

OCEAN ACIDIFICATION AND THE UNFCCC: FINDING LEGAL CLARITY IN THE TWILIGHT ZONE

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I. INTRODUCTION

Ocean acidification—the rise in ocean acidity due primarily to the absorption of carbon dioxide (CO₂) from the atmosphere—is often thought of as a consequence of climate change; however, it is a separate, albeit very closely related, problem. Despite their common driver, the processes and impacts of ocean acidification and climate change are distinct and it should not be assumed that policies intended to alleviate climate change will simultaneously benefit the oceans. Indeed,

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some proposed climate change policy interventions, such as geoengineering schemes or the reduction of non-CO₂ greenhouse gases, either do nothing to alleviate increasing ocean acidification or have the potential to exacerbate it.¹ Ultimately, climate change and ocean acidification are two manifestations of the one problem, anthropogenic carbon dioxide emissions, and it is only with its reduction that the most serious impacts of both phenomena can be avoided.

Therefore, any efforts to regulate these emissions should consider both climate change and ocean acidification.² However, such attempts raise questions about the ability to incorporate ocean acidification into existing environmental treaties due to limitations in their mandates. This is particularly pertinent to the workings of the United Nations Framework Convention on Climate Change (UNFCCC, also referred to as the Convention),³ as it is widely recognized as the preeminent regime tasked with the stabilization of greenhouse gases in the atmosphere, including carbon dioxide.⁴ Applying the basic principles of treaty interpretation, as per the Vienna Convention on the Law of Treaties,⁵ I contend that ocean acidification can be included in the workings of the UNFCCC and that it is justifiable within the scope of the treaty's mandate to do so. While it may be pragmatic for the UNFCCC to consider ocean acidification in its efforts to reduce carbon dioxide, this has, to date, not occurred in any meaningful way. The only mention of the phenomena in any of the outcome documents of the Conference of the Parties (COP)

1. See generally P. Williamson & C. Turley, *Ocean Acidification in a Geoengineering Context*, 370 PHIL. TRANS. R. SOC. A (2012) (reviewing various geoengineering schemes and their implications for ocean acidification).

2. It is important to note that a holistic response to ocean acidification entails more than the reduction of carbon dioxide, including adaptation and restoration plans for areas that impacted by changes in ocean chemistry, as well as the mitigation of local factors that exacerbate ocean acidification. However, a discussion of these responses and the venues in which they should be governed are beyond the scope of this paper, which is focused on the main driver and most significant element in the toolbox for alleviating ocean acidification—the reduction of carbon dioxide emissions.

3. UNFCCC, June 12, 1992, 1771 U.N.T.S. 107

4. INTERNATIONAL LAW IN THE ERA OF CLIMATE CHANGE (Rosemary Gail Rayfuse & Shirley V. Scott eds., 2012) (discussing the role of the UNFCCC in the context of other regimes and international law).

5. Vienna Convention on the Law of Treaties, art. 31(1), May 23, 1969, 1155 U.N.T.S. 331.

is within a footnote of the 2010 *Cancun Agreements*.⁶ Rachel Baird and colleagues suggest that this apparent dearth of policy making can be attributed to the structural limitations of the UNFCCC which render it “incapable of adequately addressing ocean acidification.”⁷ Rakhuyun Kim concludes that, due to limitations in the Convention’s mandate, future incorporation of this issue would be a difficult task at best.⁸

However, it is the contention of this paper that these interpretations present a very narrow and static reading of the Convention, one that does not accurately reflect the “ordinary meaning” of the text nor its “purpose,” crucial elements in interpreting a treaty, as set forth by the Vienna Convention on the Law of Treaties.⁹ Indeed, Heidi Lamirande suggests that “[t]he UNFCCC should be read as a document that changes according to the surrounding environmental circumstances, not as a document stuck in time.”¹⁰ In addition, others within the academic and policy communities appear to interpret the mandate of the UNFCCC as being broad enough to read-in ocean acidification.¹¹

These opposing treatments of the issue suggest that there is a schism within the (albeit very limited) body of literature

6. United Nations Framework Convention on Climate Change, Cancun, Mex., Nov. 29–Dec. 10, 2010, *Report of the Conference of the Parties on its Sixteenth Session*, at n. 3, U.N. Doc. FCCC/CP/2010/7/Add.1, n.3 (Mar. 15, 2011). *See generally* United Nations Framework Convention on Climate Change, Conference of the Parties (COP) Reports, UNFCCC (2014), <http://unfccc.int/bodies/body/6383/php/view/reports.php> [hereinafter UNFCCC].

7. Rachel Baird, Meredith Simons, & Tim Stephens, *Ocean Acidification: A Litmus Test for International Law*, 4 CARBON & CLIMATE L. REV. 459, 464 (2009).

8. Rakhuyun E. Kim, *Is a New Multilateral Environmental Agreement on Ocean Acidification Necessary?*, 21 REVIEW OF EUROPEAN COMMUNITY & INT’L ENVTL. LAW 243, 246 (2012).

9. Vienna Convention on the Law of Treaties, May 23, 1969, 1155 U.N.T.S. 331.

10. H.R. Lamirande, *From Sea to Carbon Cesspool: Preventing the World’s Marine Ecosystems from Falling Victim to Ocean Acidification*, 34 SUFFOLK TRANSNAT’L L. REV. 183, 204 (2011).

11. E.R. Harrould-Kolieb & D. Herr, *Ocean Acidification and Climate Change: Synergies and Challenges of Addressing Both Under the UNFCCC*, CLIMATE POLICY (2011) (discussing a number of avenues for inclusion of ocean acidification in the work of the UNFCCC); *see also* D. HERR, K. ISENSEE, E. HARROULD-KOLIEB, & C. TURLEY, OCEAN ACIDIFICATION: INTERNATIONAL POLICY AND GOVERNANCE OPTIONS, IUCN, 18 (2014) (presenting an argument for why ocean acidification should be considered a falling within the mandate of the UNFCCC); IOC/UNESCO, IMO, FAO, UNDP, *A Blueprint for Ocean and Coastal Sustainability*, Paris: IOC/UNESCO, 32 (2011) (calling on the UNFCCC to consider changes in ocean chemistry in its deliberations).

addressing the international governance of ocean acidification. In light of this schism, further analysis of the mandate of the UNFCCC is warranted to determine its appropriateness as a venue for responding to ocean acidification. The discussion offered in this paper is significant in the theoretical context as there is clearly a point of contention that would benefit from further illumination. In addition, it is prudent that an alternative view to that of Baird et al.¹² and Kim¹³ be offered to highlight that the incorporation of ocean acidification within the UNFCCC is not only warranted, but also justifiable within the bounds of its mandate. In offering this alternative viewpoint, it is hoped that this paper can contribute to the meaningful advancement of efforts to address ocean acidification.

The remainder of the paper will be set out in the following three sections: the first will look at how ocean acidification has been treated within the UNFCCC to date. The second will offer an argument for why the mandate of the UNFCCC is capable of including ocean acidification. This will be done via a textual reading of the objective of the Convention and an analysis of the purpose with which the Convention was created. The third and final section provides a summary of the paper and some concluding remarks.

II. OCEAN ACIDIFICATION IN THE UNFCCC TO DATE

The UNFCCC is an environmental treaty that provides the policy framework for guiding the international response to climate change caused by the build-up of anthropogenic greenhouse gas emissions in the atmosphere.¹⁴ Negotiated in 1992 and entered into force in 1994, the Convention now has 195 signatories. The Convention acts as a general treaty setting out the objective of the regime and the broad commitments of its parties. More detailed rules are then decided upon in subsequent agreements, including legally binding protocols.¹⁵ In 1995, in recognition of the inadequacy of

12. Baird, et al., *supra* note 7.

13. Kim, *supra* note 8, at 246.

14. Nele Matz-Lück, *Framework Conventions as Regulatory Tools*, 1 GOETTINGEN J. OF INT'L L. 439 (2009).

15. *Id.* at 452.

the emission reduction provisions of the Convention, Parties initiated negotiations on a new protocol that resulted in adoption of the Kyoto Protocol two years later.¹⁶

Ocean acidification first appeared under the auspices of the UNFCCC in 2005 in a submission by the United Kingdom on behalf of the European Community,¹⁷ in which it noted the “potential, significant impact of ocean acidification on marine biota.” This submission was made under the Subsidiary Body for Scientific and Technological Advice (SBSTA).¹⁸ SBSTA is one of two permanent subsidiary bodies of the Convention that assists the work of the Conference of the Parties (COP) and the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP). SBSTA serves as a link between the scientific community and the Parties through the provision of scientific and technological information pertinent to the Convention and Kyoto Protocol. In 2007, the SBSTA workshop on climate-related risks and extreme events discussed ocean acidification,¹⁹ and the SBSTA has consistently mentioned the topic in subsequent discussions.²⁰

SBSTA has recognized ocean acidification as an emerging issue relevant to the UNFCCC²¹ and has outlined ocean

16. *Background on the UNFCCC: The International Response to Climate Change*, UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/essential_background/items/6031.php (last visited Apr. 15, 2016).

17. Views on the report on progress made towards implementing the initial ocean climate observing system, and on the final report on the analysis of data exchange issues in global atmospheric and hydrological networks. Rep. of the Subsidiary Body for Scientific and Technological Advice on Its Twenty-Third Session, Nov. 22–Dec. 6, 2005, 8, U.N. Doc. FCCC/SBSTA/2005/MISC.15 (2005).

18. *Subsidiary Body for Scientific and Technological Advice*, UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, <http://unfccc.int/bodies/body/6399.php> (last visited Apr. 15, 2016).

19. Rep. on the Workshop on Climate-Related Risks and Extreme Events, Dec. 3–11, 2007, 6, U.N. Doc. FCCC/SBSTA/2007/7 (2007).

20. Information provided by regional and international climate change research programmes and organizations on developments in research activities relevant to the needs of the Convention. Rep. of the Subsidiary Body for Scientific and Technological Advice on Its Twenty-Eighth Session, Jun. 4–13, 2008, 6, U.N. Doc. FCCC/SBSTA/2008/MISC.8 (May 23, 2008); *see also* Research and systematic observation. Developments in research activities relevant to the needs of the Convention, Rep. of the Subsidiary Body for Scientific and Technological Advice on Its Thirtieth Session, Jun. 1–10, 2009, U.N. Doc. FCCC/SBSTA/2009/MISC.5 (May 20, 2009).

21. Report of the Subsidiary Body for Scientific and Technological Advice on its forty-second session, held in Bonn from 1 to 11 June 2015, U.N. Doc. FCCC/SBSTA/2011/L4, para. 6 (Jun 14, 2011).

acidification research as a priority need under the Convention.²² In addition, SBSTA has encouraged Parties to include ocean acidification in their deliberations over the updated global climate observation system, a program seen as critical to supporting mitigation attempts.²³

Ocean acidification first appeared on the agenda of the Ad Hoc Working Group on Further Commitments for Annex I Parties Under the Kyoto Protocol (AWG-KP)²⁴ in 2009 in a submission made by Grenada on behalf of the Association of Small Island States (AOSIS).²⁵ Also in 2009, ocean acidification appeared in a submission of the Marshall Islands on behalf of AOSIS to the Ad Hoc Working Group on Long-Term Cooperative Action under the Convention²⁶ for input on the revised negotiating text; in this text it was suggested that “[i]n order to achieve the ultimate objective of the Convention the shared vision for long-term cooperative action aims to: . . . prevent environmental degradation such as damage to marine ecosystems arising from ocean acidification.”²⁷ This forum further mentioned ocean acidification as a slow-onset event for which developing countries may be provided compensation and rehabilitation for loss and damages through an international mechanism to address the unavoidable adverse effects of

22. Report on the workshop on technical and scientific aspects of ecosystems with high-carbon reservoirs not covered by other agenda items under the Convention, Note by the Secretariat, Report of the Subsidiary Body for Scientific and Technological Advice on Its Fortieth Session, Jun. 4–15, 2014, U.N. Doc. FCCC/SBSTA/2014/INF.1, Annex 1 (Apr. 1, 2014).

23. Rep. of the Subsidiary Body for Scientific and Technological Advice on Its Forty-First Session, Dec. 1–6, 2014, Sect. B.2.38, U.N. Doc. FCCC/SBSTA/2014/5 (Feb. 4, 2015).

24. *Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP)*, UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, <http://unfccc.int/bodies/body/6409.php> (discussing further commitments for industrialized countries under the Kyoto Protocol) (last visited Apr. 15, 2016).

25. U.N. Doc. FCCC/KP/AWG/2009/MISC.1/Add.1, PAPER NO. 1: GRENADA ON BEHALF OF THE ALLIANCE OF SMALL ISLAND STATES, 7 (2009) (noting ocean acidification as a reason for more ambitious and urgent action to reduce emissions).

26. *Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA)*, UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, <http://unfccc.int/bodies/body/6431.php> (assisting in cooperative actions to enable effective and sustained implementation of the Convention) (last visited Apr. 15, 2016).

27. Revised negotiating text, Rep. of Ad Hoc Working Group on Long-term Cooperative Action Under the Convention on Its Seventh Session, Sept. 28–Oct. 9; Nov. 2–6, 2009, 6, U.N. Doc. FCCC/AWGLCA/2009/INF.1/Add.1 (Sept. 17, 2009).

climate change.²⁸

This language made its way into the discussions of the COP and ultimately appeared in the outcome documents of the seventeenth COP, which was held in Cancun in 2010.²⁹ In this context, ocean acidification is provided as an example of a *slow-onset event*, along with, sea level rise and glacial retreat, amongst others.³⁰ This reference can be found in section two of the COP outcome document, where the COP recognized the need for greater effort to better understand and reduce the loss and damage associated with the impacts of slow-onset events.³¹ This recognition led to the initiation of a work program under the Subsidiary Body for Implementation (SBI)³² and then the establishment of the Warsaw International Mechanism on Loss and Damage (Mechanism).³³ Under the Mechanism, a two-year work-plan has been commenced to assess the risks, identify approaches to explore the role of the Convention in implementing these approaches for addressing loss and damage due to climate change.³⁴ Due to its only recent formation, it is unclear how the Mechanism will progress³⁵ and how ocean acidification will be factored in and to what extent. At this stage, it does not appear as though ocean acidification will be a significant agenda item as it has not featured in any

28. Rep. of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention, Rep. of Ad Hoc Working Group on Long-term Cooperative Action Under the Convention on Its Seventh Session, Sept. 28–Oct. 9; Nov. 2–6, 2009, 6, U.N. Doc. FCCC/AWGLCA/2009/14, ¶D.18 (Nov. 20, 2009).

29. Conference of the Parties, *Work Undertaken by the Conference of the Parties at its Fifteenth Session on the Basis of the Report of the Ad Hoc Working Group on Long-Term Cooperative Action Under the Convention*, U.N. Doc. FCCC/CP/2010/2, 16, n.6 (Feb. 11, 2010).

30. Conference of the Parties, *Report of the Conference of the Parties on Its Sixteenth Session*, 6, ¶25, n.3, U.N. Doc. FCCC/CP/2010/7/Add.1 (Mar. 15 2011).

31. *Id.*

32. See *Chronology – Loss and Damage*, U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/adaptation/workstreams/loss_and_damage/items/7545.php (last visited May 20, 2016).

33. *Id.*; see also UNFCCC, Conference of the Parties, 19th Sess., Warsaw, Pol., Nov. 11–23, 2013, Addendum Part Two, U.N. Doc. FCCC/CP/2013/10/Add.1 (Jan. 31, 2014) (outlining establishment of the Warsaw International Mechanism).

34. *Id.*

35. See generally Swenja Surminski & Ana Lopez, *Concept of Loss and Damage of Climate Change—a New Challenge for Climate Decision-Making? A Climate Science Perspective*, 7 CLIMATE AND DEVELOPMENT 267 (2015).

substantive discussions of the Mechanism since its inception.³⁶

Ocean acidification has also received attention under the 2013–15 review,³⁷ commissioned by the COP in 2010. This review is significant because it questions whether the long-term goal of limiting the rise in global temperatures to less than 2°C, which was agreed upon at COP 16,³⁸ is adequate for meeting the ultimate objective of the Convention (as laid out in Article 2).³⁹ The COP carried out the review with the assistance of the SBI, SBSTA, and involved over seventy experts in dialogue with Parties. During this process, experts highlighted that in a 2°C warmer world the risks associated with combined ocean warming and acidification would be high, and in a 4°C warmer world these risks would become very high. In addition, there is a high likelihood of meaningful differences between 1.5°C and 2°C of warming regarding the level of risk from ocean acidification.⁴⁰ The difference being that with 1.5°C of warming, risk for marine species would be on the verge of high risk, whereas with 2°C the risk would already be high.⁴¹

In 2015, the co-facilitators of the Structured Expert Dialogue (SED) produced a report offering a technical summary and compilation of the findings from the four sessions of the SED.⁴² The report found that defining the long-term goal by a temperature target was appropriate; however, it did acknowledge that such a strategy does not take into account all impacts associated with rises in CO₂ emissions, including

36. *Documents—Loss and Damage*, U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/adaptation/workstreams/loss_and_damage/items/7585.php (last visited May 20, 2016).

37. *See generally* UNFCCC, The 2013–2015 Review, U.N. Doc. FCCC/SB/2015/INF.1 (Dec. 12, 2015), http://unfccc.int/science/workstreams/the_2013-2015_review/items/6998.php (referring to ocean acidification 68 times).

38. UNFCCC, Copenhagen Accord, draft dec. /CP.15, 2, n.2, U.N. Doc. FCCC/CP/2009/L.7 (Dec. 18, 2009).

39. *See* UNFCCC art. 2, June 12, 1992, 1771 U.N.T.S. 107 (Article 2 sets out the primary goal of the UNFCCC and establishes the essential purpose for which the Convention was designed).

40. UNFCCC, Rep. on the Structured Expert Dialogue on the 2013–2015 Review Note by the Co-Facilitators of the Structured Expert Dialogue, U.N. Doc. FCCC/SB/2015/INF.1, n.108 (May 4, 2015).

41. *Id.* at n.42, 110.

42. *Id.*

ocean acidification.⁴³ The report further suggested that the addition of other limits alongside a temperature target would serve to reinforce the emerging understanding that “urgent and strong action” to reduce greenhouse gas emissions is required to meet the ultimate objective of the convention, and that any limitations of working towards a temperature goal could be taken into account by lowering the limit to below 2°C.⁴⁴ This is due to the need to reduce emissions of carbon dioxide to zero in the early part of the second half of this century in order to provide the best chance of remaining below 2°C. Reducing emissions in order to remain below 2°C would also offer a high likelihood of avoiding the most serious impacts associated with ocean acidification.⁴⁵

The report concluded that—in light of the current impacts of climate change (including the impacts of ocean acidification) and the risks associated with further temperature increase—the 2°C as a *guardrail* is inadequate and should instead be viewed as a *defense line* or *buffer zone*.⁴⁶ Such an approach would favor emission pathways to limit warming to below 2°C. The report, however, fell short of recommending a strengthening of the long-term goal to 1.5°C, despite clear benefits in terms of avoiding increased risk from ocean acidification and other climate-related impacts.⁴⁷

In the Paris Agreement, parties to the Convention agreed to aim towards “[h]olding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels.”⁴⁸ In order to achieve this long-term goal Parties also agreed to “undertake rapid reductions” of greenhouse gas emissions “so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century.”⁴⁹ These aims essentially pave the way for strong and ambitious

43. *Id.* at n.20.

44. *Id.* at Message 1.

45. See generally J.P. Gattuso, et al., *Contrasting Futures for Ocean and Society from Different Anthropogenic CO₂ Emissions Scenarios*, 349 SCIENCE 45 (2015) (comparing the risks of impacts of ocean acidification under high and low emission scenarios).

46. UNFCCC, *supra* note 40, at Message 5.

47. *Id.* at n.117.

48. Paris Agreement, FCCC/CP/2015/L.9, art. 2, no.1(a) (Dec. 12, 2015).

49. *Id.* at art. 4, no.1.

global action to reduce carbon dioxide emissions; however, room is also left to allow for less ambitious action, including surpassing a 1.5°C rise in global temperatures and a reduction to net zero emissions by as late as the end of the century. In addition, this agreement alludes to the use of (as yet unproven) technologies that would remove substantial amounts of carbon dioxide from the atmosphere later in the century. This would allow for continued high emissions in the short-term and rapid reductions in atmospheric concentrations of CO₂ in the future. While such efforts would allow for the stipulations of this agreement to be met, there would still be worsening ocean acidification in some areas of the ocean, particularly the deep ocean.⁵⁰ Thus, leaving “a substantial legacy of anthropogenic CO₂ emissions” far into the future and conditions that would likely result in high to very high risk of impacts to many marine species, ecosystems and the services they provide.⁵¹ In light of these arguments, it is difficult to conclude that the Paris Agreement in its current form is strong enough to avoid unacceptable levels of risk associated with ocean acidification. Consideration of the impacts of ocean acidification would certainly strengthen the impetus to implement the agreement in its most stringent form.

III. READING A NEW PROBLEM INTO AN OLD DOCUMENT

Ocean acidification has only received peripheral consideration within the workings of the UNFCCC, perhaps in part because its identification by the scientific community is relatively recent and is predated by the writing of the Convention and Kyoto Protocol. While the acidity of the surface ocean has increased approximately thirty percent since the industrial revolution, measured as an average decrease of 0.1 pH units,⁵² it was only in the late 1990s that the scientific

50. Sabine Mathesius, Matthias Hofmann, Ken Caldeira, & Hans J. Schellnhuber, *Long-term Response of Oceans to CO₂ Removal from the Atmosphere*, 5 NATURE CLIMATE CHANGE 1107 (2015).

51. *Id.* at 1112.

52. Ken Caldeira & Michael E. Wickett, *Anthropogenic Carbon and Ocean pH*, 425 NATURE 365 (2003); see also THE ROYAL SOCIETY, OCEAN ACIDIFICATION DUE TO INCREASING ATMOSPHERIC CARBON DIOXIDE (2005) (reviewing and further discussing current and future changes in ocean chemistry).

community began to understand the possible consequences of this change for marine life.⁵³ Since that time, there has been a rapid increase in research effort in this area that has raised awareness of the implications for not only marine organisms, but the ecosystems they belong to, the biogeochemical processes that they contribute to, and the socio-economic systems they support.⁵⁴ Ocean acidification is now widely acknowledged within the scientific community as an issue of significant concern.⁵⁵

The international policy community is also beginning to express concern over this issue and initiating activities to better understand the implications of inaction.⁵⁶ There are also acknowledgements that greater efforts are needed to respond within a timeframe that will provide the greatest opportunity of avoiding the most serious of impacts.⁵⁷ To achieve this outcome, international efforts will need to work cooperatively with the efforts to reduce carbon dioxide emissions. The most

53. J.A. Kleypas, et al., *Geochemical Consequences of Increased Atmospheric Carbon Dioxide on Coral Reefs*, 284 SCIENCE 118 (1999) (This is one of the earliest papers discussing the possible impacts of ocean acidification).

54. See generally OCEAN ACIDIFICATION (J.P. Gattuso & L. Hansson eds., 2011) (reviewing comprehensively the impacts of ocean acidification).

55. See e.g., THE INTERACADEMY PANEL ON INTERNATIONAL ISSUES, IAP STATEMENT ON OCEAN ACIDIFICATION (2009), <http://www.interacademies.net/File.aspx?id=9075>; INT'L OCEAN ACIDIFICATION REFERENCE USER GRP., OCEAN ACIDIFICATION: ACTING ON EVIDENCE, MESSAGES FOR RIO+20 (Dan Laffoley & J.M. Baxter eds., 2011), https://www.iaea.org/ocean-acidification/download/11_Dissemination/OA%20Acting%20on%20evidence/OA.AoE_RIO+20_hi-res.pdf; IOC-UNESCO, OCEAN ACIDIFICATION SUMMARIES FOR POLICYMAKERS, http://www.ioc-unesco.org/index.php?option=com_content&view=article&id=148&Itemid=76; EGU Position Statement on Ocean Acidification, EUROPEAN GEOSCIENCES UNION, <http://www.egu.eu/about/statements/egu-position-statement-on-ocean-acidification/> (last visited May 31, 2016); see also J.P. Gattuso, K.J. Mach, & G. Morgan, *Ocean Acidification and its Impacts: an Expert Survey*, 117 CLIMATIC CHANGE 725 (2012) (providing a survey of scientific community understandings of ocean acidification).

56. See G.A. Res. A/RES/61/222, p.3 (Mar. 16, 2007); see also Convention on Biological Diversity, Decision Adopted by the Conference of the Parties to the Convention on Biological Diversity at its Ninth Meeting, U.N. Doc. UNEP/CBD/COP/DEC/IX/16, A.3. (Oct. 9, 2008) [hereinafter CBD]; Int'l Maritime Org. [IMO], *Notification of Amendments to Annex 1 to the London Protocol 1996*, IMO Doc. LC-LP.1/Circ.5., ANNEX RESOLUTION LP.1(1) (Nov. 27, 2006), <https://docs.imo.org/Search.aspx?keywords=%22LC-LP.1%2FCirc.5%22>.

57. United Nations Environment Programme, UNEP Emerging Issues: Environmental Consequences of Ocean Acidification: A Threat to Food Security (2010); United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Oceanographic Commission (IOC) of UNESCO: Annual Report, 2010, U.N. Doc. IOC/2011/AR/17 (2011).

logical forum for this would be the UNFCCC, which is the primary international institution tasked with the reduction of carbon dioxide and other greenhouse gases.⁵⁸ Therefore, a keystone question that must be answered is whether the UNFCCC as an institution has the ability, as defined by its mandate, to provide a meaningful forum for an issue that was not widely recognized by the global community at its inception.

Varying opinions of the applicability of the UNFCCC mandate regarding ocean acidification center upon interpretations of Article 2 of the Convention, which sets out the primary objective of the UNFCCC, as well as guiding its operationalization and that of any implementing agreements (including the Kyoto Protocol and any agreement designed to take its place).⁵⁹ Article 2 establishes that the essential goal of the Convention is to “prevent dangerous anthropogenic interference with the climate system” via the “stabilization of greenhouse gas concentrations in the atmosphere.”⁶⁰ Indeed, this focus is pre-empted by the preamble that states that Parties to the Convention are “determined to protect the climate system for present and future generations.”⁶¹

A. *Reading the Text of Article 2*

1. *Ocean Acidification as a Threat to the Climate System*

In one of the earliest discussions of this issue in 2006, the German Advisory Council on Global Change argued that the mandate of the Convention of the UNFCCC “does indeed establish an obligation to take into account the impacts of climate change upon the oceans,” which is considered to

58. CBD, doc. UNEP/CBD/EM-IOAMCB/1/2 (2011); UNGA, doc. A/65/164 (2010) (both provide examples of international community deferring to the UNFCCC as the primary sight for the regulation of carbon dioxide).

59. UNFCCC, *supra* note 3, art. 2, ¶4 (“The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.”).

60. *Id.* at 6.

61. UNFCCC, *supra* note 3, at Preamble, ¶3.

include ocean acidification.⁶² The authors base this opinion largely upon the Convention's definition of the *climate system* as the "totality of the atmosphere, hydrosphere, biosphere and geosphere and their interactions."⁶³

The interpretation that ocean acidification can be understood as being a threat to the climate system is not disputed.⁶⁴ Carbon dioxide emissions that are emitted to the atmosphere are transferred to the ocean as a result of the interactions between the atmosphere and ocean, which is part of the hydrosphere. These emissions not only change the ocean itself, but also have repercussions for marine wildlife and plants—both elements of the biosphere—and through feedback mechanisms also result in changes to biogeochemical processes that can alter the make-up of the atmosphere. Thus, ocean acidification undoubtedly falls within the ambit of the Convention in regards to *anthropogenic interference with the climate system*.

2. *Ocean Acidification as Dangerous Anthropogenic Interference*

Baird and colleagues⁶⁵ question whether ocean acidification can be considered relevant when assessing what constitutes 'dangerous' anthropogenic interference. Given the focus of Article 2 on the stabilization of atmospheric concentrations of greenhouse gases, Baird, et al. suggest it is unlikely that declining ocean pH can be considered under the Convention. However, Article 2 does not focus on the atmosphere to the exclusion of other elements of the climate system; rather Article 2 presents the stabilization of greenhouse gases in the atmosphere as an avenue for protecting the climate system.⁶⁶ Thus, this action is not antagonistic to addressing ocean acidification. In fact, stabilization is deemed a necessity to

62. GERMAN ADVISORY COUNCIL ON GLOBAL CHANGE, THE FUTURE OCEANS-WARMING UP, RISING HIGH, TURNING SOUR 75 (Christopher Hay trans., 2006), http://www.wbgu.de/fileadmin/templates/dateien/veroeffentlichungen/sondergutachten/sn2006/wbgu_sn2006_en.pdf, [hereinafter WBGU].

63. UNFCCC, *supra* note 3, art. 2, ¶4.

64. Baird et al., *supra* note 7; Harrould-Kolieb & Herr, *supra* note 11; WBGU, *supra* note 62.

65. Baird et al., *supra* note 7.

66. UNFCCC, *supra* note 3, art. 2, ¶4

achieving protection of marine systems from ocean acidification⁶⁷ and as Lamirande suggests, “[t]he stabilization of GHG emissions directly correlates with the stabilization of the ocean’s pH.”⁶⁸ Consequently, because ocean acidification is a result of anthropogenic emissions of carbon dioxide—the most significant of the greenhouse gases—and poses a threat to the climate system, there appears to be no impediment to the consideration of its impacts when considering what should be deemed dangerous anthropogenic interference with the climate system.

Further, the focus of the Convention on protecting the climate system rather than the atmosphere was in part a recognition of the emerging science of the time that was beginning to shed light on the ocean’s role in the management of the global carbon cycle and its regulation of both the global climate and atmospheric carbon dioxide levels.⁶⁹ It is now widely accepted that the ocean is a significant driver of the global climate and, on time scales of millennia, the ocean determines the concentration of CO₂ in the atmosphere.⁷⁰ Thus, it could be argued that protecting the climate system necessarily involves protecting the ocean and the role it plays in the regulation of the climate—a role that is disrupted by the increase in ocean acidification.⁷¹

This evolution of scientific knowledge is significant as Parties are encouraged to take into account the best scientific evidence when considering operationalization of the Convention; and, thus, defining dangerous anthropogenic interference with the climate system. It is for this reason that the COP can turn to the findings provided by scientific bodies, such as the Intergovernmental Panel on Climate Change (IPCC), discussions within SBSTA, and the outcomes of periodic reviews including the 2013–15 review, to determine

67. Gattuso, et al., *supra* note 45.

68. Lamirande, *supra* note 10.

69. Personal communication with W. Howard, Office of the Chief Scientist of Australia and The University of Melbourne (Aug. 6, 2014) (on file with author).

70. P. Falkowski et al., *The Global Carbon Cycle: A Test of Our Knowledge of Earth as a System*, 290 *SCIENCE* 291 (2000).

71. M. Gehlen, Nicolas Gruber, Reidun Gangstø Skaland, Laurent Bopp, & Andreas Oschlies, *Biogeochemical Consequences of Ocean Acidification and Feedbacks to the Earth System*, in *OCEAN ACIDIFICATION* 230, 231 (J.P. Gattuso & L. Hansson eds., 2011).

what should be considered relevant to the decision making process.

The findings of these scientific bodies have become more representative of ocean acidification in recent years. For instance, in the Fifth Assessment Report of the IPCC, coverage of ocean acidification was substantially increased and included findings that ocean acidification will likely impact physiology, behavior, and population dynamics across a range of species;⁷² and, ocean acidification poses a substantial risk to marine ecosystems, especially coral reefs and polar systems.⁷³ Given the substantial increase of scientific knowledge on ocean acidification and its increased appearance in IPCC and SBSTA documents, it is not beyond the scope of the COP to consider the impacts of increasing ocean acidity. Indeed, the UNFCCC should not be seen as being hamstrung by superseded understandings of physical processes or limited to the use of scientific knowledge available at the time of writing. Rather, it should be viewed as a dynamic instrument with a mandate that obligates Parties to address ocean acidification due to the interconnected nature of the climate system.

3. *Establishing a Time-frame and Mechanism for Stabilization*

In addition to offering a pathway for protecting the climate system via stabilization, Article 2 sets out three criteria for establishing a time-frame in which the stabilization of greenhouse gases should be achieved. The Article guides Parties to act within a time-frame sufficient to “allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.”⁷⁴ Despite the threat posed to ecosystems by ocean acidification.⁷⁵ The first of these three criteria is not readily applicable to ocean acidification due to the Convention defining climate change

72. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2014: SYNTHESIS REPORT. CONTRIBUTION OF WORKING GROUPS I, II AND III TO THE FIFTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 67 (Rajendra K. Pachaur et al. eds., 2014) [hereinafter IPCC].

73. *Id.*

74. UNFCCC, *supra* note 3, at art. 2, ¶4.

75. IPCC, *supra* note 72, at ¶ 67.

simply as a “change in climate,”⁷⁶ a definition that is not readily applicable to ocean acidification. However, this does not preclude ocean acidification from being considered when setting time-frames for emission reductions to protect food production and economic development. Two systems threatened by increasing ocean acidity.⁷⁷ Ocean acidification, thus, offers an important metric when considering stabilization time-lines and trajectories.

Article 2 also lays out the mechanism by which the climate system should be protected—the “stabilization of greenhouse gas concentrations in the atmosphere.”⁷⁸ This objective does not prioritize the reduction of carbon dioxide over other greenhouse gases, which has led to the current practice within the UNFCCC of treating all GHGs, including carbon dioxide, as a *basket*.⁷⁹ The term *basket* demonstrates that the CO₂ maintains no position of privilege over the other gases⁸⁰ and it has been argued allows countries to maintain, or even increase, their emissions of CO₂ provided that their cumulative emissions are reduced.⁸¹ Such a response would not address ocean acidification because non-CO₂ emissions are not a significant driver of oceanic pH change.⁸²

While efforts that focus on reducing these ‘low hanging fruits’ are theoretically feasible in regards to the overall obligations of the Convention, recent commitments to limit

76. UNFCC, *supra* note 3, at art.1, 2, ¶3.

77. Julia A. Ekstrom et al., *Vulnerability and Adaptation of US Shellfisheries to Ocean Acidification*, 5 NATURE CLIM. CHANGE 207 (2015) (providing a review of the vulnerability of the shellfish industry to ocean acidification); *see also* Gattuso et al., *supra* note 45 (offering a review of likely impacts to ecosystems and ecosystem goods and services from ocean acidification); UNITED NATIONS ENV'T PROGRAMME, UNEP EMERGING ISSUES: ENVIRONMENTAL CONSEQUENCES OF OCEAN ACIDIFICATION: A THREAT TO FOOD SECURITY (2010), http://www.unep.org/dewa/Portals/67/pdf/Ocean_Acidification.pdf (examining likely threat of ocean acidification to food security).

78. UNFCCC, *supra* note 3, at art. 2, ¶4.

79. UNFCCC SECRETARIAT, UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE HANDBOOK 22–23 (2006).

80. *Id.*; *see also* UNFCCC, *supra* note 3 (Article 2 does not place a greater significance on carbon dioxide over other greenhouse gases).

81. Baird et al., *supra* note 7, at 464; Kim, *supra* note 8, at 245; Tim Stephens, *Ocean Acidification*, in RESEARCH HANDBOOK ON INTERNATIONAL MARINE ENVIRONMENTAL LAW 431, 437 (Rosemary Rayfuse ed., 2015).

82. *See generally* OCEAN ACIDIFICATION (J.P. Gattuso & L. Hansson eds., 2011) (discussing the drivers of ocean acidification).

warming to 2°C⁸³ or below⁸⁴ largely rule out such a response. In order to meet the 2°C goal global carbon dioxide levels need to decrease to net zero by no later than 2070 and all greenhouse gases need to decline to net zero by the end of the century.⁸⁵ Consequently, any efforts aimed at achieving a warming of no more than 2°C would need to prioritize carbon dioxide reductions over other non-CO₂ gases and in effect preclude a scenario where countries can reduce non-CO₂ greenhouse gases at the expense of carbon dioxide reductions.

Thus, the practicalities of avoiding dangerous anthropogenic interference do not compromise the ability to address ocean acidification under the Convention despite the focus of Article 2 on the stabilization of greenhouse gases rather than carbon dioxide. In addition, the Convention does appear to prioritize carbon dioxide over other non-CO₂ gases in later Articles when it calls for a return “to earlier levels of anthropogenic emissions of carbon dioxide and other greenhouse.”⁸⁶

B. Interpreting the Purpose of the Convention

1. Protection of the Climate System as a Whole

The desire to protect the climate system, rather than the atmosphere, hints at the purpose with which the Convention was written. The Convention considers the ocean and atmosphere as indivisible parts of the one climate system, driven by feedback mechanisms.⁸⁷ Thus, suggesting that the treatment of and effects on one should be considered when dealing with the other. Indeed, as highlighted earlier, it is difficult to protect the climate system without due consideration of ocean acidification, therefore it is reasonable to assume that had ocean acidification been recognized at the time of the Convention’s writing it would likely have been incorporated into its considerations.

83. See, e.g., Copenhagen Accord, *supra* note 38.

84. UNFCCC Paris Agreement, doc. UNFCCC/CP/2015/L.9/Rev.1 (Dec. 12, 2015), art. 2.1(a).

85. REPORT ON THE STRUCTURED EXPERT DIALOGUE, *supra* note , at 10.

86. UNFCCC, *supra* note 3, at art. 4, ¶2(a).

87. UNFCCC, *supra* note 3, at art. 1.3.

2. *Conservation of Marine Carbon Sinks and Reservoirs*

Furthermore, the Convention recognizes the importance of the ocean, marine, and coastal ecosystems as sinks and reservoirs of carbon dioxide, and calls for their conservation.⁸⁸ This call for conservation could be understood as obligating the Parties to protect marine and coastal ecosystems and the ocean from ocean acidification. The potential of mangroves, salt marshes and seagrass meadows to store carbon is thought to be significant and ocean acidification threatens their functioning as sinks and reservoirs.⁸⁹ While it is unclear how the carbon storage capacities of these systems may fair, it is expected that the systems will experience alterations in the future due to ocean acidification.⁹⁰

The ocean itself is also understood to be a critically important store of carbon dioxide—holding more than fifty times the amount of dissolved inorganic carbon than the atmosphere.⁹¹ However, as ocean acidification progresses, biological and physiological processes are altered including calcification and photosynthesis.⁹² Changes to these processes are likely to result in indirect feedbacks to the climate system, as well as decreasing the ability of the ocean to absorb carbon dioxide.⁹³ As a result, the current capacity of the near-surface ocean to take up carbon dioxide is only seventy percent of what it was in pre-industrial times and is likely to be reduced to just twenty percent by the end of the twenty-first century.⁹⁴

88. *Id.* at Preamble, art. 4, ¶1(d).

89. INTERNATIONAL UNION FOR CONSERVATION OF NATURE, *THE MANAGEMENT OF NATURAL COASTAL CARBON SINKS 2* (Dan Laffoley & Gabirel Grimsditch eds., 2009).

90. Gattuso et al., *supra* note 45, at aac4722-1. The possible decline in these habitats would not only result in a loss in capacity for absorption of carbon dioxide, but would also result in the release of stored carbon dioxide, thus exacerbating climate change and ocean acidification. *Id.*

91. Falkowski et al., *supra* note 71, at 292.

92. *See generally* OCEAN ACIDIFICATION, *supra* note 54 (reviewing the effects of ocean acidification); *see also* Ligia B. Azevedo et al., *Calcifying Species Sensitivity Distributions for Ocean Acidification*, 49 ENVTL. SCIENCE & TECHNOLOGY 1495 (2015) (examining the calcification effects of ocean acidification).

93. Gehlen et al., *supra* note 71, at 231 (noting the ocean's decreasing ability to absorb carbon dioxide).

94. WORLD METEOROLOGICAL ORG., GREENHOUSE GAS BULLETIN: THE STATE OF GREENHOUSE GASES IN THE ATMOSPHERE BASED ON GLOBAL OBSERVATIONS THROUGH 2014, at 4 (2014).

3. *Acting in a Sustainable and Appropriate Manner*

Despite this, Baird et al. and Kim both read the Convention's requirement to conserve sinks and reservoirs as inadvertently encouraging the exacerbation of ocean acidification, suggesting that "the uptake of atmospheric CO₂ by the oceans is presented in the climate regime as part of the solution to climate change, rather than as a problem in and of itself."⁹⁵ Indeed, Baird et al. and Kim understand this requirement as not only calling for the passive absorption of CO₂ in marine systems, but even encouraging the active sequestration of carbon dioxide in the ocean through activities like direct injection of CO₂ or iron fertilization. However, the requirement to "sustainably manage," and "conserve and enhance sinks, where appropriate," would largely rule out storage of carbon dioxide in the ocean via direct injection, fertilization and similar activities. Such activities are widely understood as being unsustainable due to their ineffectiveness, their likely impacts on marine ecosystems, and their potential to exacerbate ocean acidification.⁹⁶

Indeed such activities have largely been deemed illegal by agreements under other international treaties. For instance, the London Convention and Protocol (LC-LP), also known as 'the dumping regime,' was established to prevent the dumping of pollution at sea.⁹⁷ Dumping at sea is viewed as hazardous to human health and living marine resources.⁹⁸ Due to concerns related to the impacts of ocean acidification on the marine environment, the Parties to the Convention and Protocol permitted the disposal of carbon dioxide beneath the seabed,

95. Baird et al., *supra* note 64, at 464.

96. Ken O. Buesseler et al., *Ocean Iron Fertilization—Moving Forward in a Sea of Uncertainty*, 319 *SCIENCE* 162, 162 (2008); accord Kenneth L. Denman, *Climate Change, Ocean Processes and Ocean Iron Fertilization*, 364 *MARINE ECOLOGY PROGRESS SERIES* 213, 224 (2008); accord Fortunat Joos & Ulrich Siegenthaler, *Possible Effects of Iron Fertilization in the Southern Ocean on Atmospheric CO₂ Concentration*, 5 *GLOBAL BIOGEOCHEMICAL CYCLES* 135 (1991) (questioning the efficacy with which iron fertilization can be deployed as a method of mitigating climate change).

97. *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter*, INT'L MARITIME ORG., <http://www.imo.org/en/OurWork/Environment/LCLP/Pages/default.aspx> (last accessed May 21, 2016).

98. *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter Preamble*, Nov. 13, 1972, 26 U.S.T. 2403, 1046 U.N.T.S. 120.

thereby effectively prohibiting its disposal on the sea floor or in the water-column.⁹⁹ The LC–LP amendment was then followed by a 2007 resolution that expressed concern over the effectiveness and likely impacts of iron fertilization programs.¹⁰⁰ Additionally, an agreement in 2008 ruled out ocean fertilization activities beyond those undertaken for scientific reasons.¹⁰¹

This ocean fertilization decision was further supported by the Convention on Biological Diversity, in which the COP urged all Parties and other governments to act in accordance with the decision of the London Convention.¹⁰² In addition to these widely supported regimes, the regional OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic has echoed the resolution of the anti-dumping regime by further placing a prohibition on the disposal of CO₂ in the water-column and on the sea-bed. An activity that was recognized as not being sustainable and “likely to result in harm to living resources and marine ecosystems,” and therefore not a “viable solution with regard to mitigating climate change.”¹⁰³

Therefore, in light of the efforts by the broader international community to prohibit unsustainable active sequestration activities, it is unlikely that members of the UNFCCC would move to include such activities within the climate regime. Consequently, the commitment to enhance natural sinks should not be seen as an argument against responding to ocean acidification, as Baird et al. and Kim suggest. Quite the converse it should be seen as a requirement to sustainably manage natural sinks and to protect and conserve coastal and marine systems in a sustainable manner that will alleviate both ocean acidification and climate change.¹⁰⁴

99. Int'l Marine Org. [IMO], Res. LC-LP.1/Circ. 5, at 1 (Nov. 2, 2006).

100. Int'l Marine Org. [IMO], Res. LC-LP.1/Circ. 14, at 1 (July 13, 2007).

101. Int'l Marine Org. [IMO], Res. LC 30/16 Annex 6, ¶8 (Oct. 31, 2008).

102. Conference of the Parties to the Convention on Biological Diversity, Ninth Meeting, Bonn, Ger., May 19–30, 2008, *Decision Adopted by the Conference of the Parties to the Convention on Biological Diversity at its Ninth Meeting: 9, Biodiversity and Climate Change*, at 2, UNEP/CBD/COP/DEC/IX/16 (Oct. 9, 2008).

103. OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic, Ostend, Belg., June 25–29, 2007, *OSPAR Decision 2007/1 to Prohibit the Storage of Carbon Dioxide Streams in the Water Column or on the Sea-bed*, Annex 5 (Jan. 15, 2008).

104. See generally Richard K.F. Unsworth et al., *Tropical Seagrass Meadows Modify*

The fact that ocean acidification was not recognized at the time of the Convention's writing should not preclude its incorporation. This document was penned in order to create a dynamic instrument capable of acknowledging the progression of science and responding in turn.¹⁰⁵ The focus within the Convention on sustainable management and conservation is indicative of this purpose.¹⁰⁶ Indeed, the Convention requires Parties to take new scientific developments into consideration when reviewing "the obligations of the Parties and the institutional arrangements under the Convention."¹⁰⁷

IV. CONCLUSION

This paper has provided an examination of the mandate of the UNFCCC in an effort to highlight that not only is the incorporation of ocean acidification warranted into mitigation discussions under the Convention, but also justifiable within the scope of the mandate of the Convention. While the UNFCCC has been slow to take up ocean acidification as an issue of primary concern in determining targets and timelines for the reduction of carbon dioxide emissions it should not avoid the issue due to perceived structural limitations of its mandate. Ocean acidification, as highlighted by the 2013–15 review, offers an additional impetus for urgent and substantial reductions in CO₂ emissions and bolsters arguments for a strengthening of the long-term goal for action to 1.5°C.¹⁰⁸ Consideration of ocean acidification alongside climate change makes arguments for inaction even more absurd.

Seawater Carbon Chemistry: Implications for Coral reefs Impacted by Ocean Acidification, 7 ENVTL. RES. LETTERS 1 (2012) (discussing the ability of seagrass meadows to offset ocean acidification by raising the pH of surrounding waters).

105. UNFCC, *supra* note 3, art. 4.

106. Diana M. Liverman, *Conventions of Climate Change: Constructions of Danger and the Dispossession of the Atmosphere*, 35 J. OF HISTORICAL GEOGRAPHY 279, 294 (2009).

107. UNFCCC, *supra* note 3, at art. 7, ¶ 2(a).

108. *Id.*