]

Coral reef degradation is another major danger of ocean acidification. As acidity rises, corals begin to erode raster than they are able to grow.[23] With coral reefs dying, comes a threat to potentially millions of species. Healthy reefs are the foundation of many fisheries.[24] If acidification rates stay on their current path, scientists believe that by the middle of the century,

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[15] *Id.*
[16] *Id.*
[17] Antarctic Climate & Ecosystems Cooperative Research Centre, *Position Analysis: CO_2 Emissions and Climate Change: Ocean Impacts and Adaptation Issues*, at 8 (2008) (*available at* http://www.acecrc.org.au).
[18] NRDC, *supra* note 14.
[19] UN-DESA, *supra* note 2, at 2.
[20] Pteropods account for 60 percent of the diet of Alaska's juvenile pink salmon. NRDC, *supra* note 14.
[21] Feely et al., *supra* note 5, at 3.
[22] *Id.*
[23] NRDC, *supra* note 14, at 2.
[24] Feely, et al., *supra* note 5, at 3.

coral reefs may erode faster than they can be rebuilt.[25] Coral species in Australia's Great Barrier Reef have already shown a 14% decline in calcification since 1990.[26] Areas around the world that depend on reefs for food, shoreline protection and tourism will be heavily impacted by these losses.[27] While ocean acidification as a stand alone problem has many potential impacts, those impacts increase when combined with other ecological pressures facing the oceans.[28] Whether it be coral bleaching or over fishing, the oceans are being threatened on multiple fronts. Acidification is one more stressor on an already delicate ecosystem.

In addition to the effects on individual species, ocean acidification will have a direct effect on global climate change. While climate change does not cause ocean acidification, the two are directly related. Since the ocean absorbs CO_2 from the atmosphere, it helps to mitigate climate change; but the oceans can also aggravate climate change. Warmer oceans absorb less CO_2. When the oceans warm from the effects of climate change in the atmosphere, they are able to hold less CO_2. This means that more CO_2 is left in the atmosphere, which increases the rate of global climate change even further.[29]

Besides the ecological and biological problems caused by ocean acidification, there are other costs both socially and economically. More than one billion people in the world depend on fish as their principle source of animal protein, and it is the most important source, and often the

[25] *Id*. (citing Maria Hood, (Oct-Nov. 2004) *A Carbon Sink That Can No Longer Cope?* A World of Science, 2(4), 2-5).
[26] NRDC, supra note 14.
[27] *Id*. at 2.
[28] *Id.*
[29] Since cold water can absorb more CO_2 than warm water, the greatest effects of ocean acidification will be felt first in the polar regions of the globe. Antarctic Climate & Ecosystems Cooperative Research Centre, *Position Analysis: CO_2 Emissions and Climate Change: Ocean Impacts and Adaptation Issues*, at X (2008) (*available at* http://www.acecrc.org.au).

lowest priced, of animal protein in developing countries.[30] Additionally, the global marine fishing industry provides jobs for over 500 million people, with 90% of that coming from people living in developing countries.[31] Any change in biodiversity could lead to food shortages amongst those with the greatest need and least amount of money to cope with changes, and with little or no other options of animal protein available. Tourism provided by coral reefs is also an important economic foundation for many communities, and is threatened by acidification.[32] It is estimated that the food, tourism, and other benefits provided by coral reefs is worth $172 billion per year worldwide.[33]

Potentially devastating effects have been predicted for the future, but the impacts of ocean acidification are already being felt in many places today. In Australia, coral in the Great Barrier Reef has already seen a 14% decline in calcification since 1990,[34] and Pacific oysters have not successfully reproduced in the wild since 2004, likely from increased acidity in the waters off the coast of Washington.[35] One of the world's leading coral biologists predicts that if the levels of CO_2 in the atmosphere remained at their current rate, all of the world's coral reefs are on a path to irreversible decline.[36] If emissions stay on their current path and the decline in pH and mollusk harvests continue, the economic losses for the United States alone could be $1.5-6.4 billion by 2060.[37] Scientists predict that if we want to avoid mass extinctions on the land and in the sea, we need to aim for stabilizing atmospheric levels of CO_2 at around 350 parts

[30] UN-DESA, *supra* note 2, at 2.
[31] *Id.*
[32] Feely et al., *supra* note 5, at 3.
[33] Miyoko Sakashita, *Harnessing the Potential of the Clean Water Act to Address Ocean Acidification*, 36 Ecol. L. Currents 239, 241 (2009).
[34] *Id.*
[35] NRDC, *supra* note 14.
[36] Miyoyo Sakashita, *supra* note 33.
[37] *Id.* at 241.

per million (ppm).[38] Instead, it is predicted that within 100 years, CO_2 levels could reach 788 ppm.[39]

III. OCEAN ACIDIFICATION IS A DIFFICULT POLICY PROBLEM

There are many characteristics about the ocean acidification problem that make it a difficult and unconventional policy problem to deal with. The first reason is because of the global nature of the problem, and because much of the ocean lies beyond the national jurisdiction of any one state.[40] Sixty four percent of the oceans are considered the "high seas" and belong to the world as a whole.[41]

Ocean acidification is also unique in that it took decades for the ocean to uptake this elevated amount of CO_2, but it could take anywhere from hundreds to thousands of years to undo.[42] This means that even with immediate action, the consequences are already in play.

Another problem facing ocean acidification is the lack of public knowledge on the issue. While everyone by now is clearly aware of global climate change, almost no one has heard of the related problem of ocean acidification. Ocean acidification was only recently identified as a problem in scientific research and literature.[43] Despite its recent arrival on the scientific scene,

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[38] *Id.* at 240.
[39] *Id.*
[40] Lucy Wiggins, *Existing Legal Mechanisms to Address Oceanic Impacts From Climate Change*, 7 Sustainable Dev. L. Pol'y 22 (2006-2007).
[41] *Id.*
[42] Edward L. Miles & James Bradbury, *What Can Be Done to Address Ocean Acidification Through U.S. Policy and Governance?* 25 J. Marine Educ. 30, 31 (2009).
[43] Dr. Tim Stephens, Faculty of Law, Univ. of Sydney Ctr. for Int'l Law, Lunchtime Seminar at ANU College of Law, Centre for International and Public Law: Ocean Acidification: A Litmus Test for International Law, PowerPoint presentation slide 10 (April 3, 2009) (Power point presentation available at <http://usyd.academia.edu/TimStephens/Papers/90926/Responding-to-Ocean-Acidification--A-Litmus-Test-for-International-Law--ANU-Coillege-of-Law--3-April-2009>).

there is a remarkably high level of certainty regarding acidification. Without public knowledge, it is hard to pressure policy makers to address the problem at all.

Finally, ocean acidification is difficult to address because, while it has a connection to global climate change, the solutions to deal with it may diverge from those capable of addressing climate change. For example, ocean acidification is driven only by CO_2, which is the most voluminous greenhouse gas, but not the most potent.[44] Additionally, ocean acidification operates independent of climate change.[45] "Ocean acidification differs from global warming in that its impact derives from the chemistry of carbon dioxide (CO_2) in seawater, rather than from its physical action as a greenhouse gas in the atmosphere. This means that even if the climate does not warm, increasing atmospheric CO_2 will inevitably increase ocean acidity."[46]

IV. OCEAN PROTECTION REGIME STRATEGIES

Broadly speaking, combating ocean acidification requires reducing CO_2 emissions and improving the health of the oceans. The main goal of any policy addressing ocean acidification must be to reduce increases in atmospheric CO_2 emissions and limit future levels of CO_2. Combating ocean acidification will ultimately require dramatic reductions in CO_2 emissions. Another factor that is important, but one that is beyond the scope of this paper, is a policy that aims to protect the marine environment from other stressors. Improving the health of the oceans overall will help protect species from increased harm from acidification. Options like sustainable fishing, marine reserves, and better water quality create more resilient ecosystems, which in turn protects the marine environment's ability to adapt to climate change and ocean acidification.

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[44] Dr. Tim Stephens, supra note 43, at slide 10.
[45] *Id.*
[46] <http://www.aad.gov.au/default.asp?casid=36141> Will Howard & Rosemary Sandford, *Developing Ocean Acidification Policy*.

In addition to working towards an immediate reduction in CO_2 and increasing the overall health of the oceans, there is also a pressing need for more research on the subject of ocean acidification. Given the fact that emissions will likely continue over the next number of decades, the scientific response to ocean acidification must focus on anticipating impacts and assisting policy-makers to develop informed responses. This ongoing research is needed if we are to adapt to the changes that are ahead.[47]

A. BIODIVERSITY REGIME

Because ocean acidification harms plants and animals, a biodiversity regime is one way to address ocean acidification within an already existing legal framework. As acidification increases, species will be threatened. There are various biodiversity laws that protect endangered species already in place that can be used to mitigate ocean acidification, and force reductions in carbon dioxide emissions.

1. US Policy - Endangered Species Act

The Endangered Species Act[48] (ESA) is often described as one of the most powerful environmental statutes in the United States because under the ESA, once a species is listed as threatened or endangered, "take" of the species is strictly prohibited. Section four of ESA describes the framework for how species become listed as threatened or endangered.[49] Under this section:

> The Secretary shall . . . determine whether any species is an endangered or a threatened species because of any of the following factors:

[47] *Id.*
[48] Endangered Species Act, 16 U.S.C. § 1531 *et seq.,* (2009) [hereinafter ESA]
[49] ESA § 1533.

(A) the present or threatened destruction, modification, or curtailment of its habitat or range;

(B) overutilization for commercial recreational, scientific, or educational purposes;

(C) disease or predation;

(D) inadequacy of existing regulatory mechanisms; or

(E) other natural or man made factors affecting its continued existence.[50]

A declaration that a species is endangered means that it is "in danger of extinction throughout all or a significant portion of its range."[51] One of the most important parts of the ESA, and one that makes it so strong of a statute, is that in deciding whether or not to list a species, economic considerations are *not* allowed to be part of the determination since the purpose of listing is solely the preservation or recovery of species.[52] Upon the listing of a species, the responsible agency must designate a critical habitat for that species within one year of the listing date.

Once a species is listed, section nine of the Endangered Species Act prohibits the "take" of any threatened or endangered species within the U.S. or its territorial seas, or on the high seas.[53] Take is defined by statute to mean "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or to attempt" to do any of these acts to an endangered or threatened species.[54] Regulations further elaborate on the scope of "take" by defining the word "harm" to mean an act that "actually kills or injures wildlife . . . . Such act may include significant habitat modification

[50] ESA § 1533(a)(1)(A)-(E).
[51] ESA § 1532(6).
[52] *Compare* § 1533(b)(1)(A) (scientific and ecological consideration of listing species) with § 1533(b)(1)(B)(2) (scientific, *economic*, and "any other" bases for consideration of degradation of critical habitat).
[53] ESA §1538(a)(1)(B)-(C).
[54] ESA § 1532(19); 50 C.F.R. § 17.21(c).

or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering."[55] Thus the ESA prohibits any act that will injure a threatened or endangered species by impairing essential behavioral patters.[56]

Scientists estimate that by the year 2100, 70 percent of cold water corals could be exposed to corrosive waters.[57] The ESA can be used to protect those species that are threatened, and protect the ocean as a habitat. A suit can be brought under the ESA against those who greatly contribute to the release of CO_2 into the atmosphere on the basis that such emissions harm or risk harming marine species, including corals, pteropods, and others.[58] As a remedy, the suit can seek an injunction against increases in CO_2 emissions from the creation of new emission sources, or the reduction of emissions from existing sources.[59]

On January 13, 2009, in response to a petition by the Center for Biological Diversity ("Center"), the black abalone, an edible shellfish that declined by 99 percent since the 1970s, was listed as an endangered species under the ESA.[60] The black abalone is threatened because of the combined effects of overfishing, global warming, and ocean acidification.[61] Once the black abalone was listed, the National Marine Fisheries Service (NMFS) then had a legal obligation to designate critical habitat for the species. In response to NMFS' failure to designate critical

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[55] 50 C.F.R. § 17.3.
[56] *Id.*
[57] Louis Gray, *Copenhagen Climate Conference: Ocean Acidification Could Leave One Billion Hungry*, U.K. Telegraph (Dec. 19, 2009) (*available at* http://www.telegraph.co.uk/earth/copenhagen-climate-change-confe/6811984/Copenhagen-climate-conference-ocean-acidification-could-leave-one-billion-hungry.html).
[58] Ari N. Sommer, *Taking the Pit Bull Off the Leash: Siccing the Endangered Species Act on Climate Change*, 36 B.C. Envtl. Aff. L. Rev 273, 298 (2009).
[59] *Id.* at 299.
[60] Press Release, Center For Biological Diversity, *Suit Filed to Protect Habitat for California's Endangered Black Abalone, Pushed Toward Extinction by Fishing, Disease, and Ocean Acidification* (March 23, 2010) (*available at* http://www.biologicaldiversity.org/news/press_releases/2010/black-abalone-03-23-2010.html).
[61] *Id.*

habitat, on March 23, 2010, the Center sued the Obama administration for failing to designate critical habitat for the black abalone.[62] This suit is currently pending.

Additionally, on January 20, 2010, the Center formally notified NMFS of its intent to sue because of its failure to respond to a prior petition by the Center, which sought to protect 83 imperiled coral species under the ESA.[63] The petition claims that the corals face a growing threat of extinction from rising ocean temperatures and ocean acidification.[64] If these suits are successful, and the species are listed, the result will be a prohibition on anything that "harms" the species' habitats, potentially including increased emissions of CO_2.

2. International Biological Diversity Protection

a. 1980 Convention on the Conservation of Antarctic Marine Living Resources

In 1982, the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) came into force.[65] The objective of CCAMLR is "the conservation of Antarctic marine living resources"[66] which includes "the populations of fin fish, mollusks, crustaceans and all other species of living organisms."[67] The treaty was originally established in response to concern about an increase in Southern Ocean catches of krill, a shell-forming organism at the base of the food chain in the Southern Ocean.[68] The Convention creates two institutions to implement it: the Commission and the Scientific Committee.[69] The Scientific Committee gauges

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[62] *Id*.
[63] Press Release, Center For Biological Diversity, *Suit Will Be Filed to Protect 83 Corals Threatened by Global Warming, Ocean Acidification*, (January 20, 2010) (*available at* http://www.biologicaldiversity.org/news/press_releases/2010/corals-01-20-2010.html).
[64] *Id.*
[65] Convention on the Conservation of Antarctic Marine Living Resources, May 20, 1980, U.K.T.S. No. 48, 19 I.L.M. 837 [hereinafter CCAMLR].
[66] CCAMLR, *supra* note 65, at art. II § 1.
[67] CCAMLR, *supra* note 65, at art. I § 2.
[68] CCAMLR website, http://www.ccamlr.org/pu/e/gen-intro.htm.
[69] CCAMLR, *supra* note 65, at art. XV.

the "effects of proposed changes in the methods or levels of harvesting and proposed conservation measures,"[70] and then the Commission acts on the Scientific Committee's recommendations at an annual meeting in addressing formulation of harvesting qualities and methods, and the designation of protected species.[71] The scientific committee has recently considered the effects of ocean acidification.[72] While this has not yet let to any related policy changes, it may prompt new conservation measures in the future.

b. Convention on International Trade of Endangered Species of Wild Fauna and Flora.

At an international level, protection of individual threatened species has often focused on restricting trade in certain species. The Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES) was created in response to growing concern that international trade in wild animals and plants would threaten the survival of some species.[73] CITES main focus is on trade, and it prohibits the trade of certain listed species in most cases.[74] Since it is designed to regulate trade, it is not able to fully protect marine ecosystems from other threats like atmospheric pollution. The one potential to use CITES comes from a provision that says when species are listed in Appendices II and III, the burden is on the exporting country to ensure that trade in a listed species is sustainable and will not threaten the species or its ecosystem.[75] For countries that are highly dependent on certain species, this may encourage

[70] *Id.* at art. XV(2)(d).
[71] *Id.* at art. IX.
[72] Antarctic and Southern Ocean Coalition [ASOC], *Climate Change and Implementation of CCAMLR's Objectives*, Paper for XXVI Meeting of Convention on the Conservation of Antarctic Marine Living Resources [CCAMLR] (Oct.-Nov. 2007).
[73] Convention on International Trade in Endangered Species of Wild Fauna and Flora, Mar. 3, 1973, 27 U.S.T. 1087*,* 1976 U.N.T.S. 244.
[74] CITES, *supra* note 73, at art. II.
[75] *See, e.g.*, Barbara Best & Alan Bornbusch, Overview, in Global Trade and Consumer Choices:

them to work towards CO_2 reductions so that they can continue to trade in certain species that may otherwise become listed.

c. Convention on Biological Diversity

At first glance, the Convention on Biological Diversity (CBD) may seem like a logical tool to use internationally, but its effectiveness is limited because the United States, the biggest global emitter of CO_2, is not a party to it, and because of the land-based threats to the oceans.[76] The Convention on Biological Diversity directs member states to implement conservation plans for biodiversity and to designate protected areas to support biodiversity.[77] Its works mainly for the protection of specific ecosystems, rather than for the protection of specific species, like the ESA. "Broadly interpreted then, the Convention obligates member states to establish protected marine areas and to take steps to shelter these areas from the impacts of climate change."[78] The definition of biological diversity to be considered under the convention includes "marine and other aquatic ecosystems and the ecological complexes of which the are a part."[79] There are marine protected areas created under this convention that help with the overall health of marine ecosystems. These protected areas can help protect marine ecosystems from overfishing, but they are currently not enough to protect from land-based threats of ocean acidification and climate change.[80] A major weakness of this Convention is that as a framework convention, the CBD is composed primarily of aspirational goals, with little in the way of substantive mandates.

Coral Reefs in Crisis at 2 (Barbara Best & Alan Bornbusch eds., 2001) (*available at* http://www.aaas.org/international/africa/coralreefs/Coral Reefs.pdf).

[76] Convention on Biological Diversity, June 2, 1992, U.N. Doc. DPI/130/7 (1992), reprinted in 31 J.L.M. 818 (1992).

[77] Lucy Wiggins, *supra* note 40, at 24.

[78] *Id.*

[79] Convention on Biological Diversity, *supra* note 76, at art. II.

[80] Marjorie Mulhall, *Saving the Rainforests of the Sea: An Analysis of International Efforts to Conserve Coral Reefs*, 19 Duke Envtl. L. & Pol'y F. 321, 337 (2009).

Additionally, there is no enforcement mechanisms, leaving compliance largely to "informed self-interest [of the Parties] and peer pressure from other countries and from public opinion."[81]

B. WATER POLLUTION REGIME TO REGULATE AIR POLLUTION

Initially, it may not seem like marine pollution regimes are the proper way to address atmospheric CO_2 pollution, but many marine laws and international treaties are broad enough to address the problem of ocean acidification. Air pollution and water pollution are inherently intertwined, and "[t]here is an increasing understanding in environmental law that eco-system based management is needed."[82] When addressing water pollution of any sort, "[t]o close our eyes and pretend that air pollution has no effect on water is simply untrue."[83] In fact, in the US, water pollution laws may serve as one of the strongest tools available to protect the oceans from CO_2.

1. US Policy – Clean Water Act

The Clean Water Act[84] (CWA) requires states to set water quality standards to protect designated uses of navigable waters. Legal action is already under way to begin to enforce the CWA in a way that protects the oceans and marine life forms from the threats of increased pH. The CWA provides a mandate to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters," which includes the territorial seas within three miles of the shore.[85] To reach this mandate, the CWA first creates standards against which to measure water

[81] Mary Gray Davidson, Protecting Coral Reefs: The Principal National and International Legal Instruments, *26 Harv. Envtl. L. Rev. 499, 531 (2002).*
[82] Miyoko Sakashita, *supra* note 33, at 241.
[83]Miyoko Sakashita, *supra* note 33, at 241.
[84] Federal Water Pollution Control Act, 33 U.S.C. § 1251, *et seq.* [hereinafter CWA].
[85] CWA §§ 1251(a), 1362(7), (8).

quality.[86] Then, an "impaired waters" list is made of all of the waters within a state that do not meet these standards. Finally, actions must be taken to correct the impairment.

Water quality standards must be set to "provide water quality for the protection and propagation of fish, shellfish and wildlife for recreation."[87] The CWA operates under a cooperative federalism model, and states set their individual water quality standards based on the US EPA's water quality criteria.[88] When the EPA sets or changes a criterion, states must either update their water quality standards to meet the new criteria, or provide a scientifically defensible alternative.[89] It is based on these state standards that water impairment is determined.[90] Once a standard is determined, the state enacts a total maximum daily load (TMDL) for each pollutant, which states how much of a pollutant can be discharged into the water body from all sources without it becoming impaired.[91] Once a TMDL is determined, an individual discharge permit is issued to each point source of pollution, telling it what portion of the TMDL it is allowed to emit.

Ocean water acidity is a standard that already exists under the CWA.[92] Standards vary by state, but the current US EPA criteria for ocean acidification prohibits a deviation of more than 0.2 pH units from natural variation.[93] While this might seem small, it actually correlates to a 60% change in acidity since pH is measured on an exponential scale, and decrease of 1

[86] Miyoko Sakashita, *supra* note 33, at 241.
[87] 40 C.F.R. § 130.3 (2008).
[88] Miyoko Sakashita, *supra* note 33, at 243.
[89] 40 C.F.R. § 131.1(b) (2008); Miyoko Sakashita, *supra* note 33, at 243.
[90] Miyoko Sakashita, *supra* note 33, at 243.
[91] CWA § 1313(d)(1)(D).
[92] 33 U.S.C. 1314(a)(4); Miyoko Sakashita, *supra* note 33, at 242.
[93] Miyoko Sakashita, *supra* note 33, at 242; EPA Quality Criteria for Water 1976: 342-43.

represents a 10-fold increase in acidity.[94] In response to a citizen-petition by the Center for Biological Diversity, the EPA is currently reviewing its recommendation for marine pH criteria to see if changes are needed to protect marine plants and animals from ocean acidification effects.[95] The petition argued that the EPA's pH governing criteria, which was adopted in 1976, is outdated and needs to be updated based on current scientific knowledge of ocean acidification and its effects.[96]

Once water quality standards are set, section 303(d) requires states to identify and list as "impaired" water bodies within their jurisdiction in which the state's current pollution controls are not strong enough to meet each of the applicable water quality standards.[97] Every other year, states must review these listings of impaired waters and submit that list to the EPA.[98] The EPA then reviews the list, and has the authority to add additional water bodies that it believes were improperly omitted.[99] Section 303(d) requires states to list as impaired any coastal waters with pH levels that exceed the seawater pH standard.[100] Despite the leniency of the current pH

[94] Laura B. Fandino, *Petition Seeks to Use CWA's TMDL Process to Address Climate Change Impacts*, 2008 Emerging Issues 3001 (Sept. 5, 2007) (Marten Law Group); Miyoko Sakashita, *supra* note 33, at 242.
[95] Center for Biological Diversity, Petition for Revised pH Water Quality Criteria under Section 304 of the Clean Water Act, 33 U.S.C. sec. 1314, to Address Ocean Acidification 1 (Dec. 18, 2007), *available at* http://www.biologicaldiversity.org/programs/oceans/pdfs/section-304-petition-12-18-07.pdf.) The petition argued that the EPA's pH governing criteria, which was adopted in 1976, is outdated and needs to be updated based on current scientific knowledge of ocean acidification and its effects. Miyoko Sakashita, *supra* note 33, at 242.
[96] *Id.*
[97] CWA § 1313(d)(1)(A); Noreen Parks, *Is Regulation On Ocean Acidification on the Horizon?*, Envtl. Sci. & Tech. 6118 (Aug. 15, 2009).
[98] CWA § 303(d); Noreen Parks, supra note 97.
[99] 40 C.F.R. § 130.7(d)(2).
[100] Miyoko Sakashita, *supra* note 33, at 243.

criteria, it is already being exceeded in certain areas, triggering the listing of waters as impaired.[101] [102]

Once a water body is listed as impaired, the state is required to identify pollutants causing or expected to cause violations of waters quality standards, and then use its authority pursuant to 303(d) to control pollutants from all sources that are causing the impairment.[103] This may require adjustments to TMDL permits, or limitations on other sources of pollution. This entire process must be based on the best available science.[104]

During 2007, the Center for Biological Diversity petitioned ten coastal states, urging them to list their ocean waters as impaired for pH on the states' CWA 303(d) lists, and to establish total maximum daily loads for CO_2 "due to decreases in pH resulting from anthropogenic CO_2 emissions."[105] On May 14, 2009, the Center filed the first federal lawsuit on ocean acidification, claiming that the EPA unlawfully failed to protect the Washington State's coastal waters from pollutants.[106] A deal was recently reached between the Center and EPA settling this case.[107] As part of the settlement, on March 22, 2010, the EPA agreed to begin a

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[101] *Id*.
[102] In response to a study that showed a decline in pH of more than 0.2 units off the coast of Washington state (Timothy J. Wootton, Catherine A. Pfister & James D. Forester, *Dynamic Patterns and Ecological Impacts of Declining Ocean pH in a High-Resultion Multi-Year Dataset*, 105 Proceedings of the Nat'l Acad. Of Sci. 18,848, 18,849 (2008)), a case was brought seeking to compel the U.S. EPA to list these coastal waters as impaired. Ctr. For Biological Diversity v. EPA, No. 2:09-cv-670 (W.D. Wash. Filed May 15, 2009) – maybe just cite the study, not the case.
[103] CWA § 1313(d); Miyoko Sakashita, *supra* note 33, at 244.
[104] Leska S. Fore et al., *Heeding A Call To Action For US Coral Reefs: The Untapped Potential of the Clean Water Act*, 58 Marine Pollution Bulletin 1421 (2009).
[105] *See, e.g.,* Center For Biological Diversity petition to the Washington State Department of Ecology, August 15, 2007, at 1.
[106] Noreen Parks, *supra* note 97, at 6118.
[107] Allison Winter, *OCEANS: Some See Clean Water Act Settlement Opening New Path To GHG Curbs*, Greenwire Blog, N.Y. Times website (March 12, 2010) (*available at*

rulemaking process by soliciting public comments on the effects of ocean acidification as it related to the 303(d) program, how to determine if coastal waters are affected, and how to use TMDLs to regulation pollutants that lead to acidification.[108]

The main problem with using the Clean Water Act to address ocean acidification is that nonpoint sources of pollution do not require discharge permits under CWA, so enforcement of any standards that are set may be difficult, as CO_2 emissions may be the ultimate nonpoint source. But, the EPA has used the CWA to create pollution targets to protect against acid rain caused by SO_2 emissions from coal burning, which, like CO_2 is also a pollutant that enters the waters through dispersed atmospheric sources, including international ones.[109] It was the effect of acid rain on surface waters and their inhabitants that was the main cause of legislation that reduced air emissions of SO_2.[110] The Clean Water Act has not yet been used to its full potential for the protection of marine environments. "Reporting the effects of CO_2 emissions on coral reefs through the formal, legal process of the CWA frames the issue to legislators and citizens in a way that scientific publications cannot."[111]

2. International Marine Protection – Law of the Sea Convention

When one thinks of international ocean policy, the first thing that comes to mind is probably the Law of the Sea Convention. The 1982 UN Convention on the Law of the Sea

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http://www.nytimes.com/gwire/2010/03/12/12greenwire-some-see-clean-water-act-settlement-opening-new-4393.html

[108] *Id.*

[109] Leska S. Fore et al., *Heeding A Call To Action For US Coral Reefs: The Untapped Potential of the Clean Water Act*, 58 Marine Pollution Bulletin 1421-1423 (2009); Noreen Parks, *supra* note 97, at 6119 (quoting Miyoko Sakashita).

[110] *Id.*

[111] Leska S. Fore et al., supra note 109, at 1422.

(UNCLOS) has been ratified by 152 countries.[112] Since it is directly based on protecting the oceans, its framework is a good fit for protection from acidification. It provides a general obligation to protect and preserve the marine environment,[113] and a broad directive that states should take all measures necessary to prevent, reduce and control pollution of the marine environment from any source.[114] In fact, it goes so far as to say that "[s]tates shall adopt laws and regulations to prevent, reduce and control pollution of the marine environment from or through the atmosphere."[115]

Not only does the Law of the Sea Convention have the proper framework for addressing ocean acidification, it has already been brought up as a topic of concern. The UN General Assembly is responsible for undertaking an annual review of the implementation of UNCLOS.[116] Acting in this regard, the General Assembly recently held the 64th session on Oceans and the Law of the Sea where scientists and policy makers expressed serious concern over the ability of coral reefs to withstand ocean acidification.[117] There was an urgent call for further research on ocean acidification, with a special emphasis on programs for observation and measurement of levels of ocean acidification around the globe.[118] There was encouragement of states and international organizations to improve efforts to address coral bleaching.[119] The Law of the Sea may be the most appropriate way to address ocean acidification internationally.

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[112] United Nations Convention on the Law of the Sea, Dec. 20, 1982, 1833 U.N.T.S. 397 [hereinafter UNCLOS].
[113] *Id.* at art. 192; Dr. Tim Stephens, *supra* note 43, at slide 16.
[114] UNCLOS, supra note 112, at art. 194(1).
[115] *Id.* at art. 212.
[116] UN-DESA, *supra* note 2, at 3.
[117] Tariq Banuri, Director for Division of Sustainable Development, United Nations, *Ocean Acidification: The Other CO2 Problem: What Can We Do About It?* Power point presentation, slide 4, United Nations Climate Change Conference 2009.
[118] *Id.*
[119] *Id.*

C. CLIMATE CHANGE REGIME

Another option for addressing ocean acidification on the international level is through a climate change regime. This is probably the solution that has received the most attention over the last year because of the recent 2009 United Nations Climate Change Summit Copenhagen.

There are a few problems with using a climate change treaty to address ocean acidification. First, ocean acidification could actually be accelerated by some of the mitigation policies that are being proposed to mitigate climate change.[120] For example, using active ocean sequestration of CO_2 as a method of curbing global climate change may help qualm the climate change problem, but it will actually exacerbate the ocean acidification problem.[121]

The second problem of using a climate change regime to address ocean acidification is that the target levels of CO_2 reduction needed to mitigate ocean acidification may be different from than those needed to mitigate climate change because effects may occur at differing thresholds for the atmosphere and ocean.[122] International treaties to keep atmospheric levels of CO_2 below 550 or 450 parts per million may prevent some degree of climate change, but may not prevent the majority of the polar oceans from becoming corrosive enough to effect the shells of key marine species.[123] Additionally, as time passes, the global community continues to struggle to come to an agreement on climate change. During these ongoing global talks and negotiations,

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[120] Dr. Tim Stephens, supra note 43, at slide 11.

[121] *Id.;* John Lorinc, *Climate: Many Geoengineering Ideas Won't Help Oceans*, N.Y. Times Green Inc. Blog (July 8, 2009), http://greeninc.blogs.nytimes.com/2009/07/08/study-geoengineering-wont-help-oceans/.

[122] *Ocean Acidification: A Summary for Policy Makers from the Second Symposium on the Ocean in a High-CO_2 World*, at 6 (Maria Hood, Wendy Broadgate, et al., eds) (October 6-9, 2008) (*available at* www.ocean-acidification.net).

[123] *Id.*

ocean acidification may ultimately reach a threshold from which it cannot recover in a reasonable amount of time. Climate change regimes may be an option, but they may be too slow to pose a real solution within a reasonable time.

Despite these potential drawbacks, a climate change treaty may be the international solution closest in reach from where we stand today. The need for international cooperation to protect the earth from climate change is readily understood, so an international regime would not need to start from scratch. Instead, ocean acidification could be addressed through climate change conventions already adopted by many countries around the world.

The 1992 United Nations Framework Convention on Climate Change (UNFCCC) has potential to be adapted to abate acidification of the oceans, its reach is not currently wide enough.[124] "Climate change" is defined by the convention as changes attributable to human activity that alters composition of the atmosphere,[125] and does not directly encompass ocean acidification. Further, "climate system" is defined as the totality of the atmosphere, hydrosphere, biosphere and geosphere,[126] which encompasses oceans, but only in the sense that the oceans affect climate.[127] Additionally, the UNFCCC is concerned with greenhouse gases, which includes CO_2, but it is only concerned with the warming potential of CO_2, not the acidification effect of it.[128] The overall goal of UNFCCC and other similar or related agreements is to stabilize greenhouse gas levels in the atmosphere to protect against human interference with the climate system, and the pH level of the oceans do not play a role in this goal.[129] In 1997, the

[124] United Nations Framework Convention on Climate Change, June 14, 1992, 1771 U.N.T.S. 107 [hereinafter UNFCCC].
[125] *Id.* at art. 1(2)
[126] *Id.* at art. 1(3)
[127] Second International Symposium on the Ocean in a High-CO_2 World, *supra* note 122.
[128] *Id.* at 7.
[129] *Id.*; UNFCCC, *supra* note 124, at art. 2.

Kyoto Protocol to the UNFCCC was passed.[130] The Kyoto Protocol sets actual quantitative emissions targets for six greenhouse gases, of which one is CO_2.[131]

These two climate change regimes are examples of systems already in place that may be adapted to include ocean acidification. While they are not currently designed to protect the oceans, with political support, they could be easily adapted to include prevention ocean acidification as an objective. For example, the Kyoto Protocol could set CO2 emission targets at a level that would protect both the atmosphere and the oceans.

Ocean acidification is beginning to be addressed internationally through climate change negotiations. At the 2009 Climate Change Summit in Copenhagen, an entire day of the 11-day conference was devoted to the health of oceans. While the main focus was on the effect of climate change, concern over ocean acidification, especially from scientists form around the world, was brought to the table on multiple occasions. Despite the time was devoted to the discussion of ocean acidification, no policy was adopted or adapted that would directly address the acidification of the oceans. However, there was a consensus that funding to research and increased research was needed around the world, and ocean acidification was not completely ignored.

Negotiations aimed at reducing greenhouse gas emissions need to take ocean acidification into account. Ocean acidification must be considered by policy makers when setting targets for stabilizing levels of atmospheric CO_2, and the times by which target levels

[130] Kyoto Protocol to the U.N. Framework Convention on Climate Change, 37 I.L.M. 22 (1998).
[131] *Id.* at Annex A; Second International Symposium on the Ocean in a High-CO_2 World, *supra* note 122, at 7.

need to be met. A level and time frame that may protect against certain effects of climate change may not be enough to protect against devastating effects of ocean acidification.[132]

IV. CONCLUSION

The biggest challenge facing our oceans is that no one regime on its own can fully address the challenges that stem from ocean acidification. We need all of the approaches discussed above, plus other, new and innovative approaches. We need to address the issues from all angles. Individual states need to take actions that reduce their own CO_2 emissions, but given the global nature of the problem, it cannot be fixed by one nation alone.

So what is the answer? The first requires countries to recognize the essential role that oceans play in providing food, economic benefits, and cultural beauty. The second step is for countires to take immediate action to protect the earth's oceans. There may still be hope for the oceans, but only if nations around the world commit to stark reductions in CO_2.

[132] Will Howard & Rosemary Sandford, supra note 46.