Climate Change and the Arctic: Adapting to Changes in Fisheries Stocks and Governance Regimes

Jennifer Jeffers[*]

This Note analyzes climate change impacts on Arctic fisheries and governance structures, and examines the role of science, policy, and law in minimizing future repercussions of such impacts. The Arctic is currently undergoing unprecedented shifts in marine species, and climatic conditions in the region are changing at a rate nearly twice as fast as those at lower latitudes. In addition, long-term climatic changes present entirely new challenges. These ecological and socioeconomic alterations will have a significant effect on fisheries governance structures and interactions between Arctic countries and could potentially destabilize existing management regimes. Positive changes to fishery stock compositions and distributions may also lead to conflicts between Arctic nations due to overlapping jurisdictional claims, unregulated fishing, and a lack of multi-regional agreements.

The current Arctic regulatory and governance framework is not sufficient in scope and flexibility to adequately address future fishery changes brought on by climate change. This Note suggests that the region needs a new, dynamic management regime in order to successfully negotiate the uncertainties inherent in climate change predictions and anticipate the effects such climatic changes will have on fisheries stocks. I propose four primary components of such a regime: (1) increased overlap of nation-state actors and scientists, (2) institutional nesting, (3) division

[*]Jennifer Jeffers will join the San Francisco office of Morrison & Foerster LLP in October 2010 as an associate in the firm's Land Use and Environmental Law Practice Group. In December 2009, she graduated from the University of California, Berkeley with a J.D. from the School of Law (Boalt Hall) and an M.S. from the Department of Environmental Science, Policy, and Management. Jennifer received the Ellis J. Harmon Prize for legal writing in environmental law and policy and the Prosser Prize for scholastic excellence in Ocean Law and Policy. She is greatly indebted to and would like to thank Kate O'Neill, Holly Doremus, Harry Scheiber, Eric Biber, David Winickoff, and David Caron for their helpful input and direction throughout the development of this Note. She is also thankful to Clare Tarpey, Danny Kramer, and the ELQ editorial staff for their valuable contributions and refinements.

and management of resources (both in terms of jurisdictional concerns, as well as conservation and utilization principles), and (4) non-political measures. I integrate these components into specific governance options for the future, including the creation of an Arctic regional treaty, an overhaul of the Arctic Council, and the formation of an Arctic-wide Regional Fisheries Management Organization. This Note concludes that although a regional treaty or agreement is currently unrealistic, overhauling the Arctic Council and establishing a new Arctic Ocean Regional Fisheries Management Organization may be feasible options to create an effective governance regime.

INTRODUCTION

Rising atmospheric temperatures, warming sea water, and changing oceanic currents are causing the rapid melting of polar ice.[1] Recent research suggests that due to the impacts of climate change, by the year 2040, previously inaccessible portions of the Arctic Ocean[2] presently enclosed by ice caps will no longer be beyond human reach; some of the most recent climate studies have predicted that an ice-free summer Arctic Ocean could occur even as early as 2030.[3] Such ecological transformations will have monumental effects on fishery stocks, access to oil and gas reserves, shipping routes, and tourism opportunities in the Arctic.

If the prevailing scientific views of Arctic warming hold true, there may be massive ecological shifts in marine species compositions and distributions throughout the Arctic, including a movement of fish populations northward into previously inaccessible areas nearly five times the size of the Mediterranean Sea.[4] There is little doubt that fishing fleets will also move north, inevitably resulting in significant conflicts over

---

1. *See, e.g.*, ARCTIC CLIMATE IMPACT ASSESSMENT (2005), *available at* http://www.acia.uaf.edu/pages/scientific.html; Intergovernmental Panel on Climate Change [IPCC] Home Page, http://www.ipcc.ch (last visited June 17, 2010); WORLD WILDLIFE FUND, ARCTIC CLIMATE IMPACT SCIENCE—AN UPDATE SINCE ACIA, 7–8 (2008) [hereinafter ACIA UPDATE], *available at* http://www.wwf.org.uk/filelibrary/pdf/arctic_climate_report.pdf.

2. The Arctic Ocean occupies a roughly circular basin and covers an area of about 14,056,000 sq. km. (5,427,000 sq. mi.), slightly less than 1.5 times the size of the United States. The coastline length is 45,389 km (27,085 mi.). Nearly landlocked, it is surrounded by the land masses of Eurasia, North America, Greenland, and several islands. It includes Baffin Bay, Barents Sea, Beaufort Sea, Chukchi Sea, East Siberian Sea, Greenland Sea, Hudson Bay, Hudson Strait, Kara Sea, Laptev Sea, White Sea, and other tributary bodies of water. It is connected to the Pacific Ocean by the Bering Strait and to the Atlantic Ocean through the Greenland Sea and Labrador Sea. *See* Central Intelligence Agency [CIA], The World Factbook: Arctic Ocean, https://www.cia.gov/library/publications/the-world-factbook/geos/xq.html (last visited May 29, 2010).

3. *See* Marika Holland et al., *Future Abrupt Reductions in the Summer Arctic Sea Ice*, 33 GEOPHYSICAL RES. LETTERS L23503 (2006); ACIA UPDATE, *supra* note 1, at 8.

4. *See* Clifford Krauss et al., *As Polar Ice Turns to Water, Dreams of Treasure Abound*, N.Y. TIMES, Oct. 10, 2005, at A1.

fishing rights and resource ownership between nation-states.[5] In addition, it is anticipated that some fish stocks will expand their range or alter their migration patterns such that they will soon straddle numerous nations' exclusive economic zones (EEZs), thus potentially leading to unsustainable "race to the bottom" fishing practices and resource struggles between neighboring countries.[6] As a result, the Arctic region may be on the brink of becoming a major conflict zone between eight powerful countries,[7] all of whom are increasingly asserting claims over the region.[8]

Research on climate change impacts to Arctic fisheries is still in its infancy, primarily because changes in ocean currents, uncertainty regarding future Arctic water temperatures, and alterations to fish migration patterns make predictions difficult and result in high levels of scientific uncertainty.[9] A number of scientific assessments have evaluated possible effects of climate change on the region. Although long-term fishery impacts are indefinite, one prevailing view is that many species' ranges will shift north, current regional species compositions will change, and, depending on the species and area in question, stock abundances and productivity will actually increase. Concern for Arctic fisheries may seem premature, especially for those stocks expected to increase in

---

5. *See generally* James McGoodwin, *Effects of Climatic Variability on Three Fishing Economies in High-Latitude Regions: Implications for Fisheries Policies*, 31 MARINE POL'Y 40, 40–55 (2007); Kathleen Miller & Gordon Munro, *Climate and Cooperation: A New Perspective on the Management of Shared Fish Stocks*, 19 MARINE RESOURCE ECON. 367, 367–93 (2004).

6. *See* McGoodwin, *supra* note 5; Miller & Gordon, *supra* note 5.

7. The eight Arctic countries are Russia, Norway, Denmark (which governs Greenland), Canada, the United States, Finland, Sweden, and Iceland. Of note, however, is that on November 25, 2008, 76 percent of Greenland voted "in favor of self-rule, in a referendum that paves the way for independence from Denmark and gives Greenland rights to lucrative Arctic resources." *Greenland Vote Favors Independence*, N.Y. TIMES, Nov. 26, 2008, at A7. The new status took effect June 21, 2009. *See id.* It is unclear at this time, however, how the new self-rule framework will impact ongoing Arctic resource and jurisdiction discussions.

8. The United Nations Convention on the Law of the Sea (UNCLOS) provides that a nation has sole exploitation rights in its EEZ, which extends 200 nautical miles (nm) from its coast. However, Article 76 of UNCLOS provides that a country can extend this limit to 350 nm if it can prove that its continental shelf extends from the coastline beyond the current limit of 200 nm. United Nations Convention on the Law of the Sea, arts. 76(4)–(6), 77, Dec. 10, 1982, 1833 U.N.T.S. 3 [hereinafter UNCLOS]. The potential to extend EEZ boundaries is currently a major focus of the nations claiming jurisdiction over Arctic territory—both in order to gain previously "unowned" resources, such as oil and gas reserves, as well as to alleviate potential negative economic and political impacts of migrating fish stocks.

9. *See, e.g.*, MICHAEL GLANTZ, CLIMATE VARIABILITY, CLIMATE CHANGE, AND FISHERIES (2005); Allison Perry et al., *Climate Change and Distribution Shifts in Marine Fishes*, 308 SCIENCE 1912, 1912–16 (2005); Rögnvaldur Hannesson, *Sharing the Herring: Fish Migrations, Strategic Advantage, and Climate Change*, *in* CLIMATE CHANGE AND THE ECONOMICS OF THE WORLD'S FISHERIES: EXAMPLES OF SMALL PELAGIC STOCKS (Rögnvaldur Hannesson et al. eds., 2006); Erling Stenevik & Svein Sundby, *Impacts of Climate Change on Commercial Fish Stocks in Norwegian Waters*, 31 MARINE POL'Y 19, 19–31 (2007); William Schrank, *The ACIA, Climate Change and Fisheries*, 31 MARINE POL'Y 5, 5–18 (2007).

abundance and economic value, yet history has repeatedly demonstrated that such biogeographical changes can have major consequences for exploited fish stocks, as well as the communities and industries that depend upon them.[10] Thus, proactive fisheries policies and management strategies are critical to ensure successful adaptation to potential changes.[11]

Integrating science, law, and policy is necessary to ensure that international governance regimes and natural resource management entities adapt to the impacts of climate change. Institutions and national regulatory systems must consider and use scientific data in evaluating climate change effects and claims for fisheries stocks, or else risk escalating resource ownership conflicts and the rapid depletion of natural resources. Similarly, scientific information alone will not resolve ownership claims in the Arctic, as the concerns over rights to natural resources and geographical delimitations present major considerations of international law and policy.

Climate change presents significant problems for existing governance regimes worldwide. Conflict is likely to arise in areas affected by decreasing fish populations, as well as in areas experiencing *increased* fishery production.[12] Moreover, many of the current fisheries and governance regimes for managing fisheries are unstable or too structurally complicated and inflexible to deal with future ecosystem and social change. Given that the magnitude of transformation in the Arctic is uncertain, there is a clear need to implement, as much as possible, forward-thinking, dynamic, and adaptive governance regimes to oversee and manage future fishery issues.

This Note analyzes climate change impacts on Arctic fisheries and governance structures, and examines the roles of science, policy, and law in minimizing future repercussions of such impacts. Part I describes the current state of Arctic fisheries, focusing specifically on existing governance regimes and the 2005 *Arctic Climate Impact Assessment* (ACIA) data. Part II analyzes potential fish stock responses to changes in climatic conditions, implications arising from uncertainty, significant

10. *See* discussion of the Norwegian spring spawning herring case study *infra* Part III.B; *see also* Brian MacKenzie, *Impact of 21st Century Climate Change on the Baltic Sea Fish Community And Fisheries*, 13 GLOBAL CHANGE BIOLOGY 1348 (2007); Grégory Beaugrand et al., *Plankton Effect on Cod Recruitment in the North Sea*, 426 NATURE 661 (2004); Francisco Chavez et al., *From Anchovies to Sardines and Back: Multidecadal Changes in the Pacific Ocean*, 299 SCIENCE 217 (2003).

11. *See* ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, at 589–90, 636–40, ch. 13.

12. Although often considered in context of oil reserves, this idea relates to the "paradox of plenty" or "resource curse" theory that "resource-exporting governments respond perversely or ineffectively" to abundant natural resource wealth, resulting in weakened state institutions and political conflicts. *See generally* Michael Ross, *The Political Economy of the Resource Curse*, 51 WORLD POL. 297, 321 (1999).

climate change scientific assessment data (particularly with regard to marine ecosystems), and projected effects of climate change on Arctic fisheries. Part III clarifies how climate change and fishery alterations may impact Arctic regional governance and management frameworks, describes how societal uncertainty can complicate governance responses, and examines problems with existing Arctic governance regimes. Finally, Part IV suggests that the Arctic needs a dynamic management framework in order to successfully negotiate the uncertainties inherent in climate predictions and anticipate the effects climatic changes will have on fishery stocks, and proposes four necessary components of such a framework. Part IV also examines and critiques various governance options for the future, including an Arctic regional treaty, an overhaul of the Arctic Council, and the formation of an Arctic-wide regional fisheries management organization (RFMO), and concludes that although a regional treaty is currently unrealistic, strengthening the Arctic Council and establishing a new Arctic Ocean RFMO may be the most feasible path forward in creating a new dynamic governance regime.

I. CURRENT STATE OF ARCTIC FISHERIES

> [The] Arctic seas contain some of the world's oldest and richest commercial fishing grounds. In the Bering Sea and Aleutian Islands, Barents Sea, and Norwegian Sea, annual fish harvests in the past have exceeded two million tonnes, although many of these fisheries have declined. . . . Important fisheries also exist around Iceland, Svalbard, Greenland, and Canada. Fisheries are important to many arctic countries, as well as to the world as a whole.[13]

A. *Existing Governance Regimes*

Critical to understanding Arctic governance is recognizing that the Arctic is not a landmass, but an ice-covered ocean surrounded by land.[14] "The Arctic is an enormous area, sprawling over one sixth of the earth's landmass; more than 30 million [square kilometers] and twenty-four time zones."[15] The Arctic Ocean, central to the region, comprises a deep main basin, bordered by approximately 50 percent continental shelf—the highest percentage of any ocean.[16] The immense Lomonosov and

13. ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, at 16. For example, Norway is the world's largest fish exporter. *Id.*

14. *See* Rosemary Rayfuse, *Melting Moments: The Future of Polar Oceans Governance in a Warming World*, 16 RECIEL 196, 197 (2007).

15. Arctic Council, About the Arctic Council (Oct. 22, 2007), http://arctic-council.org/article/about.

16. *See* CIA, *supra* note 2.

Cordillera ridges divide the main Arctic basin into the Canadian, Mararov, and Amundsen basins.[17]

The land and maritime zones adjacent to the Arctic Ocean, including continental shelves and 200-mile EEZs, are under the jurisdiction of eight Arctic states—Canada, Denmark (which has historically governed Greenland), Finland, Iceland, Norway, Russia, Sweden, and the United States. However, with the exception of the Agreement on the Conservation of Polar Bears, no individual international treaty regime specifically governs the Arctic.[18] Instead, the primary governance regimes are those of the sovereign Arctic states, which enact their own legislation to govern their respective areas and nationals.[19]

Inter-Arctic governmental cooperation is overseen by the Arctic Council, a high-level intergovernmental forum established in 1996 by the Ottawa Declaration.[20] The Council builds upon work originally undertaken as part of the Arctic Environmental Protection Strategy (AEPS), a multilateral, non-binding agreement formally adopted by all Arctic nations in 1991.[21] AEPS was subsequently absorbed into the Council as part of the Council's working group framework in 1996.[22] The Council's mission is to "provide a means for promoting cooperation, coordination and interaction among the Arctic states, with the involvement of the Arctic Indigenous communities and other Arctic inhabitants on common Arctic issues, in particular issues of sustainable development and environmental protection in the Arctic."[23] The Council is comprised of all eight Arctic states, as well as six permanent participants representing Arctic Indigenous representatives.[24] In addition, four European states are official observers (Germany, the Netherlands, Poland, and the United Kingdom), as are a variety of non-governmental institutions.[25] Importantly, the Council's recommendations are "soft law"

---

17. *See id.*

18. Agreement on the Conservation of Polar Bears, Nov. 19, 1973, 27 U.S.T. 3918, *available at* http://sedac.ciesin.org/entri/texts/polar.bears.1973.html.

19. The Arctic is home to four million people, including many indigenous tribes and various languages.

20. The Ottawa Declaration was signed in Ottawa by representatives of the governments of Canada, Denmark, Finland, Iceland, Norway, Russian Federation, Sweden, and the United States. Declaration on the Establishment of the Arctic Council, Sept. 19, 1996, 35 I.L.M. 1382. For more information about the Arctic Council and the Ottawa Declaration, see Arctic Council, *supra* note 15.

21. Arctic Environmental Protection Strategy, June 14, 1991, 30 I.L.M. 1624, *available at* http://arctic-council.org/filearchive/artic_environment.pdf.

22. *See* Arctic Council, *supra* note 15.

23. *Id.*

24. *See id.*

25. Inuit Circumpolar Council (Canada), Arctic Council, http://www.inuitcircumpolar.com/index.php?ID=160&Lang=En (last visited June 18, 2010). Non-governmental observers include: International Arctic Science Committee (IASC), Nordic Council, Northern Forum, United Nations Economic Commission for Europe (UN-ECE), United Nations Environment

only—the institution does not have independent legal power.[26] It provides a "forum for discussion only . . . [and has] no independent legislative or regulatory function"[27]; neither does it focus on matters of military security.

From an international law perspective, areas of the Arctic that are outside of national jurisdiction and not included in the territorial sea or internal waters of a State fall into the "high seas" category and lie outside of any one country's sovereignty.[28] The United Nations Convention on the Law of the Sea (UNCLOS) is responsible for the creation of 200-mile EEZs by coastal nations, and governs the freedom of navigation, fishing, scientific research, and overflight in areas of the high seas.[29] UNCLOS currently serves as the most relevant international treaty for the protection of the Arctic marine environment.[30] The International Seabed Authority, an important governing body established under UNCLOS, also provides oversight to seabed activities in the region.[31] Areas of extended continental shelf are solely under individual state jurisdiction, however.

"A fundamental premise of [UNCLOS] was to provide certainty and stability in oceans governance by establishing the outer limits of maritime zones. . . . [However,] the major issue for the Arctic has been, and remains, the delimitation of these maritime zones between adjacent and

---

Programme (UNEP), Standing Committee of Parliamentarians of the Arctic Region, World Wide Fund for Nature, and the International Union for Circumpolar Health. *See* Arctic Council, Non-governmental organizations, http://arctic-council.org/section/observers_non_governmental (last visited June 18, 2010). Ad hoc observers also attend council meetings. *See* Inuit Circumpolar Council (Canada), Arctic Council, http://www.inuitcircumpolar.com/index.php?ID=160&Lang=En (last visited June 18, 2010).

26. The term "soft law" has numerous meanings, but can be best defined as law that (1) is not binding; (2) consists of general norms and principles, not rules; and (3) is not readily enforceable through binding dispute resolution. *See generally* Alan Boyle, *Some Reflections on the Relationship of Treaties and Soft Law*, 48 INT'L & COMP. L.Q. 901, 901–02 (1999).

27. Rayfuse, *supra* note 14, at 198.

28. High seas areas are also referred to as part of the global commons.

29. UNCLOS, *supra* note 8.

30. Other international agreements relevant to the Arctic include the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), Sept. 22, 1992, 932 U.N.T.S. 2. *See* OSPAR Commission, OSPAR Convention, http://www.ospar.org/content/content.asp?menu=00340108070000_000000_000000 (last visited May 30, 2010). OSPAR applies to the Arctic waters of the northeast Atlantic but is not an Arctic-specific treaty. The International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL), also applies to shipping activities throughout the Arctic. International Convention for the Prevention of Pollution from Ships, Nov. 2, 1973, 12 I.L.M. 1319, *available at* http://sedac.ciesin.columbia.edu/entri/texts/pollution.from.ships.1973.html; Protocol of 1978 Relating to the International Convention for the Prevention of Pollution from Ships, Feb. 16, 1978, 17 I.L.M. 546.

31. International Seabed Authority, About Use, http://www.isa.org.jm/en/about (last visited May 12, 2010).

opposite coastal States."[32] Numerous Arctic jurisdictional disputes are ongoing. These include boundary conflicts between Russia and the United States and between Norway and Russia in the Barents Sea, and delimitation disputes between Canada and Denmark and between Canada and the United States.[33]

Moreover, under Article 76 of UNCLOS, a coastal State may claim sovereignty over continental shelf areas beyond 200 nautical miles (nm) if it can prove that its continental shelf extends from the coastline beyond that limit, and provided its boundary extension application is approved by the Commission on the Limits of the Continental Shelf (CLCS).[34] A

---

32. Rayfuse, *supra* note 14, at 204–05.

33. *See id.* at 205–06. Regional maritime delimitation conflicts include uncertainty over the status of the 1990 agreement determining the boundary between Russia and the United States in the Arctic Ocean north of the Bering Strait; disputes between Russia and Norway in the Barents Sea over sectoral boundary delimitations and ownership of fish and oil and gas resources; Russia's rejection of Norway's claim to any EEZ and continental shelf around the islands of Spitsbergen; and conflict between Canada and Denmark over Hans Island and between Canada and the United States over delimitation in the Beaufort Sea. *See id.*

34. *See* UNCLOS, *supra* note 8, art. 76; *see also* Commission on the Limits of the Continental Shelf, Continental Shelf, http://www.un.org/Depts/los/clcs_new/continental_shelf_description.htm#definition (last visited May 29, 2010).

UNCLOS legally defines a state's "continental shelf" as "the seabed and subsoil of the submarine areas that extend beyond its territorial sea throughout the natural prolongation of its land territory to the outer edge of the continental margin, or to a distance of 200 nautical miles from the baselines." UNCLOS, *supra* note 8, art. 76(1). "Geologically, the seabed that slopes away from the coast typically consists of, first, a gradual slope (the continental shelf proper), then a steep slope (the continental slope), and then a more gradual slope leading to the deep seabed floor. These three areas are collectively known as the continental margin." *U.S. Reaction to Russian Continental Shelf Claim*, 96 AM. J. INT'L L. 969, 969 (2002). If the continental margin extends beyond 200 nm from the shore, a State's establishment of the outer edge of the continental shelf may not exceed either 350 nm from the baselines or 100 nm beyond the 2,500 meter isobath (a line connecting the depth of 2,500 meters). *See* UNCLOS, *supra* note 8, art. 76(5).

Under Article 76 of UNCLOS, after a state has become party to the Convention, it has a period of ten years to submit oceanographic information justifying the extension of its continental shelf boundaries beyond 200 nm to the Commission on the Limits of the Continental Shelf (CLCS). *See id.* annex II, art. 4. The CLCS reviews the information submitted by the state and makes recommendations to the state regarding the delimitation of the continental shelf. *See* Commission on the Limits of the Continental Shelf, Purpose, Functions and Sessions, http://www.un.org/Depts/los/clcs_new/commission_purpose.htm (last visited June 30, 2010). Provided the state follows those recommendations in establishing the outer limits of its continental shelf, the recommendations become "final and binding." UNCLOS, *supra* note 8, art. 76(8).

In 1996, the five Arctic coastal states convened a workshop in Russia to discuss technical and scientific issues arising from the submission of continental shelf claims beyond 200 nm. *See* IOC/IASC/IHO EDITORIAL BOARD FOR THE INTERNATIONAL BATHYMETRIC CHART OF THE ARCTIC OCEAN, THE CONTINENTAL SHELF BEYOND 200 NAUTICAL MILES IN THE ARCTIC OCEAN: SUMMARY REPORT app. c (1998), *available at* http://www.ngdc.noaa.gov/mgg/bathymetry/arctic/copenappc.html. "It was recognized that all five coastal States have valid grounds for developing continental shelf claims beyond their 200 [nm] limits, and that the possibility, if not the likelihood, existed of overlapping claims between neighbouring states."

nation's incentive for extending its continental shelf is immense. Under UNCLOS, "a coastal State exercises over the continental shelf sovereign rights for the purpose of exploring it and exploiting its natural resources,"[35] as well as jurisdiction in matters relating to the environment. The potential for vastly increased jurisdiction over marine areas and resources is so attractive that every Arctic state, with the exception of the United States, has already submitted claims or is in the process of doing so. In 2001, Russia was the first Arctic state to file a claim, thereby asserting control over approximately 460,000 square miles of seabed beyond the 200 nm boundary.[36] CLCS reviewed the submission and requested further revisions, which Russia is now completing.[37] Norway submitted its claim in 2006,[38] Iceland and Denmark (with regard to the Faroe Islands) each filed a claim in April 2009,[39] and Canada is currently preparing its submission.[40] The United States, the only Arctic nation not to have ratified UNCLOS (and thus, not able to file claims with CLCS), is extensively mapping its own portions of the Arctic.[41] The question of how to resolve all of these jurisdictional disputes fairly and peacefully is an ongoing challenge.[42]

In terms of specific fisheries governance structures, the 1995 United Nations Fish Stocks Agreement provides an international framework for creating RFMOs to govern the exploitation of straddling and highly migratory fish stocks.[43] The main goal in establishing this agreement was

---

GlobalSecurity.org, Arctic Ocean, http://www.globalsecurity.org/military/world/war/arctic.htm (last visited May 12, 2010).

35. UNCLOS, *supra* note 8, art. 77(1).

36. *See* United Nations, Submissions, through the Secretary-General of the United Nations, to the Commission on the Limits of the Continental Shelf, Pursuant to Article 76, Paragraph 8, of the United Nations Convention on the Law of the Sea of 10 December 1982, http://www.un.org/Depts/los/clcs_new/commission_submissions.htm (last visited July 18, 2010).

37. *See* United Nations, Commission on the Limits of the Continental Shelf (CLCS): Outer Limits of the Continental Shelf: Submission by the Russian Federation, http://www.un.org/Depts/los/clcs_new/submissions_files/submission_rus.htm (last visited July 18, 2010).

38. *See* United Nations, *supra* note 36.

39. *See id.*

40. *See* Fisheries and Oceans Canada, Canada's Submission to the Commission on the Limits of the Continental Shelf Under the United Nations Convention on the Law of the Sea (the "Continental Shelf Program"), http://www.dfo-mpo.gc.ca/ae-ve/evaluations/09-10/6b060-eng.htm#ch1 (last visited June 18, 2010).

41. *See* Rayfuse, *supra* note 14, at 207.

42. *See id.*

43. Agreement for the Implementation of the Provisions of the United Nations on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, Aug. 4, 1995, 2167 U.N.T.S. 3, *available at* http://www.un.org/Depts/los/convention_agreements/convention_overview_fish_stocks.htm. The UN defines "straddling" fish stocks as "stocks of fish such as pollock, which migrate between, or occur in both, the economic exclusive zone (EEZ) of one or more States and the high seas. Thus, the definition also includes highly migratory fish stocks." UNEP, UN Atlas of the Oceans,

to create a regime that "allowed for the monitoring and enforcing of fish stocks that had migrated to the high seas."[44] Numerous regional fisheries management plans and RFMOs have been developed for limited regions of the Arctic, including the North East Atlantic Fisheries Commission (NEAFC),[45] the North Atlantic Fisheries Organization (NAFO),[46] and the North Pacific Fisheries Management Council,[47] which regulates fisheries like those of the Barents and Bering Seas on the margin of the Arctic. However, there is no existing framework in the Arctic Council to provide for the discussion of fishery issues, nor is there an overarching RFMO cooperative fisheries management structure for the Arctic as a whole.

B. *Arctic Climate Impact Assessment*

The 2005 ACIA serves as the most comprehensive independently reviewed evaluation of Arctic climate change to date and details the current state of scientific knowledge concerning climate change and its effects in the region.[48] The ACIA began as an international project between the Arctic Council, which is a regional high-level intergovernmental forum, and the International Arctic Science Committee (IASC),[49] "to evaluate and synthesize knowledge on climate variability, climate change, and increased ultraviolet radiation and their consequences."[50] With the exception of the Arctic Monitoring and

---

Straddling Stocks, http://www.oceansatlas.org/servlet/CDSServlet?status=ND0xOTk0MSY2PW VuJjMzPSomMzc9a29z (last visited June 27, 2010).

44. ROB HUEBERT & BROOKS YEAGER, A NEW SEA: THE NEED FOR A COOPERATIVE FRAMEWORK FOR MANAGEMENT AND CONSERVATION OF THE ARCTIC MARINE ENVIRONMENT 40 (2008), *available at* http://assets.panda.org/downloads/a_new_sea_jan08_final_11jan08.pdf.

45. *See* North East Atlantic Fisheries Commission, Managing Fisheries in the NEAFC Regulatory Area, http://www.neafc.org/managing_fisheries (last visited May 12, 2010).

46. *See* North Atlantic Fisheries Organization, About NAFO, http://www.nafo.int/about/frames/about.html (last visited May 12, 2010).

47. *See* North Pacific Fisheries Management Council, About the Council, http://www.fakr.noaa.gov/NPFMC/about.htm (last visited May 12, 2010).

48. ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1. The ACIA was commissioned by the Arctic Council in 2000 and prepared by two of its working groups, the Arctic Monitoring and Assessment Program and the Conservation of Arctic Flora and Fauna, and the International Arctic Science Committee (IASC). *See id.*; ACIA EXECUTIVE SUMMARY, *infra* note 53; ACIA, ARCTIC CLIMATE IMPACT ASSESSMENT, POLICY DOCUMENT (2004). The ACIA Synthesis Report, Scientific Report, and Policy Report can be found at http://www.acia.uaf.edu.

49. The IASC is a non-governmental organization that "facilitates cooperation in all aspects of arctic research in all countries engaged in arctic research and in all areas of the arctic region." ACIA, Arctic Climate Impact Assessment, http://www.acia.uaf.edu/ (last visited July 4, 2010); *see* International Arctic Science Committee, Arctic Portal, http://web.arcticportal.org/iasc/ (last visited June 30, 2010).

50. ACIA, Arctic Climate Impact Assessment, http://www.acia.uaf.edu/ (last visited July 4, 2010).

Assessment Program's (AMAP) Arctic pollution report in 1998,[51] ACIA serves as the first Arctic-wide assessment of the impacts and consequences of climate change on the region. Thus, the ACIA report provides the most definitive, well-regarded, and detailed Arctic climate change data to date, at a scale that is meaningful for purposes of regional fishery management and governance regimes.

ACIA's assessments utilized peer-reviewed publications, indigenous knowledge, and other documented data to analyze environmental, human health, social, and economic impacts of climate change to recommend future actions. The ACIA's regional focus complements the suite of Intergovernmental Panel on Climate Change (IPCC) reports, and has been reinforced by subsequent IPCC assessments.[52] The ultimate goal of ACIA's work was to provide important and reliable data to governments, organizations, and indigenous peoples of the region in order to support policy processes and the IPCC's work on climate change.

The ACIA defines the marine Arctic boundaries as

> the Arctic Ocean, including the deep Eurasian and Canadian Basins and the surrounding continental shelf seas (Barents, White, Kara, Laptev, East Siberian, Chukchi, and Beaufort Seas), the Canadian Archipelago, and the transitional regions to the south through which exchanges between temperate and arctic waters occur. The latter includes the Bering Sea in the Pacific Ocean and large parts of the northern North Atlantic Ocean, including the Nordic, Iceland, and Labrador Seas, and Baffin Bay. Also included are the Canadian inland seas of Foxe Basin, Hudson Bay, and Hudson Strait.[53]

Because "[p]hysical, biological, and societal conditions vary greatly across the Arctic," as do changes in climate and ultraviolet radiation, the ACIA specified four major regions in its report: the Northeast Atlantic, the Central North Atlantic, Northeast Canada, and the North Pacific.[54] These regions were "identified based on differences in large-scale weather- and climate-shaping factors" in order to prevent overgeneralization and over-specialization.[55]

---

51. AMAP, AMAP ASSESSMENT REPORT: ARCTIC POLLUTION ISSUES (1998), *available at* http://www.amap.no/documents/index.cfm?dirsub=/AMAP%20Assessment%20Report%20-%20Arctic%20Pollution%20Issues. AMAP is one of the Arctic Council's working groups, and is responsible for monitoring the levels of, and assessing the effects of, anthropogenic pollutants in all aspects of the Arctic environment, including humans. *See* AMAP, Welcome to AMAP—The Arctic Monitoring and Assessment Programme, http://www.amap.no (last visited May 12, 2010).

52. The ACIA was published between the third and fourth IPCC assessment and contributed to the fourth assessment.

53. ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, at 454.

54. *Id.* at 2. For a detailed map of how the ACIA demarcated the regions, see ACIA, IMPACTS OF A WARMING ARCTIC: ARCTIC CLIMATE IMPACT ASSESSMENT: EXECUTIVE SUMMARY 18–19 (2004) [hereinafter ACIA EXECUTIVE SUMMARY], *available at* http://amap.no/acia.

55. ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, at 2.

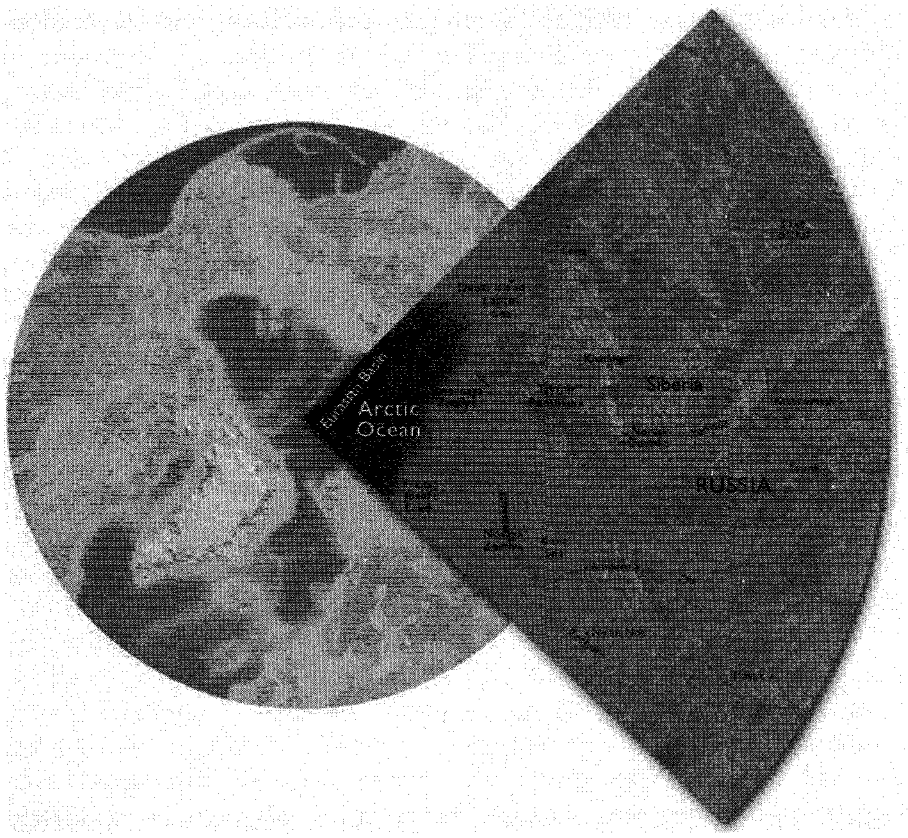

FIGURE 1: NORTHEAST ATLANTIC (©2004, ACIA)

1. Northeast Atlantic[56]

The Northeast Atlantic region encompasses the Barents Sea to the east and north, the northern and eastern parts of the Norwegian Sea to the south, and portions of Norwegian and Russian EEZs.[57] Regional fishing activities are highly lucrative—in 2001 alone, 2.1 million tons of fish were exported from the region, amounting to a gross revenue of more than US$2 billion.[58] Norway's primary commercial stocks include Northeast Atlantic cod, herring, and northern shrimp, and Russia's primary catch is Northeast Atlantic cod.[59] Regional fish stocks' seasonal

56. *See id.* at 695–709 for full details of the region.
57. *Id.* at 695.
58. *See id.* at 701.
59. *See id.*

migrations correlate with ice formation and melting, and interactions between species have significant impacts on the size of stocks due to predation and food availability. In particular, cod, capelin, and herring are dominant species in the ecosystem, and their interactions affect not only other fish stocks, but also marine mammals and birds due to predator-prey relationships.[60] Migrations also generally follow populations of smaller food fish.[61] The majority of commercial stocks are fished within the Norwegian EEZ, although the spawning grounds of most fish in the area are along the coasts of both Norway and Russia, and most stocks move between the EEZs of two or more countries.[62]

The political and legal setting of the region is highly complex. Norway and Russia have various joint management regimes and bilateral agreements, and cooperation on resource management issues is generally functional.[63] For instance, the two countries have agreed on joint management of the Barents Sea fisheries since 1975.[64] There are two areas of "high seas,"[65] however—the "Loophole" in the Barents Sea and the "Herring Hole" in the Norwegian Sea—which present issues of illegal, unreported, and unregulated fisheries exploitation.[66]

The economic importance of the regional fishing sector cannot be overstated. Fish are one of the main export earners for Norway, comprising 14 percent of all exports.[67] Russia is somewhat less economically dependent on fisheries, as most of its catches are landed abroad.[68] Fisheries also play a key role in the social structure of the region—many northern coastal communities have been intricately connected to fisheries economically, historically, and socially for the past thousand years.[69] Additionally, regional fisheries activities are important to fishers from outside of the region, particularly those from southern Norway and Europe.[70]

---

60. *See id.* at 696 (citing Bogstad et al., *MULTSPEC—A Multi-Species Model for Fish and Marine Mammals in the Barents Sea*, 22 J. N. ATLANTIC FISHERY SCI. 317 (1997).

61. *See id.*

62. *See id.*

63. *See id.* at 704.

64. *See id.* at 695.

65. As defined above, the term "high seas" refers to those areas of the ocean not included in the territorial sea or internal waters of a State, and located outside of any one country's sovereignty. *See supra* Part I.A.

66. *See* ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, at 707.

67. *Id.* at 700.

68. *See id.* at 701. The term "landed abroad" generally refers to fish caught by a ship registered to a particular country and then brought to shore and sold in a country different than that to which the ship is registered.

69. *See id.* at 701.

70. *See id.*

FIGURE 2: CENTRAL NORTH ATLANTIC (©2004, ACIA)

2. *Central North Atlantic*[71]

The Central North Atlantic region consists of Iceland and Greenland.[72] The dominant commercial stocks for Iceland include Atlantic cod and capelin, and Greenland's primary fish stocks include Atlantic cod, marine mammals, and halibut.[73] Icelandic waters are

71. *See id.* at 709—31 for full details of the region.

72. Greenland is considered part of Denmark with a "home rule" government, but see *supra* note 7.

73. *See* ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, at 711–12.

warmer and usually ice-free, enabling relatively easy accessibility to fishing activities, species-rich waters, and tremendous amounts of zooplankton (which serve as a major food source to fish stocks).[74] Conversely, Greenland's waters are cold, sea-ice is common, and there are relatively few commercially exploitable species.[75] However, the two disparate ecosystems are connected by Atlantic cod stocks, which cross into the waters of both countries—the larvae drift from Iceland to Greenland, and some adult fish migrate back to Iceland.[76]

In the year 2000 alone, the export value of fish and fish products from Iceland and Greenland accounted for US$1.2 billion and US$270 million, respectively,[77] and seafood exports continue to serve as major sources of revenue for both countries. The importance of fisheries to Iceland has declined over time, but fisheries revenues are still a significant contribution to the country's economy, especially because the importance to Iceland of indirect impacts of the fishing sector is likely to be underestimated.[78] Additionally, from a social perspective, reduced fisheries yields could be "economically . . . disastrous" for smaller towns.[79] Larger cities would likely see the influx of labor and the revision of current economic activity, and thus, securing good jobs may prove increasingly difficult.[80] It is estimated that such social impacts would take five to ten years to repair in Iceland, and much longer, if at all, for communities in Greenland.[81] The fishing industry is the most important production sector in Greenland, and there is a close connection between the country's gross domestic product (GDP) and the fishing sector.[82] Similarly to Iceland, a decline in fishing activity would also be "devastating" to Greenland since its communities are so highly dependent on fisheries and there is very little alternative employment.[83]

Significantly, the region has undergone several warming and cooling periods over the last century.[84] As such, the effects of changing climatic conditions on regional fish stocks have been well-studied, and the region presents an effective platform from which to project future climatic and fisheries trends.

---

74. *See id.* at 709–10.
75. *See id.*
76. *See id.* at 710.
77. *See id.* at 723–24.
78. *See id.* at 724.
79. *Id.*
80. *See id.*
81. *See id.*
82. *See id.*
83. *Id.*
84. For instance, the Central North Atlantic experienced warming in the 1920s and 1930s, cooling in the 1940s and 1950s, sharp cooling in the 1960s, and warming now again. *See id.* at 730–31.

TABLE 1. SUBREGIONAL ANALYSIS COMPARING PRIMARY FISH STOCKS, GROSS REVENUE FROM FISHERY EXPORTS, AND ECONOMIC AND SOCIAL IMPORTANCE OF THE FISHERIES SECTOR IN EACH REGION

	Northeast Atlantic	Central North Atlantic	Northeast Canada	North Pacific
Primary Fish Stocks	Norway: Northeast Atlantic cod, herring, northern shrimp Russia: Northeast Atlantic cod	Iceland: Atlantic cod, capelin Greenland: Atlantic cod, marine mammals, halibut	capelin, polar cod, Atlantic cod, halibut	walleye pollock, Pacific cod, flatfish, salmon, crabs
Gross Revenue (USD) from Fishery Exports	2001: $2 billion	2000: $1.22 billion (Iceland) $270 million (Greenland)	2001: $189 million	2001: $1.4 billion (U.S.) $3 billion (Russia)
Economic Importance of Fisheries Sector	Norway: HIGH Russia: MEDIUM-HIGH	Iceland: HIGH Greenland: HIGH	LOW	HIGH
Social Importance of Fisheries Sector	Norway: HIGH Russia: HIGH	Iceland: HIGH Greenland: HIGH	HIGH	LOW-MEDIUM (mostly large-scale commercial operations and distant water fisheries)

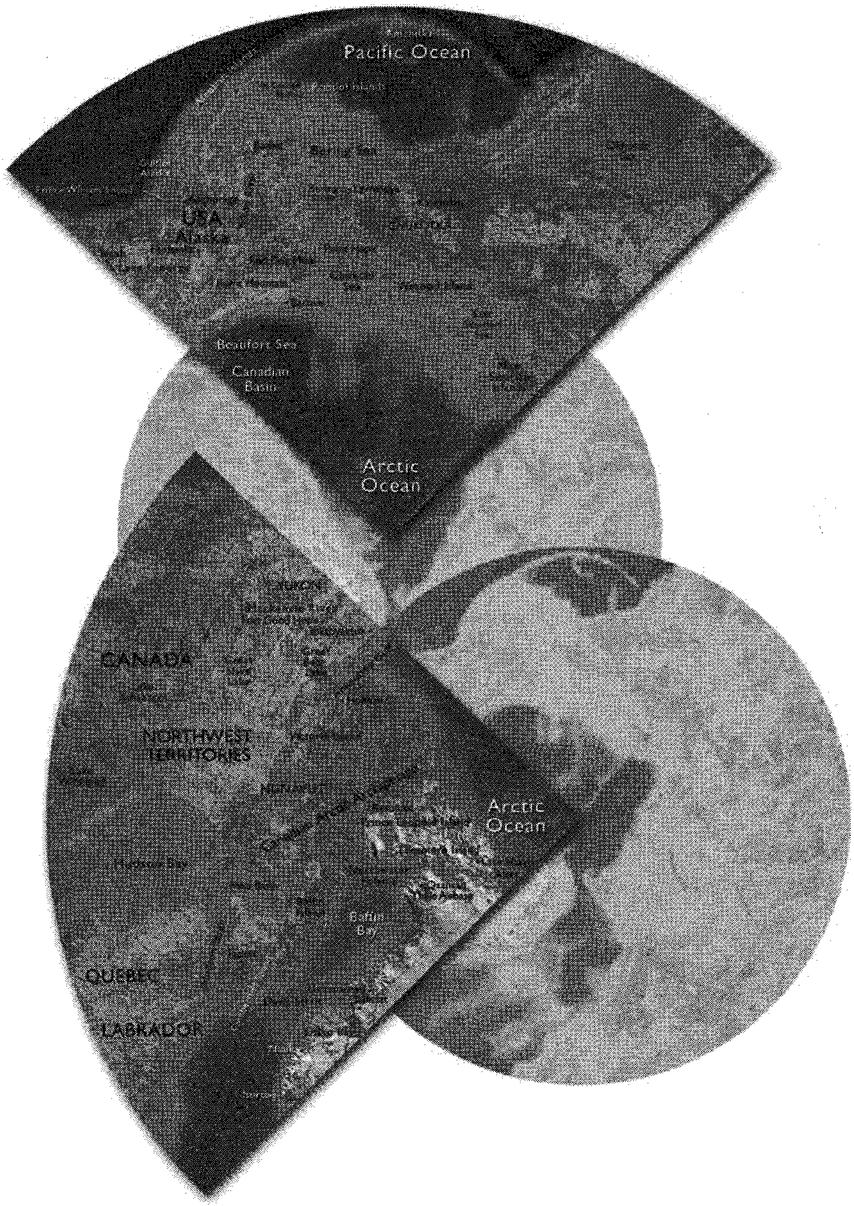

FIGURE 3: NORTHEAST CANADA (BOTTOM)
AND NORTH PACIFIC (TOP) SUBREGIONS (©2004, ACIA)

3. *Northeast Canada*[85]

The Northeast Canada region is comprised of Newfoundland and the Labrador area, including waters near the coasts of Canada and Greenland, as well as deep waters between the two countries.[86] Commercially dominant species in the region include capelin, polar cod, Atlantic cod, halibut, and others.[87] The ecosystem off of the northeastern coast of Canada has relatively few species of commercial value, but some of those species are found in great abundance.[88] There has been a dramatic shift in fisheries since 1980, at least in part due to massive overfishing of commercial stocks.[89] The region has witnessed major cod declines and fisheries collapses since the 1960s, and formerly undervalued stocks, particularly various crustacean species, are now increasing in commercial importance and value.[90] It is unclear whether the collapses are due entirely to overexploitation, or to what extent, if any, changes in water temperatures and ice-cover may have contributed.

Politically, the region is entirely within the fisheries convention area of the NAFO, an RFMO.[91] As such, all stocks are managed by the coastal states or the NAFO. There are no regions of high seas.

The total value of landings in Newfoundland was US$189 million in 2001.[92] Newfoundland is primarily a service economy, so fishing is not critically important to the country's financial security.[93] From a social perspective, however, fishing has "dominated" the history of the country since British colonization in the sixteenth century.[94] Thus, although fisheries are not highly important from an economic standpoint, they are critically important to rural areas and national culture.

4. *North Pacific*[95]

The North Pacific region encompasses the Bering Sea, the continental shelves of the eastern and western Bering Sea, and U.S. and Russian waters.[96] Dominant commercial species include walleye pollock,

---

85. See *id.* at 731–46 for full details of the region.
86. *See id.* at 731.
87. *See id.* at 732.
88. *See id.*
89. *See id.* (changes in the physical environment may have also played a role in fish stock alterations).
90. *See id.* at 733–35.
91. *See id.* at 731.
92. *See id.* at 742.
93. *See id.* at 741.
94. *Id.* at 732.
95. See *id.* at 746–68 for full details of the region.
96. *See id.* at 746–47.

Pacific cod, flatfish, salmon, and crabs.[97] The region includes one of the most productive and largest fishing areas in the world—for instance, a total of 25 percent of the *global* yield of fish came from the Bering Sea in the 1970s.[98] In 2001, the United States exploited US$426 million worth of fish (the processed value of the catches totaled US$1.4 billion) and Russia brought in revenues of US$3 billion.[99]

Politically, there are numerous bilateral and multilateral fisheries agreements governing the area.[100] The Bering Sea separates the continental shelves on the Russian and American sides and falls partly outside of the EEZs of the two countries.[101] This area of high seas is known as the "Doughnut Hole."[102]

Most of the fishing in the Bering Sea is done by large-scale trawl fisheries. Thirty percent of catches are processed at sea, with the rest delivered to the U.S. and Russian mainlands.[103] As such, due to high cost and restricted service availability, most fishing vessels in the area have their home port outside of the immediate region.[104] Fishing is very limited north of the Bering Strait, due to the lack of natural resources, difficulties operating fishing vessels, and the vast distance from markets.[105] Although the majority of vessels are registered outside of the region, the land side of the fishing industry (such as processing plants) is also economically important.[106] There have also been major changes in commercial fisheries regarding the distribution of harvests among nations, as well as shifts in overall species compositions due to varying environmental conditions and overfishing.[107]

The commercial fishing industry for the region is relatively new compared to other Arctic areas. Therefore, it is difficult to predict the adaptability of the fishing sector to climatic alterations, because it has not been tested under past changes in ecological conditions.

---

97. *See id.* at 747–52.
98. *See id.* at 746.
99. *See id.* at 762–63. Note, however, that "[e]conomic value data for the Russian Far East are difficult to locate" and as such, the figure of US$3 billion is based on press reports. *Id.*
100. *See id.* at 765.
101. *See id.* at 746.
102. *See id.* at 747. This is also spelled "Donut" hole, depending on the source. *See id.*
103. *See id.* at 763.
104. *See id.*
105. *See id.* at 747.
106. *See id.* at 763–64.
107. *See id.* at 766.

II. EFFECTS OF CLIMATE CHANGE ON EXISTING FISHERIES STOCKS

A. *Problems of Scientific Uncertainty*

Uncertainty plays a major role in attempting to clarify how fish populations will respond to climate change. Is it possible to reduce uncertainty on a useful time scale at a reasonable cost? Moreover, does uncertainty make it easier or more difficult to work out effective governance regimes and fisheries management arrangements in the present? There are three major types of uncertainties inherent in the Arctic system with respect to defining climate change impacts pertinent to this Note.[108]

The first type of uncertainty revolves around the study of historical changes in fish biology and ecosystem resilience throughout the Arctic region due to previous climatic fluctuations. This is due to the scale and extent of overfishing and exploitation over past centuries, which have altered both the fisheries themselves and marine ecosystems as a whole. It may be possible to use past variations in climate and effects on fisheries populations as a model for how to manage and prepare for future climate change impacts on Arctic fisheries. However, it is unclear whether fish stocks, and even particular species, will respond to future climatic changes in the same way they have in the past. It is also important to note that fishing pressure and exploitation "have a strong potential to alter . . . [and] modify the outcome of climate-induced changes."[109] Thus, it is difficult to determine whether historical fishery collapses were due primarily to over-exploitation, or whether environmental change also played a defining role.[110]

A second source of uncertainty concerns future climate change effects. Climatic variability causes seasonal alterations in the location of the most productive fishing grounds and leads to "changes in abundance and catchability that are as-yet imperfectly understood."[111] This uncertainty creates great difficulty for scientists suggesting or developing management regimes for fisheries exploitation. As a result, projections of climate change impacts on marine systems have been based largely on

---

108. *See id.* at 693–94. *See* Schrank, *supra* note 9. There is another major type of uncertainty, which centers on the causes (natural or anthropogenic) of past changes of fish populations. This factor in and of itself is not controlling in the discussion at hand, however. Governance regimes and the fishing industry must adapt to changes exacerbated or caused by climate change regardless of what specifically caused the changes.

109. MacKenzie, *supra* note 10, at 1360.

110. *See generally* Schrank, *supra* note 9; ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1.

111. Kathleen Miller, *Climate Variability and Tropical Tuna: Management Challenges for Highly Migratory Fish Stocks*, 31 MARINE POL'Y 56, 66 (2007).

scientific predictive models, especially with regard to potential changes in thermohaline circulation.[112] However, modeling is difficult to replicate and presents difficulties when trying to project changes in climate. For instance, "current climate models do not include scenarios for ocean temperatures, watermass mixing, upwelling, or other relevant ocean variables" either on a global or regional basis.[113] Fish stocks depend on these variables for survival, so the models' uncertainty is a key factor in future projections; indeed, these numerous inter-dependent factors, lumped together in the models as an "uncertainty," will determine much of the extent and severity of future fisheries changes.

Another difficulty in determining future climate change effects arises because Arctic species belong to many distinct ecosystems, and it is unclear how the interaction and dynamics between these systems will play out in the future. Fisheries management scientists agree that harvesting is just one of many variables that affect fish stocks, and often not even the most significant one. "Changes in natural conditions, especially water temperature and salinity, can often have a considerable impact; and the same goes for much discussed but little understood interrelationships between various components in marine ecosystems."[114]

The third type of uncertainty lies in accurately predicting social, economic, and political responses to potential fish stock changes. This specific component of uncertainty is discussed in more detail in Part III of this Note, *Climate Change and Fisheries Management.*

A tangible example of how various scientific uncertainties may play out in reality is best exemplified by the Northeast Atlantic geographic analysis below. The examination is a prime example of how changes in fish stock distribution, abundance, and migrations will significantly affect state fishery industries, and highlights the extent to which numerous factors interrelate to determine the final outcome of climate change effects.

1. Regional Example: Northeast Atlantic[115]

The Northeast Atlantic includes the North Sea, the Norwegian Sea, and the Barents Sea. Russia and Norway are the dominant countries in this region, and most fish stocks are found in the Norwegian EEZ.

---

112. *See* explanation of thermohalines *infra* note 130.

113. ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, at 770.

114. Olav Schram Stokke, Lee G. Anderson & Natalia Mirovitskaya, *The Barents Sea Fisheries*, *in* INTERNATIONAL ENVIRONMENTAL REGIMES: CAUSAL CONNECTIONS AND BEHAVIORAL MECHANSISMS 114 (Oran Young ed., 1999).

115. The information in this geographic analysis is cited from, and can be found in much greater detail at, the following two sources: Stenevik & Sundby, *supra* note 9, at 19–31; ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, at 695–709.

Warming temperatures are expected to have significant impacts on many of the major commercial fish stock compositions and distributions, the abundance of prey species, and the length of time fish stocks spend in the Norwegian Sea.

The North Atlantic Oscillation (NAO) is the difference in sea-level atmospheric pressure zones in the Azores and Iceland. This large-scale pattern of natural climate variability serves a critical role in impacting wind patterns, weather, and climate in the region and surrounding continents. The NAO also significantly impacts ocean circulation patterns and sea temperatures, and is a dominant factor in many biological systems, including fisheries. There is still substantial scientific uncertainty as to what ecological and atmospheric processes govern NAO variability, however, especially in the context of climate change. Scientists have forecasted various potential scenarios that could play out for the Northeast Atlantic region, depending on how the NAO responds to climate change.

The most likely scenario includes a high NAO and inflow of Atlantic water due to increased effects of climate change. In the North Sea, ecosystem change is predicted to cause a generally northward movement of species. Water temperature increases of one to three degrees Celsius in the next fifty years will have major impacts on circulation, regional ecology, and the movement of plankton and prey species. There will likely be a northward shift in all species, and increased biomass in the Arctic region, but the current fish stocks in the North Sea will decline. New species from the south—not currently present in the North Sea—will likely modify their ranges and fill the gaps left by northerly migrating species. Although the total abundance of species will not change significantly, the species compositions will be dramatically different than what is currently present and overall catch value will decrease.

The Norwegian Sea, however, will generally benefit from the warming and see an increased abundance of species. This increase in abundance may be considerable—for instance, in the 1920–30 local warming period, the biomass of herring increased tenfold. The Barents Sea will also experience increased temperatures in the southern and eastern parts of the Sea, causing a more northeastern distribution of capelin and cod—thereby reducing the amount of time the species spend in the Norwegian EEZ.

As a result of the changes above, overall negative effects on the Norwegian EEZ could be tremendous. The EEZ is currently the most productive portion of the region and comprises more than 40 percent of the total regional area. In the winters, more than three-quarters of cod populations are confined to the Norwegian EEZ because of ice cover and abundance of prey species. However, as ice cover retreats and declines due to climate change, two-thirds of the cod stock may still use the

Norwegian EEZ for spawning habitat; but, more stock, and a much higher biomass, will be seen moving into the Russian EEZ.

Although scientists hypothesize that the scenario presented above is the most likely to occur, high uncertainty associated with changes to the NAO may result in quite different changes to the ecosystem. For instance, the NAO could be reduced, leading to a decreased inflow of Atlantic water. In the North Sea, the effects of a reduced NAO will increase the probability of recruitment and population growth of current species, but many southern stocks will not increase in abundance, nor extend their distributions northward. A decreased inflow of Atlantic water to the Norwegian Sea will increase water temperatures in the western part of the Sea and cause migration changes in some stocks. The Barents Sea will experience a colder climate and a decrease in prey species abundance due to a reduction in water inflow. However, other stocks will spend more time in the Norwegian EEZ than they otherwise would in the first scenario described above.

As evidenced by the two possibilities above, uncertainty over future climate change impacts in the Arctic can serve to complicate responses and lead to major implications for and impacts to governance regimes, because each option results in different winners and losers. For instance, in the first scenario, Norway faces a major loss in fish abundance in its waters (and therefore economic benefit), while Russia comes out as a clear winner due to increased fish stocks in its EEZ. However, should the NAO be reduced as the result of climate change as in the second scenario, fish stocks will spend even more time in Norway's EEZ, resulting in an increased opportunity for fishing and economic profit. The recognition of this uncertainty paves the way for designing and implementing proactive fisheries governance, policies, and management regimes to adequately deal with the changes that are likely to come.

B. *Climate Change Assessments*

Before analyzing whether an Arctic governance regime can address variations to the status quo of fisheries, it is critical to recognize the magnitude and complexity of potential changes anticipated for the region. The Arctic is currently seeing unprecedented shifts in marine species. However, short- and long-term variations must be distinguished from true climate change effects. Ordinary climatic variability "is something most fishing people are accustomed to, even expect, and they can usually accommodate to it without experiencing serious economic problems—at least if they are not already harvesting their key fisheries resources."[116] Long-term climatic changes, however, present an entirely

116. McGoodwin, *supra* note 5, at 41.

new host of challenges and unexpected impacts both to marine ecosystems and to social and governance structures.

The IPCC is a scientific intergovernmental body created in 1988 by the World Meteorological Organization and the United Nations Environment Program.[117] The IPCC's role is "to assess on a comprehensive, objective, open and transparent basis the latest scientific, technical and socioeconomic literature produced worldwide relevant to the understanding of the risk of human-induced climate change, its observed and projected impacts and options for adaptation and mitigation."[118] As part of its work, the IPCC has released four technical reports detailing the current status of global climate change effects and suggesting paths forward.[119] These reports are regarded as some of the most comprehensive and authoritative analyses available with regard to climate change and potential future impacts on the natural world and society.

The IPCC reports reach the following main conclusions: the earth's temperature is steadily rising and the planet's climate has changed over the last century; the ten warmest years on record have occurred in the last fifteen years; the rise in global temperature and changes in climate have been caused, at least in part, by anthropogenic factors; and climate change will bring about "wide-spread and radical changes in natural ecosystems," though currently there is high uncertainty for how these changes will specifically play out.[120]

In addition to the IPCC, there are numerous institutions and actors which specifically focus their research on climate change effects on the Arctic region, such as the Arctic Council and the IASC. In 2004, the Arctic Council and the IASC created the ACIA, which, as mentioned previously, released its scientific report in 2005 evaluating the current state of scientific knowledge concerning climate change and its effects in

---

117. *See* IPCC, Organization, http://ipcc.ch/organization/organization.htm (last visited May 29, 2010).

118. IPCC, The Role of the IPCC and Key Elements of the IPCC Assessment Process, http://www.ipcc.ch/pdf/press/role_ipcc_key_elements_assessment_process_04022010.pdf (last visited June 30, 2010).

119. The four IPCC Assessment Reports were released in 1990, 1995, 2001 and 2007. IPCC, Reports, http://www.ipcc.ch/publications_and_data/publications_and_data_reports.htm (last visited May 12, 2010).

120. McGoodwin, *supra* note 5, at 42 (citing IPCC 2001 working group report conclusions).

the Arctic.[121] The report concluded that the rate of climatic change taking place in the Arctic is nearly twice that of lower latitudes.[122]

What potential big-picture changes do these reports suggest for fisheries stocks generally? Marine systems are in a constant state of change depending on spatial and temporal scales, and these changes impact fish species' reproduction, recruitment, abundance, and distribution patterns.[123] "Most fish species have a narrow range of optimum temperatures related to both their basic metabolism and the availability of food organisms that have their own optimum temperature ranges."[124] Thus, changes in ocean conditions may shrink, expand, or relocate fish stocks depending on the region and particular species.[125] Given that most historic fisheries data is limited to industrial and recreational exploitation information, however, rather than climatic factors, long-term trends in fish abundance and distribution due to climate change necessarily become difficult to predict with great accuracy.[126]

Even with this general measure of uncertainty, though, specific trends are anticipated to take place in the Arctic over the next few decades that will have significant implications for fisheries as a result of climatic and ecological change to marine ecosystems:

1. *Atmospheric and ocean warming in Arctic and sub-Arctic regions.* The greatest temperature changes over the past 35 years have occurred in the northern pole region. Atmospheric temperatures have risen as much as 7 to 10 degrees Fahrenheit (3.9–5.6 degrees Celsius). Such drastic warming over time could lead to "rapid disruption, alteration, or collapse" of marine ecological systems unable to adapt to such rapid rates of change.

---

121. *See* ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1. The ACIA report was developed at the Fourth Arctic Council Ministerial Meeting in Reykjavik, Iceland on November 24, 2004. Arctic Council, Fourth Arctic Council Ministerial Meeting, http://arctic-council.org/meeting/fourth_arctic_council_ministerial_meeting%2C_reykjavik%2C_iceland%2C_november_24%2C_2004 (last visited May 12, 2010).

122. *See* McGoodwin, *supra* note 5, at 42. Likewise, the Center for Global Change and Arctic System Research (CGCASR) at the University of Alaska reported in 2001 that "[g]lobal climate models indicate that global warming . . . will be most acute in polar regions, most likely resulting in changes in the extent of sea ice, increased thawing of permafrost, and melting of polar ice masses, with profound social impacts around the globe." CGCASR, The Role of the Arctic, http://www.cgc.uaf.edu (last visited May 12, 2010).

123. U.S. National Oceanographic and Atmospheric Administration, Climate Variability and Marine Fisheries, http://www.pfeg.noaa.gov/research/climatemarine/cmffish/cmffishery.html (last visited June 30, 2010).

124. *Id.*

125. *See id.*

126. *See id.*

2. *Decrease in aggregate fish production.* Marine ecosystems will be unable to keep pace with the high rate of environmental change.
3. *Lack of "credible assessment advice" for preventing fisheries collapses and fish migrations.* As temperatures in the Arctic move farther away from historic baseline conditions, many fish species will no longer inhabit regions where they were once abundant. Species shifts and migration changes will become more common. As a result, fisheries scientists and managers will experience increased difficulty in preventing or preparing for widespread fisheries collapses and political conflicts due to altered fish patterns.
4. *Sea level rise between 6 and 37.5 inches above current level, causing persistent coastal flooding in some areas and complete inundation in others.* The extent of sea level rise will lead to substantial marine-ecological change and costly relocation of shore-based fisheries facilities.[127]

Thus far, "climate change scenarios for the ocean are highly uncertain" and research examining climate change effects on fisheries is still in its infancy for a variety of reasons.[128] Long-term changes to natural resources are often difficult to predict because data detailing baseline conditions is scant, or there is no historical information about changing climatic effects on fisheries stocks in the past. In addition, an immense number of possible interrelating factors often determine the extent and severity of changes. For example, even if it is possible to determine the levels at which temperature and salinity will be affected for a particular ocean ecosystem, it still may be unclear how fish distribution, abundance, and migration will be affected, if at all, because of the vast number of other significant variables involved.

Furthermore, although the majority of climate scientists agree that it is more likely than not that ocean temperatures in the Arctic will rise over time, disagreement still exists as to whether ocean temperatures will ultimately rise or fall in specific sub-regions, given the dependency on ocean currents and water movement. For instance, "[t]he temperature and salinity levels of the various water bodies in the marine Arctic vary considerably, reflecting the extent of the Pacific and Atlantic influence, heat exchange with the atmosphere, direct precipitation, freshwater runoff, and the melting and freezing of sea ice,"[129] not to mention regional variations in climate change due to changes in ocean currents, and the

127. McGoodwin, *supra* note 5, at 42–43.
128. Schrank, *supra* note 9, at 9.
129. ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, at 455.

weakening of the Gulf Stream and thermohaline circulation.[130] Thus, while the interaction between these factors has caused general widespread warming for most of the region, "[a] few places, such as parts of Canada and Greenland surrounding the Labrador Sea . . . have actually cooled."[131]

Despite considerable uncertainty, there is relative consensus on some of the broad projections for change, including changes in fisheries abundance and distribution, changes to underlying ecosystems that may indirectly affect target species, and changes in the fisheries industry's accessibility to fishing locations.

C. *Effects of Climate Change on Fisheries*

Environmental conditions dramatically influence the production and distribution of fish populations: they determine reproductive and recruitment success, spatial distributions, stock abundance, migration patterns, rates of growth and mortality, food availability and other factors.[132] "Fisheries are even more dependent than agriculture on climatic conditions," yet humans are unable to control the effects of nature on fisheries the way they can for agriculture (such as increasing irrigation and fertilizers).[133]

Although uncertainty is a major factor in any climate change model, the ACIA stated that changes in ecological trends due to climate warming are "very likely."[134] For instance, the timing and location of spawning and feeding migrations will be altered, the decrease or elimination of seasonal sea ice will lead to changes in zooplankton abundance and increases in primary production (and thus, food sources for commercially important fish species will be affected and expanded), and all of these ecological trends could have major implications for fish stocks.

---

130. *See* Rögnvaldur Hannesson, Editorial, *Introduction*, 31 MARINE POL'Y 1, 1 (2007). "Thermohaline circulation is initiated when cooling and freezing of sea water increase the density of surface waters to such an extent that they sink and are exchanged with waters at greater depth." ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, at 461 (citing Broecker et al., *Does the Ocean-Atmosphere System Have More Than One Stable Mode of Operation?*, 315 NATURE 21, 21-26 (1985)).

131. ACIA EXECUTIVE SUMMARY, *supra* note 54, at 18.

132. *See* MacKenzie, *supra* note 10, at 1348.

133. Hannesson, *supra* note 130, at 1. This Note does not include aquaculture and capture fisheries in its assessment; rather it pertains specifically to wild fish populations.

134. Schrank, *supra* note 9, at 12.

1. Ecosystem Alterations

a. Physical Ecosystem Modifications

Water temperature fluctuations present one of the most important climate change-induced considerations for Arctic ecosystems. According to the ACIA, there is a high degree of certainty that Arctic water temperatures will increase, especially where ice cover is reduced.[135] Fish have an "optimal" ecosystem temperature[136]—a change in ambient temperature of just one degree Celsius leads to behavioral adjustments in many species, and a change of four degrees Celsius leads "to major changes in fish distributions."[137] An increase in water temperatures will most likely lead to northward shifts of fish species, migration changes, geographical extensions of current feeding areas, and increased growth rates.[138] There is also projected cooling in some areas, depending on regional factors.[139]

In addition to increased water temperatures, the melting of the polar ice cap is also a major contributor to climate change impacts on fisheries. The ACIA acknowledged a high degree of certainty that most present-day ice-covered areas are likely to experience reductions in ice extent and coverage, especially in summer months.[140] A decrease in ice cover will likely lead to an increase in primary productivity and increased numbers of zooplankton, and thus, increased fish production.[141] As discussed later in this section, new open areas of the Arctic will also have a great effect on the accessibility of new access areas for fishing and on the ability of fishing fleets to operate year-round in some areas where it was impossible to do so before.

Substantial ice melt is already occurring. For instance, in the summer of 2007, the total area of regularly ice-covered ecosystems in the Arctic shrank by more than one million square miles.[142] The Arctic ice cap is only half of what it was fifty years ago, and the September rate of sea ice decline since 1979 has been recorded at nearly 10 percent per decade.[143]

---

135. *See* ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, *passim*.
136. Stenevik & Sundby, *supra* note 9, at 24.
137. *Id.*
138. *See, e.g.*, *id.* at 23–24. *See generally* ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, ch. 13.
139. *See, e.g.*, Stenevik & Sundby, *supra* note 9, at 20–22. *See generally* ACIA ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, ch. 13.
140. *See generally* ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, ch. 4.
141. *See id.* at 505.
142. Scott Borgerson, *Arctic Meltdown: The Economic and Security Implications of Global Warming*, FOREIGN AFF., Mar.–Apr. 2008, at 63, 63.
143. *See id.*; National Snow and Ice Data Center, http://nsidc.org/news/press/2007_seaiceminimum/20071001_pressrelease.html (last visited June 30, 2010). The monthly average

Looking to the future, ACIA models project that the extent of winter ice will continue to decrease (ranging from several percent to a complete loss depending on the region), culminating in winter ice-free areas in the high Arctic by 2080.[144] Sea ice cover is important to fisheries in a variety of ways, as it affects albedo (the extent to which a material reflects light from the sun), salinity levels, and thermocirculation.

Increased water temperatures and sea ice melt are not the only physical ecosystem components of concern when assessing future fisheries impacts. A third crucial factor is the potential for alterations to ocean thermohaline circulation patterns.[145] Unlike water temperature and sea ice cover, however, there is still a great deal of uncertainty surrounding this factor.

Thermohaline circulation occurs "when cooling and freezing of sea water increase the density of surface waters to such an extent that they sink and are exchanged with waters at greater depth."[146] This circulation pattern takes place in the Labrador Sea, the Nordic Seas, and on the arctic shelves.[147] Once the dense North Atlantic water sinks, it flows out of the Arctic ocean basin in a deep southward current. Salty, tropical waters replace the surface waters and flow north, releasing heat into the atmosphere and moderating the climate of the North Atlantic region. This "conveyor-like movement of water" is called the Atlantic meridional overturning circulation (MOC).[148]

---

sea ice extent for September is commonly used to compare the current year's minimum against the long-term monthly average. *See id.*

144. *See* ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, at 997, 1005. However,

> [t]he decreasing trend in extent of summer arctic sea ice has massively accelerated since publication of [the] ACIA, with the two lowest years on record occurring in 2005 and 2007. . . . [T]he recent acceleration in sea-ice retreat is not captured by most models. Many scientists now speculate that a 'tipping point' could soon be reached, in which multiple positive feedback effects will send sea ice into a low from which it cannot recover—a process which is inadequately simulated in models. After the 2007 low in sea ice extent, scientists at the National Snow and Ice Data Center (NSIDC) speculated that an ice-free Arctic Ocean in summer could occur by 2030. And in a recent synthesis of model results with observations, Whelan et al. (2007) predicted that there will be no summer arctic sea ice by 2013.

World Wildlife Fund, ACIA UPDATE, *supra* note 1, at 7–8.

145. *See* ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, at 461–65.

146. *Id.* at 461 (citing Broecker et al., *Does the Ocean-Atmosphere System Have More Than One Stable Mode of Operation?*, 315 NATURE 21, 21–26 (1985)).

147. *See id.*

148. Bob Dickson & Stephen Dye, *Interrogating the Great Ocean Conveyor*, OCEANUS, Sept. 6, 2007, http://www.whoi.edu/oceanus/viewArticle.do?id=20727 ("8.5 million cubic meters (225 million U.S. gallons) of warm, salty Atlantic water passes north across the Greenland-Scotland Ridge per second . . . . As dense water returns south and flows over the ridge, its salinity has decreased from about 35.25 to 34.88 salinity units, and its temperature has dropped from 8.5°C (47°F) to 2°C (35.6°F) or less. Not surprisingly, the ocean's surrendering of that amount of heat to the atmosphere has more than local climatic importance.").

The MOC affects fish distribution, impacts larvae transport and recruitment, determines salinity levels and water density, recycles nutrients, and impacts other factors that fish and marine resources depend upon for survival.[149] The ACIA predicts that "if the current warming trend continues, increasing precipitation, snow melt, and freshwater runoff will reduce the cooling effect in the Arctic waters, thus slowing the thermohaline circulation, resulting in increased sea level and reduced upwelling of nutrients."[150] There is a high degree of certainty that there will be a thermohaline circulation slowdown this century, but great uncertainty as to the level of climatic change necessary to bring about an abrupt transition or the associated impacts.[151] The IPCC states with medium confidence (33–67 percent) that global thermohaline circulation will weaken due to climate change. Changes in thermohaline circulation could have massive effects on the Arctic, and on global climate and economy.[152] What effects a weakened MOC could have on marine ecosystems is still very uncertain, but it is possible that the result could be immense. A slowed MOC could also lead to *cooler* water temperatures in the Northeast Atlantic.

b. Biotic Changes

The most significant biotic change to fisheries initiated by climate change is a potential transformation in prey distribution and availability of food sources. Between 1958 and 1999, warm water plankton communities underwent a major northward shift in the eastern North Atlantic by ten degrees latitude (1000 km).[153] In addition to the northern advancement of warm water plankton, cold water plankton are moving out of the North Sea.[154] The impact to fisheries of moving plankton and prey distribution is clear: the abundance of fisheries in any system depends on the quantity and composition of plankton, and the breeding

149. *See* UNITED NATIONS ENVIRONMENT PROGRAMME [UNEP], IN DEAD WATER: MERGING OF CLIMATE CHANGE WITH POLLUTION, OVER-HARVEST, AND INFESTATIONS IN THE WORLD'S FISHING GROUNDS 9, 38–41 (Christian Nellemann et al. eds., 2008). *See generally* Schrank, *supra* note 9.

150. Schrank, *supra* note 9, at 7–8; *see* Harry Bryden et al., *Slowing of the Atlantic Meridional Overturning Circulation at 25°N*, 438 NATURE 655, 655–57 (2005).

151. *See* UNEP, *supra* note 143, at 40.

152. *See generally* Schrank, *supra* note 9.

153. Group on Earth Observations, Continuous Plankton Recorder (CPR) Survey, http://www.earthobservations.com/documents/sbas/ec/85_The%20Continuous%20Plankton%20Recorder%20survey.pdf (last visited July 11, 2010).

154. Grégory Beaugrand et al., *Biodiversity and Climate Reorganization of North Atlantic Marine Copepod*, 296 SCIENCE 1692, 1692–94 (2002). Even more astonishing is the fact that in 1998 a planktonic plant was recorded in the Northwest Atlantic for the first time in 800,000 years, due to a transfer across the top of Canada facilitated by high rates of melting ice. *See* UNEP, *supra* note 149, at 38 fig.9.

and recruitment success of fish populations directly depend on the timing and matching of fish larvae with suitable planktonic food.

c. Accessibility of Fishing Locations

A reduction in the extent and duration of sea ice is likely to increase fishing activity and exploitation. Sea ice melt and associated ecosystem changes will create openings to previously inaccessible fishing channels and increase the time period available for access to fishing grounds. It will also likely affect some fisheries more strongly than others, depending on whether fish stocks are harvested during spawning seasons. As such, it is possible that even small commercial fisheries could have significant impacts on the arctic ecosystem as a whole and lead to even greater ecosystem damage in the future.

2. *Alterations in Fisheries Stocks and Abundance*

> Climate change is predicted to drive species ranges toward the poles, potentially resulting in widespread extinctions where dispersal capabilities are limited or suitable habitat is unavailable. For fishes, climate change may strongly influence distribution and abundance through changes in growth, survival, reproduction, or responses to changes at other trophic levels. These changes may have impacts on the nature and value of commercial fisheries.[155]

a. Range Shifts

Changes attributed to climate change in the North Sea have taken place over the last fifty years with a temperature increase of only 0.6 degrees Celsius between 1962 and 2001.[156] "Temperatures are expected to continue to increase, with a possible . . . increase of 6°C north of the latitude of Scotland by 2100 which, if it occurs, will lead to a further poleward movement of marine organisms."[157]

Research examining the distributions of North Sea fisheries stocks in response to historical changes in temperature shows pronounced trends in species shifts in mean latitude, depth, or both over a twenty-five year time period.[158] In a study of thirty-six fish species, twenty shifted northward, with significant changes in distributional boundaries for half of these fish.[159] Most of these same species also shifted into deeper waters,

155. Perry, *supra* note 9, at 1912 (citations omitted).

156. *See id.*

157. UNEP, *supra* note 143, at 38 (predicting temperature change on an annualized basis, averaged over the extent of the area).

158. *See* Perry, *supra* note 9, at 1912.

159. *See id.* at 1912–13.

and six species moved deeper offshore or into areas of deeper water in response to increased temperatures, but did not change latitude.[160] The study determined that "fishing alone could not explain climate-related shifts,"[161] and that climate change is having observable effects on fish distributions such that "observed rates of boundary movement with warming indicate that future distribution shifts could be pronounced."[162]

The study also highlights the fact that climate change will likely threaten fish populations with slow life histories which are unable to reproduce quickly when overexploited, and that species will not uniformly shift northward at the same pace. The resulting spatial overlap of species could have significant impacts on species interactions, predation rates, competition for food and resources, and breeding success. Moreover, "[s]uch changes could have unpredictable effects in an ecosystem already under heavy anthropogenic pressure."[163]

Range shifts and atypical movement patterns will have a significant effect on fisheries governance structures and interactions between Arctic countries. Transboundary migrations and distribution mean that fish stocks will cross over into national EEZs or high seas territory where they did not previously. For instance, warming water temperatures will cause some species to move northward, either entirely out of their present geographic range or extending the boundary of their current range. Other species may soon move into areas where they were never recorded before.

A timely example of how such a climate change-induced transboundary distribution of fishery resources may occur can be found in examining the management and ownership of the Pacific sardine stocks currently off the western coast of North America.[164] Although not Arctic-specific in scope, the dilemma is one which is easily transferable to any region. Variation of Pacific sardine abundance and distribution is often correlated with environmental fluctuations in sea surface temperature and ecosystem conditions.[165] Sardine populations increase as water temperatures warm, and as climate change effects become more pronounced and severe, it is possible that Pacific sardine stocks could soon occur within the EEZs of Canada, the United States, and Mexico.[166] As such, management decisions will depend on whether there is a

160. *See id.*

161. *Id.* at 1913.

162. *Id.* at 1914.

163. *Id.*

164. *See generally* Samuel Herrick Jr. et al., *Management Application of an Empirical Model of Sardine-Climate Regime Shifts*, 31 MARINE POL'Y 71 (2007).

165. *See id.* at 72–73.

166. *See id.* at 77–78.

cooperative transboundary management plan in place between the neighboring countries.[167]

Such international cooperation could provide "dynamically located, moving refuges for sardine populations that would insure the preservation of seed stocks sufficient to rapidly expand and fill the entire range with harvestable populations when environmental conditions are favorable."[168] For example, if such a plan is in place, it could help guarantee that the sardine population will be sustainably harvested in Mexico, thereby allowing the stocks to adequately recover and expand northward into the United States and Canada. Alternatively, if cooperation breaks down, Mexico's harvest rate may increase so substantially that few, if any, harvestable stocks move into U.S. waters, much less into Canadian waters. As such, focusing on the establishment of a viable cooperative transboundary management regime will increase nations' "abilit[ies] to analyze climate shifts and monitor their effects on the sardine populations[in order to] reduce uncertainty in making resource management, social, and business decisions."[169]

In addition to transboundary migration issues, the impact of climate change on currently depressed fish stocks is an entirely separate concern which must also be addressed in terms of current fishing activities, claimed jurisdictional authority, and economic and social impacts.

b. Population Trends

The southern limit of distribution for colder water fish species, such as capelin, polar cod, and Greenland halibut, will likely move northward due to climate change, thereby shrinking the species' current range and leading to a decline in abundance.[170] For more southernly fish species, such as Atlantic cod, herring, and walleye pollock, the distributions will likely move northward, thus expanding the species' current ranges and leading to an increase in overall abundance.[171] The increased distribution for southerly fish species will most likely result from increased food production due to reduced sea ice, and "extensive expansions" of habitat for cod and herring in particular.[172]

Generally, scientists expect that climate change effects will result in greater fish stock abundance in most fisheries, northerly poleward migrations of fish stocks, and improved overall productivity due to warmer waters and the melting of ice caps. However, it is difficult, if not

167. *See id.*
168. *Id.* at 77.
169. *Id.* at 71.
170. *See* Schrank, *supra* note 9, at 12.
171. *See id. See generally* ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, at 692–772.
172. ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, at 692.

impossible, to quantify these effects and confirm anticipated results with certainty.

3. *Impacts on the Four ACIA Arctic Regions*

In most Arctic areas, temperatures are likely to continue to increase, resulting in a northward distribution shift of species, potential changes in migration times, changes to feeding areas, and increases in fish growth rates.[173] Moreover, "moderate warming will improve conditions for some of the most important commercial fish stocks, e.g. Atlantic cod, herring, and walleye pollock."[174]

However, climate change impacts on the region will not be uniform. As mentioned previously, the ACIA examined climate change effects on the Arctic by dividing the region into four major geographical areas—the Northeast Atlantic, Central North Atlantic, Northeast Canada, and the North Pacific.[175] Within the Northeast Atlantic, substantial short term change (by 2020) is very unlikely, but warming is likely in longer-term scenarios.[176]

In the Central North Atlantic, primary and secondary production[177] has historically increased in warm periods, with the opposite effect occurring during periods of cooling.[178] Although greater production (that is, greater levels of organic material available to support herbivores and carnivores) often leads to higher populations of fish stocks, modifications are highly dependent on the size of the current stock and fish-prey relationships. In Iceland, for instance, climate change is unlikely to have great impacts on fisheries stocks over the next fifty to one hundred years.[179] Changes that do take place will likely be beneficial, assuming the climate change impacts are gradual in scope and severity.[180] If drastic changes occur, however, short-term impacts on Iceland's gross domestic product (GDP) could be significant, due to substantial economic losses from fishery declines. In Greenland, like in Iceland, scientists suggest that gradual climate change effects over the next fifty to one hundred years will benefit the region's valuable fish stocks.[181] Even the possibility of drastic changes may not be a major concern to the Greenland's GDP,

---

173. *See id.* at 694.
174. *Id.* at 692.
175. *See* ACIA EXECUTIVE SUMMARY, *supra* note 54, at 18–19.
176. *See* Northeast Atlantic regional example, *supra* Part II.B.
177. Primary production is traditionally known as productivity of autotrophic organisms (primarily algae and phytoplankton in the marine ecosystem), whereas secondary production is the productivity of heterotrophic organisms (herbivores, carnivores and detritivores).
178. *See* ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, at 719.
179. *See id.* at 727.
180. *See id.* at 731.
181. *See id.*

since warmer waters will allow for a greater biomass of fish species to survive in surrounding waters.

In Northeast Canada, the major source of uncertainty is the direction and magnitude of change in oceanographic variables such as water temperatures and ocean circulation. With moderate warming, cod and capelin stocks will likely move northward, although current capelin spawning beaches will disappear due to sea level rise. An increase in temperatures will also slow the growth of crustaceans, leading to a cod-capelin ecosystem reminiscent of the past, before the fish stocks declined in the 1990s and crab became the dominant local fishery.[182] Gradual warming may also lead to a shift of more southernly species (such as haddock, squid, mackerel, and bluefin tuna) into the area, which could create new opportunities to exploit these previously absent fish stocks. Warming will likely have negative repercussions on most marine mammal predators due to changes in and loss of sea ice:

> Reduced sea-ice extent and more open water are very likely to change the distribution of marine mammals (particularly polar bears, walrus, ice-inhabiting seals, and narwhals) . . . , reducing their populations to vulnerable low levels. It is likely that more open water will be favorable for some whale species and that the distribution range of these species is very likely to spread northward.[183]

Lastly, in the North Pacific, similarly to the Northeast Canada region, water temperatures and ocean circulation patterns are primary concerns when predicting climate change effects. The Bering Sea is separated from the North Pacific by the Alaskan Peninsula, so linkages with the climate system are primarily though ocean-atmosphere interactions. Changes in sea ice cover and increasing ice melt can have both positive and negative effects on fishery stocks.

III. CLIMATE CHANGE AND FISHERIES MANAGEMENT

A. *Norwegian Spring Spawning Herring—A Cautionary Example*

Before examining what impacts climate change may have on future fisheries management, it is critical to note how changing climate conditions, resource overexploitation, and a lack of adaptive management and governmental foresight have impacted the region in the past.

Imagine a scenario where a particular fishery, comprised of species X, reaches such abundance and size that it is quickly elevated to one of the largest fisheries in the world. Four major countries claim rights to the

182. *See id.* at 740.
183. *Id.* at 999.

fishery, and each benefit substantially, both economically and socially. However, unsustainable fishing quickly decimates fish stocks to the point at which population recovery is impossible. A contributing factor to fish declines may also be secondarily attributed to changes in regional climatic conditions, which directly impact the species' feeding areas and migration routes. A lack of adaptive management and political will leads to a total collapse of species X and the associated fishery and results in major economic and social consequences for those who depended on it. The industry redirects its efforts to a new unexploited fish species and begins harvesting anew.

Without any fishing pressure on the remaining stock of species X, it begins to recover slowly. Initially, the small population of fish remains close to the shore of one particular country, and is properly managed on a national level where all fishing of species X is strictly prohibited. Gradually, stocks begin to increase due to a lack of exploitation and favorable climatic conditions. Over the course of the next few decades, the stock gets large enough so that fishing can resume at reduced levels. As the population size becomes larger, however, the stock extends its range to increase its feeding grounds and resume its old migration routes, and necessarily crosses over into neighboring states' EEZ boundaries.

Problems arise immediately. Unilateral national jurisdiction and management, a major reason for the stock's recovery, is no longer the controlling governance regime for the fishery since the stock has moved into areas of other nations' jurisdiction, as well as into international waters. Each country now involved lays claim to "their" part of the fishery since the stocks are within their jurisdiction, and therefore within their right of exploitation.

The formation and implementation of an international management regime is necessary to ensure sustainable harvesting of the stock. However, all countries involved fail to reach any fishing and management agreement and communication breaks down at the negotiation table. Consequently, the total catch quota recommended by international marine and fisheries scientists is quickly exceeded. The high economic value of the fishery elevates the extent of the conflict and, as a result, individual fishermen, fisheries, science organizations, industry, and national governments become engaged in heated disputes concerning the allocation of resources and proper management and governance regimes to oversee the fishery.

Eventually, the countries reach agreement on total allowable catch quotas, resource distribution allowances, and governance structures. Tensions still run high, however, and even today the current arrangements are tenuous at best and, more often, dysfunctional at worst. For instance, the management framework is not currently operational due to outstanding disagreements over quota distribution. As a result, any future changes in fish migration patterns and stock abundance levels will likely have significant effects not only on the existing international agreement, but any other fishery management regimes in the future. It is highly foreseeable that *either* negative or positive changes in stock abundance and distribution could have devastating consequences for the fishery, in addition to negative repercussions for economic and social structures.

* * *

Although the scenario above may sound far-fetched—both in its claim that positive changes in stock abundances could have dramatic effects on fishery conflicts and that a single fishery could result in international conflicts—the hypothetical is actually based directly on events that played out in the Norwegian spring-spawning herring fishery in the mid-to-late twentieth century.[184] This particular fishery is a classic example of the effects of overexploitation and changing climatic conditions on fisheries stocks, and how governance regimes ineffectively dealt with the fallout from both.

In the early 1950s, the Norwegian spring-spawning herring fishery, estimated at fourteen million tons, was "one of the largest fish stocks in the world."[185] The fishery brought immense economic and social benefits to Norway, Iceland, Russia, and the Faroe Islands, but the herring stocks collapsed by the late 1960s.[186] Overfishing and unsustainable fishery operations were the primary drivers of the collapse, although it is important to note that changes in climatic conditions in Iceland and the western Norwegian Sea also led to changes in herring feeding areas and migration routes.[187] Neither the fishing industry nor the existing governance regimes prepared in advance for what changing climatic consequences would mean for the fisheries, and thus, operations continued unabated until the fisheries collapsed.[188] When fish stocks finally recovered, the fish extended their range into former territory.[189] Conflict ensued between the four countries claiming jurisdiction over the stocks, and the EU, various fishery and science management organizations, and the North East Atlantic Fisheries Commission intervened.[190] A multilateral agreement currently exists between all of the players, but is considered dysfunctional due to outstanding arguments over quota distributions.[191]

184. *See* ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, at 698.
185. *See id.*
186. *See id.*
187. *See id.*
188. *See id.*
189. *See id.*
190. *See id.*
191. *See id.*

It is fairly appropriate to apply the Norwegian example as a proxy for the Arctic region as a whole and to the many bilateral, multilateral, and international governance regimes currently in place which focus on fisheries activities. The example "provides cautionary lessons by demonstrating how quickly such tightly schooling stocks can be depleted when a poorly understood natural decline in recruitment is amplified by competitive harvesting."[192] Thus, the lessons learned—and in some cases, the ongoing conflicts—highlight the need for highly functional and effective political efforts to play a leading role in avoiding or adapting to future fisheries disputes resulting from climate change impacts.

B. *How Societal Uncertainties Complicate Responses*

> The magnitude of the physical and ecological changes in the Arctic creates an unprecedented challenge for governments, the corporate sector, community leaders and conservationists to reinforce the potential for natural systems to adapt, and to define a sustainable future for the people and ecosystems of the Arctic.[193]

As mentioned in Part II of this Note, there is one additional major type of uncertainty inherent in the Arctic system with respect to defining climate change impacts. This additional uncertainty revolves around accurately predicting societal effects from potential fish stock modifications.[194]

Given that there are such distinct ecosystems at play in the Arctic region, climate change effects will not likely impact all regions similarly. As such, uncertainties create major implications for governance regimes. For instance, adjustments in fishing effort, stock choices, and revenue generation must be made as species compositions and distributions shift.

Fluctuations in fisheries stocks and changes to current species compositions may profoundly impact not only the current state of fisheries, but also social, political, and economic conditions in Arctic. Although the full extent of climate change on fisheries will depend on the "direction, magnitude, and rapidity of these changes," the "ability of the relevant social structures to adapt to altered conditions" must also be taken into consideration.[195] The ACIA states that the total effect of climate change on fish stocks will depend on the quality of available fisheries policies and their enforcement.[196] The impacts on economic and social frameworks also depend on the ability of society to react and adjust

---

192. Miller, *supra* note 111, at 59.

193. ACIA UPDATE, *supra* note 1, at 9.

194. *See* ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, at 693–94. *See generally* Schrank, *supra* note 9.

195. ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, at 729.

196. *See id.* at 770.

to changes from a modified climate.[197] Other scientists have declared that a "proper harvesting policy would have a greater effect on the economic yield of [a] fishery than even the most optimistic climate scenario."[198] Establishing the presence of sound resource management practices and a viable regional governance regime can help ensure the future of fisheries.

Arctic governance regimes will be challenged in various ways due to climate change effects, and projected changes in fish stock distributions and abundance may even be so significant as to destabilize existing management regimes. For instance, areas where relatively few species are currently harvested may be faced with the prospect of species populations shifting in both composition and range as a result of climate effects on marine ecosystems, particularly increasing water temperatures. If this happens, a regional fishing industry may be forced to relocate to follow the stocks or completely switch over to harvesting freshwater species.[199]

Fishermen affected by climate change are relatively limited in their options for adapting to such change. Due to increased fisheries specialization over the past few decades,[200] it is now much harder for fishermen to adapt to changes in the industry than ever before. Today, there is "less need for raw muscle strength, which has been replaced by machines, and more need for special skills involved in operating these machines and everything behind them. Such skills are much less transportable between different sectors of the economy than the raw muscle strength of fishermen and fish workers."[201] Further, the increase in new computer-controlled equipment and machinery require a level of technical training that many fishermen do not have.[202]

Tighter restrictions on current fisheries sectors have also made it more difficult for fishermen to gain a foothold in another fishery if theirs collapses.[203] Moreover, changes to existing fish populations due to climate change may trigger such significant reductions in fishery quotas that the fishing industry collapses altogether. This last concern is especially relevant if additional contributing factors have also deteriorated such that implementing new quotas or revising management practices will not be sufficient to recover current stocks.

As mentioned in the Norwegian herring case study earlier in this Note, *positive* changes to fishery stock compositions and distributions may also lead to conflicts between Arctic nations due to overlapping jurisdictional claims, unregulated fishing, a lack of multi-regional

197. *See id.* at 770–71.
198. Schrank, *supra* note 9, at 14.
199. *See* MacKenzie, *supra* note 10, at 1361.
200. Hannesson, *supra* note 130, at 2.
201. *Id.*
202. *See id.*
203. *See id.* at 2–3.

agreements, and race to the bottom concerns. Whereas total abundance of a fishery may not be reduced over time due to climate change, the catch value for a given nation could be, depending on the extent of potential changes in fisheries compositions. In addition, fishing communities in high-latitude regions may not be able to respond to long-term climatic and environmental change, and this adaptability is critical to sustaining cultures and economies for the long term.[204]

Political efforts must attempt to remedy the potential for such conflicts. It is imperative that components of risk and uncertainty be incorporated into future management regimes as comprehensively as possible. Furthermore, governance regimes must also consider long-term management strategies and fishery management actions. For instance, climate change impacts may require only minor adjustments in the fishing sector, but these changes will include negotiations on fishing rights, catch limits, and other exploitation constraints which present some of the most contentious and difficult policies to which nations must agree.[205]

"[T]he quality of the human response to whatever changes occur will depend on both on the employment of effective fishery management techniques and on the ability of the societies to make the necessary political decisions."[206] Uncertainty will no doubt require greater precaution in management.[207]

All of these concerns point to the need for a dynamic, rather than static, management regime. Given the predictions of climate change effects and the associated uncertainties, management strategies and governance frameworks must not be solely based on assumptions of constant and static environmental factors. Environmental change and uncertainty is inherent in climate change modeling, and must be incorporated into governance. "[F]ishing and environmental variability jointly affect the risk for [fish] population decline."[208]

Despite difficulties in dealing with uncertainty, scientific experts, the private sector, the political community, civil society, and indigenous peoples must find a way to deal with climate change effects on fisheries and prepare for adaptation. Taking into account the conclusions above, is the current Arctic regulatory and governance framework sufficient in scope and flexibility to adequately deal with future fishery changes brought on by climate change? Is international law, as applied by UNCLOS or the UN Fish Stocks Agreement, robust enough to deal with forecasted fisheries changes and state conflict, or is there a need for an

---

204. *See* McGoodwin, *supra* note 5, at 40.
205. *See* ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, at 771.
206. Schrank, *supra* note 9, at 17.
207. *See* MacKenzie, *supra* note 10, at 1362.
208. MacKenzie, *supra* note 10, at 1357.

entirely new region-wide, legally binding treaty? Alternatively, is it more efficient to expand upon existing regimes, such as RFMOs, and supplement these regimes with new national governance frameworks to fill remaining gaps? Or, is there another approach that may work better?

C. *Problems with Existing Governance Regimes*

1. *International Law*

Many consider the option of relying on UNCLOS to manage the future of Arctic fisheries to be problematic and ineffective. Some critics state that "[t]he situation [in the Arctic] is especially dangerous because there are currently no overarching political or legal structures that can provide for the orderly development of the region or mediate political disagreements over Arctic resources or sea-lanes."[209] As a result, "diplomatic gridlock could lead the Arctic to erupt in an armed mad dash for its resources."[210]

Although the extent of this fear is likely exaggerated, nonetheless, it does appear that UNCLOS has gaps in its authority and scope that may present substantial obstacles to adequately managing fisheries changes due to climate change. For instance, if the Arctic becomes ice-free due to glacial melting, a new high seas area will open up over the North Pole. This area will consist of waters over which no one nation has jurisdiction, but which borders the EEZs of six powerful Arctic countries.[211]

Potential difficulties in managing this future high seas area can be analogized to historical fishery issues impacting another Arctic high seas area: the Bering Sea Doughnut Hole. Much of the Bering Sea Doughnut Hole was unregulated before 1977, leaving huge swaths of ocean open to

---

209. Borgerson, *supra* note 142, at 71.

210. *Id.* at 72.

211. The purpose of UNCLOS is to establish rules to govern all uses of the ocean and its resources. As UNCLOS currently stands, it is widely accepted under international law that a coastal state has jurisdiction over marine biodiversity found within its internal waters and territorial seas, and often over biological diversity in archipelagic waters. *See* YOSHIFUMI TANAKA, A DUAL APPROACH TO OCEAN GOVERNANCE: THE CASES OF ZONAL AND INTEGRATED MANAGEMENT IN INTERNATIONAL LAW OF THE SEA 133 (2008). In areas of high seas, UNCLOS provides a framework that allows all States to engage in freedom of navigation, overflight, laying of submarine pipelines and cables, fishing, and scientific research. Regulation of these freedoms is subject to international agreement. *See* UNCLOS, *supra* note 8. However, since no State is allowed to claim sovereignty over these areas, conflicts often arise, and enforcement and controlled fishing activities become difficult. Rayfuse, *supra* note 14, at 209. High seas are prone to "over-exploitation, inadequate exercise of flag State responsibilities, and lack of compliance with and enforcement of internationally agreed measures and conflict between different ocean uses." *Id.*

fishing activities with little oversight.[212] However, it wasn't until the United States and Russia declared their 200 nm EEZs in 1977 that the Doughnut Hole, an area of open seas completely encircled by U.S. and Russian fishing zones, became high seas territory.[213] Because foreign states were now restricted from fishing in American and Russian EEZs without paying a fee and gaining each country's permission, fishers simply moved their operations to the high seas Doughnut Hole area, which had little or no regulation and enforcement.[214] The result was massive unregulated catches, uncontrolled overexploitation, and the eventual collapse of the stock by 1992.[215] The Bering Sea Doughnut Hole example highlights how an immense fishery can come into being almost overnight in previously unexploited waters—a reality that could very well arise in the Arctic without a controlling governance regime in place.

Given that UNCLOS primarily focuses on rights of coastal states within their sovereign territories, as opposed to the high seas, UNCLOS will likely provide an ineffective governance model under which to comprehensively regulate fisheries in this area.

Examining other international treaties, it may be possible to govern the region under the terms of the UN Fish Stocks Agreement, but problems attributed to illegal, unregulated, and unreported fishing would still remain and duly undermine any sustainable management plans thus implemented.[216]

2. *Bilateral and Multilateral Treaties*

Existing bilateral and multilateral Arctic treaties between various states also do not appear to be sufficiently poised to address future climate change impacts on Arctic fisheries. For instance, the majority of regional agreements between Arctic states are directly related to protecting the marine environment from pollution.[217] The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), for example, which applies to the Arctic waters of the northeast Atlantic but is not an Arctic-specific treaty, focuses on the control and monitoring of land-based and offshore oil and gas pollution

---

212. *See* David Balton, *The Bering Sea Doughnut Hole Convention: Regional Solution, Global Implications*, *in* GOVERNING HIGH SEAS FISHERIES 144 (Olav Schram Stokke ed., 2001).

213. *See id.* at 144–46.

214. *See id.* at 147.

215. *See id.*

216. *See, e.g.*, Rayfuse, *supra* note 14, at 212–13.

217. *See* Alexei Roginko & Matthew LaMourie, *Emerging Marine Environmental Protection Strategies for the Arctic*, 16 MARINE POL'Y 259, 265 (1992).

and the dumping of wastes at sea, but does not deal with fishery issues or vessel-based pollution.[218]

The Northeast Atlantic region of the Arctic is governed by a few regional fishery agreements, such as the NEAFC Convention,[219] the Convention for the Conservation of Salmon in the North Atlantic,[220] and a Barents Sea tripartite agreement between Iceland, Russia and Norway,[221] yet many of these mandates overlap and the implementation of the agreements is delayed or lacking altogether.[222] Moreover, the geographical scope of the fishery agreements in the Northeast Atlantic constitutes only a small percentage of the overall Arctic Ocean, within which there is no agreed upon regional fisheries management regime.

Another issue of import is that current regional agreements include only Arctic nation-states. Due to the Arctic's increasing prominence in world politics as a result of climate change, melting sea ice, and improved access to regional oil, gas, and fisheries resources, new actors not traditionally seen in conventional treaties will emerge and need to be incorporated into regional governance regimes. These new actors include non-state actors, indigenous people, and other non-Arctic countries that contribute to, and are affected by, climate change and fish exploitation.[223] Many of these actors, such as indigenous people and small-scale regional fishermen, already have a stake in how climate change has started to affect the region, particularly in regard to economic consequences caused by alterations in fishery stocks and the need for revising existing management and quota systems. As climate change impacts increase in severity, other actors, including those located outside of the Arctic region, will play an important role in determining the future of the Arctic and ensuring a successful governance framework is in place.

Multilateral approaches to climate change effects must recognize that oftentimes, the causes of environmental problems lie outside of the Arctic region and that a "strictly limited regional approach is not likely to be adequate for problems which are transboundary and transregional in

---

218. *See* Convention for the Protection of the Marine Environment of the North-East Atlantic, Sept. 22, 1992, 32 I.L.M. 1069 (1993), *available at* http://www.ospar.org/content/content.asp?menu=00340108070000_000000_000000.

219. North East Atlantic Fisheries Convention, Jan. 24, 1959, 486 U.N.T.S. 158, *available at* http://ec.europa.eu/world/agreements/prepareCreateTreatiesWorkspace/treatiesGeneralData.do?step=0&redirect=true&treatyId=503.

220. Convention for the Conservation of Salmon in the North Atlantic, *opened for signature* Mar. 2, 1982, 1338 U.N.T.S. 33, *available at* http://www.nasco.int/convention.html.

221. Agreement Concerning Certain Aspects of Co-operation in the Area of Fisheries, Nor.-Ice.-Russ., May 15, 1999, 2070 U.N.T.S. 203, *available at* http://eelink.net/~asilwildlife/RussIceNorFish.html.

222. *See* Rosemary Rayfuse, *Protecting Marine Biodiversity in Polar Areas Beyond National Jurisdiction*, 17 RECIEL 3, 7 (2008).

223. *See Non-Northern Nations Get More Interested in Arctic Council*, CBC NEWS, April 11, 2008, http://www.cbc.ca/canada/north/story/2008/04/11/arctic-council.html.

nature,"[224] such as greenhouse gas emissions and toxic pollutants. Further, principles of ecosystem-based management, sustainable development, and climate change mitigation and adaptation are not adequately encapsulated in the present Arctic bilateral and multilateral treaties, yet must be considered when addressing climate change impacts.[225] As the next Part discusses, the incorporation of additional actors into the Arctic governance regime will increase the likelihood of success of future mitigation and adaptation frameworks—including the development of feasible, long-term planning strategies, reconciling competing development agendas, and fully addressing external drivers of environmental degradation.

3. *The Arctic Council*

As mentioned in Part I, *supra*, the Arctic Council is a high-level forum created to "provide a means for promoting cooperation . . . among the Arctic States . . . on common Arctic issues, in particular issues of sustainable development and environmental protection in the Arctic."[226] Although the Arctic Council's recommendations are soft law, and a number of other regional organizations and councils have proliferated over the last 20 years, the institution serves as the Arctic regime's primary governing body.[227]

The Arctic Council was formed to extend the previous AEPS strategy "beyond purely environmental issues,"[228] and the Council has assumed an important role in the governance of the region. For instance, the Council has overseen and drafted regional management guidelines for protected areas, data monitoring, and oil spill assessment and response actions.[229] Its six working groups have also produced highly-regarded and comprehensive documents.[230] Most importantly, the Council has served as

---

224. Roginko & LaMourie, *supra* note 217, at 266.

225. *See* Rayfuse, *supra* note 222, at 7.

226. Arctic Council, *supra* note 15.

227. These other groups include the Nordic Council, the Saamai Council, the Inuit Circumpolar Conference, the International Arctic Science Committee (IASC), the Northern Forum, the North Atlantic Marine Mammal Commission (NAMMCO), the Council of the Barents Euro-Arctic Region (BEAR), and the Standing Committee of the Parliamentarians of the Arctic Region (SCPAR). *See* LINDA NOWLAN, IUCN ENVIRONMENTAL LAW PROGRAM, IUCN ENVIRONMENTAL POLICY AND LAW PAPER NO. 44, ARCTIC LEGAL REGIME FOR ENVIRONMENTAL PROTECTION 6–7 (2001).

228. *Id.* at 9.

229. *See id.* at 16.

230. *See id.* The Council also serves as a Regional Seas partner with the United Nations Environment Program (UNEP) on a program entitled "Protection of the Arctic Marine Environment (PAME)" with the mandate "to address policy and non-emergency pollution prevention and control measures related to the protection of the Arctic marine environment from both land and sea-based activities." Arctic Council, PAME, http://arctic-council.org/working_group/pame (last visited June 28, 2010).

a key link between regional concerns and actors and the broader global governance scene,[231] and it is one of the few existing operational models for international cooperation on sustainable development.

However, the Council is not without its critics. "[T]he Council has no enforcement authority, has been underfunded, and contains very few, if any, substantive commitments on the part of the signatories to take concrete action."[232] In addition, its work has been considered "quite general, lack[ing] [in] specificity, and largely descriptive."[233] The Council is not "strictly an organization," in that it has no official offices or staff, and it lacks any meaningful budget to create new programs or increase regional activities.[234] Further, the eight Arctic nations have not provided the Council with decision-making powers, and at least one critic claims that this authority "has been very purposely been limited, by the United States in particular."[235] As to the overall role of the Council, it may be "more appropriate to treat the council as a forerunner intended to play a role in a continuing process of regime formation in contrast to an entity designed to administer the provisions of a regime that is already in place."[236]

IV. THE NEED FOR A DYNAMIC GOVERNANCE REGIME

Whether the focus is on international law, bilateral and multilateral treaties, or the Arctic Council, too many of these governance frameworks have resulted in "recurring disputes, ineffective control of harvesting activities, and degradation of the shared resource stocks."[237]

> In many cases, one can trace this inability to maintain stable cooperation to the fact that the agreements lack flexibility to adapt to changing circumstances. Misunderstandings and frustrated expectations have sometimes developed into serious conflicts when there have been unanticipated, climate-driven changes in stock levels or their physical distribution across various EEZs and high-seas areas.[238]

231. *See* NOWLAN, *supra* note 227, at 16. For instance, the Council drafted a statement detailing regional Arctic concerns that was key to discussions at the Stockholm Convention on Persistent Organic Pollutants (POPs), which resulted in the drafting of the POPs Treaty. *See id.*

232. *Id.* at 15.

233. *Id.* (internal quotation marks omitted) (citing David VanderZwaag, *International Commons—The Arctic*, *in* THE YEAR IN REVIEW 266–73 (1998)).

234. *Id.*

235. *Id.*

236. Oran Young, The Structure of Arctic Cooperation: Solving Problems/Seizing Opportunities, Paper presented at the Conference of the Parliamentarians of the Arctic Region 14, Aug. 27–29, 2000, *available at* http://www.arcticparl.org/_res/site/File/static/conf4_sac.pdf.

237. Miller, *supra* note 111, at 56.

238. *Id.*

Thus, the primary question to be addressed when evaluating what Arctic governance regime may work best is whether there is a need for a legally binding treaty or whether something more informal may be more effective and politically feasible. This Note suggests that the Arctic needs a dynamic, rather than static, management regime in order to successfully negotiate the uncertainties inherent in climate change predictions and anticipate the effects such climatic changes will have on fisheries stocks.

A dynamic regime must be structurally simple enough to ensure high flexibility, autonomy, and adaptability to changing conditions.[239] This structure will ensure greater resiliency to dramatic alterations expected in high-latitude regions as a result of climate change. Also essential is the need to ensure that there are strong incentives for nations to cooperate with each other, especially in times of changing climatic factors and resulting spatial changes in distribution and abundance of fish stocks. Part of these incentives should work to eliminate a nation's desire to over-fish when migratory stocks are abundant in its waters.

This Part proposes four necessary components of a dynamic regime—a focus on the role of nation-state actors and scientists, institutional nesting, division and management of resources (in terms of both jurisdictional concerns and conservation principles), and non-political measures—and attempts to integrate these components into specific governance options for the future.

A. *Role of Nation-State Actors and Scientists*

The presence of leadership determines success or failure in institutional bargaining, negotiation, and the formation of international regimes, and successful regimes usually require the interaction of at least two forms of leadership.[240] In the case of the Arctic, structural and intellectual leadership must overlap to ensure a successful dynamic regime.[241]

A structural leader is someone who acts on behalf of a nation state, effectively bringing the State's "structural power (that is, power based on the possession of material resources) to bear in the form of bargaining leverage."[242] Structural leaders—negotiators representing the eight Arctic states—have been the primary players and drivers of all existing regional

---

239. *See* McGoodwin, *supra* note 5, at 53.

240. *See* Oran R. Young, *Political Leadership and Regime Formation: On the Development of Institutions in International Society*, 45 INT'L ORG. 281, 302 (1991). It is important to remember is that although leadership is necessary for a successful regime, it is not sufficient by itself.

241. *See generally id.* (defining and discussing three leadership forms in depth, of which the two most relevant to this Note and future Arctic governance regimes are structural and intellectual leadership).

242. *Id.* at 288.

negotiations and agreements. Structural leaders obviously also have an important role to play in the creation of a new dynamic regime. They will naturally aim to create agreements that serve the overall interests of their respective states and use their structural power as bargaining leverage. Structural leadership has been employed (usually at the exclusion of other forms of leadership) in prior high-level regional governance discussions, but little overall success has been realized on the climate change front. Confronted with new challenges and potential paths forward, a need exists for inclusion of intellectual leadership into Arctic institutional bargaining processes to augment the existing structural leadership framework.

An intellectual leader "may or may not be affiliated with a recognized actor in international politics but [is one] who relies on the power of ideas" to influence how institutional participants understand the issues and develop solutions to those issues.[243] Intellectual leaders are individuals who "produce intellectual capital or generat[e] systems of thought that shape the perspectives" of all players in regime development.[244] Intellectual leaders work to break down the barriers of entrenched mindsets held by policymakers and infuse new ideas into the current system.[245] A good example of this can be seen throughout the history of fisheries management approaches by examining the concept of maximum sustainable yield (MSY) and the "dilemma of common property resources or the tragedy of the commons."[246] Historically, policymakers were intent on believing that MSY was a panacea to problems of overexploitation and ecosystem degradation, and therefore they crafted international regimes that solely relied upon the concept.[247] However, the absence of integrating scientific knowledge and broader issues, such as whole ecosystem protection or interactions between species, created gaps in fisheries policies and derailed any success that might have come out of the regimes.[248] The MSY failure illustrates the need for intellectual leaders in order to ensure that sound science is at the forefront of environmental policies.

Assimilating intellectual leaders into a new Arctic regime could take many forms. One option would be to choose intellectual leaders on a

243. *Id.*
244. *Id.* at 298.
245. *See id.*
246. *Id.* at 299.
247. *See id.*
248. *See id.* Focusing solely on MSY leads to fish stock estimation problems, unanticipated interactions between species, incorrect assumptions of surplus production, and a total lack of best-available science integration. *See, e.g.*, Louis Botsford et al., *The Management of Fisheries and Marine Ecosystems*, 277 SCIENCE 509 (1997); Colin Clark, *The Economics of Overexploitation*, 181 SCIENCE 630 (1973).

region-wide basis and appoint them as permanent representatives of the overall governance regime, putting them on equal footing with structural leaders in developing and negotiating management and policy decisions, rather than merely serving as observers or advisors. Given the ACIA's recognized legitimacy in the region, intellectual leaders could be nominated by the ACIA Secretariat or culled from the group of ACIA scientists that served as the assessment's "experts" in their respective areas of interests (such as fisheries, natural science, social science, climate modeling). Intellectual leaders could be considered permanent representatives of the regime, or be held to term limits, whereby new scientists would routinely replace the previous group of intellectual leaders. Arctic states could also choose to nominate their own top regional scientists, and build a primary base of intellectual leaders that originate from each Arctic state. As discussed in Part IV.E, *infra*, additional options also include improved incorporation of intellectual leaders into the Arctic Council, as well as into a new Arctic-wide RFMO structure.

Regardless of how intellectual leaders are specifically integrated into the system with existing structural leaders, a dynamic regime must coordinate the development of its formation with improvements in scientific data and understanding; otherwise, "seemingly productive fisheries can be quickly decimated if competing harvesting nations misunderstand or ignore the impacts of natural changes in stock dynamics."[249] Of course, "better science alone will not lead automatically to more effective management, and in a competitive fishery could, in fact, hasten the demise of fragile stocks" by encouraging or creating a race to the bottom for existing resources.[250] Thus, a regime must be designed to function successfully regardless of the inevitable uncertainty in predicting future fish-stock abundance and distribution. Integrating the precautionary principle approach as part and parcel of a governance regime is one way to ensure the coordination of regime creation with advances in scientific understanding.[251]

249. Miller, *supra* note 111, at 68.

250. *Id.* at 67 (emphasis omitted).

251. Although its definition changes somewhat depending on the context, the precautionary principle is generally defined as the conservation of resources and management of risk when scientific knowledge is uncertain. *See* SIDNEY J. HOLT & LEE M. TALBOT, NEW PRINCIPLES FOR THE CONSERVATION OF WILD LIVING RESOURCES, 59 WILDLIFE MONOGRAPHS 15-16 (1978). ("Management decisions should include a safety factor to allow for the facts that knowledge is limited and institutions are imperfect . . . . The magnitude of the safety factor should be proportional to the risk."). The safety factor encompasses anticipation and prevention and should be utilized to "prevent harm, not measure and manage it." *Id.*

B. *Institutional Nesting*

In addition to fishery concerns, climate change impacts related to future oil and gas exploration and exploitation, new opportunities for global shipping pathways, and increasing potential for the tourism sector are also of particular ecological and economic significance for the region. All of these activities have direct effects on fisheries, and vice versa, thereby increasing the possibility for conflict between the overlapping sectors.

Importantly, "the emphasis on sectoral approaches and problem-based research means that there is little opportunity in the current framework to consider the Arctic from an ecosystem management perspective."[252] Implementing such a perspective, however, is likely to be critical for successful management of Arctic fisheries, "which exist in a powerfully interactive dynamic that cannot easily be managed within national boundaries" or in isolation from the other activities in the region.[253] Thus, it is important to consider a governance regime that is multifaceted and dynamic enough to address the full range of activities impacted by climate change within the Arctic rather than having numerous regional regimes addressed in a piecemeal fashion.

The idea of "institutional nesting" for the region, as discussed by Oran Young, takes specific criteria and folds them "into broader institutional frameworks that deal with the same general issue area but that are less detailed in terms of their application to specific problems."[254] Creating "clustered regimes" through institutional nesting can serve a variety of purposes: "[j]oining together analytically differentiable issues, such as fishing, offshore hydrocarbon development, navigation, and pollution control . . . may prove attractive as a means of achieving success in institutional bargaining."[255] Moreover, such clustering may result in agreements that provide net benefits to all parties.[256]

Applying institutional nesting to the Arctic could have big rewards. Instead of working in a piecemeal format, which has traditionally occurred in the Arctic, and which is still often discussed for the future of regional oil and gas reserves, fishing, and shipping, clustering these problems into one broader institutional framework will make it much easier to successfully manage the region in the face of climate change.

Of course, institutional nesting can have negative repercussions—overlapping regimes may involve conflicting or incompatible

252. *Id.* at 23.
253. *Id.* at 23.
254. Oran Young, *Institutional Linkages in International Society: Polar Perspectives*, 2 GLOBAL GOVERNANCE 1, 3 (1996).
255. *Id.* at 5.
256. *See id.*

arrangements, thereby making it difficult to fully succeed in any one regime.[257] However, more often than not, "institutional intersections can lead to the development of unusually effective international regimes by stimulating efforts to think in whole-ecosystems terms and to devise integrated management practices."[258] Additionally, those nested regimes that involve reciprocal and symmetrical institutional overlaps will often lead to more conducive bargaining and mutual understanding than if the overlaps are merely unidirectional or asymmetrical.[259]

Young also states that there are several motives that may cause issue-specific regimes to be nested into a broader framework. The first is to "avoid raising larger and more fundamental issues" that require all new governance structures, by placing issue-specific regimes into already familiar categories inherent in regulatory structures.[260] Nesting can also legitimize issue-specific regimes, or "mak[e] it easier for affected parties to accept new initiatives by incorporating them into existing arrangements" which are already routine for parties.[261] A third motive may be that nesting is a last resort due to the "limits of . . . institutional bargaining involved in the creation of international regimes."[262]

Institutional nesting appears especially appropriate for the Arctic given historical state conflicts over resources and jurisdictional boundaries and an overall apparent inability to reform existing governance structures. Establishing an overlapping governance framework focused on numerous issue-specific regimes may be the most effective way to initiate small changes that will traverse all of the issues, eventually creating "perceptible changes in the deep structure of the system as a whole."[263]

C. Division and Management of Resources

In addition to using the precautionary principle to look ahead, a successful governance regime must also be competent at determining how to divide and manage resources now. There are two general aspects of resource management: "the jurisdictional basis for regulation . . . and the need to balance the concerns for conservation and utilization."[264]

Addressing the jurisdictional component, there are competing views as to whether a regime must first stabilize jurisdictional and boundary claims before proceeding any further in its overall governance strategy.

257. *See id.* at 7.
258. *Id.*
259. *See id.*
260. *Id.* at 9–10.
261. *Id.* at 10.
262. *Id.* at 11.
263. *Id.* at 8.
264. Stokke, Anderson & Mirovitskaya, *supra* note 114, at 101.

Although it may seem intuitive that countries will only enter into discussions regarding shared resource management if the extent of their own jurisdictional boundaries is unambiguous, some experts maintain that "resolution of jurisdictional problems is not a necessary condition for the development of institutionalized management practices."[265] Given the contentious politics already at play in the region, it seems prudent and necessary to clarify jurisdictional and boundary claims now in order to clearly articulate and gain buy-in from Arctic countries as to the scope of the controlling governance regime(s), and the need for adaptive management policies as climate change impacts progress. This task will be challenging, no doubt, but without clear understandings of how a dynamic system will operate, countries will have little incentive to follow and enforce the terms of the regime.

With regard to the conservation and utilization component, problems of uncertainty and future trade-offs over time are intricately intertwined, and a regime must balance these competing concerns. By integrating scientific investigation and knowledge uptake as a critical component of the decision-making process, perhaps through intellectual leadership discussed above, the regime will be more adept at legitimizing the allocation of current resources among and within states.

There are a few possible avenues for determining how to divide and manage resources now. One option would be to essentially "freeze" all current fishing claims and activity to determine what species and what percentage of fish each nation is currently harvesting per year. These ratios could be used to determine how much economic gain each country is entitled to over time, even if stocks shift into other EEZs due to climate change. The administrative costs associated with this option are likely to be high, however, and there would be difficulties in verifying how much quota each country actually catches per year and whether these quotas are truly sustainable.

Similarly, a governance regime may want to place a hold on new and expanded fisheries operations in the region until sufficient scientific data is available to assist in guiding the decision of whether new fishery effort is sustainable. One example of this is the North Pacific Fishery Management Council, which recently released its final *Fishery Management Plan for Fish Resources of the Arctic Management Area* (FMP) in August 2009.[266] The FMP aims to prohibit new fisheries in the

265. *Id.* at 252.

266. NORTH PACIFIC FISHERY MANAGEMENT COUNCIL, FISHERY MANAGEMENT PLAN FOR FISH RESOURCES OF THE ARCTIC MANAGEMENT AREA (2009), *available at* http://www.fakr.noaa.gov/npfmc/fmp/arctic/ArcticFMP.pdf). The U.S. Secretary of Commerce approved the FMP on Aug. 17, 2009. *See id.* at ES-1.

United States' Arctic EEZ indefinitely until enough scientific data is available to plan for sustainable fishing.[267]

However, as the experience of using moratoriums for the northern cod fishery in Newfoundland illustrates, fishing closures are not always a cure-all:

> The closure of the Newfoundland groundfisheries is reputed to have involved the largest mass layoff of labor in Canadian history. In social terms (due to the mass layoff), in biological terms (due to the decimation of the fish stock), and in governmental financial terms (due to billions of dollars spent on income maintenance for fishers and fish plant workers), the moratoria were disasters.[268]

It is clear, as climate change affects commercial fish stocks and the government, industry, and public come face-to-face with the consequences, the Newfoundland experience could very well replicate itself elsewhere. As such, this example "may also indicate the need for alternative policies."[269]

D. *Non-Political Components*

It may be possible for a dynamic Arctic governance regime to rely on non-political measures to assist with climate change adaptation. The major actors in this framework would most likely be international and regional environmental and social non-governmental organizations (NGOs). However, the private sector could also play an important role: large commercial fishing companies faced with the threat of imminent revenue reduction or fisheries moratoriums may decide it is in their best interest, both from an economic and public relations standpoint, to try and shift some of their workforce out of fishing and into new careers.

Options may include developing and promoting alternative means of employment to current fishermen and enhancing the resiliency of coastal communities who rely on the fisheries sector as a major component to their ultimate livelihoods. These options are long-term and time-intensive, but may prove to be some of the best options for dealing with climate change impacts to fisheries. Hand in hand with such social

---

267. The FMP states:

> Pursuant to Title II of the Magnuson-Stevens Act, there is no allowable level of foreign fishing for the fisheries covered by this FMP. While fishing vessels and fish processors of the U.S. have the capacity to harvest and process up to the level of optimum yield of all species subject to other Council FMPs, Council policy as articulated in this Arctic FMP is to prohibit commercial harvests of all fish resources of the Arctic Management Area until sufficient information is available to support the sustainable management of a commercial fishery.

Id. at ES-2. NOAA refers to the FMP as the Arctic Fishery Management Plan.

268. ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, at 743.

269. *Id.*

changes is the idea of employing aspects of adaptive management, such as fishery quotas, regulations on gear, and closures to fishing in certain areas or in certain months. The regime could revisit and revise such restrictions on a yearly or multi-yearly basis as more climate and fisheries data become accessible.

E. *Options for the Future*

Numerous options have been put forth over the past few years with regard to future governance structures for the Arctic region—with some more realistic and achievable than others. This section does not attempt to provide a definitive prediction of what solution will ultimately emerge, but aspires to highlight key considerations that must not be overlooked when addressing climate change impacts to fisheries and considering the integration of dynamic governance components. Although a regional treaty or regional seas agreement is likely improbable, strengthening and overhauling the Arctic Council and establishing a new Arctic Ocean RFMO show promise and may be the most realistic paths forward for the creation of an effective Arctic dynamic governance regime.

1. *Regional Treaty / Regional Seas Agreement*

Various scholars and politicians have argued for the creation of a regional treaty or a regional seas agreement for the management of the Arctic. Supporters claim that "a regional treaty arrangement could form the strongest basis for a management framework capable of conserving the Arctic's living resources and mak[e] sure that existing and new economic activities in the region are sustainable for the future."[270]

Advantages of such a treaty would be numerous. It would encourage Arctic nations to prioritize environmental issues and develop a specific regional environmental mandate for action. The treaty could encourage the use of the precautionary principle and ecosystem-based management. Additionally, a holistic management approach could mandate the creation of a financial mechanism, channeled through the Arctic Council, to fund environmental and natural resource projects and enforcement activities.

Although the idea of a cohesive and comprehensive framework for the region is ideal, in reality, "[i]t would be naïve to suggest that Arctic coastal States might suspend or relinquish their existing sovereignty in favour of an internationalized legally binding pan-Arctic regime,"[271] especially in an area that has such considerable economic, geopolitical, and military-strategic importance. A coordinated set of negotiations

---

270. HUEBERT & YEAGER, *supra* note 44, at 3.
271. Rayfuse, *supra* note 14, at 214.

among all of the Arctic governments is not promising. Even in discussions between the Arctic states, "proposals for a comprehensive Arctic Environmental Protection Treaty have fallen on ears interested only in non-binding or soft-law approaches. More limited proposals for an Arctic treaty regulating conservation and management of the Arctic marine environment have similarly thus far received little support."[272]

The existing governance framework among the Arctic states is primarily one of soft law and voluntary measures, "reflecting the lack of appetite of at least some of the Arctic governments for more strenuous treaty arrangements."[273] This reluctance is due in part to security concerns, protection of national sovereignty, and the threat of competition over natural resources and boundary delimitations.[274] In addition, as evidenced by criticisms of the Arctic Council, Arctic nations are hesitant, and even resistant, to commit the financial resources and human capacity necessary to be truly serious about a region-wide governance mechanism, not to mention the associated mandates and commitments that come along with it.

The disadvantages of a regional treaty are significant. The soft law mechanisms currently in place are not sufficient, but there is little, if any, political will for hard law and binding commitments, especially with regard to natural resource ownership.[275] The Arctic system is unique in that it is governed by a myriad of powerful nation-states, none of which is eager to sacrifice any of its sovereignty.[276] As exemplified through the existing conflicts between nations over jurisdictional boundaries and resource ownership, future ecosystem changes due to climate change may only exacerbate these ongoing conflicts, which would prevent the ratification of any larger treaty system and achievement of region-wide consensus. Finally, numerous legal frameworks already exist for the region. Although there are still gaps to be filled, it may be more politically and socially feasible to revise existing governance structures,

272. *Id.* at 215 (referring to Oran Young, *Arctic Governance: Preparing for the Next Phase*, Paper presented at the Arctic Parliamentary Conference (Aug. 11-13, 2002), *available at* http://www.arcticparl.org/reports.aspx?id=2989&p=3); *see* LINDA NOWLAN, *supra* note 227 (proposing a new regional environmental protection treaty, which was later rejected); Timo Koivurova, *Environmental Protection in the Arctic and Antarctic: Can the Polar Regimes Learn From Each Other?*, 33 INT'L J. LEGAL INFO. 204, 217-18 (2005); *see also* David VanderZwaag, Rob Huebert & Stacey Ferrara, *The Arctic Environmental Protection Strategy, Arctic Council and Multilateral Environmental Initiatives: Tinkering While the Arctic Marine Environment Totters*, *in* THE LAW OF THE SEA AND POLAR MARITIME DELIMITATION AND JURISDICTION 225 (ALEX G. OUDE ELFERINK & DONALD R. ROTHWELL eds., 2001).

273. HUEBERT & YEAGER, *supra* note 44, at 29.

274. *See id.* at 33.

275. *See* Rayfuse, *supra* note 14, at 215.

276. *See id.*

rather than trying to build an entirely new one. Even proponents of the Arctic Treaty concur:

> Without strong support by the eight arctic states and their citizens, any efforts to develop a new arctic treaty arrangement is probably doomed to fail. An arctic treaty is ultimately possible only if all key participants are convinced of the substantial benefits of a stronger, more truly cooperative management regime.[277]

Most significant when considering whether a regional treaty may be a realistic possibility is the result of a recent meeting between key Arctic states—a result which points to anything but support for such an agreement. The five Arctic coastal states met, in their first ministerial meeting to date, in May 2008 at the Arctic Ocean Conference in Ilulissat, Greenland to discuss climate change, resource allocations, and claims to the seabed.[278] The meeting resulted in the Ilulissat Declaration, which states that the nations will not negotiate an alternative regime for the Arctic above and beyond UNCLOS. The Declaration asserts that the UNCLOS "framework provides a solid foundation for responsible management by the five coastal states and other users of this Ocean through national implementation and application of relevant provisions. We therefore see no need to develop a new comprehensive international legal regime to govern the Arctic Ocean."[279]

Working within bilateral or multilateral treaties may be a more realistic alternative, given that the probability of getting two nations or a small group of nations to reach agreement on fisheries and climate change issues stands to be more successful than an overarching agreement by all eight Arctic states. However, it is important to remember the Norwegian spring spawning herring example discussed at Part III.A, *supra*, and how multilateral treaties have not always worked within the region. Moreover, instead of promoting institutional nesting and the foundations for a dynamic regime, bilateral and multilateral agreements will likely result in numerous piecemeal and separate modes of international cooperation focused on specific subregions only, rather than on a unified regime for circumpolar environmental protection.

---

277. HUEBERT & YEAGER, *supra* note 44, at 29.

278. *See Officials Meet in Ilulissat*, SIKU NEWS, May 28, 2008, http://www.sikunews.com/art.html?artid=4943&catid=6.

279. Ilulissat Declaration, May 27–28, 2008, *available at* http://www.oceanlaw.org/downloads/arctic/Ilulissat_Declaration.pdf. Although the Ilulissat Declaration recognizes the fact that other states will participate in the governance of the region under the International Maritime Organization (IMO), Arctic Council, and other international fora, the other three Arctic nations—Finland, Sweden and Iceland—were pointedly not invited to the meeting; nor were environmental groups and Inuit people. *See A Carve-up Deal?*, SIKU NEWS, May 28, 2008, http://www.sikunews.com/art.html?artid=4946&catid=2. Critics worry that such exclusions may "pave[] the way for a land grab by countries who have claims to the continental shelf at the pole." *Id.*

2. Overhaul of the Arctic Council

The Arctic Council serves a critical niche in the region by facilitating cooperation between the Arctic nations and also ensuring that indigenous peoples' concerns are heard. However, the Council could serve a much greater role in fisheries and ecosystem management and regional decision-making than it currently does by building a strong foundation for a dynamic governance regime through the incorporation of structural and intellectual leaders, promotion of institutional nesting and non-political components, and contribution of guidance regarding the division and management of resources.

The Arctic Council requires the support and financial contributions of its membership to effectuate any change or to expand its existing mandate. Arctic nations have the ability to provide this authority, but may not yet have the political will to do so. The most important modification needed is increased funding and allocation of power by current Council members. Currently, however, "[t]he Arctic Council has no permanent secretariat, nor any system of obligatory contributions which would allow it to construct a budget and plan the allocation of resources to needed activities."[280] Thus, a first order of business should be for Council members to agree on an annual obligatory financial contribution to the Council. This would enable the Council to establish a basic budget with which it could undertake future fisheries management and climate change actions. The budget should include both a general fund, allocated to coordinating a stronger institutional nesting approach, as well as sector-specific resources to apply to specific areas, such as fisheries management, if the need arises.

As discussed above, in addition to funding, there is a critical need for new state and non-state actors to be involved in an Arctic governance regime, since climate change causes and effects are often transboundary and transregional in nature. Currently, the Council is comprised of eight Arctic states and six permanent participants representing Arctic Indigenous peoples, although the Council does grant "observer status" upon some non-Arctic states, intergovernmental and inter-parliamentary organizations, and NGOs.[281] In addition to national governments and NGOs, however, the inclusion of scientists (including those outside of the IPCC and ACIA processes), the corporate sector (in particular, fisheries, shipping, oil and gas, and tourism sectors), and additional indigenous peoples is key to ensure that the interplay of structural and intellectual leadership is most effective.

280. HUEBERT & YEAGER, *supra* note 44, at 23.

281. Arctic Council, *supra* note 15.

Determining what role each actor will play and what level of authority they will be given in regime formation and implementation will no doubt be contentious, but member states and official indigenous permanent participants should provide the authority and legitimacy necessary to these new "observers" so that their full participation can be utilized. Moreover, the Council should "adequately accommodate not only the rights but also the obligations of both the international community and [Arctic] States in access to and long-term conservation and sustainable management of Arctic fisheries resources."[282]

A last major change to implement under the framework of the Arctic Council would be the creation of an additional working group to focus solely on fisheries issues. The Council currently has six expert working groups, which focus on issues such as monitoring, assessing and preventing pollution in the Arctic, climate change, biodiversity conservation and sustainable use, emergency preparedness and prevention, and sustainable development.[283] However, to effectively address the impacts of climate change on fisheries management, the Council should consider creating a specific fisheries group.[284] This group's mandate could include such responsibilities as assessing current states of knowledge with regard to fisheries and interactions with other wildlife (focusing particularly on data gathered since the ACIA report was published), identifying gaps in current regulatory and cooperative structures, and developing better frameworks for ecosystem- and precautionary principle-based resource management practices.

The fisheries group could also provide guidance on issues regarding the division and management of resources between Arctic players. One major question to consider is whether or not a regional moratorium, similar to the North Pacific Fishery Management Council's FMP, is practicable on an Arctic-wide scale for particularly vulnerable species. In addition, the fisheries group may also be in a position to suggest realistic and feasible options for promoting non-political "solutions" to fishermen who either want to leave the fisheries sector altogether or who want to make their current fishing practices more sustainable because they recognize the impact climate change will have on fish stocks.

The Arctic Council has great potential to serve a much larger and more powerful role in the region. However, a successful overhaul of the Council depends on the will of its current members. In addition, even if the Arctic Council gains authority in the region and establishes clear environmental mandates and action items, it will still necessarily rely on

---

282. Rayfuse, *supra* note 14, at 213.

283. *See* Arctic Council, Working Groups, http://arctic-council.org/section/working_groups (last visited May 26, 2010).

284. *See* HUEBERT & YEAGER, *supra* note 44, at 30.

national governments for final implementation and enforcement, which will no doubt be difficult.

3. *Arctic Regional Fisheries Management Organization*

Given the fact that a pan-Arctic regime may lie outside of the scope of reality, another option for the region would be the creation of an Arctic-wide RFMO. RFMOs are intergovernmental fisheries organizations or arrangements responsible for managing fish stocks on the high seas, as well as fish stocks that migrate through more than one state's EEZ. RFMOs have mandates to conserve species that are affected or associated with their fisheries,[285] and have the authority to establish fishery management and conservation measures on the high seas. In addition, RFMOs play a critical role in ocean governance since they can often best achieve collaboration and cooperation between and among nations and reach agreement on fisheries management strategies.

A new Arctic-wide RFMO could be created under the UN Fish Stocks Agreement, which all eight Arctic nations have ratified.[286] As such, all nations have already conceded to the agreement's terms, including the enforcement of RFMOs over high seas areas. Thus, the establishment of an Arctic-wide RFMO could predate the formation of new high seas areas in the Arctic due to melting polar ice, thereby preempting at least some of the future conflict that would arise if no management regime were in place. An Arctic Ocean RFMO would also be innovative in its "holistic and integrated approach" to regulating high seas activities.[287]

Assuming the political will exists (which is not an insignificant feat and usually the primary reason why RFMOs succeed or fail), a region-wide RFMO could mitigate disagreements between nations regarding the division and management of resources—both in the short-term and into the future. The RFMO would be in a unique place to examine the social, economic, and political drivers of Arctic fish exploitation and could use the information to allocate rights and share allotments between nations. This authority would have major implications as climatic changes begin to impact the distribution and abundance of various fish stocks within and across EEZ boundaries. The RFMO would also have a powerful role to play in compliance and enforcement measures, and give some teeth to the

---

285. *See generally* Food & Agriculture Organization of the United Nations, Code of Conduct for Responsible Fisheries (1995), *available at* ftp://ftp.fao.org/docrep/fao/005/v9878e/v9878e00.pdf; Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, *opened for signature* Dec. 4, 1995, 34 I.L.M. 1542, *available at* http://www.un.org/Depts/los/convention_agreements/convention_overview_fish_stocks.htm [hereinafter UN Fish Stocks Agreement].

286. *See* UN Fish Stocks Agreement, *supra* note 285.

287. Rayfuse, *supra* note 14, at 215.

largely ineffective soft law and voluntary governance system currently in place for the region.

An Arctic RFMO could increase the use of science in regional policy processes by bringing relevant science to bear in policy discussions, as well as utilizing science to trigger collective action by nation-states in their fisheries management plans. Additionally, the RFMO could be structured so that non-contracting parties (non-Arctic states) could still participate in the work of the RFMO as either observers or cooperating non-members, and intergovernmental organizations and NGOs could participate as observers. The RFMO would specify in its institutional framework how permissive or restrictive these categories would ultimately be. Lastly, given that the RMFO would be only one piece of the overarching regional governance framework, it could establish strong linkages and cooperative agreements with other organizations and associations involved in activities that may impact fisheries management activities, including scientific research, oil/gas exploration, tourism, and shipping. As such, the RFMO would serve a critical role in creating a truly institutionally nested governance regime.

There are no legal restrictions to the Arctic states forming a new RFMO, but as mentioned above, "[t]he question is whether the political will to do so is there. The difficulty faced by Iceland, Norway and Russia in reaching agreement regarding the fisheries in the Barents Sea Loophole demonstrates how challenging such an effort can be."[288] Moreover, reaching an agreement between all states regarding consistent fishery policies across national borders and into areas of high seas will likely take place only *after* each nation has effectively implemented sustainable and successful policies in their own waters—something that is still generally lacking in the region.

F. Toward Choosing a Governance Structure

There is little doubt that disagreements will persist regarding which system or governance regime structure may work best for the Arctic in the face of climate change. Relying on international law or bilateral and multilateral treaties to provide an effective governance regime for the Arctic and address future climate change effects on fisheries stocks is inadequate because of their inherent legal and geographical limitations. Similarly, the Arctic Council as it currently operates is often powerless to exert real authority over the region and also fails to encompass the necessary actors. The need for a dynamic, ecosystem-based, and adaptive governance regime points away from a formal binding regional treaty, and instead suggests that strengthening existing soft law mechanisms in

288. HUEBERT & YEAGER, *supra* note 44, at 31.

the region and expanding upon intergovernmental fisheries arrangements may work best to address future climate change impacts and to determine how to manage resources now.

CONCLUSION

The ACIA scientific report concludes that "there are likely to be future surprises" as to possible climate change consequences[289] for the region. Many agree that there is little doubt this sentiment will hold true.

The challenge presented by climate change impacts on the Arctic region is immense, but progress is achievable. There is still much uncertainty over the actual impacts that climate change will have in the region, particularly on fisheries stocks and existing governance frameworks. Notwithstanding this uncertainty, however, the time is now to create a new dynamic, ecosystem-focused governance regime, which will encompass existing frameworks and include new components to fill current gaps, utilizing the information at hand and gleaning lessons learned from historical fisheries alterations and conflicts.

Although a pan-Arctic Treaty is likely unrealistic, future governance frameworks could be built through a combination of relying on existing international, bilateral, and multilateral agreements and strengthening existing regional institutions, such as redefining the scope of the Arctic Council and creating a region-wide RFMO. Of course, these reforms will succeed only with a comprehensive, adaptive regime and the political will and financial support of Arctic players.

Understanding and preparing for climate change effects on Arctic ecosystems will allow humankind to better recognize and plan for adaptations to climate change on a global scale. The Arctic ecosystem is being altered at a staggering pace, and many of the implications of climate change, including effects on fisheries stocks, will be witnessed first in the Arctic. Along with uncertainty comes responsibility to effectively address the impacts of such change and to use the insight gleaned from Arctic fisheries to preempt similar conflicts that will likely take place around the world when climate change effects are felt more acutely. In addition, successfully addressing issues of climate change uncertainty in the Arctic will serve as a useful model for comparison to other resource management contexts. Climate change does not occur in isolation. How we handle the governance and management of the Arctic system will no doubt have global repercussions.

---

289. ARCTIC CLIMATE IMPACT ASSESSMENT, *supra* note 1, at 1019.

We welcome responses to this Note. If you are interested in submitting a response for our online companion journal, *Ecology Law Currents*, please contact ecologylawcurrents@ boalt.org. Responses to articles may be viewed at our website, http://www.boalt.org/elq.