SCIENTIFIC CERTAINTY THRESHOLDS IN FISHERIES MANAGEMENT: A RESPONSE TO A CHANGING CLIMATE

BY

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Fisheries in federal waters have long been regulated on an as-needed basis. Many requirements under the Magnuson-Stevens Act are only triggered once a fishery is determined to be "overfished." This reactive management method is troubling because of the vast levels of uncertainty as to stock population, recruitment rates, and other measures of health. Furthermore, fish stocks in many areas are already being affected by climate change, compounding the existing uncertainties as to their health and resilience.

In response to the uncertainty as to health of the fish stocks, compounded by the additional uncertainty posed by climate change, the North Pacific Fishery Management Council recently closed the Arctic Management Area to commercial fishing. The Council is arguably without the authority to preemptively close the Arctic Management Area without providing specific benchmarks and a timeline for re-opening the fisheries because the Magnuson-Stevens Fishery Conservation and Management Act does not favor preemptive measures or require any level of scientific certainty. Additionally, while international suggestions for regulation of fisheries are increasingly more precautionary, they have not yet contemplated the closure of a fishery due to scientific uncertainty. The Council determined, of its own accord, that some level of scientific certainty of the health and resilience of fish stocks should be required prior to the exploitation of fish stocks. The Council's determination that a scientific certainty threshold should be met prior to exploitation should be a federal requirement of all fisheries to ensure the continued health and vitality of this crucial resource.

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I. INTRODUCTION

On August 17, 2009, the North Pacific Fishery Management Council (NPFMC or the Council) bucked decades of reactive fishery management by closing 150,000 square nautical miles to commercial fishing because of overwhelming uncertainty in data.[1] In the absence of regulation, marine fisheries are open to free exploitation.[2] Although the closed area has not yet supported a commercial fishing industry,[3] NPFMC expects that warming conditions, reduced ice cover, and the altered ranges of fish stocks due to climate change may bring commercial exploitation to the area in the future.[4] Regardless of whether an entrenched and invested

[1] Charles K. Ebinger & Evie Zambetakis, *The Geopolitics of Arctic Melt*, 85 INT'L AFF. 1215, 1218–19 (2009); Nat'l Oceanic and Atmospheric Admin., Amendments to Bering Sea and Gulf of Alaska Fishery Management Plans, http://www.fakr.noaa.gov/sustainablefisheries/amds/ (last visited Feb. 13, 2011).

[2] *See* Marian Macpherson & Mariam McCall, *Judicial Remedies in Fisheries Litigation: Pros, Cons, and Prestidigitation?*, 9 OCEAN & COASTAL L.J. 1, 6 (2003).

[3] *See* N. PAC. FISHERY MGMT. COUNCIL, FISHERY MANAGEMENT PLAN FOR FISH RESOURCES OF THE ARCTIC MANAGEMENT AREA 4 (2009), *available at* http://www.fakr.noaa.gov/npfmc/fmp/arctic/ArcticFMP.pdf.

[4] *Id.*

commercial interest is present, closing a fishery[5] has the same regulatory effect—restricting the traditional right of free access to marine fisheries. Can NPFMC's closure be the beginning of a new proactive regulatory standard in fisheries management?

The Secretary of Commerce apparently agreed with NPFMC's predictions as to the future exploitability of the closed area by approving this unprecedented[6] precautionary closure of the Chukchi and Beaufort Seas to commercial fishing.[7] The Chukchi and Beaufort Seas together make up the Arctic Management Area, which extends out 200 miles from the northern coast of Alaska.[8] Recognizing that there exists a substantial degree of scientific uncertainty as to the types and respective statuses of fish stocks in the Arctic Management Area, NPFMC opted to preemptively close it to commercial fishing to avoid unregulated development and its possible adverse effects on the ecosystem.[9] NPFMC's decision to close the Arctic Management Area is unprecedented and unique because fisheries management is generally reactive, not proactive,[10] and because this is the first closure of a fishery due to climate change.[11]

While NPFMC's proactive closure of the Arctic Management Area received overwhelming support within the Council and from industry, environmental groups, tribal representatives, and the public,[12] such a proactive closure is at best a discretionary option under the Council's governing statute, the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act or the Act).[13] NPFMC is a Regional

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[5] A "fishery" is defined in the Magnuson-Stevens Fishery Conservation and Management Act as both a fish stock managed as a single unit and the fishing of such a stock. 16 U.S.C. § 1802(13) (2006).

[6] Leslie Kaufman, *Arctic Sea Partly Closed to Fishing*, N.Y. TIMES, Feb. 6, 2009, at A17 (calling the closure "unusual . . . because it was the first time the United States had acted to close a fishery as a result of climate change instead of in reaction to overfishing"); *see* Robin Kundis Craig, *Taking the Long View of Ocean Ecosystems: Historical Science, Marine Restoration, and the Oceans Act of 2000*, 29 ECOLOGY L.Q. 649, 655 (2002) (characterizing current marine policy as a "presumption of use" and speculating that future regulations may lead to "precautionary preservation and restoration").

[7] N. PAC. FISHERY MGMT. COUNCIL, *supra* note 3, at 2. The National Marine Fisheries Service (NMFS) issued its final rule implementing the Arctic FMP on November 3, 2009. Fisheries of the Arctic Management Area; Bering Sea Subarea, 74 Fed. Reg. 56,734, 56,734 (Nov. 3, 2009) (to be codified at 50 C.F.R. pt. 679).

[8] N. PAC. FISHERY MGMT. COUNCIL, *supra* note 3, at 1.

[9] *Id.* at 2, 4.

[10] *See* Craig, *supra* note 6, at 655.

[11] Kaufman, *supra* note 6, at A17.

[12] N. PAC. FISHERY MGMT. COUNCIL, COUNCIL MOTION – ARCTIC FISHERY MANAGEMENT PLAN (2009), *available at* http://www.fakr.noaa.gov/npfmc/current_issues/Arctic/ArcticFMP209motion.pdf (unanimously voting to submit the Arctic FMP to the Secretary of Commerce for approval); Fisheries of the Arctic Management Area; Bering Sea Subarea, 74 Fed. Reg. 56,734, 56,735 (Nov. 3, 2009) (codified at 50 C.F.R. pt. 679) ("Comments were received from members of the public, environmental organizations, tribal representatives, and fishing industry representatives, all of which supported the Arctic FMP . . . ."); Kaufman, *supra* note 6, at A17.

[13] 16 U.S.C. §§ 1801–1883 (2006).

Fishery Management Council (FMC) created by and deriving its authority from the Magnuson-Stevens Act.[14] The Act tasks the Council with preparing a fishery management plan (FMP) for each fishery within its region[15] in need of conservation and management.[16] In the absence of Council or agency regulation, a fishery is open to commercial exploitation.[17] A fishery may be closed under the Act as a discretionary action.[18] Exercising the option of closing a fishery carries with it specific requirements prior to agency approval.[19] First, the Act's closure requirements charge the Council with ensuring that a closure is based both on the best available science and a consideration of the costs and benefits of the closure.[20] Second, a discretionary closure must provide criteria by which to assess its benefit along with a timetable for review of the closure.[21] These criteria, together with provisions of the Act and agency guidelines designed to manage exploitation of fisheries despite vast knowledge gaps and scientific uncertainty,[22] suggest Congressional disfavor for using scientific uncertainty as the sole basis for acting to curb or prohibit commercial fishing. Instead, the Act generally encourages exploitation both as an economic, social, and cultural goal, as well as a means for carrying out scientific research using

14 *Id.* § 1852(a).

15 NPFMC has authority over fisheries of the Arctic Ocean, Bering Sea, and Pacific Ocean seaward of Alaska. *Id.* § 1852(a)(1)(G).

16 *Id.* § 1852(h)(1). "Conservation and management" is a defined term under the Act used to refer to any measure required or useful in "rebuilding, restoring, or maintaining, any fishery resource and the marine environment." *Id.* § 1802(5). The measures taken must assure the continuing availability of food, products, and recreation; avoid irreversible adverse effects; and ensure other options for future uses of the managed area remain available. *Id.*

17 Macpherson & McCall, *supra* note 2, at 5–6 ("A notable aspect of the Magnuson-Stevens Act that sets it apart from other resource management statutes . . . is that, absent some affirmative agency action, fisheries in federal waters go unregulated. The default status . . . is open access, allowing unrestricted harvests."). To the extent that FMCs do not choose to regulate a fishery, states may regulate fisheries in federal waters for those vessels registered with the state. *E.g.*, Fish & Game Code, ALASKA STAT. § 16.05.475 (2008) (requiring registration); ALASKA ADMIN. CODE tit. 5, § 29.120 (1998) (defining registration and closing certain areas).

18 16 U.S.C. § 1853(b).

19 *Id.* § 1853(b)(2).

20 *Id.*

21 *Id.*

22 *See Implementation of the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act: Hearing Before the Subcomm. on Insular Affairs, Oceans, and Wildlife of the H. Comm. on Natural Resources*, 111th Cong. [hereinafter *Reauthorization Hearings*] (statement of Steven A. Murawski, Director of Scientific Programs and Chief Science Advisor, Nat'l Marine Fisheries Serv., Nat'l Oceanic & Atmospheric Admin., U.S. Dept. of Commerce), *available at* http://www.legislative.noaa.gov/Testimony/Murawski102709.pdf ("If assessment results are uncertain, target catch levels need to be set lower to ensure the stock is not being overfished. As assessment results become more accurate, fishery catches can be set higher and closer to the overfishing limit."); 50 C.F.R. § 600.310(b)(3) (2009) (requiring Councils to consider scientific uncertainty and lower risk levels accordingly); *id.* § 600.310(e)(1)(iv) (requiring Councils to take uncertainty into account when setting maximum sustainable yield for a fishery); *id.* § 600.310(f)(1) (requiring management actions to become more conservative as population estimates decline and scientific or management uncertainty increases).

adaptive management.[23] The Act's requirements for closure of a fishery do not expressly contemplate a proactive measure due to scientific uncertainty such as NPFMC's closure. The Act instead presumes unfettered use of fisheries, favoring reactive measures when exploitation results in depleted fish stocks.[24] Given this incongruence between the spirit of the Act and the Council's decision to close the Arctic Management Area, the Council's closure cannot be attributed solely to compliance with the provisions of the Magnuson-Stevens Act.

The Magnuson-Stevens Act is not the only regulatory regime affecting U.S. fisheries; there are four important international organizations and agreements applicable in the Arctic,[25] but none of these regulatory regimes and frameworks alone provides an additional basis for the Council's action. Rather than mere compliance with a national or international regulatory directive or suggestion, the Council's decision should thus be seen as NPFMC's and the National Marine Fisheries Service's (NMFS) direct response to rapidly changing environmental conditions and the uncertainty associated with such changes.

NPFMC's decision to use its discretionary authority to close the Arctic Management Area implies a scientific certainty threshold that scientific data must satisfy before exploitation of a stock can occur. Because NPFMC instituted this threshold as an adaptation to climate change and not in response to statutory or regulatory directives, it should serve as a model for dealing with increasingly high uncertainty levels in fisheries management. Climate change promises to alter both marine habitats and essential characteristics of stocks to the extent that stocks considered "known"—because sufficient data are available—may effectively become unknown without aggressive monitoring and data collection programs. In order to

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[23] *See* Diana L. Stram & Diana C. K. Evans, *Fishery Management Responses to Climate Change in the North Pacific*, 66 J. OF MARINE SCIENCE 1633, 1635 (2009) (discussing the Council's research plan to allow commercial trawlers in certain areas to evaluate effects). Adaptive management is a management method designed to improve management by learning from its results. BYRON K. WILLIAMS ET AL., ADAPTIVE MANAGEMENT WORKING GROUP, U.S. DEPT. OF THE INTERIOR, ADAPTIVE MANAGEMENT: THE U.S. DEPARTMENT OF THE INTERIOR TECHNICAL GUIDE 1 (2009). A classic adaptive management scenario begins with a set of alternatives. *Id.* Managers predict the outcome of each alternative. *Id.* By implementing alternatives and monitoring the effects, managers seek to learn about the impacts of the alternatives and adjust accordingly. *Id.*

[24] Without an FMP under the Magnuson-Stevens Act, fisheries subject to federal control are unregulated, subject to a sort of free-for-all. *See* Hope M. Babcock, *Grotius, Ocean Fish Ranching, and the Public Trust Doctrine: Ride 'Em Charlie Tuna*, 26 STAN. ENVTL. L.J. 3, 9–10 (2007) (characterizing unregulated fisheries as tragedies of the commons). Even where an FMP exists for a fishery, the Magnuson-Stevens Act requires Councils to temper their conservation measures according to their economic impact. 16 U.S.C. § 1851(a)(1), (8) (requiring FMPs to prevent overfishing while accounting for the economic impacts of conservation measures).

[25] *See infra* Part III; *see also* U.N. Conference on Environment and Development, Rio De Janiero, Braz., June 3–14, 1992, *Rio Declaration on Environment and Development*, princ. 15, U.N. Doc. A/Conf.151/26/Rev.1 (Vol. 1), Annex I (Aug. 12, 1992), *available at* http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm [hereinafter *Rio Declaration*] (setting forth the precautionary approach).

maintain sustainability and avoid collapse of the nation's fisheries, it is imperative that national regulations require Councils to cease or pause commercial fishing when uncertainty in the data on fish stocks reach a predetermined threshold level. Because scientific uncertainty as to fish stocks is essentially a problem of scientific indeterminacy,[26] it does not lend itself to measurement using probability or other statistical methods for measuring uncertainty.[27] Instead, predetermined levels of certainty in scientific data could be established by analogy to a defined baseline of data—a sort of ideal data set. If there are too many unknowns for a given stock so that the qualitative certainty level is unknown or not satisfied, fishing for the stock would be suspended, thus using the certainty level as a threshold. The Magnuson-Stevens Act or, more likely, its implementing regulations should require scientific certainty thresholds for allowing commercial exploitation of fish stocks to prevent irreversible effects or collapse.

Part II of this Comment begins with a discussion of the Magnuson-Stevens Act and its implementing regulations. Part II also characterizes the Council's preemptive closure of the Arctic Management Area as an example of a precautionary scientific certainty threshold, establishing a level of scientific certainty required before management or exploitation can occur even in an adaptive management context. Because the Council's proactive closure exceeds the Magnuson-Stevens Act's conservation requirements, Part III turns to international agreements such as the United Nations Code of Conduct for Responsible Fisheries[28] and the United Nations Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks[29] to determine the role of precautionary fisheries management outside of the Magnuson-Stevens Act. Part IV examines the projected effects of climate change on marine fisheries, and argues that NPFMC's response in closing the Arctic Management Area was appropriate and should serve as a model

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26 *See* N. PAC. FISHERY MGMT. COUNCIL, ARCTIC FISHERY MANAGEMENT PLAN: A POLICY OUTLINING COMMERCIAL FISHERY MANAGEMENT IN THE U.S. EXCLUSIVE ECONOMIC ZONE OF THE BEAUFORT AND CHUKCHI SEAS 2–3 (2009), *available at* http://www.fakr.noaa.gov/npfmc/current_issues/Arctic/ARCTICflier209.pdf.

27 *See* Robert Costanza & Laura Cornwell, *The 4P Approach to Dealing with Scientific Uncertainty*, 34 ENVIRONMENT, no. 9, Nov. 1992, at 12, 13 (defining statistical uncertainty as uncertainty with a known probability and true uncertainty as uncertainty with an unknown probability or indeterminacy).

28 U.N. FOOD & AGRIC. ORG., CODE OF CONDUCT FOR RESPONSIBLE FISHERIES (1995), *available at* ftp://ftp.fao.org/docrep/fao/005/v9878e/v9878e00.pdf. Adopted unanimously by FAO, the Code of Conduct "provides a necessary framework for national and international efforts to ensure sustainable exploitation of aquatic living resources in harmony with the environment." *Id.*

29 United Nations Conference on Straddling Fish Stocks & Highly Migratory Fish Stocks, New York, U.S., July 24–Aug. 4, 1995, *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*, U.N. Doc. A/Conf.164/37 (Sept. 8, 1995) [hereinafter U.N. Fish Stocks Agreement], *available at* http://daccess-dds-ny.un.org/doc/UNDOC/GEN/N95/274/67/PDF/N9527467.pdf?OpenElement (seeking to "ensure the long-term conservation and sustainable use of straddling fish stocks and highly migratory fish stocks").

management response to increased uncertainty because of climate change. To require other management bodies to respond to changing conditions, as NPFMC has done, Part V suggests that future ocean policy should expressly direct regional fishery management bodies to establish precautionary scientific certainty thresholds similar to that used by NPFMC in its proactive closure of the Arctic Management Area. In so doing, fisheries managers would have both the ability and the responsibility to proactively respond to the scientific uncertainty that accompanies rapid environmental changes.

II. REGULATORY AUTHORITY AND NPFMC'S CERTAINTY THRESHOLD

Recent amendments to the Magnuson-Stevens Act have increased its conservation focus,[30] but the Act remains inadequate, as evidenced by its failure to provide a framework for or require a scientific certainty threshold such as NPFMC has found necessary to manage fisheries in its region. The Magnuson-Stevens Act does not require any particular level of scientific certainty before exploitation can occur. In fact, the Act promotes just the opposite: it assumes exploitation unless conservation is needed.[31] Instead, the Act should require a specified level of scientific certainty in the data underlying Councils' management decisions. A comparison of history and provisions of the Act and its current implementation with NPFMC's closure of the Arctic Management Area demonstrates the Act's inability to adequately regulate fisheries in the face of changing climatic conditions without scientific certainty thresholds.

A. The Magnuson-Stevens Act

While amendments to the Magnuson-Stevens Act have recently prioritized conservation goals, fisheries management has traditionally focused on nationalizing United States waters and developing the industry

[30] *See* Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006, Pub. L. No. 109-479, 120 Stat. 3575 (2007); Niki L. Pace, *Ecosystem-Based Management Under the Magnuson-Stevens Act: Managing the Competing Interests of the Gulf of Mexico Red Snapper and Shrimp Fisheries*, 2 SEA GRANT L. & POL'Y J., Winter 2009–2010, at 1, 4, *available at* http://nsglc.olemiss.edu/SGLPJ/Vol2No2/vol2no2.pdf ("[To address the national fish crisis,] the FCMRA addresses the timeline for rebuilding overfished stocks; establishes a regional cooperative research and monitoring program and a regional ecosystem study; strengthens the role of science in decision-making; develops new measures for fish habitat; and authorizes limited access privilege programs (LAPPs)." (citations omitted)).

[31] Pace, *supra* note 30, at 7 (Noting that fishery management plans under the Magnuson-Stevens Act "require[] management measures that 'prevent overfishing while achieving, on a continuous basis, the optimum yield from each fishery for the United States fishing industry.' [The Magnuson-Stevens Act] defines optimum yield as 'maximum sustainable yield from the fishery.' Maximum sustainable yield is defined by regulation as 'the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions.'" (quoting 16 U.S.C. § 1851(a)(1) (2006) (management requirements); *id.* § 1802(28)(b) (optimum yield); 50 C.F.R. § 600.310(1) (2009) (maximum sustainable yield))).

rather than ensuring sustainable use.[32] The Act is implemented by the Secretary of Commerce through the National Marine Fisheries Service (NMFS), which in turn defers to the regional Councils so long as they comply with the Act.[33] In the absence of agency regulation, fisheries beyond state waters[34] are generally unregulated.[35] The open access default is somewhat of a relic of the traditional freedom of the high seas.[36] Open access makes sense in the historical context because the Magnuson-Stevens Act was originally passed in 1976 with the intent of requiring foreign fisheries to obtain permits to fish within two hundred miles of the United States coast, while also further developing the national fishing industry.[37] Because of the default open access and emphasis on economic development, regulations under the Act are often only promulgated when fisheries are already at a reduced capacity.[38] In 1996, Congress passed the Sustainable Fisheries Act,[39] which introduced additional conservation aspects to the Magnuson-Stevens Act,[40] but without removing the commercial slant.

The Act requires an FMP for fisheries found to be overfished;[41] FMPs can contain measures for protecting habitat, requiring observers, reducing bycatch, or imposing gear restrictions.[42] An FMP is only required upon the Secretary of Commerce's determination that a fishery is at or is approaching overfished status.[43] An overfished fishery is one that had or has a level of anthropogenic fish mortality that "jeopardizes the capacity of [the] fishery to

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32 PEW OCEANS COMM'N, AMERICA'S LIVING OCEANS: CHARTING A COURSE FOR SEA CHANGE 40, 44–45 (2003), *available at* http://www.pewtrusts.org/uploadedFiles/wwwpewtrustsorg/Reports/Protecting_ocean_life/env_pew_oceans_final_report.pdf.

33 16 U.S.C. § 1854(a)–(c)(2006).

34 Submerged Lands Act, 43 U.S.C. § 1312 (2006) (designating the seaward boundary of coastal states as three miles from the coast line).

35 Macpherson & McCall, *supra* note 2, at 6.

36 *See* Kate Miles, *International Investment Law: Origins, Imperialism and Conceptualizing the Environment*, 21 COLO. J. INT'L ENVTL. L. & POL'Y 1, 13 (2010) (describing the origin of the *De Mare Liberum*, the doctrine of the freedom of the high seas).

37 Roger Fleming & John D. Crawford, *Habitat Protection Under the Magnuson-Stevens Act: Can It Really Contribute to Ecosystem Health in the Northwest Atlantic?*, 12 OCEAN & COASTAL L.J. 43, 47 (2006) (describing the Act's passage as "[d]riven in part by alarm at the biological effects of foreign fishing in the northwest Atlantic and in part by a desire to capture the economic and social benefits of those fisheries for Americans"); 16 U.S.C. § 1821(a)(2006) (establishing that foreign fishing within the exclusive economic zone requires a permit); 50 C.F.R. § 600.10 (2009) ("Exclusive economic zone (EEZ) means . . . that area adjacent to the United States which . . . encompasses all waters from the seaward boundary of each of the coastal states to a line on which each point is 200 nautical miles . . . from which the territorial sea of the United States is measured.").

38 16 U.S.C. § 1854(e) (2006) (requiring action upon a determination that a fishery is overfished).

39 Pub. L. No. 104-297, 110 Stat. 3559 (1996) (codified as amended at 16 U.S.C. § 1801 (1996)).

40 *Id.* §§ 101, 106, 110 Stat. 3559.

41 16 U.S.C. § 1854(e) (2006). It should be noted that a fishery that is subject to overfishing may not be "overfished."

42 *Id.* § 1853.

43 *Id.* § 1854(e).

produce the maximum sustainable yield on a continuing basis."[44] Maximum sustainable yield (MSY) is a concept widely used in fisheries management as a measure of the maximum number of fish that can be taken consistently over time.[45] An FMP for an overfished fishery must contain a number of specifications: a description of the fishery, an assessment of MSY and optimum yield, reporting requirements to the Secretary, identification of essential fish habitat, scientific data needed, criteria for determining whether the fishery is overfished, standardized reporting methods for bycatch, requirements of recreational fishing, rebuilding plans, and a mechanism for determining catch limits.[46]

FMPs must also be consistent with the Act's National Standards,[47] which codify the tension between economic and conservation needs inherent in the Magnuson-Stevens Act. There are ten National Standards in the Act. Most indicative of the tension between industry and environmental needs are the following: 1) measures must prevent overfishing while maintaining the optimum yield, defined as the maximum sustainable yield as reduced by social, economic, or ecological factors;[48] and 2) consistent with conservation, measures must account for a fishery's importance to local communities.[49] The Act prioritizes conservation goals by requiring economic concerns be consistent with conservation measures. However, it also uses phrases such as "to the extent practicable" to reserve discretion for the Councils and NMFS in determining the practicability of conservation.[50] The Councils preliminarily determine what measures are practicable and so long as their determinations comply with the Act, the agency must approve them.[51]

Councils have substantial discretion under the Magnuson-Stevens Act to determine what is practicable, which makes it a concern that, statistically, the Councils represent commercial and recreational interests more than any other interest.[52] Councils' determinations of what is practicable are likely

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44 *Id.* § 1802(34).

45 Eric A. Bilsky, *Conserving Marine Wildlife Through World Trade Law*, 30 MICH. J. INT'L L. 599, 605 (2009) (describing conventional fisheries management using biologically-based measurements such as MSY). NMFS regulations define MSY as "the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological, environmental conditions and fishery technological characteristics (e.g., gear selectivity), and the distribution of catch among fleets." 50 C.F.R. § 600.310(e)(1)(i)(A) (2009).

46 16 U.S.C. § 1853(a) (2006).

47 *Id.* § 1851(a).

48 *Id.* § 1802(33); 50 C.F.R. § 600.310(e)(1)(i)(A) (2009).

49 16 U.S.C. § 1851(a)(8) (2006). The National Oceanic and Atmospheric Administration, as the agency charged with administering the Act, has promulgated guidelines for the implementation of the national standards set forth in the Act at 50 C.F.R. § 600.310 (2009).

50 Macpherson & McCall, *supra* note 2, at 5.

51 *See id.*; Scott C. Matulich et al., *Policy Formulation Versus Policy Implementation Under the Magnuson-Stevens Fishery Conservation and Management Act: Insight from the North Pacific Crab Rationalization*, 34 B.C. ENVTL. AFF. L. REV. 239, 240–41, 245 (2007) (describing the agency's limited ability to review Councils' suggested regulations under the Magnuson-Stevens Act).

52 Thomas A. Okey, *Membership of the Eight Regional Fishery Management Councils in the United States: Are Special Interests Over-Represented?*, 27 MARINE POL'Y 193, 193 (2003)

made in the context of Council members' financial and recreational interests.[53] Indeed, scholars have decried Council membership as favoring commercial and recreational fishing interests.[54] "Practicable," according to the Councils, is thus likely to err on the side of commercial and recreational preferences, which is permissible under the Act. Despite congressional action with the Sustainable Fisheries Act to increase the conservation focus of the Magnuson-Stevens Act,[55] the Act continues to be implemented by Councils with substantial discretion to further financial and recreational interests in increasing exploitation, perpetuating its traditional commercially centered provisions.

B. Implementation of the Magnuson-Stevens Act

The commercially centered provisions of the Magnuson-Stevens Act, together with NMFS implementing regulations and the scientific uncertainties inherent in fisheries management, increase the already wide latitude afforded to Councils composed largely of industry stakeholders.[56] This often results in actions that tend toward the bare minimum of conservation and precaution required under the Act.[57] The Magnuson-Stevens Act grants NMFS and the Councils an enormous amount of discretion. NMFS has used its discretion to promulgate guidelines for setting reference points for stock assessments and measuring success in achieving statutory directives.[58] Council discretion extends both to conservation (how many fish can be caught) and allocation decisions (who gets to catch them).[59] By requiring the Councils to make both conservation and allocation decisions, the Act and NMFS (perhaps inadvertently) provide an incentive to focus less on conservation to avoid difficulty in allocation[60] given that less conservation of resources means that more resources are available to allocate. NPFMC has traditionally been more

(finding the regional councils between 1990 and 2001 composed of 49% commercial fishing, 33% recreational fishing, and 17% all other interests, including mandated agency presence).

53 *See, e.g.*, JOSH EAGLE ET AL., TAKING STOCK OF THE REGIONAL FISHERY MANAGEMENT COUNCILS 4 (2003) ("[F]ishing interests dominate the councils, robbing the councils of the diverse and robust perspectives needed to withstand pressures and make wise but controversial decisions."); Fleming & Crawford, *supra* note 37, at 47–48 (describing the Councils as "industry dominated").

54 *See* Fleming & Crawford, *supra* note 37, at 47–48.

55 *See* EUGENE H. BUCK & DANIEL A. WALDECK, CONG. RESEARCH SERV., RL 30215, THE MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT: REAUTHORIZATION ISSUES 7–8 (2005), *available at* http://ncseonline.org/NLE/CRSreports/05feb/RL30215.pdf.

56 Fleming & Crawford, *supra* note 37, at 47–48.

57 *See generally* Dave Owen, *Probabilities, Planning Failures, and Environmental Law*, 84 TUL. L. REV. 265, 278 (2009) (explaining that when given a range within which a recommended quota should fall, Councils stray to the top of the range, increasing the unlikelihood of recovery).

58 50 C.F.R. § 600.10 (2009). *See generally id.* pt. 600 (agency regulation for implementing the Magnuson-Stevens Act).

59 EAGLE ET AL., *supra* note 53, at 20–21.

60 *Id.*

conservation-minded than the other seven Councils, in part because of its historical responsibility to ensure enough fish remained after foreign exploitation for the developing United States fleets.[61] Even so, its management practices have shared with the other Councils a tendency toward exploitation in the face of staggering scientific uncertainty, consistent with the spirit of the Magnuson-Stevens Act.[62]

Fisheries management has long been plagued with scientific uncertainty to the extent that many fish stocks cannot even be evaluated to determine whether they are overfished, yet exploitation continues.[63] Of the 932 federally managed stocks in United States waters, regulators have sufficient information to evaluate a meager 25% to determine whether they are overfished.[64] The remaining 75% include some of the most economically valuable fisheries, which continue to be exploited without regulatory evaluation because of scientific uncertainty.[65] Economic value provides incentive to Councils to be less conservation-minded. Within NPFMC's management area, 42% of its major stocks have unknown population levels and cannot be evaluated.[66] Pollock (*Theragra chalcogramma*) is among the unknown stocks in NPFMC's management area,[67] yet the Council set the total allowable catch (TAC) at 815,000 tons in 2009 and expects to allow 1,110,000 tons in 2011.[68]

NMFS has attempted to deal with this uncertainty in stock population levels by instituting an adaptive management scheme requiring precautionary measures when setting catch limits and other management decisions within an unevaluated fishery.[69] Uncertainty as to stock levels is problematic because NMFS regulations premise adaptive management schemes on the relationship between biological reference points and associated management responses as stock levels approach the reference

61 *Id.* at 19 box6; N. PAC. FISHERY MGMT. COUNCIL, *supra* note 3, ES-2 tbl.ES-1 (describing NPFMC's thirty years of precautionary fisheries management).

62 *See* Fleming & Crawford, *supra* note 37, at 45, 47–48.

63 EAGLE ET AL., *supra* note 53, at 17.

64 *Id.*

65 *Id.*

66 *Id.* at 18 fig.1.

67 *Id.* at 17.

68 NAT'L OCEANIC & ATMOSPHERIC ADMIN., NORTH PACIFIC FISHERY MANAGEMENT COUNCIL RECOMMENDATIONS FOR BERING SEA ALEUTIAN ISLANDS GROUNDFISH OFLS, ABCS, AND TACS FOR 2010–2011 FISHERIES (2009), *available at* http://alaskafisheries.noaa.gov/npfmc/CouncilSpecs1209.pdf.

69 *Reauthorization Hearings*, *supra* note 22 (statement of Steven A. Murawski, Director of Scientific Programs and Chief Science Advisor, Nat'l Marine Fisheries Serv., Nat'l Oceanic & Atmospheric Admin., U.S. Dept. of Commerce) ("If assessment results are uncertain, target catch levels need to be set lower to ensure the stock is not being overfished. As assessment results become more accurate, fishery catches can be set higher and closer to the overfishing limit."); 50 C.F.R. § 600.310(b)(3) (2009) (requiring Councils to consider scientific uncertainty and lower risk levels accordingly); *id.* § 600.310(e)(1)(iv) (requiring Councils to take uncertainty into account when setting maximum sustainable yield for a fishery); *id.* § 600.310(f)(1) (requiring management actions to become more conservative as population estimates decline and scientific or management uncertainty increases).

points.[70] Reference points are essentially thresholds that require a management response.[71] For example, the Act designates MSY as a threshold designed to ensure the continuing sustainability of a fishery, and it cannot be exceeded.[72] NMFS regulations guide Councils in setting MSY and base all other biological reference points on it.[73] Thus, uncertainty as to stock levels impairs both the Councils' ability to set biological reference points required by NMFS implementing regulations as well as its ability to monitor the stock to determine whether it is near a reference point and in need of a management response.[74] The Act requires MSY and optimum yield as reference points, but it is NMFS regulations implementing the Act that set out guidelines to deal with the double-edged sword of uncertainty by requiring Councils to measure uncertainty and incorporate it in their reference points.[75] Thus, as uncertainty increases, reference points should become more and more conservative to provide an adequate margin of error so that uncertainty does not adversely affect the management response. This margin of error is designed to allow exploitation even where there is substantial uncertainty without impairing the sustainability of the fishery.

The Councils' discretion under the Act allows them to effectively reduce the margin of error, threatening the sustainability that NMFS adaptive management is designed to ensure. Councils must adhere to the requirements of the Magnuson-Stevens Act by ensuring their proposed FMPs are consistent with the Act's National Standards and other provisions.[76] The National Standards require the Councils to prevent overfishing, ensure optimum yield, base their decisions on the best scientific information available, and take other issues into consideration such as bycatch, efficiency of use, and the needs of fishing communities to the extent practicable.[77] The National Standards set forth two hard and fast requirements: prevent overfishing and ensure optimum yield.[78] These requirements appear to be straightforward, scientifically based conservation measures to maintain a balance between environmental needs, preventing overfishing, and the commercial interest in obtaining optimum yield. The population level that will determine whether a fishery is overfished and the level that will produce optimum yield sound like purely scientific quantities.

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70 *See Reauthorization Hearings*, *supra* note 22 (statement of Steven A. Murawski, Director of Scientific Programs and Chief Science Advisor, Nat'l Marine Fisheries Serv., Nat'l Oceanic & Atmospheric Admin., U.S. Dep't of Commerce) ("Fishery management and fishery science have complementary roles in fulfilling the mandates of the *MSA*."); 50 C.F.R. § 600.310(a)–(b) (2009).

71 *See, e.g.*, 50 C.F.R. § 600.310(c)(1), (c)(3), (e)(1), (e)(3).

72 Magnuson-Stevens Act, 16 U.S.C. §§ 1802(34), 1854(e) (2006).

73 50 C.F.R. § 600.310(b), (c)(2)(i) (2009).

74 *See id.* § 600.310(c)(2)(ii), (f)(4)(v), (f)(5)(i).

75 *Id.* § 600.310(c)(2)(ii).

76 16 U.S.C. § 1854(a)(1)–(3) (2006).

77 *Id.* § 1851(a).

78 *Id.* § 1851(a)(1).

Nevertheless, these presumably scientific quantities are subject to the discretion of the Councils.[79]

For example, Councils determine MSY based on a range recommended to them by the Scientific and Statistical Committee (SSC),[80] required under the Act.[81] Because of scientific uncertainty in estimating fish stock populations, scientists can only provide the Councils with a likely range for MSY. A higher level of uncertainty in the data requires a larger range to achieve the same level of confidence. The higher the uncertainty level, the larger the recommended range for MSY given to the Council. A wider range for an uncertain stock provides the Council with the opportunity to set the MSY at the higher end of the range while still arguably relying on the best available science. Therefore, greater uncertainty in data translates to greater Council discretion.

Councils tend to set management measures such as MSY at the higher end of the range rather than the more precautionary option of the middle or lower end of the range, and at times, ignore scientifically estimated ranges entirely.[82] While the Magnuson-Stevens Act requires Councils to make determinations—such as MSY levels—based on the best available science,[83] the Act does not require Councils to give any particular weight to the recommendations of their SSCs.[84] NMFS guidelines urging precaution where population levels are uncertain do not apply to the Council's determination of MSY.[85] MSY provides the upper limit for optimum yield, the goal for setting acceptable biological catch levels, and other reference points that are supposed to be increasingly more conservative as uncertainty increases.[86]

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79 *See* 16 U.S.C. § 1802(33)(A)–(C) (describing the "optimum" yield of a fishery as that which balances the environment, overfishing, and commercial needs); *id.* § 1852(g)(5) ("[R]ecommendations made by committees . . . established under this subsection shall be considered to be advisory in nature."); *id.* § 1853(a)(3) (requiring Councils to specify in a FMP the MSY and optimum yield (OY) of the fishery); *id.* § 1853(a)(10) (requiring Councils to specify the criteria by which to determine whether a fishery is overfished in a FMP).

80 *See* EAGLE ET AL., *supra* note 53, at 14.

81 16 U.S.C. § 1852(g)(1)(B) (2006) ("Each [SSC] shall provide its Council ongoing scientific advice . . . including recommendations for . . . [MSY] . . . .").

82 EAGLE ET AL., *supra* note 53, at 14, 15 box4 (noting how Councils generally exercise their discretion in relation to scientific advice, and providing the actions taken by the Gulf Council and the Pacific Council as examples of this process).

83 16 U.S.C. § 1851(a)(2) (2006) (establishing the obligation to make decisions according to the best available science); *id.* § 1853(a)(3) (noting that any FMP prepared by a Council must include an assessment of MSY).

84 *Id.* § 1852(g)(1)(B) (requiring SSCs to provide Councils with assistance and recommendations); *see also id.* § 1852(g)(5) ("[R]ecommendations made by committees . . . established under this subsection shall be considered to be advisory in nature.").

85 *Compare* 50 C.F.R. § 600.310(e)(1)(iv) (2009) (noting that when population data are insufficient to estimate MSY for the stock, Councils are to use other measures of reproductive potential to serve as a proxy for MSY), *with id.* § 600.310(f)(1) (urging that control rules should be designed such that management decisions become more conservative as science and management uncertainty increases).

86 *Id.* § 600.310(b)(2)(i) (noting that OY may not exceed MSY); *see id.* § 600.310(e)(2)(i)(E) (noting that a stock's overfishing limit (OFL) is designed to ensure the stock's continuing

Reference points are crucial because they inform and trigger the Councils' management responses in an FMP.[87] Thus, by setting MSY at the highest level possible while still in compliance with the Act, Councils can use scientific uncertainty to reduce the likelihood they will have to exercise precaution in subsequent reference points which determine catch levels and other management responses.

In addition to setting goals and catch levels based on scientific information, Councils also allocate valuable commercial and recreational quotas,[88] which provide further incentive to maximize risk to managed stocks.[89] Councils may allocate fishing quotas to individual operations or create licensing programs.[90] For example, in *Alaskan Trojan Partnership v. Gutierrez*,[91] the United States Court of Appeals for the Ninth Circuit described a limited license program (LLP) created by NPFMC.[92] Pursuant to the LLP, NPFMC granted licenses to fishing vessels based on prior harvests during a specified period.[93] The Magnuson-Stevens Act limits the Councils' ability to allocate fish quotas; allocation must be necessary for conservation and management of the stock.[94] If the Council must allocate fishing quotas, it cannot discriminate based on state citizenship, must be fair and equitable, allocations must be reasonably calculated to promote conservation, and cannot grant an excessive share to a particular entity.[95] The Act allows Councils to discretionarily limit access to a fishery provided Councils take the following into account: current use, historical dependence, economics, vessel capability and access to other fisheries, cultural and social importance to fishing communities, and fair and

capacity to produce MSY); *id.* § 600.310(f)(1) ("Control rules should be designed so that management actions become more conservative as biomass estimates, or other proxies, for a stock or stock complex decline and as science and management uncertainty increases."); *id.* § 600.310(f)(2)(ii) (defining acceptable biological catch (ABC) as the catch level that accounts for scientific uncertainty based on the stock's OFL, thus making the connection between MSY and ABC); *id.* § 600.310(f)(2)(iv)–(f)(3) (noting that annual catch targets may not exceed Acceptable Catch Limit (ACL), which may not exceed ABC, which may not exceed OFL).

87 *Id.* § 600.310(b)(2)(iv) (defining "reference points" as status determination criteria (SDC), MSY, ABC, and ACL); *see id.* § 600.310(c) ("Councils must evaluate and describe the [reference points] in their FMPs and amend the FMPs, if necessary, to align their management objectives to end or prevent overfishing.").

88 *See* 16 U.S.C. § 1853(a)(14) (2006) (requiring Councils to include allocate harvest restrictions in FMPS where necessary); *see also* EAGLE ET AL., *supra* note 53, at 21.

89 *See* EAGLE ET AL., *supra* note 53, at 21–22 (explaining that Councils allocate quotas and set conservation goals, and that because these two interests inherently conflict, Councils often set lax conservation standards in favor of more aggressive catch quotas).

90 16 U.S.C. § 1853(b)(1) (2006) (allowing Councils to enforce permitting programs as part of FMPS); *id.* § 1853(b)(3) (allowing Councils to establish limitations where necessary as part of FMPS).

91 425 F.3d 620 (9th Cir. 2005).

92 *Id.* at 623.

93 *Id.* at 623–34.

94 16 U.S.C. § 1851(a)(4) (2006).

95 *Id.*

equitable distribution.[96] An assessment of the Regional Council system described the difficulty of weighing the many competing interests at stake in making allocation decisions:

> Councils often must decide how to allocate a limited quota among diverse fishing interests, all of whom have significant economic and, frequently, social and cultural interests at stake. Councils must decide on the relative claims of commercial and recreational fishermen, small and large fishing interests, longtime fishermen and relative newcomers, varying geographic areas and boat types, and fishermen from different regions, among others.[97]

This description comports with the many lawsuits brought by various commercial and recreational fishing interests challenging the legality, fairness, and validity of allocations.[98] Difficult allocation decisions can become necessary upon a finding that a stock is overfished or overfishing is occurring. If the MSY for a stock is set as high as possible, the likelihood of an overfished finding is reduced. Subsequently, the likelihood that the Council would have to make difficult allocation decisions would also be reduced, providing an incentive to manipulate scientific data for political purposes and thereby increase risks to fish stocks.

All eight Councils[99] have the incentive and the ability to increase risks to fish stocks in order to decrease political unpopularity due to economic and social impacts, but NPFMC has a reputation of being more conservation-minded than the other seven Councils;[100] nevertheless, it too has a tradition of favoring exploitation over conservation.[101] When the Magnuson-Stevens Act was originally passed in 1976, NPFMC's management area was largely subject to foreign fishing fleets.[102] Because of the Act's emphasis on developing the domestic fishing industry, NPFMC focused on limiting foreign fishing to conserve resources for the developing domestic fleets.[103] To this day, NPFMC issues stricter catch limits and requires more marine observers than do the other seven Councils.[104] Arctic fisheries, including those within NPFMC's management area, are some of the most

96 *Id.* § 1853(b)(6).

97 EAGLE ET AL., *supra* note 53, at 21.

98 *See, e.g.*, Fishermen's Finest Inc. v. Locke, 593 F.3d 886, 893 (9th Cir. 2010) (denying claims of a particular sector of commercial fishing that NPFMC reallocated quotas based on an "impermissible and arbitrary political compromise"); Alliance Against IFQs v. Brown, 84 F.3d 343, 350 (9th Cir. 1996) (upholding individual fishing quotas allocated to owners and lessees of vessels, but not to non-owners or lessees, but noting the economic effects on excluded fishermen); Hall v. Evans, 165 F. Supp. 2d 114, 117 (D.R.I. 2001) (invalidating gear restrictions because, among other issues, there is no evidence the restrictions are fair and equitable to all fishermen).

99 16 U.S.C. § 1852(a)(1).

100 EAGLE ET AL., *supra* note 53, at 19 box6.

101 *See id.*

102 *Id.*

103 *Id.*

104 *Id.*

productive in the world.[105] Couple NPFMC's resource-conservative slant with the relative abundance of area waters, and it comes as no surprise that only one known stock in NPFMC's management area is classified as "overfished."[106] However, fifty-five percent of stocks within NPFMC's management area do not have defined reference points by which to determine whether they are "overfished."[107] Claims of success in fisheries management must be taken with an appropriate grain of salt due to the inherent risk posed by vast levels of scientific uncertainty. Keeping in mind the uncertain stock levels in NPFMC's management area, the Council has maintained its stocks relatively well under the Magnuson-Stevens Act to the extent determinable.[108]

The Magnuson-Stevens Act both requires conservation and limits the extent to which a Council can conserve its fisheries. The Act's original focus on developing domestic fishing has not been removed by subsequent amendments introducing stronger conservation requirements. Many of the Councils have used this tension between commercial fishing and conservation interests together with the scientific uncertainty inherent in fisheries management to maximize risk to fisheries in order to maximize commercial profit insofar as the Act allows.[109] While NPFMC has set itself apart as the more conservation-minded Council, its conservation measures are limited by the Act's preference for exploitation despite scientific uncertainty. For example, the Act allows a Council to exercise its discretion to close a fishery, but the Council must ensure its closure: 1) is based on the best scientific information; 2) includes criteria and a timetable by which to assess the benefit of the closure; and 3) is based on the Council's assessment of the benefits and impacts of the closure.[110] The Magnuson-Stevens Act may contain conservation measures, but unless a fishery is overfished or subject to overfishing, Councils must justify the economic impacts of conservation

105 Daud Hassan, *Climate Change and the Current Regimes of Arctic Fisheries Resources Management: An Evaluation*, 40 J. MAR. L. & COM. 511, 514 (2009).

106 OFFICE OF SUSTAINABLE FISHERIES, NAT'L MARINE FISHERIES SERV., NAT'L OCEANIC & ATMOSPHERIC ADMIN., U.S. DEP'T OF COMMERCE, OVERFISHED STOCKS AS OF DECEMBER 31, 2009, *available at* http://www.nmfs.noaa.gov/sfa/statusoffisheries/2009/fouthquarter/mapoverfishedstockscy_q4_2009.pdf (identifying the blue king crab as overfished).

107 *See* OFFICE OF SUSTAINABLE FISHERIES, NAT'L MARINE FISHERIES SERV., NAT'L OCEANIC & ATMOSPHERIC ADMIN., U.S. DEP'T OF COMMERCE, 2008 REPORT TO CONGRESS: THE STATUS OF U.S. FISHERIES 8 tbl.1 (2009), *available at* http://www.nmfs.noaa.gov/sfa/statusoffisheries/SOSmain.htm (follow "2008 Report Text" hyperlink) (illustrating that thirty-nine out of the seventy-one total fish stocks within NPFMC's jurisdiction are "not defined" to determine whether they are overfished).

108 NPFMC has, however, come under increasing scrutiny, particularly in regards to the Steller sea lion (Eumetopias jubatus) controversy. Beth C. Bryant, *Adapting to Uncertainty: Law, Science, and Management in the Steller Sea Lion Controversy*, 28 STAN. ENVTL. L.J. 171, 178–79 (2009).

109 *See* EAGLE ET AL., *supra* note 53, at 14–15 (describing the process by which Councils dominated by fishing interests set biological reference points such as maximum sustainable yield in the context of the various economic incentives to over-exploit fish stocks).

110 16 U.S.C. § 1853(b)(2)(C) (2006).

measures by setting specific goals and providing criteria by which to measure success in achieving those goals. Because of its strong commercial slant, the Magnuson-Stevens Act does not provide for precautionary closures due solely to scientific uncertainty unless they can be justified by scientific information, assessed according to specific criteria, temporally limited, and not overly detrimental to commercial interests without sufficient, measurable environmental goals.

C. NPFMC's Closure of the Arctic Management Area

Implementing NPFMC's Arctic FMP closing the Arctic Management Area, NMFS regulation describes it as "a precautionary, ecosystem-based approach to fisheries management,"[111] purportedly combining these two distinct approaches to resources management. While the hallmarks of these two approaches may be present in the FMP, alone they do not compel NPFMC's Arctic FMP. Instead, the FMP evinces a concern about the high degree of scientific uncertainty in the Arctic Management Area due to a historic lack of commercial data[112] and present climatic changes. Rather than using traditional adaptive management strategies such as phasing in exploitation gradually,[113] NPFMC chose to respond to the high level of uncertainty by prohibiting exploitation altogether until more data became available. Thus, in preemptively closing the Arctic Management Area, NPFMC has implicitly determined that a higher level of scientific certainty is necessary for implementing its precautionary, ecosystem-based management than is currently available. In addition to characterizing NPFMC's closure, the precautionary, ecosystem-based management labels are announcing future management intentions for the Arctic Management Area in response to climate change.

The Arctic FMP is an exceptionally precautionary measure considering the traditionally weak precautionary management directives, sometimes referred to as the "precautionary approach" and the "precautionary principle." The Rio Declaration on Environment and Development is credited with defining the precautionary approach, suggesting that "[w]here there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."[114] As stated in the Rio Declaration, the precautionary approach does not establish an affirmative obligation; it merely disallows uncertainty from being used as an excuse not to act.[115] NPFMC, however, cites precaution as requiring an affirmative

111 74 Fed. Reg. 56,734, 56,734 (Nov. 3, 2009).

112 N. PAC. FISHERY MGMT. COUNCIL, *supra* note 3, at 9.

113 The gradual phasing in of a fishery for new or under-exploited fisheries is recommended in international agreements as an adaptive management measure. *See infra* text accompanying notes 186–90.

114 *Rio Declaration*, *supra* note 25, princ. 15.

115 *Id.*

obligation to respond to scientific uncertainty.[116] Often the precautionary principle is separated from the Rio Declaration's precautionary approach in that it sets out an affirmative obligation requiring managers to favor caution in the case of uncertainty.[117] Rather than forbidding the use of scientific uncertainty as an excuse for inaction in the Rio precautionary approach, the precautionary principle makes precaution part of decision making when uncertainty is present. NPFMC's closure of the Arctic Management Area is in keeping with this precautionary principle in that it responded to uncertainty, but the precautionary principle certainly does not currently require closure of a fishery due to scientific uncertainty. Indeed, if it did, less than half of U.S. fisheries would remain open.[118]

In addition to being precautionary according to the precautionary principle, NPFMC's closure of the Arctic Management Area is also labeled as ecosystem-based, which may suggest the ethos underlying its management decisions, but adds little to the requirements of discretionary closures under the Magnuson-Stevens Act.[119] In its Interim Report, President Obama's Interagency Ocean Policy Task Force described ecosystem-based management as the integration of "ecological, social, economic, commerce, health, and security goals," while recognizing "humans as key components of the ecosystem and healthy ecosystems as essential to human well-being."[120] The National Standards for FMPs under the Act already require Councils to consider variations and contingencies in fisheries, social and economic data, and taking care to involve fishing communities.[121] Further, FMPs must contain descriptions of essential fish habitats and guidelines to minimize adverse effects to the habitat.[122] Identification of essential fish habitat in FMPs accounts for various life stages of a stock, the interactions in and among species, and the stock's contribution to the ecosystem as a whole.[123] Aside from health and security goals, the Magnuson-Stevens Act and its implementing regulations already address each of the combined goals of ecosystem-based management. The Act and agency regulations do not, however, require Councils to implement regulations pursuant to the recognition that healthy ecosystems are essential to human health; incidentally, neither does the Arctic FMP. In a technical sense, the Arctic FMP simply closes the Arctic Management Area until scientific uncertainty

116 N. PAC. FISHERY MGMT. COUNCIL, *supra* note 3, at 4.

117 Linda R. Larson & Jessica K. Ferrell, *Precautionary Resource Management and Climate Change*, 24 NAT. RESOURCES & ENV'T, Summer 2009, at 51.

118 *See* OFFICE OF SUSTAINABLE FISHERIES, *supra* note 107, at 8 tbl.1.

119 74 Fed. Reg. 56,734 (Nov. 3, 2009) (codified at 50 C.F.R. pt. 679).

120 THE WHITE HOUSE COUNCIL ON ENVIRONMENTAL QUALITY, INTERIM REPORT OF THE INTERAGENCY OCEAN POLICY TASK FORCE 12 (2009), *available at* http://www.whitehouse.gov/assets/documents/09_17_09_Interim_Report_of_Task_Force_FINAL2.pdf.

121 16 U.S.C. § 1851(a) (2006).

122 *Id.* § 1853(a)(7).

123 50 C.F.R. § 600.815(a)(1)(iv)(E) (2009).

decreases to the point at which the Council can ensure that commercial fishing in the area will be sustainable.[124]

The Arctic FMP combines aspects of the precautionary principle as well as ecosystem-based management, but neither of these management approaches explains the scientific certainty thresholds established by the Arctic FMP. The Arctic FMP is precautionary in that it "[incorporates] forward looking conservation measures that address differing levels of uncertainty."[125] Accounting for uncertainty in management decisions is generally classified as precautionary.[126] However, the Magnuson-Stevens Act has always allowed fishing despite uncertainty[127] and fishery closures or moratoria are most often premised on management failures, public health concerns, effects of a fishery on other species, or low stock populations.[128] Similarly, the Arctic FMP does not follow directly from ecosystem-based management despite NPFMC's claim that it "recognizes the need to balance competing uses of marine resources and different social and economic goals for sustainable fishery management, including protection of the long-term health of the ecosystem . . . ."[129] Ecosystem-based management tends to focus on interactions in and among various ecosystem processes within the managed area and surrounding connected areas.[130] In order to manage an entire ecosystem, managers need an understanding of the various processes and interdependencies involved. NPFMC's closure of the Arctic Management Area thus addresses the scientific needs of precautionary, ecosystem-based management. By closing the Arctic Management Area, NPFMC

124 74 Fed. Reg. at 56,734.

125 N. PAC. FISHERY MGMT. COUNCIL, *supra* note 3, at ES-2 tbl.ES-1.

126 *See* sources cited *supra* note 22.

127 *See* Fleming & Crawford, *supra* note 37, at 45, 47–48.

128 *See* Extension of Emergency Fishery Closure Due to the Presence of the Toxin that Causes Paralytic Shellfish Poisoning, 74 Fed. Reg. 58,567, 58,567 (Nov. 13, 2009) (to be codified at 50 C.F.R. pt. 648) (requesting comments on the proposed continued closure of the bivalve molluscan shellfish due to toxins); Closure of the 2009 Gulf of Mexico Recreational Fishery for Red Snapper, 74 Fed. Reg. 21,558, 21,558–59 (May 8, 2009) (to be codified at 50 C.F.R. pt. 622) (closing the Red Snapper fishery earlier than expected due to incompatible management among states); Fisheries Off West Coast States, 72 Fed. Reg. 4225, 4225 (Jan. 30, 2007) (to be codified at 50 C.F.R. pts. 224, 660) (requesting comments on the proposed continued closure of the drift gillnet fishery on the west coast due to its effect on endangered loggerhead sea turtles); *see also* Ransom A. Myers, Jeffrey A. Hutchings & Nicholas J. Barrowman, *Why Do Fish Stocks Collapse? The Example of Cod in Atlantic Canada*, 7 ECOLOGICAL APPLICATIONS 91, 91 (1997), *available at* http://www.fmap.ca/ramweb/papers-total/why_do_fish.pdf ("Abundance was so low . . . that bans of unspecified duration were imposed on commercial exploitation . . . ."); Ray Gambell, *International Management of Whales and Whaling: An Historical Review of the Regulation of Commercial and Aboriginal Subsistence Whaling*, 46 ARCTIC 97, 100–01 (1993), *available at* http://pubs.aina.ucalgary.ca/arctic/Arctic46-2-97.pdf (citing the inability to manage commercial whaling according to MSY as the primary reason for the International Whaling Commission's 1986 moratorium on commercial whaling).

129 N. PAC. FISHERY MGMT. COUNCIL, *supra* note 3, at ES-2 tbl.ES-1.

130 *See* Karen Hansen, Kathryn Mengerink & Michael Sutton, *A Bold New Ocean Agenda: Recommendations for Ocean Governance, Energy Policy, and Health*, [2009] 39 Envtl. L. Rep. (Envtl. Law Inst.) 10,017 (January 2009).

implicitly suggests that a certain level of scientific certainty is required before exploitation can be managed according to a precautionary ecosystem-based approach.

More than precaution and ecosystem-based management, NPFMC's closure of the Arctic Management Area is principally concerned with addressing the uncertainty inherent in fisheries management[131] compounded with the uncertainty in dealing with the effects of climate change on sensitive Arctic ecosystems.[132] By anticipating the need for a management framework prior to commercial fishing development, NPFMC is essentially establishing a threshold of scientific certainty required before exploitation of fisheries can occur and be managed according to precautionary, ecosystem-based principles.

D. The Arctic FMP and the Magnuson-Stevens Act

The unique and unprecedented Arctic FMP takes advantage of the wide discretion afforded the Councils under the Magnuson-Stevens Act, but NPFMC's closure departs from the traditional management methods under the Act, suggesting there may be other sources influencing NPFMC's decision. The Magnuson-Stevens Act does not require regulation until a fishery is overfished or is subject to overfishing; federal fisheries are open access unless they become depleted.[133] Yet NPFMC has closed the Arctic Management Area to avoid unregulated fishing of stocks regardless of their overfished status.[134] NPFMC felt it could not regulate the Area because of the vast scientific uncertainty due to lack of historical data and climate change.[135] The Magnuson-Stevens Act does not require any particular level of scientific certainty, although Councils are required to set reference points for fisheries such as maximum sustainable yield (MSY) and optimum yield,[136] and under NMFS implementing regulations, allowable catch level,[137] status

131 *See supra* notes 63–68 and accompanying text.

132 N. PAC. FISHERY MGMT. COUNCIL, *supra* note 3, at 89–90.

133 Macpherson & McCall, *supra* note 2, at 6.

134 Fisheries of the Arctic Management Area; Bering Sea Subarea, 74 Fed. Reg. 56,734, 56,738 (Nov. 3, 2009) (codified at 50 C.F.R. § 679) (explaining that the Arctic Management Area's closure is to "prevent the possibility of unregulated fishing that may result in overfishing of fish stocks").

135 ROBERT D. MECUM, NAT'L MARINE FISHERIES SERV., ENVIRONMENTAL ASSESSMENT/REGULATORY IMPACT REVIEW/FINAL REGULATORY FLEXIBILITY ANALYSIS FOR THE ARCTIC FISHERY MANAGEMENT PLAN 7 (2009) (explaining the Council's reasoning behind closing the Arctic Management Area due to the changing environment and no routine fish surveys in the region); N. PAC. FISHERY MGMT. COUNCIL, *supra* note 3, at ES-2 (explaining the Council is opting to close the Arctic Management Area "until sufficient information is available to support the sustainable management of a commercial fishery").

136 16 U.S.C. § 1853(a)(3) (2006) (requiring Councils to set MSY and optimum yield levels in FMPs).

137 50 C.F.R. § 600.310(b)(2)(v)(D) (2009) (requiring Councils to develop allowable catch levels for each managed fishery).

determination criteria,[138] and so on. Councils have always set these levels despite uncertainty, using analogies to similar stocks, observer data, and other statistical models and techniques.[139]

The Act's implementing regulations require Councils to exercise increasing precaution as the level of scientific certainty decreases, but without transparent scientific certainty thresholds, the requirement is little more than a suggestion. Scientific certainty as to a particular measurement or estimation can be compared by analogy to better-known stocks. Rather than setting an acceptable scientific certainty threshold for data and associated reference points, NMFS merely provides a precautionary suggestion for setting reference points where scientific data are uncertain.[140] For example, NMFS provides the following guidance for specifying MSY:

> As MSY values are estimates or are based on proxies, they will have some level of uncertainty associated with them. The degree of uncertainty in the estimates should be identified, when possible . . . and should be taken into account . . . . Where this uncertainty cannot be directly calculated, such as when proxies are used, then a proxy for the uncertainty itself should be established . . . .[141]

The Act and its implementing regulations provide room for Councils to account for uncertainty *when possible*, but nowhere does uncertainty provide a barrier such as NPFMC has constructed in its Arctic FMP. The Arctic FMP implicitly suggests that at some threshold level, scientific uncertainty can no longer be accounted for and instead should preclude exploitation entirely.

The Magnuson-Stevens Act does not require a scientific certainty threshold such as NPFMC has instituted in its Arctic FMP; arguably, the Act does not even contemplate a fishery closure due solely to scientific uncertainty.[142] Because of the large degree of discretion afforded the Councils, the Act does *permit* a closure due solely to scientific uncertainty, provided the Council justifies its action.[143] The Arctic FMP has little

138 *Id.* § 600.310(e)(2) (requiring Councils to specify status determination criteria for managed fisheries).

139 *Oversight Hearing on the Importance of Fishery Data Collection Programs: Hearing Before the Subcomm. on Fisheries, Conservation, Wildlife, and Oceans of the H. Comm. on Resources*, 105th Cong. (June 16, 2004) (Testimony of Dr. Cynthia M. Jones), *available at* http://naturalresources.house.gov/uploadedFiles/jones_6.16.04.pdf (describing use of fishery-dependent data from observers, log books, trip tickets, and landing bills); N. PAC. FISHERY MGMT. COUNCIL, *supra* note 3, at 78 ("Habitat use may . . . be inferred, if appropriate, based on information on a similar species or another life stage."); *see* Natural Res. Def. Council v. Kempthorne, 506 F. Supp. 2d 322, 365–66 (E.D. Cal. 2007) (citing cases in which Councils used population models to ensure compliance of FMPs with the Endangered Species Act).

140 50 C.F.R. § 600.310 (2009).

141 *Id.* § 600.310(e)(1)(iv).

142 16 U.S.C. § 1853(b)(2) (2006) (setting forth requirements of fishery closures emphasizing conservation benefit rather than research or scientific benefit).

143 *Id.* The Act does not expressly bar closures due to scientific uncertainty, but places requirements on the benefits of a closure outweigh the detrimental effect to economic or social interests.

discussion of the justifications, including scientific or temporal benchmarks, required by the Act.[144] Likely, the lack of any vested commercial interests in the Arctic Management Area[145] and the overwhelming support of the fishing industry[146] have allowed NPFMC to stretch the limits of its discretion under the Magnuson-Stevens Act to accommodate its other directives. While NPFMC described its Arctic FMP both as a response to climate change as well as its statutory directives, numerous international organizations and agreements related to fisheries management[147] may have influenced NPFMC's action. Indeed, the Arctic FMP references one such agreement: the International Pacific Halibut Commission.[148] Part III examines certain organizations and agreements to further contextualize NPFMC's closure and determine the extent to which international organizations and agreements may have influenced its unprecedented proactive decision to close the Arctic Management Area prior to the development of commercial fisheries.

III. INTERNATIONAL FISHERIES ORGANIZATIONS AND AGREEMENTS

International organizations and agreements may have influenced NPFMC's proactive closure of the Arctic Management Area, but as with the Magnuson-Stevens Act, none of the governing documents of such organizations, agreements, or suggested frameworks for fisheries management require a threshold level of scientific certainty in fishery data be met before commercial exploitation may proceed. International organizations and agreements generally urge precaution in managing fisheries, but it is often the weak form of precaution,[149] which suggests that scientific uncertainty may not be used as an excuse for not acting to address an environmental threat. More recent international agreements suggest a form of adaptive management similar to that contained in agency guidelines[150] pursuant to the Magnuson-Stevens Act designed to assist Councils in implementing the National Standards of the Act.

The United Nations (U.N.) favors regulated fisheries and precaution when exploiting previously unexploited or underexploited resources.[151]

144 N. PAC. FISHERY MGMT. COUNCIL, *supra* note 3, at 6–7 (prohibiting commercial fishing in the Arctic Management Area until "sufficient information exists to authorize a sustainable fisheries management program"). According to its Arctic FMP, NPFMC intends to consider authorizing commercial fishing on a single target-species basis upon receiving a petition from an individual or a recommendation from NMFS. Upon receiving a petition or recommendation, the Arctic FMP lists the information it will analyze in order to determine whether it will allow commercial fishery development in the Area. *Id.* This, however, is separate from the periodic review process required under the Magnuson-Stevens Act. 16 U.S.C. § 1853(b)(2)(C)(iii) (2006).

145 N. PAC. FISHERY MGMT. COUNCIL, *supra* note 3, at 47.

146 N. PAC. FISHERY MGMT. COUNCIL, *supra* note 12.

147 *E.g.*, FOOD & AGRIC. ORG., *supra* note 28, arts. 2–5; U.N. Fish Stocks Agreement, *supra* note 29, art. 47.

148 N. PAC. FISHERY MGMT. COUNCIL, *supra* note 3, at 2.

149 *See supra* text accompanying notes 114–15.

150 *See Reauthorization Hearings*, *supra* note 22, at 2.

151 *See infra* Part III.B.

Similarly, NPFMC has committed itself to preventing unregulated fishing in contrast to the national policy of open access unless the fishery is in need of conservation and management. Also similar to NPFMC's measures, more recent international agreements treat unfished and lightly fished stocks differently, requiring catch limits to start low to account for the uncertainty involved in exploiting a formerly unexploited resource. NPFMC's closure of the Arctic Management Area prevents unregulated fishing and owes some of its precaution to the Council's appreciation of the uncertainty involved in managing previously unfished stocks, but these concepts do not compel a threshold of scientific certainty.

International agreements continue to favor development in response to socioeconomic, nutritional, and other needs of people tending to rely on ocean resources. International agreements share the Magnuson-Stevens Act's preference for exploitation in the case of uncertainty so long as it begins precautionarily low and only gradually increases along with scientific certainty levels. This section examines regional fishery management bodies affecting NPFMC's management area—the International Pacific Halibut Commission (IPHC)[152] and the Convention on the Conservation and Management of the Pollock Resources in the Central Bering Sea (CCBSP)[153]—along with an agreement formed by the U.N. Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks (Fish Stocks Agreement or the Agreement)[154] and the U.N. Food and Agriculture Organization's Code of Conduct for Responsible Fisheries (FAO Code of Conduct)[155] to conclude that NPFMC's closure is internationally—in addition to nationally—unique.

A. International Pacific Halibut Commission and the Convention on the Conservation and Management of the Pollock Resources in the Central Bering Sea

The regional fishery management bodies in the North Pacific, IPHC and CCBSP, share the Magnuson-Stevens Act's tendency to err on the side of exploitation, rather than precautionary responses to scientific uncertainty and likely did not influence NPFMC's decision to close the Arctic Management Area. As with the open access default in federal waters of the United States, the high seas have been subject to the principle of "freedom

152 IPHC was created in 1923, but was most recently continued pursuant to an agreement between the United States and Canada signed in 1953 and amended in 1979. Convention for the Preservation of the Halibut Fishery of the Northern Pacific Ocean and Bering Sea, U.S.-Can., art. III, ¶ 1, Mar. 2, 1953, 5 U.S.T. 5; Convention for the Preservation of Halibut Fishery of Northern Pacific Ocean and Bering Sea, U.S.-Can., art. III, ¶ 1, Mar. 29, 1979, 32 U.S.T. 2483 [hereinafter Halibut Convention].

153 Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea, June 16, 1994, 34 I.L.M. 69 [hereinafter Pollock Convention].

154 U.N. Fish Stocks Agreement, *supra* note 29.

155 FOOD & AGRIC. ORG., *supra* note 28.

of the seas."[156] Both IPHC and CCBSP were developed to cooperatively manage internationally shared resources to ensure exploitation remains sustainable.[157] IPHC's governing document, the Convention for the Preservation of the Halibut Fishery of the Northern Pacific Ocean and Bering Sea (Halibut Convention) shares a ban on unregulated fishing with NPFMC.[158] That, however, is where the similarity ends. CCBSP establishes stock biomass thresholds with corresponding allowable harvest levels,[159] but its stance on scientific uncertainty is vastly different from NPFMC's required scientific certainty threshold implemented in the Arctic FMP. Thus the conservation and management practices of IPHC and CCBSP likely did not substantially influenced NPFMC's proactive closure.

Similar to NPFMC's ban on unregulated fishing, IPHC prohibits fishing for halibut (*Hippoglossus stenolepsis*) without a permit,[160] but its policy requiring scientific justification for management measures makes it so vastly different from NPFMC that it likely was not an influence on the closure of the Arctic Management Area. IPHC may establish seasons, limit sizes, regulate incidental catch, impose gear restrictions and licensing requirements, and close areas used as nursery grounds by halibut only "after investigation has indicated such action to be necessary" for conservation of the stock.[161] By requiring *necessity* to justify management actions, IPHC takes the opposite stance on scientific uncertainty than does NPFMC. Although NPFMC investigated the Arctic Management Area prior to closing it to commercial fishing,[162] the Council did not have the burden of proving the closure was strictly necessary as would be required of IPHC. Instead, the Magnuson-Stevens Act's requirements for discretionary closures such as that of the Arctic Management Area ensure the closure is prudent and warranted from an economic and conservation standpoint.[163] By requiring economic and conservative prudence, the Magnuson-Stevens Act grants Councils some discretion in closing fishing grounds rather than requiring a Council to show by the best available science that a closure is strictly necessary. IPHC has no closure provisions other than for nursery grounds and other essential habitat areas.[164] Presumably, a closure would be possible if achieving optimum yield would necessitate it,[165] but IPHC would bear the burden of showing the

156 Ted L. McDorman, *Canada-United States Cooperative Approaches to Shared Marine Fishery Resources: Territorial Subversion?*, 30 MICH. J. INT'L L. 665, 667 (2008).

157 *See id.* at 686.

158 Halibut Convention, *supra* note 152, art. I.

159 Pollock Convention, *supra* note 153, annex.

160 Halibut Convention, *supra* note 152, art. I.

161 *Id.* art. III, ¶ 3.

162 *See generally* N. PAC. FISHERY MGMT. COUNCIL, *supra* note 3, at 42–61 (discussing fisheries, as well as climatic and ecosystem characteristics).

163 *See supra* text accompanying notes 18–24.

164 Halibut Convention, *supra* note 152, art. III, ¶ 3 (allowing IPHC to close only a particular season or a particular area with immature fish and designate the area as a nursery).

165 *Id.*; *see also* Wash. Game Dep't v. Puyallup Tribe, 414 U.S. 44, 49 (1973) (speculating that stock levels may reach the point where fishing should be prohibited until it is clear the stock will survive).

necessity.[166] Because of the uncertainties of climate change,[167] IPHC likely would be unable to close the halibut fishery unless the stock was in an obviously dire situation;[168] at which point, management measures may be too late to save the stock from collapse.[169]

CCBSP, like IPHC, is unable to use scientific uncertainty as a basis for taking conservation or management measures such as NPFMC did by closing the Arctic Management Area, and it is thus unlikely an influence on NPFMC's closure. CCBSP regulates exploitation of pollock resources on the high seas.[170] The parties convene to establish seasons, quotas or annual harvest limits, and other measures as appropriate.[171] CCBSP contemplates that the annual harvest limit may, at times, be zero.[172] The Convention dictates the annual harvest limit depending on biomass estimates[173] but does not expressly provide for the closure of the fishery. The Convention specifically provides that in the case of uncertainty as to population, the parties agree to deem the population to be sixty percent of the population within a specified, smaller area in U.S. jurisdictional waters.[174] CCBSP uses population thresholds to set harvest limits,[175] but does nothing to ensure scientific certainty in determining whether those population thresholds are met. Instead, its provision regarding scientific uncertainty ensures that uncertainty cannot be a reason for action. The requirement to analogize to U.S. pollock population estimates essentially means CCBSP does not account for scientific uncertainty because any uncertainty is automatically resolved by analogy to U.S. estimates, which themselves have an element of uncertainty.[176] Nothing could be further from NPFMC's reasoning behind its closure of the Arctic Management Area. Thus, both regional fishery management organizations in the North Pacific—IPHC and CCBSP—likely did not have any substantial influence on NPFMC's closure of the Arctic Management Area.

166 *See* Halibut Convention, *supra* note 152, art. III, ¶ 2.

167 *See* ARCTIC FISHERY MANAGEMENT PLAN, *supra* note 3, at 60–61.

168 *See* Halibut Convention, *supra* note 152, art. III, ¶ 2 (requiring investigation prior to instituting conservation measures).

169 *See* Mary Christina Wood, *Advancing the Sovereign Trust of Government to Safeguard the Environment for Present and Future Generations (Part I): Ecological Realism and the Need for a Paradigm Shift*, 39 ENVTL. L. 43, 47–48 (2009) (discussing the collapse of one-third of ocean fisheries and the rate of decline toward collapse in remaining ocean fisheries).

170 Pollock Convention, *supra* note 153, arts. I–II.

171 *Id.* art. IV.

172 *Id.* art. X.

173 *Id.* annex. Biomass is a measure of population representing the "[w]eight of an individual or a group of individuals contemporaneous of a stock." EMYGDIO L. CADIMA, FOOD & AGRIC. ORG. FISHERIES DEPARTMENT, FISH STOCK ASSESSMENT MANUAL xi (2003), *available at* ftp://ftp.fao.org/docrep/fao/006/x8498e/x8498e00.pdf.

174 Pollock Convention, *supra* note 153, annex, pt. 1(b).

175 *See id.* annex, pt. 1(c)–(d).

176 *See supra* notes 69–75 and accompanying text.

B. The U.N. Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks

While the regional organizations err on the side of exploitation, the Agreement coming out of the Fish Stocks Agreement introduces more of a precautionary conservation slant. The Fish Stocks Agreement does not alone compel scientific certainty thresholds; rather, it introduces three aspects of fisheries management useful in contextualizing NPFMC's closure of the Arctic Management Area: 1) specific measures for responding to natural phenomena, 2) a separate approach for new or exploratory fisheries, and 3) stronger and more specific guidelines for using precaution in fishery management.[177] Most of the precautions of the Fish Stocks Agreement apply to straddling and highly migratory stocks in the high seas. Straddling stocks are those stocks with a range that spans multiple jurisdictions.[178] Highly migratory stocks are those that routinely cross jurisdictional boundaries in their migrations.[179] The Agreement's provisions dealing with the precautionary approach to management apply to such stocks within national jurisdictions.[180] The Agreement evinces an international trend toward increased precaution, monitoring, and responsiveness to the status of stocks. This trend may provide some context to NPFMC's precautionary closure of the Arctic Management Area. However, even if NPFMC's closure is a continuation of an international trend, the continuation does not detract from its uniqueness in fishery management.

The Fish Stocks Agreement contains a provision for dealing with natural phenomena that significantly and adversely affect fish stocks, demonstrating an appreciation of the relationship between natural occurrences in an ecosystem and fish stocks. The Agreement requires States to ensure that fishing will not exacerbate the impact of a natural phenomenon.[181] Measures taken by States under this provision are temporary and must be based on the best scientific evidence.[182] While it is appreciative of natural phenomena that may affect fish stocks such that fishing practices must be altered, this provision specifically deals with *natural* phenomena,[183] arguably not climate change.[184] Further, the Agreement contemplates some

177 U.N. Fish Stocks Agreement, *supra* note 29, art. 6, ¶¶ 1, 6–7.

178 U.N. Convention on the Law of the Sea, arts. 63–64, Dec. 10, 1982, 1833 U.N.T.S. 397; JEAN-JACQUES MAGUIRE ET AL., FOOD & AGRIC. ORG., THE STATE OF WORLD HIGHLY MIGRATORY, STRADDLING AND OTHER HIGH SEAS FISHERY RESOURCES AND ASSOCIATED SPECIES 4 (2006).

179 *See* U.N. Convention on the Law of the Sea, *supra* note 178, art. 64; *see also id.* annex (listing the recognized highly migratory species in UNCLS).

180 U.N. Fish Stocks Agreement, *supra* note 29, art. 3, ¶ 1.

181 *Id.* art. 6, ¶ 7.

182 *Id.*

183 *Id.*

184 *See* David Kriebel, *How Much Evidence is Enough? Conventions of Causal Inference*, 72 LAW & CONTEMP. PROBS. 121, 135–36 (2009) (discussing causal inference as a question of both science and policy and using climate change as an example in which scientists have weighed he risks of inaction and have determined that "we know enough that we cannot remain silent about the need for action").

kind of short-lived phenomena in that it requires responses to the situation to be temporary.[185] Requiring alterations of fishing practices in response to natural occurrences as specifically provided for in the Agreement is not a viable management policy for an unnatural and not temporally limited phenomenon such as climate change. Abstractly construed as a policy of adjusting fishery exploitation for occurrences that may affect stocks, however, this provision of the Agreement may be a sort of precursor to NPFMC's responsiveness in the climate change context.

A more direct influence on NPFMC can be seen in the Fish Stocks Agreement's provision regarding the use of precaution in dealing with new or exploratory fisheries. The Agreement requires cautious conservation and management measures for unexploited or underexploited fisheries.[186] In fact, it was the first international fishery agreement to explicitly advance a precautionary approach to fisheries management.[187] At the very least, this provision requires catch and effort limits for new fisheries.[188] The Agreement requires these limits to remain in force until there is sufficient data to assess the impact of exploitation on sustainability.[189] It thus allows for gradual development of commercial exploitation of the fishery if scientific information demonstrates that gradual development is appropriate. This provision introduces a sort of scientific certainty threshold, but notably, the threshold does not preclude fishing a previously unfished stock as NPFMC has implemented. Even so, setting new or exploratory fisheries apart and requiring more caution in regulating them is a substantial shift from the former policy of complete freedom of all high seas fisheries, which still exists in some U.S. fisheries.[190] By setting new and exploratory fisheries apart from existing fisheries, the Agreement implies that uncertainty regarding such fisheries is different enough from uncertainty in existing fisheries to require special treatment. The Fish Stocks Agreement and NPFMC's closure of the Arctic Management Area share a concern for the uncertainty posed by unexploited fisheries. NPFMC, however, chose to deal with the uncertainty by closing the fishery, rather than preliminarily allowing low levels of exploitation as does the Agreement. NPFMC's decision is a unique development in fishery management because it assumes a lasting or permanent adverse impact is likely, necessitating some level of scientific certainty as to population estimates prior to any exploitation.

The Fish Stocks Agreement calls for both the relatively weak precautionary approach and the stronger precautionary principle, but its provisions are no stronger or more precautionary than agency guidelines

185 U.N. Fish Stocks Agreement, *supra* note 29, art. 6, ¶ 7.

186 *Id.* at art. 6, ¶ 6.

187 Hassan, *supra* note 105, at 525.

188 U.N. Fish Stocks Agreement, *supra* note 29, art. 6, ¶ 6. Effort limits can include limits on incidents of effort such as the number of trips a vessel may take, the number of days, tows, or time spent fishing. CADIMA, *supra* note 173, at 4.

189 U.N. Fish Stocks Agreement, *supra* note 29, art. 6, ¶ 6.

190 McDorman, *supra* note 156, at 667; Macpherson & McCall, *supra* note 2, at 6.

under the Magnuson-Stevens Act, so its influence on NPFMC is no greater than the Act itself. The weaker precautionary approach, which disallows scientific uncertainty from providing the basis for postponing or failing to take conservation or management measures[191] suggests, but does not pose an affirmative mandate beyond prohibiting uncertainty as an excuse for inaction.[192] The Fish Stocks Agreement also contains the stronger precautionary principle in that it requires increased caution where there is uncertainty or unreliability of data.[193] Beyond simply requiring caution, Annex II of the Agreement contains guidelines for setting stock-specific reference points and required management responses should a stock reach those reference points.[194] The Fish Stocks Agreement essentially shares this adaptive management system with agency guidelines under the Magnuson-Stevens Act.

There are two precautionary reference points under the Fish Stocks Agreement, conservation limits and management goals,[195] which trigger management measures similar to the Magnuson-Stevens Act. Also similar to the Magnuson-Stevens Act, the Fish Stocks Agreement has provisions for dealing with scientific uncertainty so that it does not pose a barrier to exploitation as NPFMC has determined it should. Reference points in the Fish Stocks Agreement are supposed to account for reproductive capacity, resilience, industry practices, and other sources of mortality and uncertainty.[196] Accounting for uncertainty in the context of reference points favors exploitation because it assumes that regardless of each listed factor and the uncertainty involved in estimating the effect of each factor, a reference point will nonetheless be established for a stock and exploitation will proceed provided the stock has not dropped below a reference point used to determine whether a season must be closed.[197] Further evidencing the Fish Stocks Agreement's preference for exploitation, the guidelines for application of precautionary reference points dictate:

> When information for determining reference points for a fishery is poor or absent, provisional reference points shall be set. Provisional reference points may be established by analogy to similar and better-known stocks. In such situations, the fishery shall be subject to enhanced monitoring so as to enable revision of provisional reference points as improved information becomes available.[198]

191 *Rio Declaration*, *supra* note 25, princ. 15.

192 *See* Cass R. Sunstein, *Beyond the Precautionary Principle*, 151 U. PA. L. REV. 1003, 1011–12 (2003) (characterizing the weak version of the precautionary approach as one "to which no reasonable person could object," in effect because as an approach, it is merely a sensible suggestion).

193 Larson & Ferrell, *supra* note 117, at 51; U.N. Fish Stocks Agreement, *supra* note 29, art. 7.

194 U.N. Fish Stocks Agreement, *supra* note 29, annex II.

195 *Id.* annex II, ¶ 2.

196 *Id.* annex II, ¶ 3.

197 *See id.* annex II, ¶ 2 ("Limit reference points set boundaries which are intended to constrain harvesting within safe biological limits within which the stocks can produce maximum sustainable yield.").

198 *Id.* annex II, ¶ 6.

By requiring analogy to stocks with less uncertainty as to their statuses, the Agreement effectively ensures that uncertainty need not be a reason to halt exploitation. The Agreement thus does not acknowledge that total scientific uncertainty can exist even when there is no information on a particular stock because it substitutes analogies to other stocks. The analogy to other stocks is a proxy for actual data. The Agreement substitutes increased monitoring for actual and reliable data. It is precisely this management-by-analogy technique, similar to that employed by the Magnuson-Stevens Act, that NPFMC's closure of the Arctic Management Area implies is inadequate when paired with the uncertainty of a changing climate.[199]

The Fish Stocks Agreement parallels the Magnuson-Stevens Act in its guidelines for precautionary management, but it arguably sowed the seeds for special consideration given to new or exploratory fisheries and for responsiveness to the effect of climatic changes on fisheries, albeit with reference to natural phenomena. Even though the Fish Stocks Agreement does not allow scientific uncertainty to be a basis for halting exploitation of a fishery, instead requiring analogies to known stocks in the case of uncertainty, it expanded the factors that go into managing a fishery to include newness and natural phenomena.

C. The Code of Conduct for Responsible Fisheries

Incorporating the Fish Stocks Agreement and other fishery management resources, FAO's Code of Conduct for Responsible Fisheries is applicable to all fish stocks, not merely those that are straddling and highly migratory.[200] The FAO Code of Conduct reinforces the provisions of the Fish Stocks Agreement as well as introduces the concept of scientific certainty thresholds in a limited capacity,[201] which may have provided additional context to NPFMC's decision to close the Arctic Management Area due to uncertainty, its newness, and climate change.

The Code of Conduct for Responsible Fisheries extends and increases the specificity of other fishery management documents, but more interestingly, it introduces a scientific certainty threshold when introducing new types of fishing gear to an area,[202] suggesting NPFMC's scientific certainty threshold for the Arctic Management Area, while unique, is not entirely without precedent. That being said, the Code of Conduct does not apply a scientific certainty threshold to any other aspect of fishery management. It reinforces factoring in various categories of uncertainty when managing fisheries, but does not imply that uncertainty alone can be

199 *Compare id.* (calling for provisional reference points to be established by analogy and refined with relevant data as soon as possible) *with supra* text accompanying notes 93–94 (noting that the LLP based on the NPFMC allows licenses to be granted based on prior harvests).

200 FOOD & AGRIC. ORG., *supra* note 28, art. 1.2 (explaining that the Code is intended to be global, concerning all those involved in the conservation, management, and development of fisheries).

201 *Id.* at vi, art. 12, ¶ 11.

202 *See infra* text accompanying notes 212–16.

the basis for halting exploitation. Both the Fish Stocks Agreement and Code of Conduct assume a level of exploitation is allowable even where nothing is known about a fishery so long as development of a fishery coincides with increases in scientific certainty about the stock. NPFMC's closure of the Arctic Management Area moves the scientific certainty threshold to the pre-exploitation stage similar to the Code of Conduct's provision regarding the use of new gear in a fishery. NPFMC's decision, however, has much greater potential economic effect than does a gear restriction and may be the beginning of a new management ethos in fishery management in response to changing climatic conditions.[203]

FAO's Code of Conduct largely reflects existing frameworks such as the Fish Stocks Agreement and the Magnuson-Stevens Act because FAO intended it to be a reference instrument for State and international legal frameworks for fisheries management.[204] The Code is soft law; it does not impose binding requirements on States.[205] Still, it is useful in gauging the internationally preferred management policies and objectives for fisheries. The Code of Conduct shares the precautionary approach and biological reference points with the Fish Stocks Agreement and the Magnuson-Stevens Act.[206] It also urges managers to account for uncertainties of various types. The Code is slightly more specific or inclusive than the Fish Stocks Agreement, listing uncertainties as to stocks, reference points, stock condition in relation to the reference points, mortality, impact of fishing activities, bycatch, other non-target stocks that may be dependent on the target stocks, as well as environmental and socioeconomic conditions.[207] The Code also expressly recognizes that fishery management requires sound and available science in order to proceed responsibly.[208] In the absence of research, States are urged to initiate programs as soon as possible so that they may monitor and assess stocks, and impacts of ecosystem changes

203 Larson & Ferrell, *supra* note 117, at 53 (describing NPFMC's closure of the Arctic as precedential with a possibly substantial future impact on policy).

204 FOOD & AGRIC. ORG., *supra* note 28, art. 2.

205 W.M. von Zharen, *Ocean Ecosystem Stewardship*, 23 WM. & MARY ENVTL. L. & POL'Y REV. 1, 77 (1998) (describing the FAO's Code of Conduct as a "voluntary regime").

206 FOOD & AGRIC. ORG., *supra* note 28, art. 7.5.1, .2.

207 *Id.* art. 7.5.2.

208 *Id.* art. 12.1 ("States should recognize that responsible fisheries requires the availability of a sound scientific basis to assist fisheries managers and other interested parties in making decisions. Therefore, States should ensure that appropriate research is conducted into all aspects of fisheries . . . ."). FAO's Code of Conduct also incorporates traditional knowledge in management decisions. *Id.* art. 6.4 ("Conservation and management decisions for fisheries should be based on the best scientific evidence available, also taking into account traditional knowledge of the resources and their habitat . . . ."). This is significant in the Arctic context where traditional methods of dealing with uncertainty parallel adaptive management techniques in some ways. *See* Peter Bates, *Inuit and Scientific Philosophies about Planning, Prediction, and Uncertainty*, 44 ARCTIC ANTHROPOLOGY 87, 94, 96 (2007). NPFMC's closure of the Arctic Management Area is in keeping with the Inuit tradition of amassing knowledge of the ecosystem in the past and present and using that knowledge to adapt to occurrences in the uncertain future. *See id.* at 95–96.

from fishing, pollution or habitat alteration.[209] The Code also expressly suggests that States assess climate or environmental changes on fish stocks and aquatic ecosystems.[210] Research efforts should include these factors.[211] The Code of Conduct recognizes the increasing influence of climatic changes on aquatic ecosystems and suggests that responsible fishery management requires sound scientific data on these changes as well as more traditional stock population numbers. This recognition and suggestion moves fishery management more toward decisions similar to NPFMC's precautionary closure of the Arctic Management Area due to uncertainty as to stocks and climate. However, the Code does not institute thresholds to ensure scientific certainty as to stock population levels.

While the Code of Conduct does not use scientific certainty thresholds for stock population data, it introduces a scientific certainty threshold in the context of new gear introductions to a fishery—a smaller scale threshold than that implemented by NPFMC, but a threshold nonetheless. The Code's certainty threshold regarding new gear suggests that "States should ensure that before the commercial introduction of new types of gear, a scientific evaluation of their impact on the fisheries and ecosystems where they will be used should be undertaken. The effects of such gear introductions should be monitored."[212] This provision along with another asking that States use "research results as a basis for the setting of management objectives, reference points, and performance criteria"[213] operates as a certainty threshold because it requires scientific evaluation prior to introducing new gear and suggests that that evaluation directly inform management decisions. This is in contrast to traditionally used adaptive management techniques in fishery management which use exploitation of fishery resources to gain scientific knowledge about such resources.[214] Under FAO's Code, presumably, if a scientific evaluation indicated that new commercial gear would have adverse effects that would jeopardize the stock's position in relation to its reference points, the fishery manager should prohibit or limit use of the gear before it is introduced. While the Code does not require an express level of certainty come from this evaluation, it at least must inform the management decision regarding the gear. Similarly, NPFMC's Arctic FMP does not expressly detail specific scientific goals, questions, confidence levels, or other factors that may go into measuring scientific certainty.[215] It

209 FOOD & AGRIC. ORG., *supra* note 28, at art. 12.3, .4, .5.

210 *Id.* art. 12.5.

211 *Id.* art. 7.4.2.

212 *Id.* art. 12.11.

213 *Id.* art. 12.13.

214 *See supra* note 23.

215 N. PAC. FISHERY MGMT. COUNCIL, *supra* note 3, at ES-2 (prohibiting commercial harvest "until sufficient information is available to support the sustainable management of a commercial fishery"); *id.* at 6–7 (listing evaluations NPFMC will conduct before permitting exploitation of a stock in the Arctic Management Area). The amount of research and data to accept as scientific certainty is itself a policy decision. Holly Doremus, *Precaution, Science, and Learning While Doing in Natural Resource Management*, 82 WASH. L. REV. 547, 560–61 (2007). In

nevertheless implies that some level of certainty be achieved in order to adequately inform responsible and sustainable management decisions. NPFMC's closure thus extends the precautionary scientific certainty threshold to a stage in the decisionmaking process that it has never before occupied in fishery management.[216]

FAO's Code of Conduct, the Fish Stocks Agreement, CCBSP, and IPHC are representative of international fishery management regimes, which, together with the Magnuson-Stevens Act provide context for NPFMC's conservation and management decisions, but the regulatory context alone does not explain NPFMC's uniquely proactive closure of the Arctic Management Area. While these regulatory agreements and documents may have informed NPFMC's closure by reinforcing the precautionary reference points required under NMFS regulations, treating separately unexploited fisheries, and establishing a scientific certainty threshold for introductions of new gear to commercial fisheries, NPFMC's decision employs a certainty threshold early in the decision-making process and of a scope that has never before been seen in fishery management. NPFMC's Arctic FMP uniquely responds to changing climatic conditions more so than to any national or international regulatory directives. Its uniqueness compels, in the next section, an investigation into the other major influence on NPFMC's decision: climate change.

IV. NPFMC AND CLIMATE CHANGE

Every regulatory system and framework for management that may be applicable in the Arctic Management Area would allow commercial exploitation, so what has made NPFMC treat the Area differently? Traditional management strategies would allow commercial exploitation, perhaps using precaution and setting low catch limits, using analogies to populations and characteristics of similar stocks.[217] NPFMC has chosen instead to treat the Arctic differently for two reasons: 1) the sensitivity of the Arctic, and 2) the uncertain, but very present effects of climate change on fisheries and the ecosystem as a whole.[218] According to traditional management strategies that favor exploitation, NPFMC should be able to accommodate the sensitive ecosystem and uncertainties posed by climate change while phasing in exploitation. The Council determined that climate change and the associated increased scramble to exploit Arctic resources[219]

fact, a "general standard for judging scientific results does not exist." David E. Adelman, *The Art of the Unsolvable: Locating the Vital Center of Science for Environmental Law and Policy*, 37 ENVTL. L. 935, 939 (2007).

216 *See* Kaufman, *supra* note 6.

217 *See supra* text accompanying notes 197–99.

218 *See* N. PAC. FISHERY MGMT. COUNCIL, *supra* note 3, at 60–61 (describing characteristics of the Arctic ecosystem and discussing the range of possible benefits and costs of global warming).

219 *See id.* at 4 (assuming an unregulated commercial fishery will emerge in the Arctic absent actions by the Council). A number of commentators have observed the "scramble" for Arctic resources. Paul Arthur Berkman & Oran R. Young, *Governance and Environmental Change in the*

demanded federal jurisdiction over the Arctic Management Area.[220] The complex ecological and political uncertainties posed by climate change[221] convinced the Council to buck the national and international regulatory trend in fisheries management, which is to exploit regardless of such uncertainty. Instead of allowing exploitation, the Council has opted to institute a scientific certainty threshold, responding to the interests of the environment and political actors in the Arctic. Determining what level of scientific uncertainty to accept in a given management situation is essentially a policy, and not a scientific question.[222] NPFMC has declined to follow the policy determination of the Magnuson-Stevens Act and other fisheries management regimes that uncertainty should not be a barrier to exploitation. Instead, NPFMC has chosen to implement a policy requiring a threshold of certainty prior to determining whether and to what extent a fishery should be commercially exploited because of the unique threats posed by climate change.

A. Effects of Climate Change on Fisheries

NPFMC's innovative scientific certainty threshold is particularly timely because climate change requires new management methods to respond to its effects, which promise to introduce new stress on already stressed stocks, exacerbate existing problems such as pollution, and vastly change the already uncertain characteristics of fish stocks in ways that are also uncertain. A number of scientists and commentators have discussed the impending challenges posed by climate change,[223] so this section provides a brief survey of the main problems and sources of uncertainty that fishery managers should currently be addressing. The uncertainties and difficult problems presented by a changing climate would be problematic in and of themselves, but they are made even more so given the dire state of mismanaged national and international fisheries.[224] Management policies currently in place are inadequate even in the absence of consideration of the effects of climate change.

Climate change is introducing changes to marine environments which change essential characteristics of fish stocks, such as altering ranges, decreasing nutrient availability, altering predator-prey relationships, modifying or destroying habitat, and decreasing the resilience and

Arctic Ocean, 324 SCIENCE 339, 339–40 (2009); McDorman, *supra* note 156, at 670 ("[A] great deal of attention is being given the so-called 'scramble' for resources in the central Arctic Ocean.").

220 *See* N. PAC. FISHERY MGMT. COUNCIL, *supra* note 3, at ES-1, ES-2 tbl.ES-1.

221 *See* Berkman & Young, *supra* note 219.

222 Doremus, *supra* note 215, at 560–61; *see infra* Part V.

223 *See, e.g.*, Wood, *supra* note 169, at 46–54 (discussing "ecological bankruptcy," dead zones, tipping points due to the "climate emergency").

224 U.N. ENVIRONMENT PROGRAMME, IN DEAD WATER: MERGING OF CLIMATE CHANGE WITH POLLUTION, OVER-HARVEST, AND INFESTATIONS IN THE WORLD'S FISHING GROUNDS 10 (Christian Nellemann, Stefan Hain & Jackie Alder eds., 2008) (stating that eighty percent of the world's primarily fished stocks are currently at or have exceeded their harvest capacities).

reproductive capacity of stocks.[225] These effects are coming about because of warming, ocean acidification, and possible future changes in ocean circulation.[226] These interrelated changes are happening and their associated effects are felt by fish stocks, but from a management perspective the effect on the sustainability of fisheries is staggeringly uncertain.[227]

1. Ocean Warming

Even small changes in sea temperature affect ranges, habitat, mortality, recruitment, and species interactions. For example, small increases in temperature in the North Sea are causing species ranges to shift deeper or further to the north in search of cooler water.[228] Fish can only adapt to "a relatively moderate range of temperatures."[229] If temperature is too high, a species may reach the threshold where its respiratory need exceeds its physical capacity for respiration.[230] This threshold, the "temperature-oxygen squeeze" makes temperature "one of the primary environmental factors that determine the geographic range of a species."[231] In response to the temperature-oxygen squeeze, fish stocks and other marine species are expected to continue to move toward the poles as temperatures increase.[232]

225 *See id.* at 7–12 (summarizing climate-related changes involving invasive species, coastal development, pollution, overharvesting, nutrient cycling, loss of coral reef habitat, and acidification affecting shell-forming organisms); *id.* at 35–36, 38 (discussing effect of increased ocean acidification on food chains and noting changes in distribution of marine species due to melting sea ice and warming oceans affects entire food chains); *id.* at 41 (citing temperature-dependent nutrient cycling as the reason for large increases in recruitment); *id.* at 56 ("[I]n the light of the accelerating climate change, the natural resilience of the oceans, such as their capacity to act as natural buffers, is likely to diminish in [the] future.").

226 *Id.* at 7–12.

227 *E.g.*, *id.* at 18 (discussing nutrient cycling, which is affected by climate changes and noting the uncertainty as to how cycling mechanisms and fish stocks dependent upon them will be affected); Stram & Evans, *supra* note 23, at 1635 (discussing the future of the groundfish fishery in the north Pacific and concluding that "predictions into the future under a warming scenario are extremely uncertain").

228 Nicholas K. Dulvy et al., *Climate Change and Deepening of the North Sea Fish Assemblage: A Biotic Indicator of Warming Seas*, 45 J. OF APPLIED ECOLOGY 1029, 1032–35 (2008), *available at* http://www.dulvy.com/publications/2008/Dulvy_etal_2008_JApEandSOM.pdf; Ebinger & Zambetakis, *supra* note 1, at 1218.

229 *Effects of Climate Change on Fisheries*: *Hearing on the Effects of Climate Change and Ocean Acidification on Living Marine Resources Before the Subcomm. on Oceans, Atmosphere, Fisheries, and Coast Guard of the S. Comm. on Commerce, Science, and Transportation*, 110th Cong. 3 (2007) [hereinafter *Effects of Climate Change on Fisheries Hearing*] (statement of David O. Conover, Dean and Director Marine Sciences Research Center, Stony Brook University), *available at* http://commerce.senate.gov/public/?a=Files.Serve&File_id=8d6fd6cd-0ffa-414e-a134-90351844c7e0.

230 *Id.*

231 *Id.*

232 *Id.*

As fish and other marine life migrate toward the poles, competition for scarce resources will increase as ranges overlap.[233] Overlapping ranges may increase bycatch in fisheries, confounding catch limits and similar harvest levels.[234] The overlap will also alter the relationships between predators and their prey.[235] A species may be subject to predation by another species not previously encountered. Thus a stock may be subject to a general increase in sources of mortality. Fish at the edges of stock ranges are more vulnerable because they experience temperature changes before fish near the middle of their range.[236] Fish at the edge of stock ranges have higher rates of mortality due to natural stress and fishing.[237] They also may experience lower recruitment rates.[238]

To explain events that are expected to transpire due to warming temperatures requires extensive monitoring, which has yet to be implemented. In his written testimony on the effects of climate change submitted to the United States Senate, David O. Conover, Dean and Director of the Marine Sciences Research Center at Stony Brook, likened the ecologist's effort to explain episodic events to being "the detective at the scene of a crime with no evidence and lots of potential suspects."[239] Without additional and extensive observation systems, scientists and the managers depending on them cannot hope to respond to changes they are not aware of or cannot explain.

2. Ocean Acidification

Acidification of the ocean occurs by a process called assimilation and directly affects the ability of organisms to build skeletons and shells.[240] Essentially, carbon dioxide dissolves in the surface waters of the ocean, lowering the pH level (making the water more acidic).[241] More acidic water interferes with the ability of many marine organisms to form skeletal

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233 *See generally* Stram & Evans, *supra* note 23, at 1636–37 (suggesting that because some evidence exists for contracting salmon habitats under global warming scenarios, increases in salmon by-catch may be due to greater cooccurrence between salmon and pollock stocks, which tend to exhibit the highest densities in areas where bottom temperatures are greater than zero degrees Celsius).

234 *Id.*

235 *Id.* at 1635.

236 *Effects of Climate Change on Fisheries Hearing*, *supra* note 229, at 5 (statement of David. O. Conover) ("Resource managers need to recognize that local populations of species near the limits of their distributional ranges will need additional precautionary measures to protect them from extinction.").

237 *See id.*

238 *See* MECUM, *supra* note 135, at 89.

239 *Effects of Climate Change on Fisheries Hearings*, *supra* note 229, at 5 (statement of David O. Conover).

240 *See* SECRETARIAT OF THE CONVENTION ON BIOLOGICAL DIVERSITY, SCIENTIFIC SYNTHESIS OF THE IMPACTS OF OCEAN ACIDIFICATION ON MARINE BIODIVERSITY 12, 20, CBD Technical Series No. 46 (2009).

241 *Id.* at 11.

structures.[242] This includes corals, crabs, crayfish, starfish, sea urchins, and even single-celled organisms, which may have far-reaching effects on marine food chains.[243] Where acidification does not directly affect fish stocks, it will affect the availability of important food sources, reducing the resilience and productivity of fish stocks. The extent of this effect is unknown. Some have speculated, however, that ocean acidification "may change marine life as we know it."[244]

3. Ocean Circulation

The ocean is home to currents and seasonal changes due to density contrasts, which perform essential nutrient replenishment functions. Changes in these fundamental processes may affect ecosystem productivity, assimilation of carbon dioxide, oxygen concentrations, and shifts in ranges.[245] Certain models and predictive techniques suggest that changes in temperature may alter these currents and seasonal changes.[246] Alteration could impact the nutrient levels of shallow waters and reduce the ventilation of deeper waters.[247] Without ocean currents and water exchanges to cycle nutrients, fish stocks may not be able to recover from fishing-related mortality because stocks may be dependent on the current's nutrient cycling.[248]

An investigation linking the resilience of deep-sea shrimp to seasonal nutrient cycling theorized that the nutrient cycling leads to increased recruitment within the species, mitigating the effects of overexploitation.[249] The shrimp continue to reap the benefits of these cycling events three to five years afterwards.[250] This type of nutrient cycling is highly temperature-dependent.[251] Changes in ocean temperatures may affect the cycling, removing the natural mitigation of overfishing. If nutrient cycling such as observed with the deep-sea shrimp were to cease, a response by fishery managers after harvesters reported data indicating the problem would likely be too late to prevent collapse of the fishery. Without the mitigative effects of the nutrient cycling, resilience of the stock would already be compromised. Not only is this a scenario rife with uncertainty, it is one which cannot be remedied after the fact—it requires proactive management measures.

242 *Id.* at 12.
243 U.N. ENV'T PROGRAMME, *supra* note 224, at 36.
244 *Id.*
245 *Id.* at 39–40.
246 *Id.*
247 *Id.* at 40.
248 *See id.* at 41 (discussing dependency of deep sea shrimp on nutrient cycling).
249 *Id.*
250 *Id.*
251 *Id.* at 40 fig.21.

4. Exacerbation of Existing Stress to Fish Stocks

In addition to posing new hazards to fish stocks, climate change also exacerbates the already existing stress on fish stocks such as pollution, overfishing, bycatch, and invasive species. Changes in climatic conditions impair a stock's ability to recover from fishing pressures.[252] This inability to recover increases the vulnerability of the ecosystem to invasive species.[253] Additionally, changes in ranges increases co-occurrences of species, leading to increased bycatch.[254] Adding the many climate-induced pressures to the already stressful life of exploited fish stocks makes individuals more susceptible to the hazards of pollution because the habitat and physical health of the stock is already compromised.

The additional stress of climate change is an important, yet highly uncertain factor for fishery managers to take into account, yet the failure to manage proactively may lead to widespread collapse of important fisheries. Often once resilience thresholds are crossed, the effects become detectable after it is already too late to prevent the collapse of a fishery.[255] This point-of-no-return aspect, compounded on an already striking level of uncertainty in fishery management[256] raises the stakes of management decisions. The traditional deference to FMCs with an enormous amount of discretion in setting biological reference points, which may or may not actually correspond to the actual stock's resilience threshold, is not the appropriate management policy for dealing with climate change. In bucking the traditional fishery management policies in the Magnuson-Stevens Act, NPFMC exercised its discretion to come up with a better management alternative: thresholds of scientific certainty that must be met prior to exploitation.

Fisheries throughout the world are and will continue to change in fundamental ways in response to climate change. A stock may alter its range, its predator-prey relationships, and may have vastly different mortality and recruitment rates. Such changes in essential stock characteristics may warrant treating a given stock like a new stock—one for which pre-climate change data may provide an appropriate analogy, but is no longer directly applicable. Even known stocks may transition to unknown status for which data are uncertain. As uncertainty increases, established fisheries may come to resemble the Arctic Management Area, in that so little is known. Councils may be faced with a situation similar to that which inspired NPFMC to exercise its discretion under the Magnuson-Stevens Act to institute its precautionary scientific certainty threshold.

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252 Dulvy et al., *supra* note 228, at 9.

253 U.N. ENV'T PROGRAMME, *supra* note 224, at 52.

254 *See* Stram & Evans, *supra* note 23, at 1636 (hypothesizing that increased co-occurrence has lead to increased bycatch).

255 *See* Effects of Climate Change on Fisheries Hearings, *supra* note 229, at 5 (statement of David O. Conover).

256 *See id.* at 5–6 (discussing the inadequacy of current monitoring and data).

The health and sustainability of U.S. fisheries should not depend on the discretion of Councils to respond proactively as NPFMC has. NPFMC is an outlier in U.S. fisheries management in that it has traditionally used more conservative management measures than other Councils, but it has been increasingly criticized for mismanagement.[257] Given the track records of the other regional Councils it is unlikely their management decisions will stray from the bare minimum required under the Magnuson-Stevens Act.[258] Monitoring systems are already inadequate[259] and cannot be expected to warn managers of environmental threats before it is too late to take actions to reduce anthropogenic mortality in an affected stock. Therefore, the best way to ensure that the Councils will deal appropriately with fisheries for which uncertainty effectively parallels that of the Arctic Management Area is to institute scientific certainty thresholds in the Act or its implementing regulations.

B. Management Response to Climate Change Using Certainty Thresholds

NPFMC's closure of the Arctic Management Area provides an example of a precautionary method for dealing with scientific uncertainty in a changing climate, which should be legislatively or administratively required of Councils where uncertainty precludes appropriate and timely management responses. Setting aside issues related to the politicization of scientific data,[260] or the imprecise method by which Councils set harvest limits and reference points,[261] fishery management policy should recognize that high levels of uncertainty should provide a barrier to exploitation. NPFMC has chosen to treat it as such in the context of the new and commercially unexploited waters of the Arctic. In doing so, NPFMC recognized that commercial exploitation inherently poses risks to stocks that may not be remedied by reactive management measures under the status quo regulatory regime provided by the Magnuson-Stevens Act.[262] NPFMC's action has been lauded as appropriately precautionary given the effects of climate change by all ranges of interests: commercial, subsistence, recreational, and environmental.[263]

FMCs and NMFS must recognize and begin to react, as NPFMC has, to rising levels of uncertainty compounded by climate change. Uncertainty due

257 Bryant, *supra* note 108, at 179.

258 *See* EAGLE ET AL., *supra* note 53, at 17 ("Using the regional councils' own definitions, the state of the fisheries under their jurisdictions is not good.").

259 *Effects of Climate Change on Fisheries Hearings*, *supra* note 229, at 6 (statement of David O. Conover).

260 *See supra* text accompanying notes 80–101 (discussing the impact of discretion under the Magnusen-Stevenson Act on political decisions).

261 *See* EAGLE ET AL., *supra* note 53, at 15.

262 MECUM, *supra* note 135, at ii.

263 *See* Letter from Dr. Paul K. Dayton, Scripps Inst. of Oceanography, et al., to Eric Olson, Chair, N. Pac. Fishery Mgmt. Council (January 27, 2009), *available at* http://www.pewtrusts.org/uploadedFiles/wwwpewtrustsorg/Research/Final Arctic FMP Scientist Letter PDF 01-27-09.pdf.

to inadequate monitoring,[264] changes in fundamental stock characteristics, or changes in essential fish habitat may reach the point where responsive measures may be too late.[265] Councils must act proactively to reduce or halt exploitation as risk of unknown irreversible effects increases. Measuring this risk and responding to it is thus where the real difficulty lies. How much uncertainty is too uncertain? The level of scientific uncertainty acceptable to managers is a policy determination.[266] Holly Doremus has described the roles of science and policy:

> Science is a set of (ideally) value-neutral tools, a process for deepening our understanding of the natural world. It does not, and indeed cannot, tell us what we should do with that understanding. It can illuminate the consequences of policy choices, but it does not dictate those choices. Commentators who describe scientific decisionmaking as imposing a high standard of proof are grafting their own policy preferences onto the available scientific information.[267]

Scientists may be able to estimate risks and probabilities, but policy makers must decide how much risk is too much based on normative goals. Only one of eight Councils has proactively responded to uncertainty, indicating that if proactive and precautionary measures are desired, we as a nation cannot continue to leave decisions up to the discretion of the commercially dominated Councils. Labeling the decision of how much uncertainty to accept as a policy determination allows for more open dialogue as to the best policy for our nation's fisheries.

V. TOWARD A PROACTIVE RESPONSE TO CLIMATE CHANGE

The Arctic has long occupied the role of the canary in the coal mine, its sensitivity to environmental changes acting as an indicator of future threats and effects that may soon be felt elsewhere on the globe.[268] Likewise, management responses to changes in the Arctic environment provide an example of what may be required of the other Councils to maintain sustainability of the fisheries as they respond to increasing climatic changes.

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264 *Effects of Climate Change on Fisheries Hearings*, *supra* note 229, at 5–6 (statement of David O. Conover).

265 *See id.* at 5.

266 *Cf.* Doremus, *supra* note 215, at 560 (explaining that while science can illuminate policy choices, ultimately the policy choice is how scientific information is translated into action).

267 *Id.*

268 Reuven S. Avi-Yonah & David M. Uhlmann, *Combating Global Climate Change: Why a Carbon Tax Is a Better Response to Global Warming than Cap and Trade*, 28 STAN. ENVTL. L.J. 3, 10 (2009) (referring to the melting of Arctic as "'the canary in the coal mine' of global warming"); Memorandum from Olav Orheim, Director of the Norwegian Polar Inst., to the Panel on "Protecting Vulnerable Marine Ecosystems" of the U.N. Open-Ended Informal Consultative Process on Oceans and the Law of the Sea 5 (June 2–6, 2003), *available at* http://www.un.org/Depts/los/consultative_process/documents/no3_npi2.pdf.

Climate change is a strong and visible reality in the Arctic;[269] indeed, it is the driving force behind NPFMC's scientific certainty threshold which must be met prior to commercial exploitation.[270] If the Arctic environment is a sort of early warning system for other ecosystems, perhaps management responses to changes in the Arctic should be viewed as indicators of what may be required when the Arctic's environmental predictions come to pass. This Part suggests possible ways to use certainty thresholds to ensure the continuing sustainability of other U.S. fisheries, in the face of the uncertainty posed by our changing climate.

The Magnuson-Stevens Act already contains thresholds such as the overfished threshold, which requires that certain management measures be taken when a stock becomes overfished,[271] but such thresholds may be too late in triggering a management response where climate change is increasing the chances that exploitation will have irreversible effects on a stock.[272] Thresholds such as the overfished threshold represent the traditional reactive strategy of fisheries management.[273] NPFMC's closure, however, suggests a new management strategy in response to climate change—one that institutes thresholds to safeguard against irreversible effects earlier in the decisionmaking and management processes. Rather than waiting for an observable adverse effect, a threshold such as NPFMC's scientific certainty threshold would require a management response to the state of the scientific data underlying management decisions relating to exploitation. By situating thresholds at an earlier point in the process, fishery managers would be required to take measures to respond to uncertainty by pausing or ceasing exploitation to guard against adverse effects.

To codify scientific certainty thresholds where data are uncertain to the point of scientific indeterminacy without quantifiable probabilities of success,[274] fishery managers could use an analogy to an ideal data set. NMFS could establish, by regulation, the characteristics of this ideal data set against which Councils could compare the actual data available for a particular stock. NMFS regulations may describe categories of data according to stock characteristics such as range, breeding or spawning grounds, and maturity and recruitment rates. In its regulations, NMFS could set forth certain requirements of the data being relied upon. For example, NMFS may determine that for certain stocks characteristics, Councils must have available a certain amount of data from a given number of independent

269 Bates, *supra* note 208, at 93–94 (recounting interviews with Inuit elders, noting that they "were keen to explain that climate change was happening" based on disappearing ice banks, melting lakes, and increased mosquito populations).

270 Fisheries of the Arctic Management Area; Bering Sea Subarea, 74 Fed. Reg. 56,734, 56,734 (Nov. 3, 2009) (to be codified at 50 C.F.R. pt. 679).

271 16 U.S.C. § 1854(e) (2006).

272 *See supra* Part IV.A.

273 *See supra* notes 23–24 and accompanying text.

274 *See* Costanza & Cornwell, *supra* note 27.

observational techniques.[275] The more observational techniques that scientists use in acquiring data, the more credible the conclusions gleaned from the data.[276] Scientific certainty thresholds could thus be instituted using what are essentially procedural requirements such as a particular number of observational techniques.

Scientific certainty thresholds for underlying indeterminate data could also be qualitatively expressed while still improving fisheries management in a changing climate because in comparing actual data available to an ideal data set, Council decisions as to acceptable levels of uncertainty would become transparent policy determinations. For example, NMFS may determine that certain fish stocks are particularly habitat-dependent or play a particularly crucial role in a regional ecosystem. In such cases, NMFS may identify and prioritize a particular category of data such as regarding a stock's geographic range, spawning grounds, or bycatch level. NMFS regulations could then direct Councils that for exploitation of such an identified stock to continue, scientific certainty as to range, spawning grounds or bycatch levels must be shown to be especially high based on reliable, credible, and verifiable data.

Likely, the effect of such a qualitative requirement in the courts would translate to a probability of success of the species or some other end-result measurement that scientific certainty thresholds are designed to augment.[277] End-result measurements of the probability of success of a stock ignore the many policy determinations that are made during the underlying scientific process. David Adelman describes three categories of policy-infused determinations that must be made during the scientific process: 1) the reduction of information from a study to quantitative results; 2) the inference of conclusions from the study's results; and 3) the packaging of the results of various studies.[278] By merely imposing end-result probability of success requirements on Councils, NMFS ignores the many policy-infused judgment calls that are made during the scientific process. Scientific certainty thresholds can augment end-result requirements by ensuring that judgment calls made within the scientific process are themselves reviewable. Even so, because the certainty thresholds may need to be qualitative, it may be difficult for a reviewing court to determine whether a Council complied with agency requirements. For example, where a "fairly high level of confidence" was required of Councils in recommending a catch limit in an FMP, the court determined that the qualitative requirement translated to a fifty percent probability that overfishing will not occur.[279] The

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275 *See* David E. Adelman, *Scientific Activism and Restraint: The Interplay of Statistics, Judgment, and Procedure in Environmental Law*, 79 NOTRE DAME L. REV. 497, 539 (2004) (pointing out the benefits of using independent observational techniques).

276 *Id.* at 541.

277 *See* Natural Res. Def. Council v. Daley, 209 F.3d 747, 754 (D.C. Cir. 2000) (requiring a fifty percent probability that overfishing would not result from a quota).

278 Adelman, *supra* note 275, at 501.

279 *Natural Res. Def. Council*, 209 F.3d at 754.

court thus transformed what appears to be a scientific determination—a confidence level—to an end-result measurement of success of the species.

Because of the limitations on judicial review of agency actions, a court may translate a scientific certainty threshold designed to be applied to the scientific process within Council and agency determinations to an end-result probability of success requirement. Likely, a dialogue between fishery scientists, ecologists, and policy makers would yield additional methods of ensuring that a level of scientific certainty is present in data underlying Council decisions to continue to exploit fisheries. In effect, such a dialogue would push NMFS to determine with specificity how much uncertainty is too uncertain. The resulting scientific certainty thresholds would introduce a greater level of transparency in the Council process while providing an important safeguard against possible irreversible effects on our nation's fisheries.

VI. CONCLUSION

NPFMC's unprecedented proactive closure of the Arctic Management Area and its resounding support from commercial, tribal, and environmental groups[280] should serve as a call to reexamine our nation's fishery management policies and to respond to increasing uncertainty by defining how much uncertainty is too uncertain. NPFMC was not reacting to a statutory mandate, a regulatory provision, or even an international guideline.[281] Rather, NPFMC drew upon these regulatory contexts to respond to changing conditions in the Arctic,[282] conditions which are or will soon pose similar problems to other FMCs.[283]

Climate change may alter the fundamental characteristics of fish stocks and their ecosystems[284] and fishery managers must act before anthropogenic fish mortality compounds with climatic stressors to push fish stocks to the point of collapse.[285] Scientists predict that some stocks may actually experience population increases due to climate change.[286] However, the far-reaching effects of climatic changes on nutrient levels and organisms on lower trophic levels of the marine food chain[287] may affect such optimistic predictions. Currently fish resilience and recruitment levels mitigate the effects of commercial harvesting.[288] However, climate change will reduce

280 Fisheries of the United States Exclusive Economic Zone Off Alaska; Fisheries of the Arctic Management Area; Bering Sea Subarea, 74 Fed. Reg. 56,734, 56,735 (November 3, 2009) (codified at 50 C.F.R. pt. 679).

281 *See supra* Parts II.D, III.

282 *See supra* Parts IV, V.

283 *See supra* Part V.

284 *See supra* Part IV.A.

285 *See supra* Part V.

286 *Effects of Climate Change on Fisheries Hearings*, *supra* note 229, at 4 (statement of David O. Conover).

287 U.N. ENV'T PROGRAMME, *supra* note 224, at 35–36.

288 *Id.* at 41.

resilience and recruitment rates of many commercially important fish stocks.[289] Unless harvesting practices change *prior* to reductions in resilience and recruitment, fish stocks may not be able to recover from current exploitation levels. We cannot control environmental or biological stress tolerance thresholds. We can, however, control the stress influence of commercial exploitation, and we must do so before a fish stock reaches the limits of its unknown biological threshold beyond which it cannot recover. Fishery management policy must undergo a fundamental shift to match the fundamental changes that fish stocks are and will be experiencing in the coming decades.

Councils must take a lesson from NPFMC and institute precautionary scientific certainty thresholds that will limit the risk to stocks posed by uncertainty. In addition to existing agency guidelines requiring decreasing harvest levels as uncertainty increases,[290] Councils should place an upper limit on uncertainty—a threshold that, once reached, precludes commercial exploitation. In accounting for uncertainty, Councils should include not just uncertainty in population or biomass levels and reference points established pursuant to the Magnuson-Stevens Act, they should also consider uncertainty posed by climate change, monitoring, and ever-present uncertainties in the scientific context.[291] A scientific certainty threshold should provide a barrier to further exploitation because, as NPFMC recognizes in its Arctic FMP, without knowing otherwise, any level of commercial exploitation may cause irreversible damage that may not be recognized and dealt with until it is too late.

289 *See id.* at 58 (discussing projections of collapse of fisheries and the "significant share of global economies and basic food supply" these stocks represent).

290 Magnuson-Stevens Act Provisions, 50 C.F.R. § 600.310 (2009).

291 *See generally* Stephanie Tai, *Uncertainty About Uncertainty: The Impact of Judicial Decisions on Assessing Scientific Uncertainty*, 11 U. PA. J. CONST. L. 671, 676–80 (2009) (explaining types of scientific uncertainty). Professor Tai lists four types of scientific uncertainty: parameter uncertainty, model uncertainty, variability, and decision uncertainty. *Id.* at 677. Parameter uncertainty occurs where something is measurable in principle, but is still uncertainty because of measurement or monitoring difficulties. *Id.* Model uncertainty is uncertainty about the system itself. *Id.* Variability uncertainty stems from the variability in the system itself and thus cannot be reduced. *Id.* at 678. Decision uncertainty involves uncertainty in normative choices that factor into the method by which the research is being conducted. *Id.* at 679.