FISH, WHALES, AND A BLUE ETHICS FOR THE ANTHROPOCENE: HOW DO WE THINK ABOUT THE LAST WILD FOOD IN THE TWENTY-FIRST CENTURY?

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ABSTRACT

One of the lesser celebrated threads of Christopher Stone's scholarship was his interest in the ocean—especially international fisheries and whaling. Fish and whales are among the "last wild food"—that is, species that humans take directly from the wild for food purposes. While whales are primarily cultural food, fisheries remain important contributors to the human diet globally. Indeed, the food security issues surrounding marine foods are increasingly being recognized as an important international and domestic component of human well-being and equity. These concerns helped to spur the fall 2021 launch of the Blue Foods movement and the conscious incorporation of aquatic foods into the pursuit of the United Nations' sustainable development goals.

At the same time, changes in the ocean resulting from climate change and other anthropogenic forces are making the commercial harvest of marine wild foods increasingly unsustainable, simultaneously undermining ocean ecosystem function, marine biodiversity, and human food security. Humanity's continued engagement in industrial-scale commercial marine fisheries is thus both factually uncertain and ethically suspect.

This Article explores the multilayered ethical issues surrounding Blue Foods in the Anthropocene, drawing from Stone's work in environmental

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ethics and "Moral Pluralism." Finding a balance between protecting the world's marine ecosystems and appropriately promoting the ocean's contribution to global food security remains an important policy challenge for the twenty-first century, but it is one that nations can meet by privileging indigenous and local fisheries while simultaneously carefully expanding the more environmentally benign forms of marine aquaculture, particularly shellfish and kelp aquaculture.

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INTRODUCTION

Food security is a global issue garnering increasing attention from academics and policymakers alike. For example, Martin Barry Cole, Mary Ann Augustin, Michael John Robertson, and John Michael Manners noted that "[f]eeding the world sustainably is one of our society's grand challenges" and that "[i]n 2050, it is estimated there will be 9.7 billion people, and we will require about 70% more food available for human consumption than is consumed today."[1] After a period of improvement, global food insecurity is increasing, exacerbated over the last two years by the coronavirus pandemic and attending economic stress.[2] According to the United Nations Food & Agriculture Organization's ("FAO") 2021 food security report, "Nearly 2.37 billion people did not have access to adequate food in 2020—an increase of 320 million people in just one year";[3] 720 to 811 million people faced actual hunger in 2020.[4] Among other impacts, the pandemic exposed "the fragility of our food systems,"[5] with the result that 30 million more people will likely be dealing with hunger in 2030 than if the pandemic had not occurred.[6] Impacts have been worst in Asia and Africa and

1. Martin Barry Cole, Mary Ann Augustin, Michael John Robertson & John Michael Manners, *The Science of Food Security*, NATURE PARTNER J. SCI. FOOD, Aug. 6, 2018, at 1, https://www.nature.com/articles/s41538-018-0021-9.pdf [https://perma.cc/V98V-WKSN].

2. FOOD & AGRIC. ORG. OF THE UNITED NATIONS, INT'L FUND FOR AGRIC. DEV., UNICEF, WORLD FOOD PROGRAMME & WORLD HEALTH ORG., THE STATE OF FOOD SECURITY AND NUTRITION IN THE WORLD: TRANSFORMING FOOD SYSTEMS FOR FOOD SECURITY, IMPROVED NUTRITION, AND AFFORDABLE HEALTHY DIETS FOR ALL, at vi (2021) [hereinafter 2021 FAO FOOD SECURITY REPORT], https://www.fao.org/3/cb4474en/cb4474en.pdf [https://perma.cc/33ZA-X5DZ]; *see also id.* at 10 fig.1 (graphing the changing trajectory).

3. *Id.* at vi.

4. *Id.* at xv.

5. *Id.* at vi.

6. *Id.* at xii.

among children.[7] "[B]old actions" are needed to achieve the goal of eradicating world hunger by 2030,[8] prompting the FAO to offer both a pragmatic and an ethical vision of future food systems. In its summary, food systems "need to provide decent livelihoods for the people who work within them," "need to be inclusive and encourage the full participation of Indigenous Peoples, women and youth," and need to "ensure that children are no longer deprived of their right to nutrition."[9]

The recognition that achieving food security has an ethical dimension, while not new, has gained force over the last decade, in part because of increasing acknowledgement that food insecurity derives from multiple drivers, many of which require redress of larger social inequities. Over the last five years, for example, the FAO has documented that "[c]onflict, climate variability and extremes, and economic slowdowns and downturns (now exacerbated by the COVID-19 pandemic) are behind recent rises in hunger and slowing progress in reducing all forms of malnutrition,"[10] while "high and persistent levels of inequality" and inability to pay for healthy food exacerbate these drivers.[11] For example, "More than half of the people who are undernourished and almost 80 percent of stunted children live in countries struggling with some form of conflict, violence or fragility."[12] As for climate, "Hunger is significantly worse in countries with agri-food systems highly sensitive to rainfall and temperature variability and extremes, and where a high proportion of the population depends on agriculture for livelihoods."[13] Economic insecurity leads to multiple negative impacts on food security and nutrition, including increased hunger, consumption of cheaper but less nutritious foods, reduced nutrition, and food insecurity.[14] Finally, healthy diets are often not the cheapest diets, and "[t]he unaffordability of healthy diets . . . is associated with increasing food insecurity and all forms of malnutrition, including stunting, wasting, overweight and obesity."[15] Given these multiple drivers and influences, the FAO identified six combinable pathways toward ethical, sustainable, and resilient food systems.[16]

7. *Id.* at xii–xiii; *see also id*. at 13 fig.2 (showing that most of the world's undernourished people are in Asia and Africa).

8. *Id.* at xii.

9. *Id.* at vii.

10. *Id.* at xviii; *see also id.* at 2.

11. *Id.* at 2.

12. *Id.* at 3.

13. *Id.*

14. *Id.*

15. *Id.*

16. *Id.* at xx.

Pathway 6—strengthening food environments and changing consumer behavior to promote the environment as well as human health[17]—is the most relevant to both Christopher Stone's vision of an "Earth Ethics"[18] and this Article's pursuit of a "Blue Ethics." By "Blue Ethics," this Article refers to how we think about and modify human use of the ocean in the twenty-first century in order to keep ocean ecosystems resilient to the Anthropocene while still meeting critical human needs. Among the most pivotal of humans' uses of the ocean in terms of promoting a new Blue Ethics is food supply.

What the FAO's food security report largely left to one side is foods from the ocean and other aquatic systems, now dubbed Blue Foods.[19] That elision is not unusual; the oceanic component of human food supply is often left out of food security discussions, including the ethical dimensions of food security. This Article seeks to begin filling that near void by sketching an ethical path forward for humanity's continued dependence on Blue Foods.

This Article proceeds in four parts. Part I details humanity's continued reliance on the ocean for food. Part II explores the issue of whether humanity should continue to engage in wild-caught fisheries, sketching out a Blue Ethics at the same time. Part III establishes that attitudes toward the ocean and its importance are already changing in ways that support a Blue Ethics, while Part IV concludes by arguing that humans can pursue Blues Ethics and Blue Food security simultaneously through a measured and careful investment in marine aquaculture.

I. HUMAN FOOD SECURITY AND BLUE FOODS

As the FAO is well aware, marine foods are a significant part of the global food security equation. Worldwide, total consumption of food fish has increased at a rate almost double the rate of human population growth and about 50% faster than the increasing rate of consumption of other animal protein.[20] Indeed, "In 2017, fish consumption accounted for 17 percent of the global population's intake of animal proteins, and 7 percent of all

17. *Id.*

18. *See generally* CHRISTOPHER D. STONE, EARTH AND OTHER ETHICS: THE CASE FOR MORAL PLURALISM (1987) (laying out the principles and values of Moral Pluralism).

19. BLUE FOOD ASSESSMENT, BUILDING BLUE FOOD FUTURES FOR PEOPLE AND THE PLANET: THE REPORT OF THE BLUE FOOD ASSESSMENT 6 (2021) [hereinafter 2021 BLUE FOOD REPORT], https://bluefood.earth/wp-content/uploads/The-Report-of-the-Blue-Food-Assessment-Digital.pdf [https://perma.cc/4FV3-DSP2] (defining "Blue Food" as "foods derived from aquatic animals, plants and algae cultivated and captured in freshwater and marine environments").

20. FOOD & AGRIC. ORG. OF THE UNITED NATIONS, THE STATE OF WORLD FISHERIES AND AQUACULTURE: SUSTAINABILITY IN ACTION 3 (2020) [hereinafter 2020 FAO FISHERIES & AQUACULTURE REPORT], https://www.fao.org/3/ca9229en/ca9229en.pdf [https://perma.cc/PEJ6-3V57].

proteins consumed."[21] Around the world, 3.3 billion people consume 20% of their animal protein in the form of fish, and that number can reach "50 percent or more in countries such as Bangladesh, Cambodia, the Gambia, Ghana, Indonesia, Sierra Leone, Sri Lanka and several small island developing States (SIDS)."[22]

Importantly, despite the increase in aquaculture globally,[23] wild capture fisheries still outstrip Blue Food production in aquaculture, particularly with respect to marine fish. In 2018, the latest year for which global data are available, freshwater and marine wild capture fisheries together produced 96.4 million tonnes of fish, seafood, and algae, while freshwater and marine aquaculture produced 82.1 million tonnes.[24] The shares from the ocean, in contrast, were 84.4 million tonnes and 30.8 million tonnes, respectively.[25] In other words, almost three-quarters of the human food taken from the ocean still comes from wild-caught fisheries. These marine fisheries mostly target fish. Indeed, "Finfish represent[] 85 percent of total production" in wild capture fisheries, with anchoveta, Alaska pollock, and skipjack tuna leading the lists of species caught.[26] Seven countries account for almost 50% of this wild harvest: China (15%), Indonesia (7%), Peru (7%), India (6%), the Russian Federation (5%), the United States (5%), and Viet Nam (3%).[27]

Of potential relevance to the ethics of fishing, much of this wild Blue Food is not of particularly high value. Indeed, three of the four most valuable wild-caught groups of species—cephalopods (octopus and squid), shrimps, and lobsters—are not finfish.[28] The most valuable group of finfish species, perhaps not surprisingly, is tuna.[29]

Given humanity's dependence on Blue Foods, when the FAO noted in 2020 that "as we approach a world of 10 billion people, we face the fact that since 2015 the numbers of undernourished and malnourished people have been growing,"[30] it also emphasized that capture fisheries and especially aquaculture will play a "crucial role in global food security."[31] However, most other food security researchers and food policymakers ignore the ocean, instead focusing on land-based crops and livestock. For example,

21. *Id.* at 5.
22. *Id.*
23. *Id.* at 6, 21–22.
24. *Id.* at 3 tbl.1.
25. *Id.*
26. *Id.* at 6.
27. *Id.*
28. *Id.* at 12.
29. *Id.*
30. *Id.* at vi.
31. *Id.*

Alexander Y. Prosekov and Svetlana A. Ivanova discuss food security in terms of "[g]rain and cereals, vegetable and animal fats, and meat and dairy products."[32] Other researchers focus solely on agriculture and crops.[33] As such, the role of Blue Foods in global food security remains an underacknowledged issue for law, policy, and ethics.

Nevertheless, the world's dependence on marine foods raises real, if underappreciated, food security concerns. Simultaneously, however, the continued dependence on wild-caught fisheries also raises several ethical concerns, particularly in terms of preserving and enhancing marine biodiversity and the resilience of ocean ecosystems to climate change and other anthropogenic stressors. Part II will explore these concerns in more detail.

II. BLUE ETHICS AND WILD CAPTURE FISHERIES: SHOULD WE KEEP FISHING THE OCEAN?

Commercial exploitation of wild fisheries stocks in the ocean has plateaued,[34] despite increased fishing effort,[35] raising important ethical questions about the continued pursuit of these wild foods. The desire for a more ethical path forward regarding humanity's dependence on ocean food gave birth to the Blue Food Assessment, an emerging movement seeking to ensure that all food policies, including the environmental and climate policies surrounding food, take account of the importance and potential benefits of aquatic foods—fish and shellfish, both marine and freshwater, together with more culturally specific aquatic delicacies such as kelp and sea cucumber.[36]

The Blue Food Assessment[37] launched September 16, 2021. It focuses on using aquatic foods to help bring about the transformation of the global food system to end hunger while increasing sustainability. As its report announces:

32. Alexander Y. Prosekov & Svetlana A. Ivanova, *Food Security: The Challenge of the Present*, 91 GEOFORUM 73, 74 (2018).

33. Paul C. West, James S. Gerber, Peder M. Engstrom, Nathaniel D. Mueller, Kate A. Brauman, Kimberly M. Carlson, Emily S. Cassidy, Matt Johnston, Graham K. MacDonald, Deepak K. Ray & Stefan Siebert, *Leverage Points for Improving Global Food Security and the Environment*, 345 SCI. 325, 325–28 (2014).

34. 2020 FAO FISHERIES & AQUACULTURE REPORT, *supra* note 20, at 4 fig.1; *see also* Christopher D. Stone, *Too Many Fishing Boats, Too Few Fish: Can Trade Laws Trim Subsidies and Restore the Balance in Global Fisheries?*, 24 ECOLOGY L.Q. 505, 506 (1997) [hereinafter Stone, *Too Many Fishing Boats*] ("The world's capture fisheries are being over-exploited.").

35. Stone, *Too Many Fishing Boats*, *supra* note 34, at 507–08.

36. *The Blue Food Assessment*, BLUE FOOD ASSESSMENT, https://bluefood.earth [perma.cc/Q527-XZHV].

37. *Id.*

> There is growing recognition that food systems must be transformed—that achieving the U.N. Sustainable Development Goals (SDGs) requires shifting toward a system that is more diverse, resilient and just, as well as healthier. "Blue foods"—foods derived from aquatic animals, plants and algae cultivated and captured in freshwater and marine environments—have much to offer in that transformation.[38]

Like the FAO, therefore, the Blue Food Assessment seeks to promote a new ethical approach to food security as well as more comprehensive food management policies and assessments. For example, one of its key platforms is the need to "[c]ommit to human rights in policy and practice— . . . empowering in every part of the food value chain women, Indigenous groups, marginalized communities and youth."[39]

Another goal of the Blue Food movement is to consider the impact of Blue Food harvest on the environment itself[40]—a critical component of Blue Ethics. As such, an ethical approach to Blue Foods must start by considering what industrial-scale commercial fishing of wild marine species does both to those species and to their attendant ecosystems.

A. THE CURRENT HARVEST OF WILD MARINE SPECIES IS UNSUSTAINABLE

The FAO maintains the most reliable and comprehensive sets of data about how the world supplies itself with aquatic food, and roughly every two years it publishes a *State of the World Fisheries and Aquaculture* report.[41] According to the 2020 report, in 2018 the world produced (from all sources, including fishing and freshwater aquaculture) about 179 million tonnes of fish, crustaceans like crab and lobster, mollusks like clams and oysters, and other aquatic animals, worth $401 billion.[42] Of that total harvest, 156 million tonnes, or over 87%, were used for human food.[43]

The world's taste for fish and seafood, however, comes at a cost. Wild capture fisheries in the ocean leveled off in the late 1980s and 1990s.[44] Moreover, wild marine fisheries are becoming increasingly unsustainable:

> The state of marine fishery resources, based on FAO's long-term monitoring of assessed marine fish stocks, has continued to decline. The

38. 2021 BLUE FOOD REPORT, *supra* note 19, at 6.
39. *Id.* at 9.
40. *Id.* at 8, 16.
41. The FAO maintains a full set of these reports online, dating back to 1995. *Fisheries and Aquaculture*, FOOD & AGRIC. ORG. OF THE UNITED NATIONS, http://www.fao.org/fishery/publications/sofia/en [https://perma.cc/M777-BAT6].
42. 2020 FAO FISHERIES & AQUACULTURE REPORT, *supra* note 20, at 2.
43. *Id.*
44. *Id.* at 4 fig.1.

> proportion of fish stocks that are within biologically sustainable levels decreased from 90 percent in 1974 to 65.8 percent in 2017 (a 1.1 percent decrease since 2015), with 59.6 percent classified as being maximally sustainably fished stocks and 6.2 percent underfished stocks. The maximally sustainably fished stocks decreased from 1974 to 1989, and then increased to 59.6 percent in 2017, partly reflecting improved implementation of management measures. In contrast, the percentage of stocks fished at biologically unsustainable levels increased from 10 percent in 1974 to 34.2 percent in 2017. In terms of landings, it is estimated that 78.7 percent of current marine fish landings come from biologically sustainable stocks.[45]

Not coincidentally, marine aquaculture industries have been growing rapidly since 1986 to close the gap in global seafood demand.[46]

Christopher Stone provided as succinct a summary as anyone of the perils facing the ocean:

> The oceans—over 70% of the planet's surface—are in trouble. The omens are everywhere. Marine catches have stagnated in almost every region, even in the face of intensified harvest efforts. The wetlands and coastal nurseries vital to maintain the stocks are vanishing under the pressures of commercial development and a siege of sewage and waste. We are dousing the seas with chemicals, and seasoning them with millions of tons of stubbornly persistent litter. Periodic red tides, kelp and coral afflictions, and major die-offs of marine mammals such as harbour seals and dolphins, may be early warning signs of worse to come.[47]

The succeeding two decades since his summary have made clear that the "worse to come" is climate change and its "evil twin," ocean acidification, which are wreaking havoc on marine ecosystems.[48] In particular, ocean warming is driving marine species poleward, but not at uniform rates, disrupting marine food webs and shifting the concentrations of increasing numbers of important fisheries across management boundaries.[49]

These current and future changes to the ocean resulting from climate change and ocean acidification will only exacerbate the global insecurity of wild-caught marine fisheries. From a global perspective, the Intergovernmental Panel on Climate Change ("IPCC") concluded in 2019

45. *Id.* at 7.
46. *Id*. at 4 fig.1.
47. Christopher D. Stone, *Can the Oceans Be Harboured? A Four Step Plan for the 21st Century*, 8 REV. EUR. COMPAR. & INT'L ENV'T L. 37, 37 (1999) [hereinafter Stone, *Can the Oceans Be Harboured*].
48. Robin Kundis Craig, *Re-Valuing the Ocean in Law: Exploiting the Panarchy Paradox of a Complex System Approach*, 41 STAN. ENV'T L.J. 3, 10–19 (2022).
49. *Id.* at 16–19.

that, already, "[c]hanges in the ocean have impacted marine ecosystems and ecosystem services with regionally diverse outcomes, challenging their governance (*high confidence*)."[50] While, at the moment, these changes are both enhancing and undermining food security, depending on the exact community involved, the impacts on ecosystem services already "have negative consequences for health and well-being (*medium confidence*), and for Indigenous peoples and local communities dependent on fisheries (*high confidence*)."[51]

For example, coral reef ecosystems produce critical fisheries for island peoples, but they are increasingly vulnerable to both increasing temperatures and ocean acidification.[52] In addition, increasing ocean temperatures are already causing many marine species to shift their ranges[53]—and those range shifts are already complicating fisheries management. For example, a 2018 study of 686 marine species indicated that species along the Pacific Coast of North America could shift ranges as much as 1,500 kilometers (more than 930 miles), while those on the Atlantic Coast could shift more than 600 kilometers (more than 370 miles).[54] As the researchers noted, "In the United States, fisheries are managed regionally, including species that are managed by individual states and federally managed fisheries that are governed by regional councils with representatives from neighboring states,"[55] and their projected range shifts are more than sufficient to move commercially important fish stocks across regulatory jurisdictions within the United States, from the United States to Canada, from Mexico to the United States, and, on the Pacific Coast, from Canada to the United States and Alaska.[56] Other management challenges include "shifts in fishing locations, conflict over regional allocation of fisheries quota, displaced fisherman, and changes in stock boundaries."[57]

Future changes to the ocean, including species migration and food web simplification, pose even greater threats to global food security, fisheries

50. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, SPECIAL REPORT ON THE OCEAN AND CRYOSPHERE IN A CHANGING CLIMATE 16 (2019) [hereinafter 2019 IPCC OCEAN & CRYOSPHERE REPORT], https://www.ipcc.ch/site/assets/uploads/sites/3/2022/03/01_SROCC_SPM_FINAL.pdf [https://perma.cc/ZQV5-X4CT].

51. *Id*.

52. *Id.* at 13.

53. *Id.* at 12.

54. James W. Morley, Rebecca L. Selden, Robert J. Latour, Thomas L. Frölicher, Richard J. Seagraves & Malin L. Pinsky, *Projecting Shifts in Thermal Habitat for 686 Species on the North American Continental Shelf*, PLOS ONE, May 16, 2018, at 1, 12, https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0196127&type=printable [https://perma.cc/HL88-KNMN].

55. *Id.* at 23.

56. *Id.* at 17 fig.7, 18 fig.8.

57. *Id.* at 23.

governance, and even national security—including for the United States.[58] Moreover, the decreasing supplies of seafood are also likely to be less safe because of elevated concentrations of mercury and other toxics in marine plants and animals and increasing contamination, especially of shellfish, by both *Vibrio* pathogens (the family of bacteria that include cholera and the flesh-eating *Vibrio vulnificus*) and harmful algal blooms like red tides.[59] "These risks are projected to be particularly large for human communities with high consumption of seafood, including coastal Indigenous communities (*medium confidence*), and for economic sectors such as fisheries, aquaculture, and tourism (*high confidence*)."[60] In addition, while climate-adaptive management can in some circumstances delay the collapse of fisheries, tipping points are still likely at about 2.0°C of warming.[61]

Thus, in light of overexploited fisheries and worsening impacts from climate change and ocean acidification, enlightened self-interest alone counsels humanity to reconsider its current reliance on wild-caught Blue Foods and commercial marine fisheries. Blue Ethics adds the additional consideration of preserving marine biodiversity and increasing the resilience of marine ecosystems.

B. Blue Ethics: From Food to Ecosystems and Biodiversity

Enlightened self-interest only goes so far toward increasing the planet's chances of retaining high levels of marine biodiversity and functional ocean ecosystems. As Christopher Stone noted repeatedly, getting courts and legislatures to protect these values can be difficult, leading him to propose that natural objects and places—like the Mineral King Valley in California—should have standing to represent their own interests in court.[62] While the U.S. Supreme Court disagreed,[63] the problem of protecting larger natural values remained, a problem Stone found particularly vexing for whales:

> [A]s long as the judges . . . remain within the bounds of conventional international and U.S. legal principles, with no accounting for invasion of the whales' interests, the "harvesting" will continue. An argument truly on

58. 2019 IPCC Ocean & Cryosphere Report, *supra* note 50, at 26.
59. *Id.*
60. *Id.*
61. K. K. Holsman, A. C. Haynie, A. B. Hollowed, J. C. P. Reum, K. Aydin, A. J. Hermann, W. Cheng, A. Faig, J. N. Ianelli, K. A. Kearney & A. E. Punt, *Ecosystem-Based Fisheries Management Forestalls Climate-Driven Collapse*, Nature Commc'ns, Sept. 11, 2020, at 1–3 (2020), https://www.nature.com/articles/s41467-020-18300-3.pdf [https://perma.cc/QY9Z-W8TL].
62. Stone, *supra* note 18, at 3.
63. Id. at 3–5.

> behalf of the whales has as its starting point not the sanctity of treaties and regard for "political questions," but respect for whales.[64]

To account for the value of whales (and trees and mountains and functional ecosystems), he eschewed "Moral Monism"—the positing of one theory of ethics, such as utilitarianism, to resolve all ethical dilemmas—in favor of Moral Pluralism.[65] Moral Pluralism

> invites us to conceive moral activities as partitioned into several distinct frameworks, each governed by distinct principles and logical texture. We do not try to force the analysis of good character into the same framework as for good acts; nor are our obligations to the spatially and temporally remote subject to exactly the same rules that relate us to our kin, on the one hand, or to species, on the other.[66]

From this pluralistic framework, whales and other natural entities are entitled to moral considerateness even if they are not legal persons, such that "killing a whale is prima facie wrong: one is obligated in a fairly strong sense not to do so."[67]

However, as Stone immediately noted, the strength of that obligation can vary by the exact moral context from which we evaluate the issue, and the Inupiat occupy a different moral framework with respect to whales than a twenty-first-century Angelina who teaches at the University of Southern California (and who has absolutely no interest in eating whale meat, it should be emphasized).[68] Expanding on Stone's point, the Inupiat's moral duty to the whale may be not to waste whales, or, as was true of the Makah Tribe in the U.S. Pacific Northwest, to forebear whale hunts for cultural purposes when other food is sufficient and the whale species in question is endangered.[69] Conversely, increasing numbers of studies confirm that one key to both food security and better health for indigenous communities is access to traditional foods[70]—including Blue Foods and, when culturally *and*

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64. *Id.* at 10.
65. *Id.* at 13.
66. *Id.*
67. *Id.* at 220.
68. *Id.*
69. The Makah have endured a long-running legal battle to exercise their right to hunt grey whales. However, when grey whales were considered endangered species, the Makah cooperated in their recovery:

> [T]he Makah, who now number about 1,500, have hunted whales for more than 2,700 years. The tribe's 1855 treaty with the US reserved the 'right of taking fish and of whaling or sealing at usual and accustomed grounds[.]' The Makah continued whaling until the 1920s, when they gave it up because commercial whaling devastated populations.

Judge Recommends Tribe Be Allowed to Hunt Gray Whales off Washington State, GUARDIAN (Sept. 25, 2021, 10:30 AM) [*hereinafter Judge Recommends*], https://www.theguardian.com/environment/2021/sep/25/makah-tribe-hunt-gray-whales-washington-state-judge [https://perma.cc/X5Y5-YWFV].

70. *See generally*, *e.g.*, Jennifer Sowerwine, Megan Mucioki, Daniel Sarna-Wojcicki & Lisa

ecologically appropriate, even whales.[71]

Moral Pluralism thus allows for a Blue Ethics that takes multiple values into account simultaneously while still demanding a moral conversation about humans' uses of the ocean that goes beyond mere human utility.[72] Applying this Blue Ethics to Blue Foods, if one method of getting the Blue Foods essential to human food security imperils marine biodiversity and ocean ecosystems, while another available method not only avoids those impacts but also contributes to the ocean's resilience to climate change and other stressors, the choice between these two Blue Food security pathways is not an amoral one. As with Stone's example of killing whales, a Blue Ethics for the twenty-first century must posit that the first path—specifically, the continued reliance on industrial-scale commercial wild-caught fisheries—is simply "prima facie wrong," and "one is obligated in a fairly strong sense" to switch to the second pathway to achieve Blue Food security.

C. Marine Biodiversity Is at Risk—and the Primary Legal Tool to Protect Marine Biodiversity Conflicts with Fishing

1. Overfishing Is a Threat to Marine Biodiversity

Fishing clearly has an impact on the species caught, and multiple case studies—perhaps most famously, the collapse of the cod fishery in Canada—have documented how overfishing can semi-permanently render the target species commercially extinct.[73] However, ecosystem and biodiversity impacts extend beyond the fished species, in part because fishers initially target the largest members of the largest species, effectively removing apex predators from marine ecosystems.[74] As a result, wild-caught marine fisheries at commercial scale have also pervasively altered marine ecosystem function and ocean biodiversity. Indeed, in 2001 a large group of marine

Hillman, *Reframing Food Security by and for Native American Communities: A Case Study Among Tribes in the Klamath River Basin of Oregon and California*, 11 FOOD SEC. 579 (2019); Fidji Gendron, Anna Hancherow & Ashley Norton, *Exploring and Revitalizing Indigenous Food Networks in Saskatchewan, Canada, as a Way to Improve Food Security*, 32 HEALTH PROMOTION INT'L 808 (2017).

71. For example, in September 2021, after over two decades of legal battles, an administrative law judge recommended to the U.S. Department of Commerce (which houses the National Oceanic and Atmospheric Administration (NOAA) and the National Marine Fisheries Service (NMFS)) that the Makah be allowed "to land up to 20 Eastern North Pacific gray whales over 10 years, with hunts timed to minimize already low chances of accidentally harpooning an endangered Western North Pacific gray whale," explicitly "finding that the tribal hunts would have no effect on the healthy overall population of the whales." *Judge Recommends*, *supra* note 69.

72. *See* STONE, *supra* note 18, at 221 (discussing how there is still moral saliency in the choice, in an emergency, of whether to dump drilling chemicals on common perennial wildflowers that will reappear next year or, conversely, on rare Arctic lichen, destroying the colony forever).

73. Marten Scheffer. Steve Carpenter & Brad de Young, *Cascading Effects of Overfishing Marine Systems*, 20 TRENDS IN ECOLOGY & EVOLUTION 579, 579–80, 580 fig.1 (2005).

74. *Id.* at 579.

biologist luminaries concluded that "[e]cological extinction caused by overfishing precedes all other pervasive human disturbance to coastal ecosystems, including pollution, degradation of water quality, and anthropogenic climate change."[75] Moreover, "Any fishing tends to alter biodiversity at some or all of its levels, from genes to ecosystems," and the "fishing . . . of the largest animals results in alteration of age structure, population size, relative abundance of predators and prey, food webs, and ecosystems."[76]

Thus, overfishing has long been considered a primary threat to marine biodiversity and ecosystem function,[77] and "since the advent of industrial fishing . . . the sequential depletion of coastal, then offshore populations of marine fish has become the standard operating procedure."[78] Indeed, a whole vocabulary has developed to describe these impacts. "Ecological extinction" is the elimination of a species' ability to function as it should in an ecosystem, even if it is not entirely biologically extinct.[79] "Fishing down marine food webs" describes how fishers move from the most desirable fish to lower trophic levels—for example, from apex predators like tuna and swordfish to herring—as they exhaust the initial target species.[80] "Bycatch," in turn, encapsulates the incidental catch of nontarget species, such as marine mammals, turtles, and seabirds, and "[f]isheries bycatch has been implicated as an important factor in many population declines, including Pacific loggerhead . . . and leatherback . . . sea turtles, North Atlantic harbor porpoises . . . , vaquita . . . in the Sea of Cortez, Mediterranean striped dolphins . . . , the wandering albatross . . . and white-chinned petrel . . . of the Southern Ocean."[81] Finally, Daniel Pauly coined "shifting baseline syndrome" to describe how each generation of fishers accepts an increasingly impoverished ocean as normal.[82]

75. Jeremy B.C. Jackson, Michael X. Kirby, Wolfgang H. Berger, Karen A. Bjorndal, Louis W. Botsford, Bruce J. Bourque, Roger H. Bradbury, Richard Cooke, Jon Erlandson, James A. Estes, Terence P. Hughes, Susan Kidwell, Carina B. Lange, Hunter S. Lenihan, John M. Pandolfi, Charles H. Peterson, Robert S. Steneck, Mia J. Tegner & Robert R. Warner, *Historical Overfishing and the Recent Collapse of Coastal Ecosystems*, 293 SCIENCE 629, 629 (2001).

76. Mark J. Costello & Bill Ballantine, *Biodiversity Conservation Should Focus on No-Take Marine Reserves*, 30 TRENDS IN ECOLOGY & EVOLUTION 507, 507 (2015).

77. MELINDA HARM BENSON & ROBIN KUNDIS CRAIG, THE END OF SUSTAINABILITY: RESILIENCE AND THE FUTURE OF ENVIRONMENTAL GOVERNANCE IN THE ANTHROPOCENE 115–17 (2017).

78. Daniel Pauly & Maria-Lourdes Palomares, *Fishing Down Marine Food Web: It Is Far More Pervasive Than We Thought*, 76 BULL. MARINE SCI. 197, 197 (2005).

79. Jackson et al., *supra* note 75.

80. Pauly & Palomares, *supra* note 78, at 198.

81. Rebecca L. Lewison, Larry B. Crowder, Andrew J. Read & Sloan A. Freeman, *Understanding Impacts of Fisheries Bycatch on Marine Megafauna*, 19 TRENDS IN ECOLOGY & EVOLUTION 598, 598–99 (2004).

82. Daniel Pauly, *Anecdotes and the Shifting Baseline Syndrome of Fisheries*, 10 TRENDS IN ECOLOGY & EVOLUTION 430, 430 (1995).

2. Climate Changes and Ocean Acidification Are Also Significant Threats to Marine Biodiversity

Fishing is no longer the only primary threat to marine biodiversity; climate change has become its equal. A 2015 meta-analysis of 632 peer-reviewed studies related to ocean biodiversity concluded that warming ocean waters will likely increase primary production in the ocean (phytoplankton growth) while simultaneously disrupting marine ecosystems overall and starving both herbivores and carnivores farther up marine food chains.[83] Although specific results will likely vary by location, in general,

> We find that ocean warming and acidification increase the potential for an overall simplification of ecosystem structure and function, with reduced energy flow among trophic levels with little scope for acclimation. Ocean acidification per se appears to have the potential to bring penetrating modifications to ecological systems through changes in ecosystem processes and shifts in species community structures.[84]

Similarly, the United Nations' May 2019 biodiversity report concluded that "almost 33% of reef-forming corals and more than a third of all marine mammals are threatened" with extinction, and the planet has already lost about 30% of seagrass meadows and 50% of coral reefs—two highly productive marine habitats—since 1970 and 1870, respectively.[85] By the end of the century on the current trajectory, primary production in the ocean could decrease by 10% and total fish biomass by 25%.[86]

The IPCC concurs that, by 2100, we likely will not recognize the world's ocean.[87] Even under a low emissions scenario, ocean heat waves will likely occur twenty times more often than they do now; under a business-as-usual scenario, they will likely occur fifty times more often.[88] Most coastal ecosystems, including kelp forests, sea grass meadows, and salt marshes, face an increasing risk of destruction as a result of this heat, ocean acidification, and sea-level rise.[89] By mid-century, on our current trajectory, oxygen loss will occur to depths of 600 meters (almost 1970 feet) in 59% to 80% of the ocean.[90] Extreme sea-level events that used to occur once per

83. Ivan Nagelkerken & Sean D. Connell, *Global Alteration of Ocean Ecosystem Functioning Due to Increasing Human CO_2 Emissions*, 112 PROC. NAT'L ACAD. SCIS. 13272, 13273–75 (2015).

84. *Id.* at 13275.

85. *UN Report: Nature's Dangerous Decline "Unprecedented"; Species Extinction Rates "Accelerating,"* UNITED NATIONS (May 6, 2019), https://www.un.org/sustainabledevelopment/blog/2019/05/nature-decline-unprecedented-report [https://perma.cc/QL6X-95ZX].

86. *Id.*; *see also* 2019 IPCC OCEAN & CRYOSPHERE REPORT, *supra* note 50, at 22 (projecting nearly identical losses).

87. 2019 IPCC OCEAN & CRYOSPHERE REPORT, *supra* note 50, at 18.

88. *Id.*

89. *Id.* at 24.

90. *Id.* at 19.

century will be occurring once a year by 2050 in many locations, especially the tropics, and the rate of global average sea level rise will continue to accelerate to centimeters per year.[91] By the end of the twenty-first century, again assuming business as usual, 60% of the ocean will be experiencing all five of the IPCC's drivers of ecosystem change—surface warming, acidification, oxygen loss, nitrate pollution, and change in net primary production (growth of marine plants and zooplankton).[92]

3. Protecting Marine Biodiversity Leads to Fisheries Conflicts

Between climate change and fishing, fishing is by far the easier anthropogenic stressor to ocean ecosystems to control immediately through regulation. The primary legal tool for protecting marine biodiversity and promoting the marine resilience are marine protected areas ("MPAs").[93] MPAs legally set aside a specific area of the ocean and restrict at least some uses of that area. The most protective MPAs, generally referred to as marine reserves,[94] significantly restrict or prohibit all resource extraction from the area—especially fishing.[95]

As such, MPAs and especially marine reserves often impose tradeoffs on coastal communities: the health of local biodiversity, and often of the local fisheries themselves, may depend on leaving large swaths of the ocean unfished. In this classic environmental law conflict between short-term economic gain and longer-term ecological (and often economic and personal) health, time after time, existing fishers protest the creation of these areas. For example, virtually no marine reserve created for biodiversity purposes[96] has come into existence in the United States without significant

91. *Id.* at 20.

92. *Id.* at 18.

93. Antonios D. Mazaris, Athanasios Kallimanis, Elena Gissi, Carlo Pipitone, Roberto Danovaro, Joachim Claudet, Gil Rilov, Fabio Badalamenti, Vanessa Stelzenmüller, Lauric Thiault, Lisandro Benedetti-Cecchi, Paul Goriup, Stelios Katsanevakis & Simonetta Fraschetti, *Threats to Marine Biodiversity in European Protected Areas*, 677 SCI. TOTAL ENV'T 418, 419 (2019).

94. Costello & Ballantine, *supra* note 76.

95. *Id.*

96. The U.S. Department of Defense, most notably, has created a number of *de facto* biodiversity reserves by prohibiting entry to the waters next to coastal facilities for security purposes. For example, the Kennedy Space Center at Cape Canaveral, Florida, is now considered the United States' oldest fully protected marine reserve, protecting sportfish at significantly greater abundance and to much larger size than outside its boundary. Eric A. Reyier, Douglas M. Scheidt, Eric D. Stolen, Russell H. Lowers, Karen G. Holloway-Adkins & Bonnie J. Ahr, *Residency and Dispersal of Three Sportfish Species from a Coastal Marine Reserve: Insights from a Regional-Scale Acoustic Telemetry Network*, GLOB. ECOLOGY & CONSERVATION, Sept. 2020, at 1–2, https://doi.org/10.1016/j.gecco.2020.e01057 [https://perma.cc/H9B6-72EX].

opposition, often from fishers[97] or indigenous groups.[98] These conflicts manifest as political machinations,[99] litigation,[100] or lengthy negotiations and collaborations.[101] Nevertheless, however they arise legally, they evidence some of the practical difficulties of balancing Blue Food security with ocean health.

D. NEVERTHELESS, BLUE ETHICS REQUIRES RECOGNITION THAT NOT ALL FISHERIES ARE EQUAL

As already hinted at with respect to indigenous whaling, the Blue Ethics assessment, based on Moral Pluralism, shifts frameworks when the focus moves from reducing or eliminating large-scale commercial fishing to regulating indigenous, local community (subsistence), or artisanal fishing. While the terminology is fluid,[102] these types of fisheries are usually much

97. *A Fishing Perspective: Understanding Marine Reserve Effects*, OR. MARINE RSRVS. (Nov. 2, 2016), https://oregonmarinereserves.com/2016/11/02/garibaldi [https://perma.cc/54B7-SSBG]; Bret Yager West, *Fishermen Protest Marine Reserve at Kaupulehu*, W. HAW. TODAY (June 5, 2016, 3:33 PM), https://www.westhawaiitoday.com/2016/06/05/hawaii-news/fishermen-protest-marine-reserve-at-kaupulehu [https://perma.cc/B5KW-ULK8]; Tim Langlois, *Opposition Keen to Stop Marine Parks, but Will Fishers Benefit?*, CONVERSATION (June 4, 2013, 11:08 PM), https://theconversation.com/opposition-keen-to-stop-marine-parks-but-will-fishers-benefit-14955 [https://perma.cc/5A9U-DHZM].

98. Heidi Walters, *Scenes from Tribes' MLPA Protest,* N. COAST J. (June 30, 2010, 3:58 PM), https://www.northcoastjournal.com/NewsBlog/archives/2010/06/30/scenes-from-tribes-mlpa-protest [https://perma.cc/E4YR-5Z6K].

99. *See generally* Robin Kundis Craig, *Taking Steps Toward Marine Wilderness Protection? Fishing and Coral Reef Marine Reserves in Florida and Hawaii*, 34 MCGEORGE L. REV. 155 (2003) (discussing the creations of the Dry Tortugas marine reserve within the Florida Keys National Marine Sanctuary and the lengthy process that preceded President George W. Bush's establishment of the Papahānaumokuākea Marine National Monument).

100. Most recently, for example, the Massachusetts Lobstermen's Association, Atlantic Offshore Lobstermen's Association, Long Island Commercial Fishing Association, Garden State Seafood Association, and Rhode Island Fishermen's Alliance unsuccessfully challenged President Obama's 2016 creation of the Northeast Canyons & Seamounts National Marine Monument in the Atlantic Ocean roughly 130 miles off the coast of Massachusetts. Mass. Lobstermen's Ass'n v. Ross, 349 F. Supp. 3d 48, 68 (D.D.C. 2018), *aff'd*, 945 F.3d 535 (D.C. Cir. 2019), *cert. denied sub nom*. Mass. Lobstermen's Ass'n v. Raimondo, 141 S. Ct. 979 (2021). Nevertheless, President Trump purported to reopen the Monument to fishing by Executive Order in 2020. Proclamation No. 10049, 85 Fed. Reg. 35793, 35793 (June 11, 2020). The Conservation Law Foundation, Natural Resources Defense Council, and Center for Biological Diversity challenged the legality of this Executive Order in the U.S. District Court for the District of Columbia. Federal Defendants' Motion to Dismiss, Conservation L. Found. v. Trump, No. 1:20-cv-01589 (D.D.C. June 17, 2020). They voluntarily withdrew the lawsuit when President Biden restored the Monument's restrictions on fishing. *Conservation Law Foundation v. Biden (Northeast Canyons and Seamounts)*, NAT. RES. DEF. COUNCIL (Nov. 11, 2021), https://www.nrdc.org/court-battles/conservation-law-foundation-v-trump-northeast-canyons-and-seamounts [https://perma.cc/P3QU-572E].

101. *See generally* STEVEN L. YAFFEE, BEYOND POLARIZATION: PUBLIC PROCESS AND THE UNLIKELY STORY OF CALIFORNIA'S MARINE PROTECTED AREAS (2020) (detailing the long and convoluted public collaboration process).

102. Hillary Smith & Xavier Basurto, *Defining Small-Scale Fisheries and Examining the Role of Science in Shaping Perceptions of Who and What Counts: A Systematic Review*, 6 FRONTIERS MARINE SCI., May 7, 2019, at 2–3, https://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/18600/Smith%20and%20Basurto%202019.pdf?sequence=2&isAllowed=y [https://perma.cc/2QR2-BQX7].

smaller in scale than even small-scale commercial fisheries, generally have fewer impacts on marine ecosystem function, provide food and economic security to communities that often have few other resources, and often are deeply ingrained into local and traditional culture.[103] They also employ a much higher proportion of women than industrial fisheries.[104]

To be sure, these smaller-scale fisheries are not all the same in terms of their cultural and food security importance,[105] nor does a twenty-first-century Blue Ethics require that all existing small-scale fisheries continue unaltered. The point, rather, is that not all fisheries important to food security operate at an industrial scale, and the Blue Ethics frameworks for evaluating their continuing morality may be different.

As one example, a context of redressing the harms of colonialism may require a different framework for assessing the morality of a marine reserve. The Māori of New Zealand, for example, have strong traditions in both fishing and coastal management, and much of the early reconciliation focus and implementation of the Treaty of Waitangi in New Zealand focused on the redistribution of fishing rights.[106] Nevertheless, New Zealand's impulses toward reconciliation clashed with its desires to protect the Kermadec Islands, "one of the most pristine and unique places on the planet," located halfway between New Zealand and Tonga.[107] Christopher Finlayson, a former member of the New Zealand Parliament who was instrumental in according the Whanganui River personhood rights and Māori co-management, notes that "[t]he legislation to give effect to the Sanctuary is still stalled in the New Zealand Parliament because of objections of the indigenous people of New Zealand (The Māori) who say that the proposal will breach a historic settlement reached with them in 1992."[108] Specifically, "The complaint of Māori about the Kermadecs is that if the Crown can unilaterally alter the system it entered into as a condition of the Fisheries Settlements of 1989 and 1992, it has the capacity to alter any Treaty Settlements on its own political whim. That could undermine the entire historical settlement framework."[109] As a result, he concludes, national efforts to protect marine ecosystems from overfishing "depend[] on the circumstances and in particular the history, the expectations of the

103. *Id.* at 3–4.

104. *Id.* at 4.

105. 2021 BLUE FOOD REPORT, *supra* note 19, at 12–14.

106. Christopher Finlayson, *Plastic in the Pacific: How to Address an Environmental Catastrophe*, *in* RE-ENVISIONING THE ANTHROPOCENE OCEAN 246–51 (Robin Kundis Craig & Jeffrey M. McCarthy eds.) (forthcoming Feb. 2023).

107. *Id.* at 246.

108. *Id.* at 247 (citation omitted).

109. *Id.* at 250.

indigenous people, and the relevant legal framework."[110]

Similar conflicts are occurring in the United States in Hawai'i, where marine reserve establishment threatens subsistence fishing and privileges (or at least appears to privilege) the non-indigenous tourist sector. As a result, Native Hawaiian fishers on the Big Island of Hawai'i protested on these grounds "the establishment of the Ka'ūpūlehu Marine Reserve, the island's first initiative to put a reef off-limits to fishing," which sought to impose a ten-year moratorium on all taking of fish while a subsistence plan was being drafted for Ka'ūpūlehu Bay coastline.[111]

At the same time, it is important to emphasize that the Moral Pluralism underlying Blue Ethics is not moral relativism. As Stone elaborated, "Pluralism conceives the realm of morals to be partitioned into several planes. The planes are intellectual frameworks that support the analysis and solution of particular moral problems, roughly in the way that algebra and geometry provide frameworks for the problems to which they are respectively suited."[112] Concrete examples will help to illustrate the difference.

Moral relativism evaluates the morality of a given action or decision according to the ethical framework of the actor. Under this approach, the morality of hunting whales varies according to the ethics of each group proposing to hunt them.[113] Notably, even under moral relativism it is fairly simple to conclude that the Makah Tribe acts ethically when its members hunt non-endangered eastern gray whales, but the nations that are signatories to the International Whaling Convention[114] and who voted for its commercial whaling moratorium[115] act unethically when they authorize their non-indigenous citizens to kill whales to sell. The different ethical rules that the Makah and signatory nations impose upon themselves still mandate different answers to the question: Is it ethical to kill a whale?

A Blue Ethics based on Moral Pluralism, however, identifies different ethical frameworks independently of what individuals or specific groups believe. With respect to Blue Foods, for example, three of the relevant

110. *Id.* at 251.

111. West, *supra* note 97.

112. STONE, *supra* note 18, at 133.

113. *Id.* at 132.

114. International Convention for the Regulation of Whaling, Dec. 2, 1946, 161 U.N.T.S. 72.

115. *Commercial Whaling*, INT'L WHALING COMM'N, https://iwc.int/management-and-conservation/whaling/commercial [https://perma.cc/H5C6-5EPJ]. However, the moratorium applies only to commercial whaling; aboriginal subsistence whaling supports "the needs of indigenous communities . . . [and] is regulated by the [International Whaling Commission] which sets catch limits every six years." *Whaling*, INT'L WHALING COMM'N, https://iwc.int/management-and-conservation/whaling [https://perma.cc/N5LK-LZCY].

frameworks might be Mass Production of Seafood for Global Trade, Blue Foods as Cultural Preservation, and Indigenous Subsistence Fishing. Within the first framework, the moral considerateness of both whales and marine ecosystems is particularly strong, such that killing whales is prima facie wrong and large-scale capture fisheries become ethically suspect because of their impacts on marine biodiversity. Within the second framework, which encompasses the Makah Nation's whale hunt, the moral considerateness of the whales is still strong, but it must be balanced against the cultural and legal rights of the Makah. As a result, the species' ecological status becomes ethically relevant, and application of Blue Ethics can allow limited indigenous hunting of non-endangered eastern gray whales at levels unlikely to harm the species but prohibit any hunting of still-endangered western gray whales. Within the third framework, the survival and food security of individual community members is potentially at stake, reducing still further the moral considerateness of whales and other marine species needed for food security—but only if more ethical substitutes are not readily available.

Thus, Moral Pluralism requires Blue Ethics to distinguish among types of wild-capture marine fishing rather than embrace an outright ban on all versions of wild-capture fisheries in all locations, while still creating a presumption that there are more ethical pathways to Blue Food security than large-scale commercial marine fishing. The next question is whether the larger cultural context surrounding the ocean and the laws that govern human use of it will allow for this nuanced shift away from wild-capture fisheries, a question to which Part III now turns.

III. A BLUE ETHICS FOR THE TWENTY-FIRST CENTURY CAN EMERGE: EVOLVING ATTITUDES TOWARD AND UNDERSTANDING OF THE ANTHROPOCENE OCEAN

Blue Ethics requires seeing the ocean with a new morality that makes species, marine biodiversity, and ocean ecosystems ethically and legally considerate—essentially valuing the ocean as a complex adaptive planetary life support system, not just as a grocery store.[116] Importantly for the future success of any Blue Ethics project, nations increasingly value these larger systemic functions over fisheries.

Marine tourism provides an important example. Coral reefs are some of the most valuable ecosystems on the planet, contributing over $375 billion each year to the global economy.[117] Many of these benefits derive from

116. *See* Craig, *supra* note 48, at 3–80 (exploring a more expansive discussion of this argument).

117. J.M. Pandolfi, J.B. C. Jackson, N. Baron, R.H. Bradbury, H.M. Guzman, T.P. Hughes, C.V. Kappel, F. Micheli, J.C. Ogden, H.P Possingham & E. Sala, *Are U.S. Coral Reefs on the Slippery Slope to Slime?*, 307 SCIENCE 1725, 1725 (2005); *see* U.S. CORAL REEF TASK FORCE, THE NATIONAL ACTION

tourism. For example, the economic benefits from recreation on Australia's Great Barrier Reef alone have been valued from $700 million to $1.6 billion.[118] A study in the Maldives calculated that each shark that tourists can see when diving or snorkeling is worth $33,500, while a similar study in Palau calculated that each shark was worth $1.9 million over the course of its lifetime in reef tourism revenue—far exceeding its paltry value in a fishery.[119] In Indonesia, shark and ray (such as manta rays) tourist diving was worth at least $22 million in 2017, dwarfing the export value of the entire Indonesian shark fishery ($10 million) and expected to increase dramatically over the next decide if Indonesia invests in these species' conservation.[120] More comprehensively, a study in support of marine spatial planning in Wales found that "the economic importance of non-extractive recreational uses of marine biodiversity," such as "diving, kayaking, wildlife watching from boats and seabird watching," "is comparable to that of commercial fisheries for the same region," arguing that these interests should be given equal weight to fishing in marine planning.[121]

Marine recreation is a form of ecosystem service, and identifying and valuing these ecosystem services more generally is another means of articulating the morality of protecting the ocean's systemic functions. The Millennium Ecosystem Assessment defined ecosystem services broadly as "the benefits people obtain from ecosystems."[122] More specifically, according to Gretchen Daily, "*Ecosystem services* are the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life."[123] In 1997, Robert Costanza and several colleagues estimated that the world's ecosystem services were worth $16 to $54 *trillion* each year,[124] underscoring the economic importance of

PLAN TO CONSERVE CORAL REEFS 1 (2000) [hereinafter 2000 CORAL NATIONAL ACTION PLAN].

118. Liam Carr & Robert Mendelsohn, *Valuing Coral Reefs: A Travel Cost Analysis of the Great Barrier Reef*, 32 AMBIO 353, 353, 356 (2003).

119. David Jolly, *Priced Off the Menu? Palau's Sharks Are Worth $1.9 Million Each, A Study Says*, N.Y. TIMES (May 2, 2011), https://www.nytimes.com/2011/05/02/science/earth/02shark.html [https://perma.cc/J5AS-X83A].

120. Putu Liza Kusuma Mustika, Muhammad Ichsan & Hollie Booth, *The Economic Value of Shark and Ray Tourism in Indonesia and Its Role in Delivering Conservation Outcomes*, FRONTIERS MARINE SCI., Apr. 28, 2020, at 1–2, 8–9, https://researchonline.jcu.edu.au/62984/1/Mustika%20et%20al%202020%20Shark%20tourism%20in%20Indonesia.pdf [https://perma.cc/7NDG-ZBLH].

121. A. Ruiz-Frau, H. Hinz, G. Edwards-Jones & M.J. Kaiser, *Spatially Explicit Economic Assessment of Cultural Ecosystem Services: Non-Extractive Recreational Uses of the Coastal Environment Related to Marine Biodiversity*, 38 MARINE POL'Y 90, 90 (2013).

122. MILLENNIUM ECOSYSTEM ASSESSMENT, ECOSYSTEMS AND HUMAN WELL-BEING: A FRAMEWORK FOR ASSESSMENT 49, 53 (2003) [hereinafter MEA FRAMEWORK].

123. Gretchen C. Daily, *Introduction: What Are Ecosystem Services?*, *in* NATURE'S SERVICES: SOCIETAL DEPENDENCE ON NATURAL ECOSYSTEMS 1, 3 (Gretchen C. Daily ed., 1997).

124. Robert Costanza, Ralph d'Arge, Rudolf de Groot, Stephen Farber, Monica Grasso, Bruce Hannon, Karin Limburg, Shahid Naeem, Robert V. O'Neill, Jose Paruelo, Robert G. Raskin, Paul Sutton

ecosystem services to human well-being.

The ocean provides a significant portion of the Earth's ecosystem services. As the IPCC summarized in 2019,

> In addition to their role within the climate system, such as the uptake and redistribution of natural and anthropogenic carbon dioxide (CO_2) and heat, as well as ecosystem support, services provided to people by the ocean and/or cryosphere include food and water supply, renewable energy, and benefits for health and well-being, cultural values, tourism, trade, and transport.[125]

In their 1997 *Nature* article, Costanza and his colleagues estimated that about 63% of the total world value of ecosystem services—about $20.9 trillion—comes from marine environments,[126] and about 60% of the value of marine ecosystem services derives from coastal ecosystems.[127] These researchers emphasized that the ocean is particularly important for the gas regulation, disturbance regulation, nutrient cycling, biological control, habitat, food production, raw materials, recreation, and cultural services it provides.[128] As one often-undervalued example, the ocean provides oxygen production. Tiny plants that float near the ocean's surface around the world, known as phytoplankton, produce this oxygen.[129] Some of the oxygen remains dissolved within the ocean itself, where fish and other marine animals (but not marine mammals or sea turtles, which breathe atmospheric oxygen) use it. Most of the oxygen, however, is released into the atmosphere. In fact, marine phytoplankton produce half of the world's atmospheric oxygen[130]—the oxygen upon which terrestrial animals, including humans, depend.

Reflecting the greater moral consideration that the ocean thus deserves, many nations have shifted to ecosystem-based or resilience-based management of their marine resources. Indeed, ecosystem-based management ("EBM") has become the dominant approach for governing marine ecosystems *as* ecosystems. The National Oceanic and Atmospheric Administration ("NOAA"), for example, has adopted EBM for many of its programs in the United States, describing that approach as follows:

& Marjan van den Belt, *The Value of the World's Ecosystem Services and Natural Capital*, 387 NATURE 253, 253 (1997).

125. 2019 IPCC OCEAN & CRYOSPHERE REPORT, *supra* note 50, at 5.

126. Costanza et al., *supra* note 124, at 259.

127. *Id.* at 256 tbl.2.

128. *Id.*

129. John Roach, *Source of Half Earth's Oxygen Gets Little Credit*, NAT'L GEOGRAPHIC (June 7, 2004), https://www.nationalgeographic.com/science/article/source-of-half-earth-s-oxygen-gets-little-credit [https://perma.cc/KXJ3-95EC].

130. *Id.*

> Ecosystem-based management (EBM) is an integrated management approach that recognizes the full array of interactions within an ecosystem, including humans, rather than considering single issues, species, or ecosystem services in isolation. EBM is a broad resource management approach that considers dynamic, cumulative effects on marine environments using data and indicators . . . . EBM supports working across sectors to consider tradeoffs between marine resources, ultimately sustaining both diverse ecosystems as well as the services they provide to humans.[131]

Moreover,

> The overarching goal of EBM is to sustain the long-term capacity of marine ecosystems to deliver a range of ecosystem services, such as seafood, clean water, renewable energy (e.g., wave, tidal, and biofuels), protection from coastal storms, and recreational opportunities, with a focus on both ecosystem health and human well-being.[132]

Most recently, an ever-broadening systems view of the ocean has led to the increased adoption of resilience-based marine management. There is little debate that the ocean is a complex adaptive system containing multiple linked complex adaptive ecosystems.[133] Specifically, it is a complex of marine ecosystems, and "marine ecosystems are complex adaptive systems linked across multiple scales by flow of water and species movements."[134] The many calls for increased use of EBM arose in part because, "[d]espite their adaptive character and often redundant linkages, marine ecosystems are vulnerable to rapid changes in diversity and function."[135] "In short, marine ecosystems are in trouble, indicating that many previous attempts to manage individual threats in the absence of a system-wide approach have not worked."[136]

The concept of ecological resilience is important for the systems approach to ocean law. Ecological resilience and resilience thinking acknowledge that ecosystems and social-ecological systems are dynamic—

131. *Ecosystem-Based Management*, NAT'L MARINE ECOSYSTEM STATUS, https://ecosystems.noaa.gov/EBM101/WhatisEcosystem-BasedManagement.aspx [https://perma.cc/BQ6Z-RLZU].

132. Benjamin S. Halpern, Sarah E. Lester & Karen L. McLeod, *Placing Marine Protected Areas onto the Ecosystem-Based Management Seascape*, 107 PROC. NAT'L ACAD. SCIS. 18312, 18312 (2010).

133. Emanuele Bigagli, Marine Complex Adaptive Systems: Theory, Legislation and Management Practices (Mar. 22, 2017) (Ph.D. thesis, Wageningen University); Mary Ruckelshaus, Terrie Klinger, Nancy Knowlton & Douglas P. DeMaster, *Marine Ecosystem-Based Management in Practice: Scientific and Governance Challenges*, 58 BIOSCIENCE 53, 53 (2008); Larry Crowder & Elliott Norse, *Essential Ecological Insights for Marine Ecosystem-Based Management and Marine Spatial Planning*, 32 MARINE POL'Y 772, 775–76 (2008).

134. Ruckelshaus et al., *supra* note 133; Steven A. Levin & Jane Lubchenco, *Resilience, Robustness, and Marine Ecosystem-Based Management*, 58 BIOSCIENCE 27, 27 (2008).

135. Ruckelshaus et al., *supra* note 133.

136. *Id.*

not, as prior theories had assumed, inherently stable systems tending toward an equilibrium.[137] "Resilience," as a concept, recognizes that, in fact, there are at least three ways in which ecosystems experience and respond to changes.[138] The first and most common understanding of resilience refers to an ecosystem's ability to resist change or bounce back from system disturbances.[139] Sometimes referred to as "engineering resilience," this sense of resilience refers to "the rate or speed of recovery of a system following a shock."[140] The second aspect of resilience acknowledges that ecosystems can exist in multiple states rather than stabilizing around a single equilibrium state; as a result, changes and disturbance can "push" ecosystems over thresholds from one ecosystem state to another.[141] This second sense of resilience, ecological resilience, "assumes multiple states (or 'regimes') and is defined as the magnitude of a disturbance that triggers a shift between alternative states."[142] Finally, resilience thinking also acknowledges "the surprising and discontinuous nature of change, such as the collapse of fish stocks or the sudden outbreak of budworms in forests."[143] The long-time persistence of an ecosystem (or collection of multiple ecosystems) like the Gulf of Mexico in an apparently stable, productive ecosystem state is absolutely no guarantee that humans can continue to disturb (abuse) the system and expect only a gradual or linear response. Indeed, sudden regime shifts have been documented for a number of marine ecosystems, including Jamaican coral reefs (caused by the combined impacts of overfishing, hurricanes, and disease)[144] and Alaskan kelp forests (caused by sea otter hunting and predation).[145]

A complex systems and resilience-based approach to ocean management provides a governance framework that can operationalize Blue Ethics in the twenty-first century because this perspective changes the very goals of marine management. Increasing numbers of marine scientists are concluding, for example, that because it is no longer possible to completely control or prevent change in ocean systems, "the goal of management should

137. Lance H. Gunderson & Craig R. Allen, *Why Resilience? Why Now?*, *in* FOUNDATIONS OF ECOLOGICAL RESILIENCE xiii, xiv–xv (Lance H. Gunderson, Craig R. Allen & C.S. Holling eds., 2010).

138. *Id.* at xv (citation omitted).

139. *Id.*

140. *Id.*

141. *Id.*

142. *Id.* at xv–xvi.

143. *Id.* at xv.

144. Terence P. Hughes, *Catastrophes, Phase Shifts, and Large-Scale Degradation of a Caribbean Coral Reef*, *in* FOUNDATIONS OF ECOLOGICAL RESILIENCE 205, 205 (Lance H. Gunderson, Craig R. Allen & C.S. Holling eds., 2010).

145. James A. Estes & David O. Duggins, *Sea Otters and Kelp Forests in* Alaska, *in* FOUNDATIONS OF ECOLOGICAL RESILIENCE 249, 251 (Lance H. Gunderson, Craig R. Allen & C.S. Holling eds., 2010).

be to maintain ecosystems in a healthy, productive, and resilient condition so that they can sustain human uses and provide the goods and services humans want and need."[146] Among these scientists, the adoption of a complex systems view of the ocean, including ecological resilience and the potential for regime shifts, has led to calls for a new approach to management: resilience-based management ("RBM").[147] "Resilience-based management is defined as using knowledge of current and future drivers influencing ecosystem function (e.g., coral disease outbreaks; changes in land-use, trade, or fishing practices) to prioritize, implement, and adapt management actions that sustain ecosystems and human well-being."[148] These prioritized actions include threat mitigation ("controlling pollution, sedimentation, overfishing"), actions that support ecosystem processes (for example, improving water quality), and strengthening the abilities of communities dependent on particular marine ecosystems to adapt to the changes occurring in those ecosystems, including by changing how people earn their livelihoods.[149] RBM seeks not to maximize the goods that humans can extract from the ocean but rather to cope with the changes that

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146. Bigagli, *supra* note 133, at 15 (citing K. L. MCLEOD, J. LUBCHENCO, S.R. PALUMBI & A.A. ROSENBERG, SCIENTIFIC CONSENSUS STATEMENT ON MARINE ECOSYSTEM-BASED MANAGEMENT 1 (2005)).

147. Elizabeth McLeod, Kenneth R.N. Anthony, Peter J. Mumby, Jeffrey Maynard, Roger Beeden, Nicholas A.J. Graham, Scott F. Heron, Ove Hoegh-Guldberg, Stacy Juniper, Petra MacGowan, Sangeeta Mangubhai, Nadine Marshall, Paul A. Marshall, Tim R. McClanahan, Karen Mcleod, Magnus Nyström, David Obura, Britt Parker, Hugh P. Possingham, Rodney V. Salm & Jerker Tamelander, *The Future of Resilience-Based Management in Coral Reef Ecosystems*, 233 J. ENV'T MGMT. 291, 292 (2019). RBM has been discussed in the context of a variety of ecosystems since about 2012, although coral reefs remain a prominent focus in this research. *See generally*, *e.g.*, Vivian Y. Y. Lam, Christopher Doropoulos & Peter J. Mumby, *The Influence of Resilience-Based Management on Coral Reef Monitoring: A Systemic Review*, PLOS ONE, Feb. 10, 2017, at 1, https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0172064&type=printable [https://perma.cc/B6K4-WSUK]; Andrew K. Carlson, William W. Taylor, Kelsey M. Schlee, Troy G. Zorn & Dana M. Infante, *Projected Impacts of Climate Change on Stream Salmonids with Implications for Resilience-Based Management*, 26 ECOLOGY FRESHWATER FISH 190 (2017); David J. Yu, Hoon C. Shin, Irene Pérez, John M. Anderies & Marco A. Janssen, *Learning for Resilience-Based Management: Generating Hypotheses from a Behavioral Study*, 37 GLOBAL ENV'T CHANGE 69 (2016); KENNETH R.N. ANTHONY, JEFFREY M. DAMBACHER, TERRY WALSHE & ROGER BEEDEN, A FRAMEWORK FOR UNDERSTANDING CUMULATIVE IMPACTS, SUPPORTING ENVIRONMENTAL DECISIONS AND INFORMING RESILIENCE-BASED MANAGEMENT OF THE GREAT BARRIER REEF WORLD HERITAGE AREA (2013); Brandon T. Bestelmeyer & David D. Briske, *Grand Challenges for Resilience-Based Management of Rangelands*, 65 RANGELAND ECOLOGY & MGMT. 654 (2012).

148. McLeod et al., *supra* note 147; *see also* Lam et al., *supra* note 147, at 2 (noting that "RBM steers management actions towards the preservation of fundamental ecosystem functions, structure, identity and feedbacks. RBM departs from the classic view of steady-state resource management and instead attempts to focus on the processes that govern system dynamics. Contrary to the emphasis on the maintenance of a static perceived optimal state in traditional management approaches, RBM is closely tied to the prevention of regime shifts, whereby a conspicuous change to the structure and function of a system occurs once a threshold is surpassed. Regime shifts involve complex feedback mechanisms that affect system dynamics, hence, a critical aspect of managing for resilience is a thorough understanding of ecological processes of the relevant ecosystems.").

149. McLeod et al., *supra* note 147.

overfishing, marine pollution, climate change, and ocean acidification are bringing to the ocean, simultaneously "acknowledg[ing] that humans are capable of driving change, adaptation, and transformation."[150]

Resilience-based management effectively promotes Blue Ethics by prioritizing the reduction of anthropogenic stressors to ocean systems.[151] These stressors, as noted, include commercial fishing. The question then becomes whether we can shift humanity's dependence on Blue Foods from commercial fishing to something else. As the next Part explores, that "something else" is likely to be certain kinds of marine aquaculture.

IV. TOWARD A BLUE ETHICS FOR BLUE FOODS: REPLACING FISHERIES WITH MARINE AQUACULTURE

Blue Ethics requires that the pursuit of human food security not impoverish the rest of the planet, particularly in terms of worsening biodiversity loss and the impacts of climate change. Certain forms of marine aquaculture hold the promise of not only increasing food global security but also global planetary health and—if done with attention to access and the special needs of indigenous and small coastal communities, women, and children—equity.

However, this transition in Blue Food production and consumption patterns has two components. First, laws and policies need to de-incentivize, if not outright prohibit, large-scale marine commercial fishing. Christopher Stone had much to say on this subject. Simultaneously, however, nations need to recognize both that a replacement source of Blue Foods—marine aquaculture—exists and that not all forms of marine aquaculture are equally ethical. This Part explores both sides to implementing a more ethical approach to Blue Foods.

A. TOOLS TO DECREASE WILD-CAUGHT FISHERIES: CHRISTOPHER STONE'S FIVE-STEP PROGRAM FOR THE TWENTY-FIRST-CENTURY OCEAN

Christopher Stone recognized that global wild-caught fisheries were plateauing.[152] He noted the longstanding clash between biologists and economists on how to calculate optimum yield from a fishery, but he also underscored the need to consider bycatch and habitat destruction, as well.[153] In so doing, he made seabirds, sea turtles, and benthic habitat morally considerate in fisheries management—and he championed a multipronged

150. *Id.*
151. *Id.* at 296.
152. Stone, *Can the Oceans be Harboured*, *supra* note 47, at 37–38.
153. *Id.* at 38.

approach to give that moral consideration real-world impact.

1. End Commercial Fishing Subsidies

According to Stone, the fishing "industry has been the historical beneficiary of public subsidy. Subsidization lowers private costs at public expense, thereby increasing the investment in fishing beyond the level that market signals would warrant."[154] Government subsidies to fishers, he concluded, have "been a crucial culprit in over-fishing," promoting an increase in commercial fishing instead of its reduction.[155] "Hence, the first step in restoring the health of the oceans is to wean the industry from subsidies," a task that Stone thought international trade law was well-suited to address.[156]

2. Improve and Extend Resource Management

According to Stone, reducing fishing subsidies, "by reducing interest-group pressures in the political and regulatory environment, would enable the managers to do their jobs."[157] However—and again emphasizing international trade law as an enforcement mechanism—Stone also argued that global fisheries management also needs to be enhanced through stronger regional fisheries organizations and better management of the high seas.[158] Notably, with regard to the high seas, the United Nations is currently drafting a new treaty to protect marine biodiversity in the high seas, rendering large portion of the open ocean marine reserves protected from fishing.[159]

3. Charge for Use

Stone also advocated that, rather than rely (solely) on command-and-control catch limits and gear restrictions, governments or fishery managers charge for fishing, in the form of either a landings tax or a royalty.[160] "A charge raises the cost of fishing to the fisher," and the goal would be

> to create cost conditions that result in the fleet extracting fish at the revenue maximizing level of effort that would be employed by a sole owner. Such a sole owner would stop fishing when the landed value of a

154. Stone, *Too Many Fishing Boats*, *supra* note 34, at 514.
155. Stone, *Can the Oceans be Harboured*, *supra* note 47, at 39.
156. *Id.*; *see also* Stone, *Too Many Fishing Boats*, *supra* note 34, at 519–35.
157. Stone, *Can the Oceans be Harboured*, *supra* note 47, at 39.
158. *Id.*
159. *Intergovernmental Conference on an International Legally Binding Instrument under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction (General Assembly Resolution 72/249)*, UNITED NATIONS, https://www.un.org/bbnj [https://perma.cc/FQM7-TMR7].
160. Stone, *Can the Oceans be Harboured*, *supra* note 47, at 40.

> marginal stock reduction equalled the marginal cost of catch (including congestion costs and any impairment in future yield).[161]

Specifically, and consistently with making impacts to marine ecosystems and biodiversity morally and legally considerate, this charge would go beyond the recovery of management costs and seek "to confront the fisher with (ideally) the marginal costs of harvest rivalry, stock depletion and environmental damage."[162]

4. Establish an Ocean Trust Fund

Revenues from the fishing tax, in turn, would fund the Ocean Trust Fund that Stone proposed.[163] This fund "could support"

> the monitoring of fishing regulations; this could include expansion of satellite programmes, on-board inspectors, etc; defending, restoring, even purchasing wetland and nursery areas; carry-over payments for investors and workers to compensate for tie-up losses required by stock rehabilitation; gathering and analysis of stock data; fisheries health services, including monitoring health effects of mariculture on coastal quality and safeguarding against incursions of exotic species.[164]

Thus, in addition to making fishing itself more expensive, the fishing tax would make fisheries enforcement more effective, protect marine habitat, transition fishers to other jobs, improve fisheries science, and protect marine ecosystems more generally. Again, Stone was already effectively practicing a Blue Ethics, incorporating the greater health of the ocean into the economics and regulation of fishing.

5. Establish Ocean Guardians

At the heart of Stone's Earth Ethics was a quest to give the environment a legal voice[165] that could press at least a legal advantage (as opposed to a legal right) of intactness.[166] That voice would often come in the form of a legal guardian,[167] because "Nonpersons such as whales, . . . while possessing interests and even preferences, are at best restricted in their capacities to express them."[168] Similarly, for the ocean, "while we cannot orient the law to a Thing's welfare, we can orient it to some ideal state of the

161. *Id.*
162. *Id.* at 41.
163. *Id.*
164. *Id.*
165. STONE, *supra* note 18, at 3-4.
166. *Id.* at 48–55.
167. *Id.* at 48.
168. *Id.* at 51.

Thing,"[169] and the guardian can urge action consistent with that legal orientation.[170] Viewed in this light, guardians for the ocean could also operationalize a Blue Ethics in marine fisheries by articulating the ideal of healthy, resilient marine ecosystems free from the stresses of large-scale commercial marine fishing.

B. THE ETHICAL PROMISE OF THE MORE ENVIRONMENTALLY BENIGN FORMS OF MARINE AQUACULTURE

The last step for a Blue Ethics agenda is to substitute a more ethically sound Blue Foods production system for commercial wild-capture fisheries—and that substitute is already emerging. Given the plateauing of wild fisheries, marine aquaculture industries have been growing rapidly since 1986 to close the gap in global seafood demand.[171] Indeed, for most categories of fisheries, aquaculture production has already exceeded that of wild commercial fisheries:

> Based on time-series data of major species groups, world aquaculture production has progressively surpassed that of capture fisheries. The "farming more than catch" milestones were reached in 1970 for aquatic algae, in 1986 for freshwater fishes, in 1994 for molluscs, in 1997 for diadromous fishes, and in 2014 for crustaceans. However, despite the increasing output from global aquaculture, farming of marine fishes is unlikely to overtake marine capture production in the future.[172]

Aquaculture production of marine animals has grown from an average of 6.3 million tonnes per year between 1986 and 1995 to almost 31 million tonnes in 2018, a growth rate of 489% over about 35 years.[173] While, overall, finfish aquaculture dominates aquaculture production, most of that production occurs inland, in freshwater.[174] In contrast, "[i]n 2018, shelled molluscs (17.3 million tonnes) represented 56.3 percent of the production of marine and coastal aquaculture. Finfish (7.3 million tonnes) and crustaceans (5.7 million tonnes) taken together were responsible for 42.5 percent, while the rest consisted of other aquatic animals,"[175] including sea turtles and marine invertebrates such as sea cucumbers.[176]

However, food animals are not the only aquacultured marine species of global importance. In 2018 the world produced 32.4 million tonnes of

169. *Id.* at 60.
170. *Id.* at 48.
171. 2020 FAO FISHERIES & AQUACULTURE REPORT, *supra* note 20, at 4 fig.1.
172. *Id.* at 23.
173. *Id.* at 3 tbl.1.
174. *Id.* at 21.
175. *Id.* at 6, 26 tbl.6.
176. *Id.* at 21.

aquacultured algae (kelp, seaweed) worth $13.3 billion and 26,000 tonnes of ornamental seashells and pearls worth $179,000.[177] Seaweeds dominate the aquacultured algae, and while tropical seaweed aquaculture in Southeast Asia has decreased in recent years, seaweed aquaculture in temperate and cold waters—like those that surround most of the United States—continues to grow, albeit at a slower pace than marine animal aquaculture.[178]

As such, aquaculture, both freshwater and marine, already plays an increasing role in preserving Blue Food security.[179] The issue is whether this global expansion of marine aquaculture is also an example of Blue Ethics. The answer, perhaps unsurprisingly, is "sometimes."

As both the FAO and the Blue Food Assessment have recognized, sometimes an ethical approach to food security requires shifting consumer demand. For Blue Foods, the more ethical approach must include a careful expansion of marine aquaculture—but not in the form of the most common finfish aquaculture, Atlantic salmon. Instead, that expansion should focus on marine algae (seaweed) and bivalves such as clams, mussels, and oysters. "[A]cross all blue foods, farmed bivalves and seaweeds generate the lowest stressors" to the environment,[180] making them the most ethical choice of Blue Foods.

1. Marine Aquaculture and Climate Change

On the whole, Blue Foods are better for the environment than terrestrial foods, and most forms of marine aquaculture are better for the environment than wild-caught fisheries. The multi-author article entitled *Environmental Performance of Blue Foods* appeared in the journal *Nature* to accompany the launch of the Blue Food Assessment.[181] It provides a standardized evaluation of the environmental impacts of twenty-three species groups of blue foods across several parameters, including greenhouse gas emissions, water and land use, and nutrient pollution, all conveniently compared to chicken production.[182] Importantly, both environmental impacts and human nutritional values vary considerably across marine foods, whether wild-

177. *Id.*
178. *Id.* at 21, 23; *see also id.* at 22 fig.8 (displaying graphically the growth of seaweed aquaculture compared to other types).
179. *Id.* at 4 fig.3, 21–36.
180. Jessica A. Gephart, Patrik J.G. Henriksson, Robert W.R. Parker, Alon Shepon, Kelvin D. Gorospe, Kristina Bergman, Gidon Eshel, Christopher D. Golden, Benjamin S. Halpern, Sara Hornborg, Malin Jonell, Marc Metian, Kathleen Mifflin, Richard Newton, Peter Tyedmers, Wenbo Zhang, Friederike Ziegler & Max Troell, *Environmental Performance of Blue Foods*, 597 NATURE 360, 360 (2021).
181. *Id.*
182. *Id.* at 360.

caught or farmed (aquaculture). To take greenhouse gas emissions as just one example, the authors found that "[a]cross assessed blue foods, farmed seaweeds and bivalves generate the lowest emissions, followed by small pelagic capture fisheries, while flatfish and crustacean fisheries produce the highest."[183]

As the authors note, "fuel use drives capture fisheries emissions."[184] Even so, the greenhouse gas emissions from several wild capture fisheries remain lower than emissions from terrestrial chicken production when assessed by weight of edible food produced.[185] These fisheries include herring, sardines, anchovies, cods, hakes, haddocks, salmon, trout, and smelts; in addition, fisheries for tunas, bonitos, billfishes, squid, cuttlefishes, and octopuses are about equivalent in greenhouse gas emissions, on average (albeit with a wider range of variation) to domestic chicken production.[186] Nevertheless, tradeoffs abound—including with respect to impacts on marine biodiversity. For example, finfish fishing practices that reduce greenhouse gas emissions, such as use of gill nets and entangling nets, simultaneously increase risks to marine mammals.[187]

Seaweed and bivalve marine aquaculture avoid greenhouse gas emissions because neither seaweed nor bivalves need to be fed. "For fed aquaculture, feed production is responsible for more than 70% of emissions for most groups."[188] While seaweeds are technically not plants, like plants they rely on chlorophyll and sunlight to grow—but, unlike land crops, they do not require fertilizer. Bivalves, in turn, are filter feeders and rely on small plants and animals in the water column, known as plankton, for their food.[189]

More impressively, seaweed aquaculture has the potential to actually *sequester* carbon dioxide, the most ubiquitous greenhouse gas.[190] As noted, kelps and marine algae photosynthesize, meaning that they take in carbon dioxide. However, while the potential for terrestrial plants, especially forests, to mitigate climate change as carbon sinks is well recognized and promoted,[191] the same has not been true for seaweed aquaculture. Indeed,

183. *Id.* at 361.
184. *Id.*
185. *Id.* at 361 fig.1(d).
186. *Id.*
187. *Id.* at 363.
188. *Id.* at 361.
189. 2020 FAO FISHERIES & AQUACULTURE REPORT, *supra* note 20, at 26.
190. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, GLOBAL WARMING OF 1.5°C, at 4–6 (2018), https://www.ipcc.ch/site/assets/uploads/sites/2/2022/06/SR15_Full_Report_HR.pdf [https://perma.cc/P7C4-WR5G].
191. *E.g.*, *Reducing Emissions from Deforestation and Forest Degradation in Developing Nations (REDD+) Web Platform*, UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, https://redd.unfccc.int [https://perma.cc/C98D-CT7C]; Alan Buis, *Examining the Viability of Planting*

although "[t]he world production of marine macroalgae, or seaweed, has more than tripled, up from 10.6 million tonnes in 2000 to 32.4 million tonnes in 2018,"[192] only recently has seaweed aquaculture been "gaining increasing attention to be promoted and monitored for climate and environmentally friendly bioeconomy development."[193] Nevertheless, seaweed aquaculture's potential contribution to climate change mitigation is significant.[194] Marine kelps generally have been left out of world "blue carbon" (ocean-based climate mitigation) strategies until recently because, unlike seagrasses and salt marshes, they grow on rocks, not in submerged soil, raising questions about their ability to sequester carbon dioxide for long periods.[195] However, more recent investigations indicate that natural seaweeds do indeed sequester carbon in the deep ocean (eventually becoming, somewhat ironically, petroleum).[196]

Given the sequestration capacity of natural seaweeds, researchers have proposed that seaweed aquaculture could also significantly contribute to climate change mitigation.[197] In particular, seaweed aquaculture "should prove to be expandable to the offshore environment and the open sea, . . . unlocking a capacity to greatly increase carbon capture in biomass. This approach has been termed Seaweed Carbon Capture and Sink ('Seaweed CCS'; analogous to terrestrial Carbon Capture and Storage)."[198]

Trees to Help Mitigate Climate Change, NASA GLOBAL CLIMATE CHANGE (Nov. 7, 2019), https://climate.nasa.gov/news/2927/examining-the-viability-of-planting-trees-to-help-mitigate-climate-change [https://perma.cc/V4RP-VYR5]; Bruno Locatelli, Carla P. Catterall, Pablo Imbach, Chetan Kumar, Rodel Lasco, Erika Marín-Spiotta, Bernard Mercer, Jennifer S. Powers, Naomi Schwartz & Maria Uriarte, *Tropical Reforestation and Climate Change: Beyond Carbon*, 23 RESTORATION ECOLOGY 337, 337–38 (2015).

192. 2020 FAO FISHERIES & AQUACULTURE REPORT, *supra* note 20, at 29.

193. *Id.* at 31.

194. Calvyn F.A. Sondak, Put O. Ang Jr., John Beardall, Alecia Bellgrove, Sung Min Boo, Grevo S. Gerung, Christopher D. Hepburn, Dang Diem Hong, Zhengyu Hu, Hiroshi Kawai, Danilo Largo, Jin Ae Lee, Phaik-Eem Lim, Jaruwan Mayakun, Wendy A. Nelson, Jung Hyun Oak, Siew-Moi Phang, Dinabandhu Sahoo, Yuwadee Peerapornpis, Yufeng Yang & Ik Kyo Chung, *Carbon Dioxide Mitigation Potential of Seaweed Aquaculture Beds (SABs)*, 29 J. APPLIED PHYCOLOGY 2363, 2363, 2370–71 (2017).

195. Dorte Krause-Jensen & Carlos M. Duarte, *Substantial Role of Macroalgae in Marine Carbon Sequestration*, 9 NATURE GEOSCIENCE 737, 737 (2016). Thus, "it is difficult for seaweeds to be recognized as carbon sink agents under the current concept of CO_2 sequestration as conceived by the UN Framework Convention on Climate Change (UNFCCC)." Ik Kyo Chung, Calvyn F. A. Sondak & John Beardall, *The Future of Seaweed Aquaculture in a Rapidly Changing World*, 52 EUR. J. PHYCOLOGY 495, 500 (2017). There has been considerable debate about considering seaweeds as a CO_2 sink, particularly with respect to the time period of sequestration of the carbon in their organic matter. *Id.* "It is obvious that seaweeds draw down CO_2 from seawater through photosynthesis in the water column, but a good proportion of this carbon is easily decomposed back to CO_2." *Id.*

196. Krause-Jensen & Duarte, *supra* note 195, at 739 fig.2.

197. Chung et al., *supra* note 195, at 500–01.

198. *Id.* at 501.

2. Marine Aquaculture and Nutrient Pollution

Bivalve and seaweed aquaculture can also help to address marine nutrient pollution. Water flowing over and from farms, in the forms of both irrigation return flows and runoff from rain or snowmelt, carries excess fertilizer (mostly nitrogen compounds) to the ocean.[199] Nutrients also reach the waters through atmospheric deposition, such as from the burning of fossil fuels.[200] Once there, nutrients induce large blooms of marine plants—phytoplankton and algae. Algae are marine plants, many of which are beneficial to marine food webs.[201] Marine algae include both the large marine seaweeds and kelp and the nearly microscopic algal forms of marine phytoplankton.[202] However, the small phytoplankton forms of algae can create an "algal bloom," which "is a rapid increase in the population of algae in an aquatic system," which often "may be recognized by discoloration of the water resulting from the high density of pigmented cells."[203] This discoloration can give algal blooms common names, such as "red tides."[204] Increasing nutrient concentrations are the usual cause of algal blooms,[205] because, like terrestrial plants, marine phytoplankton respond to nitrogen and phosphorus compounds as fertilizers.

Algal blooms impact both marine ecosystems and human health. At the ecosystem level, as the blooms die off, their decomposition consumes all the oxygen in the water column, leading to hypoxic (low-oxygen) conditions that make large areas of the ocean uninhabitable by marine animals.[206] In the United States, the largest of these so-called "dead zones" occurs seasonally in the northern Gulf of Mexico at the mouth of the Mississippi River and can reach the size of Massachusetts or New Jersey—over 7,000 square miles.[207] However, dead zones are now common throughout the world's coastal regions.[208] The number of dead zones in the world's seas has doubled every

199. Robert J. Diaz & Rutger Rosenberg, *Spreading Dead Zones and Consequences for Marine Ecosystems*, 321 SCIENCE 926, 927 (2008).

200. *Id.*

201. *What Is a Harmful Algal Bloom?*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN. (April 27, 2016), https://www.noaa.gov/what-is-harmful-algal-bloom [https://perma.cc/4TUP-WGHP].

202. *Id.*

203. *Reference Terms: Algal Bloom*, SCIENCEDAILY, https://www.sciencedaily.com/terms/algal_bloom.htm [https://perma.cc/ZC5S-9ACQ]; *Algal Bloom*, BIONITY, https://www.bionity.com/en/encyclopedia/Algal_bloom.html [https://perma.cc/8LMH-PAPH].

204. Danielle Hall, *What Exactly Is a Red Tide?*, SMITHSONIAN OCEAN (Aug. 2018), https://ocean.si.edu/ocean-life/plants-algae/what-exactly-red-tide [https://perma.cc/Q9LF-2JZA].

205. *Id.*

206. *Id.*

207. *See* Jennifer Viegas, *Gulf Wildlife 'Dead Zone' Keeps Growing*, DISCOVERY NEWS (May 7, 2010, 4:10 PM), http://news.discovery.com/animals/gulf-dead-zone-oil-spill.html [https://perma.cc/H9YA-V7VV].

208. *See* Diaz & Rosenberg, *supra* note 199, at 926 ("[D]ead zones have developed in continental

decade since 1960 as a result of increasing marine pollution, and a 2008 study identified more than 400 dead zones throughout the world.[209] Perhaps most disturbingly, dead zones are missing biomass compared to what would be expected, suggesting that the oxygen deprivation that algal blooms cause can have long-term effects on the region's biodiversity and productivity.[210]

In part because of these aquatic impacts, researchers have concluded that nutrient pollution (along with biodiversity loss)—not climate change—actually poses the greatest current risk of pushing planetary systems across potentially irreversible thresholds.[211] Will Steffen, Johan Rockström, and their colleagues at the Stockholm Resilience Center first identified their nine planetary boundaries in 2009.[212] Planetary boundaries "are human-determined values of the control variable" to keep the planet from crossing thresholds and entering into transformations that represent existential threats to current social-ecological systems.[213] The nine boundaries identified represent systems operating at a global scale, either directly or cumulatively, and include climate change, ocean acidification, stratospheric ozone depletion, atmospheric aerosol loading, biogeochemical flows (phosphorus and nitrogen nutrient pollution), global freshwater use, land system change, biodiversity loss, and chemical pollution.[214] The researchers' 2015 update article moderated those conclusions by working with risk zones instead of hard boundaries[215] but nevertheless concluded that genetic biodiversity loss and both nitrogen and phosphorus pollution had crossed into red zones, while climate change remained in the yellow (lesser) risk zone.[216]

As the FAO has emphasized, mollusks like clams and oysters are filter

seas, such as the Baltic, Kattegat, Black Sea, Gulf of Mexico, and East China Sea, all of which are major fishery areas.").

209. *Id.* at 926, 928.

210. *Id.* at 927.

211. Johan Rockström, Will Steffen, Kevin Noone, Asa Persson, F. Stuart III Chapin, Eric Lambin, Timothy M. Lenton, Marten Scheffer, Carl Folke, Hans Joachim Schellnhuber, Björn Nykvist, Cynthia A. de Wit, Terry Hughes, Sander van der Leeuw, Henning Rodhe, Sverker Sörlin, Peter K. Snyder, Robert Costanza, Uno Svedin, Malin Falkenmark, Louise Karlberg, Robert W. Correll, Victoria J. Fabry, James Hansen, Brian Walker, Diana Liverman, Katherine Richardson, Paul Crutzen & Jonathan Foley, *Planetary Boundaries: Exploring the Safe Operating Space for Humanity*, ECOLOGY & SOC'Y, Dec. 2009, at 3, https://www.ecologyandsociety.org/vol14/iss2/art32/ES-2009-3180.pdf [https://perma.cc/7EY9-KWUM].

212. *See generally id.*

213. *Id.* at 3.

214. *Id.* at 8–9 tbl.1.

215. Will Steffen, Katherine Richardson, Johan Rockström, Sarah E. Cornell, Ingo Fetzer, Elena M. Bennett, Reinette Biggs, Stephen R. Carpenter, Wim de Vries, Cynthia A. de Wit, Carl Folke, Dieter Gerten, Jens Heinke, Georgina M. Mace, Linn M. Persson, Veerabhadran Ramanathan, Belinda Reyers & Sverker Sörlin, *Planetary Boundaries: Guiding Human Development on a Changing Planet*, 347 SCIENCE 736, 736 (2015).

216. *Id.*

feeders, meaning that aquacultured mollusks do not need to be fed.[217] Similarly, seaweeds grow through photosynthesis.[218] As a result, "[m]arine bivalves, filter-feeding organisms that extract organic matter from water for growth, and seaweeds, which grow by photosynthesis by absorbing dissolved nutrients, are sometimes described as extractive species."[219] These species can reduce nutrient pollution in marine environments, regardless of whether the pollution comes from fed finfish aquaculture[220] or other sources, such as fertilizer runoff from upstream agriculture.[221]

Thus, shellfish and kelp aquaculture can improve marine water quality as well as feed human beings. For example, "In the U.S., oysters are the largest grossing marine species group for U.S. aquaculture, valued at $192 million in 2016."[222] Oysters are also particularly good at filtering water.[223] Statistically significant water quality improvements have been measured in and around oyster farms in Virginia's portion of the Chesapeake Bay,[224] and the U.S. Geological Survey ("USGS") and NOAA have determined that "[a]ll of the nitrogen currently polluting the Potomac River estuary could be removed if 40 percent of its river bed were used for shellfish cultivation."[225] In the Maryland portion of Chesapeake Bay, oyster aquaculture removes nitrogen pollution associated with farm runoff, allowing oyster aquaculture (and clam aquaculture) to potentially participate in nutrient trading programs under the federal Clean Water Act.[226]

Kelp aquaculture can also improve water quality. For example, some species of kelp can remove up to 94% of ammonia pollution and up to 61% of phosphorus.[227] Similar studies along the northeastern (Atlantic) coast of

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217. 2020 FAO FISHERIES & AQUACULTURE REPORT, *supra* note 20, at 26.

218. *Id.* at 27.

219. *Id.*

220. *Id.* at 27, 29.

221. Matt Parker & Suzanne Bricker, *Sustainable Oyster Aquaculture, Water Quality Improvement, and Ecosystem Service Value Potential in Maryland Chesapeake Bay,* 39 J. SHELLFISH RSCH. 269, 277–78 (2020).

222. Jessica S. Turner, M. Lisa Kellogg, Grace M. Massey & Carl T. Friedrichs, *Minimal Effects of Oyster Aquaculture on Local Water Quality: Examples from Southern Chesapeake Bay*, PLOS ONE, Nov. 7, 2019, at 1, https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0224768&type=printable [https://perma.cc/BKJ2-FXPA] (citation omitted).

223. *Id.* at 2 (citations omitted).

224. *Id.* at 9.

225. *Oyster Aquaculture Could Significantly Improve Potomac River Estuary Water Quality*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN. (April 9, 2014), https://www.noaa.gov/oyster-aquaculture-could-significantly-improve-potomac-river-estuary-water-quality [https://perma.cc/Z6YK-G8EJ].

226. 33 U.S.C. §§ 1251–1388.

227. *See* Zhibing Jiang, Jingjing Liu, Shanglu Li, Yue Chen, Ping Du, Yuanli Zhu, Yibo Liao, Quanzhen Chen, Lu Shou, Xiaojun Yan, Jiangning Zeng & Jianfang Chen, *Kelp Cultivation Effectively Improves Water Quality and Regulates Phytoplankton Community in a Turbid, Highly Eutrophic Bay*, SCI. TOTAL ENV'T., Mar. 10, 2020, at 6–7, https://www.sciencedirect.com/science/article/pii/

the United States have "demonstrat[ed] that nutrient bioextraction through seaweed aquaculture can be an effective coastal nutrient management tool in urbanized estuaries."[228] Moreover, the nutrient extraction benefits potentially multiply when marine aquaculture facilities grow kelp and shellfish together.[229]

C. Ethical Transitions to Shellfish and Seaweed Aquaculture

Careful attention to Blue Foods could improve both the environmental impacts of human food security and human nutrition. For example, "blue foods provide the highest nutrient richness across multiple micronutrients (for example, iron and zinc), vitamins (for example, B12), and long-chain polyunsaturated fatty acids (for example, EPA and DHA) relative to terrestrial animal-source foods."[230]

More specifically as discussed above, marine aquaculture, particularly kelp and shellfish aquaculture, is a key component of a more ethical Blue Food future. On the whole, both aquacultured kelp and "bivalves have a low environmental impact per gram of protein produced, compared with finfish aquaculture, most capture fisheries, and terrestrial livestock."[231] Moreover, FAO data indicate "that 70 percent of people involved in aquaculture production are women,"[232] suggesting that marine aquaculture is already promoting gender equity in Blue Food production.

There are, of course, other ethical considerations, such as how to transition fishers to new jobs and finding ways to support communities that transition from fishing to aquaculture. Access to the new industry needs to remain equitable, and sometimes contentious issues regarding how to locate new businesses and infrastructure in crowded coastal zones will require resolution—although marine aquaculture is increasingly moving into deeper ocean waters, and co-location with offshore renewable energy facilities can save space.[233] In other words, the transition to more ethical Blue Food

S0048969719355561?via%3Dihub [https://perma.cc/5HA9-RZP4], and studies cited therein.

228. Jang K. Kim, George P. Kraemer & Charles Yarish, *Use of Sugar Kelp Aquaculture in Long Island Sound and the Bronx River Estuary for Nutrient Extraction*, 531 MARINE ECOLOGY PROGRESS SERIES 155, 160 (2015).

229. *Id.* at 161.

230. Gephart et al., *supra* note 180, at 363.

231. Turner et al., *supra* note 222, at 1 (citation omitted); *see also* Parker & Bricker, *supra* note 221, at 276 (noting that oyster aquaculture in Maryland did not affect dissolved oxygen or ammonia levels in the water, indicating that the aquaculture was not negatively affecting the environment).

232. Rob Fletcher, *Women in Aquaculture: Julie Kuchepatov*, FISH SITE (Mar. 22, 2021, 7:30 AM), https://thefishsite.com/articles/women-in-aquaculture-julie-kuchepatov#:~:text=Statistics%20from%20FAO%20show%20that,where%20women%20are%20most%20active [https://perma.cc/K7YQ-GV6A].

233. *See generally* Robin Kundis Craig, *Harvest the Wind, Harvest Your Dinner: Using Law to Encourage an Offshore Energy-Food Multiple-Use Nexus*, 59 JURIMETRICS J. 61 (2018) (providing a

security will require work, careful planning, new laws and policies, and probably some money, either from governments or investors.

CONCLUSION

The Anthropocene requires humanity to continually adjust law and policy to meet basic human needs—like food and water—without sacrificing the rest of the biosphere in the process. Although Christopher Stone is now most strongly associated with the Rights of Nature movement (as other articles in this volume make clear), he also recognized that progress was also possible through a new Earth Ethics that gives Things and Nonhumans in nature—like whales and coral reef ecosystems—both legal advantage[234] in court and moral considerateness[235] in policymaking while still stopping short of giving nature actual legal rights.

This more limited ethical framework, and the Moral Pluralism that Stone developed to support it, provides a workable framework for reconsidering the ethics of humans' dependence on Blue Foods for our overall food security. Under this new Blue Ethics, the choice of how to procure Blue Foods is not amoral; instead, giving full moral considerateness to ocean species and marine ecosystems requires consciously shifting Blue Food production away from industrial-scale commercial fishing to the most environmentally benign forms of marine aquaculture, generally involving aquaculture of bivalves and kelp. At the same time, adopting Moral Pluralism provides a principled basis for using multiple frameworks and analyses to evaluate the continued morality of other kinds of wild-caught fisheries, particularly subsistence fishing among the world's indigenous communities.

The transition from large-scale marine fishing to increased aquaculture will not be easy in all, or even most, locations. Moreover, the details of how to first define and then shift among relevant ethical frameworks without devolving into moral relativism[236] and its political manifestations will require careful thought and intimate situational wisdom, as well as a strong commitment to improving the ocean's resilience. However, the result could be both increased food security and improved health for many coastal communities and an ocean with more capacity to adapt to climate change and ocean acidification, extending the many non-fish ecosystem services it provides to future generations.

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more expansive discussion of these issues).

234. STONE, *supra* note 18, at 43–62.

235. *Id.* at 71–83.

236. *See id.* at 132 (distinguishing moral relativism).