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Partnering Law and Biodiversity for Healthy Coastal Communities: Restorative Ocean Farming

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Partnering Law and Biodiversity for Healthy Coastal Communities: Restorative Ocean Farming

Tara A. Pierce*

ABSTRACT

This article argues that states should take immediate, incremental steps toward supporting Restorative Ocean Farming (ROF). The health of our coastlines, for both the human and nonhuman communities, depends on high marine biodiversity, a goal which ROFs support. Presenting vast amounts of evidence that ROFs have an incredible amount of ecological and socio-economic benefits, ROFs also provide one step in the critical paradigm shift of improving ocean and coastal policy by taking a more holistic approach. This includes an emphasis on bioregional cooperation to ensure the highest ecological and social benefits. Waiting on federal legislation is waiting too long. However, states can look to previous attempts at federal legislation, like the Ocean-Based Climate Solutions Act, to guide their own law and policies. Additionally, there are examples of successful bioregional cooperation, like the California Ocean Acidification Action Plan, to guide states in creating policy and plans, uniting communities and increasing coastal resilience. The author concludes that states can take meaningful action now that provides equitable benefits to coastal communities and the nation. Perhaps most importantly, the emergence of ROFs in the United States signals a perspective shift away from policies with an extractive approach toward those that create mutually beneficial relationships between humans and their habitat by basing our interaction with the world on questions like “how does the ecosystem want to support us?”

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I. INTRODUCTION

“The value of a healthy ocean is difficult to overestimate.”¹ This paper will examine the legal frameworks that can support Restorative Ocean Farming (ROF): a wicked solution (the positive twin of a wicked problem) that improves ocean health, restores coastline ecosystems, increases biodiversity, creates jobs, reduces ocean acidification, reduces and mitigates multiple forms of pollution, and more.² ROFs are being pioneered in the United States by a former fisherman who asked himself: “[w]hat does the ocean want us to grow?”³ This perspective shift, deciding to work with our environment instead of against it, resulted in a harmonious method of farming the sea with numerous positive side effects. However, for the country to realize all the ecological and socio-economic benefits, ROFs need to be promoted by federal legislation and regional cooperation based on distinct ecological or geographic regions (“bioregions”) instead of current legal jurisdictions.

Ocean-based solutions have a long history and Congress has recently attempted to pass multiple pieces of legislation to support the full potential of ocean-based solutions.⁴ On a global scale, the United Nations recognizes that “[i]n no other realm is the importance of biodiversity for sustainable development more essential than in the ocean. Marine biodiversity, the variety of life in the ocean and seas, is a critical aspect of all three pillars of sustainable development—economic, social and environmental—supporting the healthy functioning of the planet and providing services that underpin the health, well-being, and prosperity of humanity.”⁵

While the United States specifically, and international waters generally, have seen improvements to how we manage our oceans, these have

1. John C. Ogden, *Maintaining Diversity in the Oceans*, 43 ENV'T 28, 31 (Apr. 2001).

2. *What's a Wicked Problem?*, STONY BROOK UNIV., <https://perma.cc/9T8S-XBNF> (last visited Feb. 11, 2023) (illustrating that there are ten features of “wicked problems”; notably, they are complex and have no simple solutions but rather endless possible approaches. For example, climate change is a wicked problem and has many sources, thus many potential solutions and a measurement of when it is “solved” is not possible. Here, the term “wicked solution” is used to describe one simple act that results in many positive solutions).

3. Important, Not Important, #81: *Legalizing the Other Weed*, at 49:27 (Oct. 18, 2019), <https://perma.cc/JNX6-3NH2>.

4. See Ocean-Based Climate Solutions Act of 2020, H.R. 8632, 116th Cong. (2020); see also Ocean Restoration Research and Development Act of 2022, H.R. 9027, 117th Cong. (2022); Keeping Ecosystems Living and Productive (KELP) Act, H.R. 4458, 117th Cong. (2021); Advancing the Quality and Understanding of American Aquaculture (AQUAA) Act, H.R. 6258, 117th Cong. (2021) [hereinafter, AQUAA Act]; see generally KOARI O'CONNOR, *SEAWEED: A GLOBAL HISTORY* (2017).

5. Cristiana Paşca Palmer, *Marine Biodiversity and Ecosystems Underpin a Healthy Planet and Social Well-Being*, U.N. CHRON. (May 2017), <https://perma.cc/6M62-EKNY>.

been consistently, if not always, limited and qualified successes.⁶ “For example, for biodiversity purposes, one of the most important limitations of regulation directed specifically at fishing is that such regulation tends to focus exclusively on the targeted species, without consideration of the larger ecosystem on which it depends.”⁷ Numerous international treaties exist to regulate individual imperiled marine species.⁸ However, this single species approach, as seen in the International Convention for the Conservation of Atlantic Tuna, “has proven largely ineffective at addressing the effects of overfishing on nontarget species, habitat, and marine ecosystems.”⁹

Given that we currently face unprecedented environmental problems, adequate solutions will require a legal paradigm shift. “Climate change . . . demands that ocean law and policy categorically shift from allowing this unsustainable use to adaptation-minded, ecosystem-focused, resilience-promoting adaptive management.”¹⁰ Among the devastating impacts of climate change is ocean acidification (OA). Places like Washington State and tropical island nations like Fiji are facing obvious and imminent risks of OA, which impacts key economic interests like oyster aquaculture and coral reef tourism.¹¹

Industrialized societies are responsible for many of the negative impacts on ocean biodiversity: oil spills, over-fishing, warming ocean temperatures, acidification, nutrient pollution (farm run-off), plastic pollution, habitat destruction, and extreme weather events from climate change.¹² These impacts together have caused, and are continuing to cause, dramatic ecological changes resulting in an overall decline of ecosystem services.¹³ Those of us in industrial societies should be grateful that we are responsible for this harm: this is not completely out of our control. We can take on our responsibility and work to mitigate, adapt, and, in some cases, restore our habitat, to create a brighter future. ROFs gives humans and nature the opportunity to reconnect and heal each other.

6. Robin Kundis Craig, *Avoiding Jellyfish Seas, or, What Do We Mean by “Sustainable Oceans,” Anyway?*, 31 UTAH ENV’T L. REV. 17, 38 (2011) (internal citations omitted) (providing the International Whaling Moratorium as an example to support her assertion that while it likely prevented the complete extinction of large baleen whales, and a few of those species’ populations have had some recovery, most species’ futures remain precarious).

7. Robin Kundis Craig, *Protecting International Marine Biodiversity: International Treaties and National Systems of Marine Protected Areas*, 20 J. LAND USE & ENV’T L. 333, 359 (Spring 2005).

8. *Id.*

9. *Id.*

10. Craig, *supra* note 6, at 45.

11. CAL. OCEAN ACIDIFICATION ACTION PLAN, CAL. OCEAN PROTECTION COUNCIL & CAL. OCEAN SCI. TR. 36–37 (Oct. 2018), <https://perma.cc/5W8D-7T7C>.

12. MILLENNIUM ECOSYSTEM ASSESSMENT, ECOSYSTEMS AND HUMAN WELL-BEING: CURRENT STATE AND TRENDS, 516 (Rashid Hassan et al. eds., 2005) [hereinafter MEA].

13. *Id.* at 516.

II. BACKGROUND: WHY WE SHOULD CARE ABOUT OCEAN BIODIVERSITY AND CURRENT THREATS

Ocean health is critical to a stable global climate.¹⁴ In addition to many economic values such as ecosystem services, the oceans are an integral part of many cultures.¹⁵ Marine biodiversity makes the ecosystem productive, resilient, and adaptable.¹⁶ High biodiversity reduces risk of ecosystem collapse in many ways; for example, by ensuring the ecosystem continues to function even if one species within it goes extinct.¹⁷ Evidence continues to emerge that shows the essential role of marine biodiversity.¹⁸ This evidence makes clear that marine biodiversity not only benefits marine life, but healthy marine ecosystems also benefit coastal communities in innumerable ways.¹⁹ For example, fishery and aquaculture sectors provide income for hundreds of millions of people and contribute directly and indirectly to food security, especially for low-income families.²⁰

However, all the benefits we receive from the oceans are at risk. The ocean is facing many stressors; however, overfishing is generally considered the primary threat to marine biodiversity.²¹ By 1996, United Nations Educational, Scientific, and Cultural Organization (UNESCO) reported that, “[t]hanks to technological advances, fishing techniques are increasingly sophisticated, leading to the over exploitation of marine resources with devastating impact on important fishing grounds. It is estimated that no fewer than 9 of the world’s 17 fishing grounds are already on the way to exhaustion.”²²

The Millennium Environmental Assessment (MEA) stated that climate change will have direct impacts on marine biodiversity and the United Nations Food & Agriculture Organization (FAO) noted that “[c]limate change is a compounding threat to the sustainability of capture fisheries and

14. *See How Does the Ocean Affect Climate and Weather on Land?*, NAT’L OCEANIC & ATMOSPHERIC ADMIN.: OCEAN EXPL., <https://perma.cc/A7FC-5H2X> (last visited Feb. 8, 2023).

15. Elise Huffer, *Raising and integrating the cultural values of the Ocean*, INT’L UNION FOR CONSERVATION OF NATURE: NEWS & EVENTS, (Oct. 6, 2017), <https://perma.cc/W2ZB-6A8C>; *see Marine and Coastal Ecosystem Services*, OCEAN & CLIMATE PLATFORM, <https://perma.cc/DT5B-7CKV> (last visited Feb. 8, 2023) (stating that ecosystem services associated with the ocean are valued at just under \$30 trillion per year).

16. *Marine Biodiversity*, MARINE STEWARDSHIP COUNCIL, <https://perma.cc/3Z8R-LGXY> (last visited Feb. 8, 2023).

17. *Id.*

18. Palmer, *supra* note 5.

19. *Id.*

20. *Id.*

21. MEA, *supra* note 12, at 479 (pertaining to the attendant problems of by-catch—the capture of non-target species—and fishing practices that destroy habitat, such as trawling).

22. *Marine Biodiversity*, 21 UNESCO-UNEP ENV’T EDUC. NEWSL. 1 (UNESCO, Nairobi, Kenya), Mar. 1996, at 2.

aquaculture development.”²³ The FAO also warned of the unsustainable impacts of overfishing, concurring with the MEA that world fish catches are leveling off or in decline despite increased fishing efforts.²⁴ Unfortunately, the FAO does not include fisheries that are no longer fished because those fish stocks have already collapsed to “commercial extinction” in prior decades; thus, the FAO’s assessments are “almost certainly overly conservative in terms of describing overall marine ecosystem health, because the history of the world’s fishing practices has been one of progressive overexploitation.”²⁵ It takes only ten to fifteen years for a new fishing industry to reduce biomass by an order of magnitude.²⁶ Around the world, since industrial fishing began, the biomass of some targeted fish has reduced 90% relative to prior levels, and harvested fish increasingly come from lower trophic levels as the populations of higher trophic level species are depleted.²⁷ Illustrating humanity’s dependence on healthy oceans, the MEA concluded that “overfishing [is] having the most widespread and dominant direct impact on food provisioning services, which *will* affect future generations.”²⁸ Moreover, models show if current trends continue, the “global collapse of all taxa currently fished by the mid-21st century . . . is projected.”²⁹

The severity of these impacts to the marine environment and to humanity cannot be overstated. About three billion people depend on the ocean for a significant source of protein.³⁰ Overfishing will result “in altered ecological states that may be impossible to restore to former conditions.”³¹

On top of overfishing, ocean ecosystems are impacted by climate change.³² Climate change increases the amount of carbon dioxide in the ocean causing ocean acidification.³³ The ocean temperature is also rising, which increases the surface temperature, sea level rise and coastal flooding,

23. MEA, *supra* note 12, at 489; U.N. FOOD & AGRIC. ORG., THE STATE OF THE WORLD FISHERIES AND AQUACULTURE 2008, 87 (2009).

24. U.N. FOOD & AGRIC. ORG., *supra* note 23, at 87.

25. Craig, *supra* note 6, at 27.

26. MEA, *supra* note 12, at 503 (citations omitted).

27. *See generally id*; Marsha Walton, *Study: Only 10 Percent of Big Ocean Fish Remain*, CNN (May 14, 2003 10:29 PM), <https://perma.cc/3W6C-489Z>.

28. MEA, *supra* note 12, at 479 (emphasis added).

29. Boris Worm et al., *Impacts of Biodiversity Loss on Ocean Ecosystem Services*, 314 SCI. 787, 790 (2006).

30. *Sustainable Seafood*, WORLD WILDLIFE FUND, <https://perma.cc/CKQ9-XRUN> (last visited Feb. 8, 2023).

31. MEA, *supra* note 12, at 488 (citations omitted).

32. *See FAQ 5.1: How Is Life in the Sea Affected by Climate Change?*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, <https://perma.cc/WX9K-7AW9> (last visited Feb. 8, 2023).

33. *Ocean Acidification: What You Need to Know*, NAT’L RES. DEF. COUNCIL (Oct. 13, 2022), <https://perma.cc/3P5W-JPFF>.

and also alters currents.³⁴ These changes damage marine biodiversity and overall ocean health by causing many negative impacts, such as coral bleaching, fish migration toward the poles, and the drowning of wetlands.³⁵ Because ocean interactions with the atmosphere occur over months to years, trends can persist for decades or even centuries.³⁶ Even if climate emissions completely stopped today, the impacts on the oceans will be seen well into the future.³⁷

However, there is still time to act to ensure the flourishing of ecosystems upon which humanity depends. Risks posed by climate change are reduced by limiting global warming to no more than 1.5 degrees Celsius.³⁸ ROF address both issues: (1) it helps reduce global warming, both directly and indirectly; and (2) kelp is one of most prolific primary producers on Earth, supporting diverse and commercially important ecosystems, providing a “wealth of ecosystem services.”³⁹ Recently, the National Oceanic & Atmospheric Administration (NOAA) stated that protecting and restoring coastal ecosystems is a good way to fight climate change.⁴⁰

III. ECOLOGICAL AND ECONOMIC BENEFITS OF RESTORATIVE OCEAN FARMING

There is a considerable amount of overlap in the ecological and economic benefits of ROFs, largely because everything in our economy comes from our environment. Bivalves common to ROFs already have a consistent presence in grocery stores and restaurants, so this section will largely focus on the lesser-known benefits of seaweeds. Some marine ecologists have dubbed seaweed “charismatic carbon” for its “Swiss army knife-like ability to address a variety of environmental ills, in the ocean and on land.”⁴¹ Seaweed can counteract ocean acidification, provide habitat for marine life in at least seventy-seven countries, be used as biofuel, and has the potential to replace petroleum-based fertilizers.⁴² Additionally, research has shown that seaweed can improve water quality by absorbing pollution

34. *Climate Change Indicators: Oceans*, ENV'T PROT. AGENCY, <https://perma.cc/725A-RG55> (last visited Feb. 8, 2023).

35. Rod Fujita, *5 Ways Climate Change is Affecting Our Oceans*, ENV'T DEF. FUND (Oct. 8, 2013), <https://perma.cc/FX8C-6EBQ>.

36. ENV'T PROT. AGENCY, *supra* note 34.

37. *Id.*

38. See Intergovernmental Panel on Climate Change, *supra* note 32.

39. Sara L. Hamilton et al., *Remote Sensing: Generation of Long-Term Kelp Bed Data Sets for Evaluation of Impacts of Climatic Variation*, 101 *ECOLOGY* 1, 1 (2020); see *infra* Part III.

40. Nat'l Ocean Serv., *What is Blue Carbon?*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., <https://perma.cc/49LA-2S2D> (last visited Feb. 8, 2023).

41. Todd Woody, *Seaweed 'Forests' Can Help Fight Climate Change*, NAT'L GEOGRAPHIC (Aug. 29, 2019), <https://perma.cc/8U58-L9LJ>.

42. *Id.*

from wastewater treatment facilities, urban storm water runoff, and farming.⁴³ These examples are not exhaustive.

A. ECOLOGICAL BENEFITS OF ROFS

ROFs can sustainably increase the production of nutritious food and animal feed, while addressing numerous environmental problems on both a local and global scale. For instance, they have been shown to enhance wild fisheries by increasing vital habitat and nursery sounds for fish and NOAA reported that the addition of seaweed cultivation to an oyster hatchery in Northern California improved water quality.⁴⁴

i. Improving Water Quality by Reducing Ocean Acidification

Ocean acidification has increased approximately 30% since the Industrial Revolution.⁴⁵ This threatens the entire ocean ecosystem, harming the survival rates of fish larvae, coral, and shell builders, including commercially significant crabs.⁴⁶ However, “a growing body of scientific research indicates seaweed aquaculture can provide ecosystem services that contribute to the reduction of local ocean acidification and assist with pollution remediation,” said California Sea Grant Aquaculture Specialist and Scripps Institution of Oceanography/Moss Landing Marine Laboratories researcher Luke Gardner.⁴⁷

There are a variety of seaweed species suitable for ROFs, depending on water temperature and the goals of the farmer. Kelp, a type of large brown seaweed, is estimated to take in five times more carbon than most land-based plants.⁴⁸ Another edible species, called sea lettuce (*Ulva lactuca*), also lowers water acidity as it grows.⁴⁹ Marine biologists calculated that a sea lettuce marine garden of approximately 180,000 square kilometers could raise the pH of the Mediterranean Sea enough to compensate for the addition of carbon dioxide since the Industrial Revolution while simultaneously supplying enough protein for the entire world population.⁵⁰

The ability of seaweeds to absorb so much carbon has exciting implications for creating carbon sinks, which may allow states to meet their

43. Caitlin Coomber, *At a California Oyster Hatchery, Farming Native Seaweed Improved Water Quality*, NAT'L OCEANIC & ATMOSPHERIC ADMIN. (July 29, 2019), <https://perma.cc/6H3P-5X9M>.

44. *Id.*; MARTIN R. STUCHTEY ET AL., HIGH LEVEL PANEL FOR A SUSTAINABLE OCEAN ECONOMY: OCEAN SOLUTIONS THAT BENEFIT PEOPLE, NATURE AND THE ECONOMY 7 (2020).

45. *Ocean Acidification*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., <https://perma.cc/C3RM-LMUZ> (last visited Feb. 8, 2023).

46. *Id.*

47. Coomber, *supra* note 43.

48. *Id.*

49. Roelof Kleis, *Growing Seaweed Can Solve Acidification*, PHYS ORG (Dec. 23, 2010), <https://perma.cc/L6XH-K4LG>.

50. *Id.*

carbon reduction goals. For example, if 3.8% of the federal waters off the coast of California were seaweed farms (which is only 0.065% of the global ocean suitable for growing macroalgae), California could neutralize emissions from its \$50 billion agriculture industry.⁵¹ Even these numbers are considered conservative: “the potential is much higher, if the crop is maintained properly,” according to Carlos Duarte, a leading seaweed scientist at the Red Sea Research Center in Saudi Arabia.⁵²

Despite these clear benefits and the long coastline suitable for seaweed cultivation, the United States has very few seaweed mariculture operations.⁵³ China and other Asian countries are expected to take the lead in establishing macroalgae as a source of blue carbon.⁵⁴ It is beyond the scope of this paper to discuss the controversies of carbon offsetting and carbon taxing, but, as discussed, seaweed mariculture remains an excellent source of carbon sequestration.⁵⁵ Regardless of their approach to blue carbon markets, each country will have to decide what to do with the seaweed once it has absorbed the carbon. One possibility is to sink the kelp to the seafloor, but not all scientists agree this is the best solution.⁵⁶ “Seaweed is a very valuable material and there are better ways of using this material, while contributing to mitigating climate change, than disposing of it in the deep sea,” Halley Froehlich, a marine scientist at the University of California, Santa Barbara, points out.⁵⁷ Many of these uses are examined in detail below.

One additional benefit of seaweeds is their potential to dramatically improve fish farming. Fish farming is known for being a massive polluter.⁵⁸ However, cultivating sea lettuce with fish farming would create a closed food cycle, as the waste products of the fish would nourish the sea lettuce. The controversies around fish farming are vast, but it is worth noting that the interest in integrated fish farming has dramatically increased in recent years, which is yet another reason for countries to pursue the many potentials of seaweeds in restorative farming models.⁵⁹

51. Woody, *supra* note 41.

52. *Id.*

53. *Id.*

54. *Id.*

55. See Last Week Tonight with John Oliver, *Carbon Offsets*, HOME BOX OFF. (Aug. 21, 2022), <https://perma.cc/VKL6-45GM> (providing a humorous but journalistically rigorous crash course in the pros and cons of carbon offsets and how it is likely that they are making climate change worse. For transcript of the video, refer to <https://perma.cc/Y4B8-SAT4>).

56. Woody, *supra* note 41.

57. *Id.*

58. Kleis, *supra* note 49.

59. *Id.*

ii. *Reducing Methane Emissions from Cows*

Kelp has been shown to dramatically reduce methane released from cows, which can help any country with a livestock or dairy industry meet its emission-reduction targets.⁶⁰ Livestock production accounts for 44% of manmade methane emissions, which contributes 14.5% of global agriculture greenhouse gas (GHG) emissions.⁶¹ At the 2021 climate talks, over 100 countries pledged to cut methane emissions by 30 percent.⁶² In the United States, environmental agriculture contributes 9.6% to GHG emissions, about 36% of which are methane emissions, mostly from livestock.⁶³ Additionally, that methane release represents an energy loss of 11% from the cows' feed. Therefore, reducing cow burps would reduce harmful climate change emissions and improve productivity by conserving feed.⁶⁴

Agricultural methane emissions are difficult to measure, which makes it difficult to set enforceable reduction targets.⁶⁵ In February of 2022, we saw a disturbing but mathematically important turn of events: satellites detected methane emissions from burping cows in a feedlot near Bakersfield, California.⁶⁶ Scientists estimated that, if sustained, the methane emissions from that single feedlot would average to 5,116 tons annually and, if captured, that methane could power over 15,000 homes.⁶⁷

Fortunately, some red seaweeds are anti-methanogenic.⁶⁸ One red seaweed (*Asparagopsis taxiformis*) was found to reduce methane burps by over 80% when fed as a dietary supplement to beef steers.⁶⁹ The same study also found no negative impact on the quality of meat (all beef, regardless of feed, was labeled as either choice or prime).⁷⁰ If fully realized, the combination of reductions in methane emissions and saved feed would help push the beef industry toward more economically and environmentally sustainable production methods.⁷¹

60. Diane Nelson, *Can Seaweed Cut Methane Emissions on Dairy Farms? Expert See Dramatic Reduction When Cows Consume Seaweed Supplement*, U.C. DAVIS (May 24, 2018), <https://perma.cc/MQR5-KUGH>.

61. *Id.*

62. Valerie Volcovici, *Satellites Detect California Cow Burps, A Major Methane Source, From Space*, REUTERS (May 4, 2022, 2:08 PM), <https://perma.cc/4FUN-TEP7>.

63. *Id.*

64. Breanna M. Roque et. al., *Red Seaweed (Asparagopsis Taxiformis) Supplementation Reduces Enteric Methane by Over 80 Percent in Beef Steers*, PLOS ONE 2 (Mar. 17, 2021), <https://perma.cc/8XG3-3VBP>.

65. Volcovici, *supra* note 62.

66. *Id.*

67. *Id.*

68. Roque, *supra* note 64, at 3.

69. *Id.* at 1.

70. *Id.* at 2.

71. *Id.* at 3.

These numbers could help states like California, where dairy cows account for 45% of the state's methane emissions.⁷² For example, the Straus Family Creamery in Petaluma hosted a trial in 2021 to test another red seaweed, *brominata*, for methane reduction.⁷³ Given the study's success (methane was reduced by 52%), the Straus Family plans to be one of the first companies to use the supplement and have one of its farms become carbon neutral by the end of 2023, with the rest of Straus Family's farms following suit within the decade.⁷⁴

iii. *Nutritional Value of Seaweed, a.k.a. "Sea-Vegetables"*

Seaweeds are gaining attention in Western societies as a valuable food source, in no small part due to their high nutritional value including high levels of carbohydrates, minerals, vitamins, and trace elements such as iodine.⁷⁵ Overall, studies favor seaweeds as a good source of nutrients and proteins.⁷⁶

Direct comparisons of seaweeds to terrestrial foodstuffs have found that seaweeds have similar or slightly more fiber.⁷⁷ For example, one study found that in only eight grams, seaweeds can provide up to 12.5% of a person's daily fiber needs, which is a relatively large amount on a weight-for-weight basis compared to other vegetables.⁷⁸

Seaweeds are also high in important minerals, such as magnesium, copper, iron, iodine, and other rarer minerals.⁷⁹ Calcium, a valued mineral, accumulates in seaweeds at much higher levels than in terrestrial foodstuffs.⁸⁰ Sea lettuce provides 260 milligrams of calcium per eight grams, which is approximately 37% of the reference nutrient intakes (RNI) of calcium for an adult male.⁸¹ On the other hand, the same portion of cheddar cheese provides only 5% of the RNI for an adult male.⁸² Seaweeds also surpass meat and spinach in their ability to deliver iron. For example, eight grams of dry dulse (*Palamaria palmata*) has more iron than 100 grams of raw sirloin steak.⁸³

72. Tara Duggan, *To Fight Climate Change, California Approves Seaweed that Cuts Methane Emissions in Cow Burps*, S.F. CHRON., <https://perma.cc/75YQ-LPKT> (last updated May 9, 2022, 5:23 PM).

73. *Id.*

74. *Id.*

75. Paul MacArtain et al., *Nutritional Value of Edible Seaweeds*, INT'L LIFE SCI. INST. (Dec. 2007), <https://perma.cc/ZHF9-K5B7>.

76. *Id.* at 541.

77. *Id.* at 536.

78. *Id.* at 537–38.

79. *Id.* at 538.

80. *Id.*

81. *Id.*

82. *Id.* at 539.

83. *Id.*

Especially exciting to anyone encouraging a reduction in meat consumption is the high levels of protein in red seaweeds. Protein varies by species and season, and different cooking and fermentation methods will make different amounts of protein available, but regardless of these variables some seaweeds are very high in protein.⁸⁴ For example, *Porphyra tenera* and *Palmaria palmate* contain especially high levels, with as much as 47.5% and 30% in their fronds.⁸⁵ *Palmaria palmate* also contains high levels of essential amino acids.⁸⁶ All seaweeds containing essential fatty acids add to their efficacy as a dietary supplement or as part of a balanced diet.⁸⁷ Half of the lipids in seaweeds are Omega-3 and Omega-6 lipids, both of which are essential and must be consumed from food.⁸⁸

Seaweeds also contain many antioxidants, including Vitamins A, B, C, and E. Vitamin E is an important antioxidant found at higher levels in *Undaria pinnatifida* (Wakame) than in peanuts.⁸⁹ Additionally, seaweeds are one of the few “vegetables” that contain Vitamin B12.⁹⁰ *Ulva lactuca* can provide this vitamin in excess of the recommended dietary allowances, making it an alternative source of Vitamin B12 for vegetarians and vegans.⁹¹ A protective pigment, beta carotene, was found in relatively high levels in a red seaweed (*Gracilaria*) compared to other vegetables.⁹²

Moreover, the inherent non-animal nature of seaweed and its high nutritional value means that seaweed has vast potential to be used in dietary supplements and other food products, which will appeal to the “newly health-conscious consumer environments of Western countries.”⁹³

B. ECONOMIC AND SOCIAL BENEFITS

Paul Greenberg, a fishing-industry expert, author, and fellow at Blue Ocean Institute, told Business Insider, “[i]f I could buy kelp futures, I would.”⁹⁴ Greenberg predicts that, in twenty years, kelp will rank in the top ten most consumed seafoods in the United States.⁹⁵ This will not only be an ethical choice, but a necessary choice as ocean resources are depleted faster than they can be renewed, due to climate change, overfishing, and pollution—all while consumer demand for seafood increases.⁹⁶ Greenberg

84. *Id.* at 540.

85. Anne-Valérie Galland-Irmouli et al., *Nutritional Value of Proteins from Edible Seaweed *Palmaria Palmata* (Dulse)*, 10 J. NUTRITIONAL BIOCHEMISTRY 353, 353 (1999).

86. *Id.* at 359.

87. MacArtain et al., *supra* note 75, at 539.

88. *Id.*

89. *Id.*

90. *Id.*

91. *Id.*

92. *Id.* at 540.

93. *Id.* at 541.

94. Dina Spector, *Forget Tuna: These Are the Seafoods We'll Be Eating in the Future*, BUS. INSIDER (July 8, 2014, 7:57 AM), <https://perma.cc/QDL5-PVP6>.

95. *Id.*

96. *Id.*

says that we need to reorganize our “seafood pyramid” to promote filter-feeders because they are easy to harvest, fast-growing, and help reduce pollution.⁹⁷ Aquaculture has a bad reputation, mainly for environmental reasons, but if done well it avoids many pitfalls.⁹⁸ That means moving away from large-scale aquaculture systems that pollute the open ocean and instead farming animals and plants that do well in small plots of ocean.⁹⁹ This includes bivalves like clams, mussels, and oysters and edible seaweeds like kelp.¹⁰⁰ “If aquaculture were organized around this principle, then it would be good for the country,” says Greenberg.¹⁰¹

The global seaweed market reached \$6.3 billion in 2021 and is expected to almost double by 2027.¹⁰² Domestically, if less than 5% of American waters were ROFs, it would create 50 million new jobs.¹⁰³ ROFs have the capacity to grow massive amounts of nutrient-rich food: one calculation estimates 180,000 square kilometers would produce 120 million pounds of bivalves and between 11 million and 40 million pounds of sea vegetables, depending on the species.¹⁰⁴

The start-up costs are non-inhibitory for governments and individuals. Many sustainable ocean-based interventions have very high benefit-cost ratios, with the potential to yield trillions of dollars of benefits.¹⁰⁵ Specifically, ocean-based food production is estimated to have a 10:1 benefit-cost ratio.¹⁰⁶ Therefore, small government investments could provide the economy with a serious boost.

Even without government help, ROFs have very low barriers to entry for individuals. Equipment is minimal, just an old boat and a few anchors, ropes, and buoys.¹⁰⁷ Bren Smith, in his mischievous writing style, says that “[i]f you can scrape, borrow, or steal twenty thousand dollars and an old boat, you can start a farm.”¹⁰⁸ Smith avoided bank loans by selling knick-knacks on the streets of New York and did a Kickstarter campaign to start

97. *Id.*

98. *Id.*

99. *Id.*

100. *Id.*

101. *Id.*

102. *Seaweed Market: Global Industry Trends, Share, Size, Growth, Opportunity and Forecast 2022-2027*, IMARC GRP. (2021), <https://perma.cc/QTF9-NYAN>.

103. BREN SMITH, *EAT LIKE A FISH: MY ADVENTURES FARMING THE OCEAN TO FIGHT CLIMATE CHANGE* 131 (2019) (Smith did the math: the report estimated that one job is created per ten dry tons of seaweed, which could directly create 50 million jobs; Smith found that to create 50 million jobs in the U.S., it would take 5% of American waters).

104. Kleis, *supra* note 49.

105. STUCHTEY ET AL., *supra* note 44, at 7.

106. *Id.*

107. SMITH, *supra* note 103.

108. SMITH, *supra* note 103.; *see also*, STUCHTEY ET AL., *supra* note 44 at 21–22 (stating that “[t]he farms are geared towards simplicity and low cost, making it possible for anyone to become a regenerative ocean farmer for ‘\$20k, 20 acres, and a boat’—far less than the cost of establishing a farm on land.”).

his farm.¹⁰⁹ In his book, he explains in just under three pages (of larger font) how to set up a farm and that the farm can easily be run by one individual.¹¹⁰

ROFs also provide a release valve for the inequities in the fishing industry, as well as the potential to prevent future fisheries collapse. One source of inequity is “ocean grabbing.” This term refers to government or private action that results in “dispossession or appropriation of use, control or access to ocean space or resources from prior resource users, rights holders or inhabitants,” which then “undermine[s] human security or livelihoods or produce[s] impacts that impair social–ecological well-being.”¹¹¹ An example is Chinese trawlers floating just outside the Exclusive Economic Zone (EEZ) of Senegal: these factory ships scoop up all the fish before they can reach the smaller boats of local fishers, devastating their livelihoods and forcing many people to leave their homes in search of work.¹¹² Until a High Seas Treaty can be created and equitably enforced to prevent ocean grabbing, the fishers of Senegal could greatly benefit from the polyculture of ROFs.¹¹³

The second issue, fisheries collapse, is a political hotbed.¹¹⁴ For example, in 1992, the Canadian government had to close cod fisheries due to the collapse of cod stocks—it was the largest layoff in Canadian history with 35,000 Newfoundlanders out of work.¹¹⁵ It devastated the local economy and culture: thousands of boats were beached and even children were banned from throwing a hook and line.¹¹⁶ While the “younger generation” at the time believed the science because they witnessed how fishing technology had become too efficient, that did not fix the problem.¹¹⁷

While there are many sources to blame for the collapse, it is not the “fisherman next door.”¹¹⁸ For starters, global conglomerates run 450-foot, 6,000 horsepower trawlers with a 4,000-ton capacity, leaving the death of

109. SMITH, *supra* note 103 at 131.

110. *Id.* at 110–12.

111. Nathan James Bennett et al., *Ocean Grabbing*, 57 MARINE POL’Y 61–68 (2015).

112. ‘Fish are vanishing’—Senegal’s Devastated Coastline, BRIT. BROAD. CORP. (Nov. 1, 2018), <https://perma.cc/YC2E-M85A>; see Camille Nedelec, *Overfishing in Senegal: Chinese Trawlers Leave Local Fishermen With Empty Nets*, FRANCE 24, <https://perma.cc/75BE-M9GR>.

113. Esme Stallard, *Efforts to Pass Global Ocean Protection Treaty Fail*, BRIT. BROAD. CORP. (Aug. 27, 2022), <https://perma.cc/N2MK-UQJT> (this is the fifth effort to pass a high seas treaty which has failed).

114. See SMITH, *supra* note 103, at 49–56.

115. *Id.* at 49.

116. *Id.*

117. *Id.* at 51 (“Our oceans were being scoured by fleets of floating factories armed with helicopters, chasing fewer and fewer fish, farther and farther out to sea. There was no fogging the pillage.”); *id.* at 54–55 (“Advances in echolocation developed during the war for locating enemy submarines were quickly taken up to locate fish with extreme accuracy. No longer do fishermen have to rely on knowledge passed down through generations to find the best fishing spots. Thanks to the war effort, they have cutting-edge devices that can pinpoint exact locations. Taking things a step further, fighter pilots and their seaplanes were repurposed to hunt bluefin tuna around the globe.”).

118. *Id.* at 54.

by-catch in their wake.¹¹⁹ However, politicians hand out subsidies to keep factory fleets afloat.¹²⁰ Twenty percent of Peru's seafood quota is owned by the second biggest equity firm in the United States and in 2018, a Wall Street firm purchased five of the largest fishing vessels in Maine.¹²¹ Combine that with the indestructible nature of modern fishing gear, "ghost nets" that float for decades at sea killing entangled animals, and *permitted*, destructive practices like bottom trawling that decimate sea floor habitat, and no one is free of blame for the collapse of fish populations.¹²²

Predictably, a political fight broke out. On one side were the scientists, environmentalists, and bureaucrats churning out two-hundred-page chart-filled reports detailing declining [fish] stocks; on the other were the captains of industry who rejected the science and remained hell-bent on fishing the last fish. Now, decades later, the lasting effect of overfishing is well documented. Less discussed is the historic failure of environmentalists and politicians to offer alternatives for the future.¹²³

ROFs are that alternative. Cultures are based on flourishing ecosystems, and thus ecological collapse can wipe out hundreds of years of culture.¹²⁴ Writing of the 1992 cod fishery collapse, one Newfoundlander said, "The metronome of our music and poetry is not the ocean—it's fish. With cod gone, meaning was swept away, dignity soon replaced with anger. Fishermen are not a bitter race, but we rot from within if beached."¹²⁵ Around the world, people are losing not just their livelihoods, but their way of life due to overfishing in various forms. As discussed in the Ecological Benefits section above, ROFs will restore coastal ecosystems, but that means so much more to coastal communities.

The combination of bivalves and sea vegetables provides fishers with a steady harvest year-round, regardless of the season or changes in fish populations.¹²⁶ This steady harvest of a quality protein source will create food security and processing jobs on land (in addition to the jobs of building/upgrading processing facilities).¹²⁷ If some fishers dedicate a few days

119. *Id.* at 53.

120. *Id.*

121. *Id.* at 54.

122. See RECENT SCIENTIFIC WORK OUTLINES THE SEVERE CONSEQUENCES THE PRACTICE OF BOTTOM TRAWLING HAS ON LOOSE SEDIMENT ON THE OCEAN FLOOR, U.S. GEOLOGICAL SURV. (Mar. 14, 2016), <https://perma.cc/XS7W-6SML>; *Ghost Nets, Among the Greatest Killers in Our Oceans*, MISSION BLUE (May 13, 2013), <https://perma.cc/8Z3G-8AVL>.

123. SMITH, *supra* note 103, at 50.

124. See *id.*

125. *Id.*

126. See *id.* at 233.

127. Kristina Siritis, *Bronx River is Classroom for Seaweed Scientists*, HUNTS POINT EXPRESS (Oct. 23, 2015), <https://perma.cc/CVU3-7M9D>.

a week to their ocean farm, logically that reduces pressure on fish stocks, ensuring a future for fishing.

Additionally, current research and future programs provide hands-on scientific experience for youth. For example, the environmental program of Rocking the Boat, a New York based non-profit, offers local high schoolers the chance to study what a small seaweed farm in the Bronx River absorbs.¹²⁸ Thus far, the students have learned the main sources polluting the Bronx River are poor septic/sewage infrastructure, lawn fertilizer, and water treatment plants, but they have also found that the seaweed farm bolsters the ecosystem by reducing the volume of these pollutants and bringing more fish, especially juvenile fish, to the area.¹²⁹ The organization is considering growing bivalves over winter, when it is too cold to grow their red seaweed.¹³⁰ “Access to the river is possible again,” said Sam Marquand, the program director, and “[w]e take that access to the next logical step, by encouraging young people from the community [to] protect their river and their natural resources.”¹³¹

One additional, rather hidden, benefit of ROFs is the ability to swap out soy for kelp as a food additive, thus saving biodiversity and traditional livelihoods around the globe. Soy production has doubled over the last two decades, resulting in the unsustainable conversion of grasslands, forests, and savannahs into farmland, endangering ecosystems and traditional livelihoods.¹³² Reducing the demand for soy could halt this land conversion and even allow some land to return to its original state.

IV. OBSTACLES AND SOLUTIONS TO SUPPORTING RESTORATIVE OCEAN FARMING

A. PARADIGM SHIFTS

Ocean and coastal law is currently spread out across many jurisdictions and agencies at various state and federal levels, while the laws themselves tend to focus on siloed issues.¹³³ Given the climate crisis and global overfishing, ocean law and policy is “in need of an abrupt paradigm shift from a use-based model to a climate change adaptation model based on principled flexibility, ecosystem-based and adaptive management, reduction of stressors, and a goal of increasing resilience.”¹³⁴ ROFs are an ideal catalyst for legislation to begin this shift.

California may have the most exciting legislation to date. As previously discussed, the use of some red seaweeds as a dietary supplement for cows

128. *Id.*

129. *Id.*

130. *Id.*

131. *Id.*

132. *See Nature is Threatened by Unsustainable Production & Consumption of Soy*, WORLD WILD FUND, <https://perma.cc/R78J-GENU> (last visited Feb. 6, 2023).

133. *See, e.g.*, N. Pac. Halibut Fishing Act of 1982, 16 U.S.C § 773.

134. Craig, *supra* note 5, at 27.

is vital to the reduction of methane emissions. One study pointed out that the “[n]ext steps for the use of *Asparagopsis* as a feed-additive would be to develop aquaculture techniques in ocean and land-based systems globally, each addressing local challenges to produce a consistent and high-quality product.”¹³⁵ California recently became the first state to approve red seaweed dietary supplements for cows, which will prompt industry to begin developing such aquaculture techniques.¹³⁶ “It’s a huge step forward that meets not only the goals of California to reduce their methane emissions . . . but it’s showing the way for California and the world that we have solutions that can be replicated,” said Albert Straus, CEO of Straus Family Creamery in Northern California.¹³⁷

With legislative support, the other obstacle ROFs face will be much easier to overcome: a market for seaweed. “In 20 to 30 years, kelp is going to be the cheapest food on the planet,” Bren Smith said in 2014 to Biz Insider.¹³⁸ Now, nearly ten years later, we need to push for that vision, if not to fight climate change, then at least to feed ourselves. Despite Smith’s optimism and the marketing ability to label seaweed as a “superfood,” seaweed has yet to appeal to the American palate outside of side salads and snacks; but Smith is single-handedly trying to change that by pairing up with restaurants in New York City.¹³⁹

What we put on our dinner plates is only one paradigm shift and it is connected to several others. The High Panel for a Sustainable Ocean Economy Report (“the Report”), compiled with information from 250 experts, concluded that:

*We can and we must produce more from the ocean, and we have to do it in ways that mitigate climate change, preserve biodiversity, regenerate ocean health and leave no one behind. We can produce more, by protecting more. The report gives us confidence in that possibility. But the report also teaches us how we have to rethink ocean policy and management altogether.*¹⁴⁰

The Report urges several societal narrative shifts to improve ocean policy and management, but one stands out: we must stop thinking of the ocean as “victim” or as too big and too complex to “fix” and instead start viewing the ocean as our partner in life.¹⁴¹ This logically requires us to abandon all policy approaches based on the false choice between environment and

135. Roque, *supra* note 63, at 16.

136. See Duggan, *supra* note 71.

137. *Id.*

138. Spector, *supra* note 93.

139. See *id.*

140. STUCHTEY ET AL., *supra* note 43, at v (emphasis in original).

141. See *id.* at 3.

economy.¹⁴² This new perspective is in contrast to the usual “‘conservation philosophy’ of [minimizing] destruction or an ‘extractive approach’ of [maximizing] the resources that can be extracted from the ocean.”¹⁴³ This new approach integrates the ‘three Ps’: effective protection, sustainable production, and equitable prosperity.¹⁴⁴

Bren Smith’s regenerative ocean farm is one of five sustainable ocean economy stories in the Report’s prologue.¹⁴⁵ The Report points out several specific struggles of becoming a restorative ocean farmer in the United States, and how Smith made it his personal mission to ease that struggle and promote a paradigm shift by starting a nonprofit, Greenwave. While native shellfish (e.g., mussels, clams, oysters, and scallops) seed is easy to obtain from established growers, sourcing microscopic kelp seed is more complicated. Greenwave educates the next generation of ocean farmers about their work in an era defined by climate change and helps them navigate the complex U.S. regulatory system.¹⁴⁶ To the credit of those who wrote the recently proposed Advancing the Quality and Understanding of American Aquaculture Act, there is a section that would establish a grant program to support the education and training of people seeking to become ocean farmers.¹⁴⁷

ROFs are a solution with the power to unite many stakeholders, as they address so many needs and wants, from boosting the economy to restoring and stewarding ecosystems for generations to come. While seaweed farming is an ancient industry in many other parts of the world, it is gaining attention in western countries like Australia and the United States, and even was featured in a 2022 movie starring George Clooney and Julia Roberts.¹⁴⁸ Society generally is ready for ROFs because there are so many reasons to support them. Creating law and policy that ensures ROFs are implemented in an equitable manner is the next step, one which many countries have already tried to take.¹⁴⁹

142. *See id.* at 2.

143. *Id.*

144. *Id.*

145. *See id.* at 21–22.

146. *See id.*

147. *See* AQUAA Act § 402(c).

148. *See supra* Part III; TICKET TO PARADISE (Universal Pictures 2022) (in the movie, the daughter wants to marry a young man she just met while on vacation in Bali; that young man is a seaweed farmer who tells his skeptical future father-in-law that his family seaweed farm just signed a contract with Whole Foods).

149. *See, generally*, ANNICK VAN HOUTTE, FOOD & AGRIC. ORG., U.N., ESTABLISHING LEGAL, INSTITUTIONAL AND REGULATORY FRAMEWORK FOR AQUACULTURE DEVELOPMENT AND MANAGEMENT (2001), <https://perma.cc/C4SW-YD7P>.

B. ROFS ALIGN WITH CURRENT LEGAL GOALS AND NEW COASTAL MANAGEMENT TRENDS

Currently in the United States, getting a license for an oil rig is easier than for a seaweed farm.¹⁵⁰ This vividly illustrates the issues with U.S. coastal law and policy. While it is common knowledge that oil rigs are bad for the immediate habitat where they are sited and contribute to climate change, getting a permit for something that benefits the ecosystem and increases food security is far more challenging.¹⁵¹ How did this happen? Sectoral management regimes have evolved as governments have incrementally responded to problems regarding to ocean uses and ocean resources, resulting in fragmented authorities and jurisdictions.¹⁵² Even within a sector, management strategies are narrowly focused, often addressing issues related to a single use or a species.¹⁵³ These approaches lack an understanding of cumulative impacts, which often undermine the broader legislative purpose of an act. In order to harmonize ocean uses, “management of the oceans and coasts would follow ecosystem boundaries, looking at interactions among all elements of the system, rather than addressing isolated areas or problems.”¹⁵⁴ For legislation to be effective at attaining all the ecological and economic benefits of ROFs, such a holistic approach must be taken. Uniting the various sectors and regimes under one common system of ocean and coastal law would not only ease the path to ROFs, but also help meet many of the original goals of the legislation.

The Magnuson-Stevens Act (MSA) created a “national program for the conservation and management of the fishery resources . . . to prevent overfishing, to rebuild overfished stocks, to insure conservation, to facilitate long-term protection of essential fish habitats, and to realize the full potential of the Nation’s fishery resources.”¹⁵⁵ While the MSA is considered, even by environmental organizations, to be the “world’s leading fisheries management” tool, it does have areas for improvement.¹⁵⁶ Originally passed to address the free-for-all fishing battle between domestic and

150. See Woody, *supra* note 40.

151. See 7 Ways Oil & Gas Drilling is Bad for the Environment, WILDERNESS SOC’Y: BLOG (July 9, 2021), <https://perma.cc/BM6W-DSMU>; see also DEEPWATER HORIZON—BP GULF OF MEXICO OIL SPILL, ENV’T PROT. AGENCY, <https://perma.cc/DT9X-YE9F> (last updated Aug. 31, 2022); see also Joan Meiners, *Ten Years Later, BP Oil Spill Continues to Harm Wildlife—Especially Dolphins*, NAT’L GEOGRAPHIC (Apr. 17, 2020), <https://perma.cc/A2NX-Q8TA>; see INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, GLOBAL WARMING OF 1.5°C (V. Masson-Delmotte et al., eds.) (2019), <https://perma.cc/YML8-NA2W>.

152. See Donna R. Christie, *Lead, Follow, or Be Left Behind: The Case for Comprehensive Ocean Policy and Planning for Florida*, 44 STETSON L. REV. 335, 386–87 (2015).

153. See *id.* at 335.

154. U.S. COMM’N ON OCEAN POL’Y, AN OCEAN BLUEPRINT FOR THE 21ST CENTURY 61 (2004), <https://perma.cc/BQV3-BQB5>.

155. Magnuson-Stevens Fishery Conservation and Mgmt. Act, 16 U.S.C. § 1801(a)(6).

156. See *The Magnuson-Stevens Act: World’s Leading Fisheries Management Under Threat*, OCEANA, <https://perma.cc/7CMS-HWWJ> (last visited Feb. 7, 2023).

foreign fishers, it expanded the Exclusive Economic Zone (EEZ) from twelve nautical miles to 200 and established federal management via regional fisheries councils.¹⁵⁷ But after twenty years, many U.S. fisheries are collapsing or near collapse.¹⁵⁸

Congress amended the MSA in 1996 and 2007.¹⁵⁹ In 2013, the National Resources Defense Council released a relatively optimistic report, finding that, of fish stocks, 64% could be considered rebuilding successes.¹⁶⁰ However, the report also found areas of concern, including gaps in the application of rebuilding requirements, certain regions (New England, South Atlantic, and the Gulf of Mexico) with significant proportions of fish stocks showing a lack of rebuilding progress, and continued overfishing during rebuilding plans.¹⁶¹ That same year in New England, “regulators realized that Gulf of Maine cod were collapsing unexpectedly after years of overly lax limits and had to impose a severe 78[%] reduction in catches.”¹⁶² Currently, Pacific sardine numbers are crashing with overfishing being the major threat.¹⁶³ Yet, the National Marine Fisheries Management (NMFS) has removed its report stating that the sardine population has declined 97% between 2006 and 2017.¹⁶⁴ When fish stocks collapse, or reach dangerously low levels, it threatens not just fishing but the entire ecosystem. For example, forage fish, like sardines, are “an essential component in the diets of many ocean animals,” such as whales, chinook salmon, sea lions, and brown pelicans.¹⁶⁵

The MSA’s success in certain regions is likely due to thoughtful application of its National Standards and consideration of the ecosystem as a whole, despite its anthropocentric purpose. The “optimum” yield from a fishery means a total catch that provides the “greatest overall benefit to the Nation . . . and taking into account the protection of marine ecosystems.”¹⁶⁶ While this language sounds like it considers the economy and the environment two separate concerns, the MSA also acknowledges that one of the greatest long-term threats to commercial and recreational fisheries is the “continuing loss of marine, estuarine, and other aquatic habitats.”¹⁶⁷ The

157. *See id.*

158. *See* Brad Plumer, *How the U.S. Stopped its Fisheries from Collapsing*, VOX (May 8, 2014, 1:01 PM), <https://perma.cc/6GMK-PGZT>.

159. *See* LAW & POLICIES: MAGNUSON-STEVENS ACT, NAT’L OCEANIC & ATMOSPHERIC ADMIN., <https://perma.cc/3SLL-DN26> (last visited Feb. 8, 2023).

160. *See* Brad Sewell, *Bringing Back the Fish: An Evaluation of U.S. Fisheries Rebuilding Under the Magnuson-Stevens Fishery Conservation and Management Act*, NAT’L RES. DEF. COUNCIL (Mar. 6, 2013), <https://perma.cc/9JXV-G332>.

161. *Id.*

162. Plumer, *supra* note 157.

163. *See* *Modern Day Pacific Sardine Collapse: How to Prevent a Future Crisis*, OCEANA, <https://perma.cc/77ST-XF4A> (last visited Feb. 8, 2023).

164. *See id.* (The NMFS report Oceana cited and linked brings up an error message saying the “Oops! This page can’t be found.” Very suspicious.)

165. *Id.*

166. 16 U.S.C. § 1802(33)(A).

167. 16 U.S.C. § 1801(a)(9).

MSA says that habitat should be considered, and provides a definition for “essential fish habitat,” areas that garner some legal protections.¹⁶⁸ Among other requirements, the MSA requires that conservation and management measures prevent overfishing while consistently achieving the optimum field from each fishery, using the best scientific information available.¹⁶⁹ Additionally, individual fish stocks are to be managed as a unit throughout their range and interrelated stocks of fish must be managed as a unit or in close coordination.¹⁷⁰

These elements begin to bring ecosystem-based management into account, though not to its full potential. However, improvements continue: NOAA’s website currently has a page explaining ecosystem-based management, its benefits, and where NOAA is implementing such practices.¹⁷¹ NOAA defines ecosystem-based management as “a holistic way of managing fisheries and marine resources by taking into account the entire ecosystem of the species being managed.”¹⁷² The way NOAA states the goal of this management is very anthropocentric: to maintain ecosystem health so as to meet the needs and wants of humans, including ecosystem services.¹⁷³ This ignores the inherent value of non-human life, as does the MSA in its goals and National Standards. However, this shift in ecological understanding is a necessary step toward the paradigm shift required for western societies to return to living in harmony with our habitat. While the goal is to serve human purposes, the recognition that humans are dependent upon ecosystems that are “healthy, productive, and resilient,” accurately ties together the fate of a species, *homo sapiens*, and their habitat.¹⁷⁴

California, ever the leading state on environmental issues in the U.S., has made its own attempts to live in better harmony with its long coastline. The Marine Life Protection Act (MLPA) recognized that California’s Marine Protected Areas (MPAs) “were established on a piecemeal basis rather than according to a coherent plan and sound scientific guidelines,” and sought to “reexamine and redesign California’s MPA system to increase its coherence and its effectiveness at protecting the state’s marine life, habitat, and ecosystems,” by establishing the Marine Life Protection Program.¹⁷⁵ The MLPA integrates human communities into the priorities by acknowledging that marine biodiversity is important to public health and well-being, as well as ocean-dependent industries, and by additionally stating that “[f]ish and other sea life are a sustainable resource and fishing is an

168. 16 U.S.C. § 1802(9)–(10) (defining the term “essential fish habitat” as “those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity.”).

169. See 16 U.S.C. § 1851(a)(1)–(2).

170. See 16 U.S.C. § 1851(a)(3).

171. See UNDERSTANDING ECOSYSTEM-BASED FISHERIES MANAGEMENT, NAT’L OCEANIC & ATMOSPHERIC ADMIN., <https://perma.cc/5BN7-JEU8> (last visited Feb. 8, 2023).

172. *Id.*

173. *See id.*

174. *Id.*

175. Marine Life Prot. Act, Cal. Fish & Game Code § 2853(a)–(b).

important community asset. MPAs and sound fishery management are complementary components of a comprehensive effort to sustain marine habitats and fisheries.”¹⁷⁶ Moreover, the goals of the Marine Life Management Program are to “sustain, conserve, and protect marine life populations, including those of economic value, and rebuild those that are depleted; . . . to improve recreational, educational, and study opportunities provided by marine ecosystems . . . and to manage these uses in a manner consistent with protecting biodiversity; and to protect marine natural heritage, . . . for their intrinsic value.”¹⁷⁷ These goals, if implemented thoughtfully with flexible management strategies that can adapt to new information, would integrate the multitude of human activities with our ecosystem. People fish, surf, research, worship, gather, and otherwise enjoy coastlines—all these activities contribute to the “well-being” that is mentioned in the MPLA. The coastlines and the EEZ are more than sources of economic importance, they are part of the identity of coastal dwelling people.

ROFs would fit well into any state’s MPA system. The ecological and economic benefits align with both the anthropocentric goals of the MSA and the more holistic goals of the MPLA. Using ROFs as a means to buffer and better connect disjointed MPAs will unite fishing industry needs with habitat and biodiversity protection. Siting ROFs will have its challenges given the many ocean uses and desire to find the most ecologically beneficial locations. Ensuring all voices are invited to the conversation and weighted appropriately is critical to creating an equitable network of MPAs and ROFs along any coastline.

Moreover, California Senate Bill 1383 (SB 1383) requires the state board to reduce methane emissions by 40% by 2030 (among other emissions).¹⁷⁸ SB 1383 prioritized measures and actions with co-benefits such as job growth, local economic benefits, public health benefits, and the potential for innovation in technology, energy, and resource management practices.¹⁷⁹ As discussed above, ROFs clearly meet all of these goals. California likely recognized this when approving the licensing of red seaweed dietary supplements for cows, but has yet to make its coastal regulatory permitting processes any easier for farmers to grow the seaweed needed for the supplements.

V. SUGGESTIONS FOR MOVING FORWARD

Written carefully, legislation supporting ROFs can help achieve socio-economic equity, food security, and flourishing biodiversity along our coasts. By considering the strengths and weaknesses of past approaches,

176. *Id.* at § 2851(b)–(d).

177. *Id.* at § 2853 (a)(2)–(4).

178. S.B. 1383 § 1, 2015–2016 Leg. Sess. (Cal. 2016).

179. *Id.* at 2(b)(4)(A)–(C).

and examining new legislation, effective paths forward are foreseeable. Thankfully, there are already examples of cooperation based on bioregions that do not require waiting on federal legislation.

A. NATIONAL LEGISLATION

The House of Representatives recently passed a bill called “Advancing the Quality and Understanding of American Aquaculture Act” (“AQUAA Act”) The purpose of the AQUAA Act is “to establish a regulatory system for sustainable offshore aquaculture in the United States exclusive economic zone.” The language of the AQUAA Act indicates that it is focused on fish farming, an industry with a controversial reputation at best.¹⁸⁰ However, the AQUAA Act also contains language that would be supportive of ROFs. Specifically, the AQUAA Act requires establishing research and development grants “to optimize the sustainable use of protein and lipid sources originating from wild fish, plants, and other sources; “to evaluate methodologies to prevent, minimize, and mitigate potential adverse environmental impacts; and most promising for ROFs, “to evaluate the potential for offshore aquaculture to serve as a tool for environmental management, including connections to water quality, watershed management, and fishery conservation and management.”¹⁸¹ The AQUAA Act is also supportive of the benefits of polyculture, and nothing in the AQUAA Act would prevent it from supporting a ROF that did not include finfish.¹⁸² If the AQUAA Act passes the Senate, it could open the doors to a grant program for Restorative Ocean Farmers.

One immediate caveat to the AQUAA Act’s ability to make ROFs accessible is that the AQUAA Act only applies to “offshore” aquaculture within the EEZ. The EEZ constitutes “the outer boundary of which is 200 nautical miles from the baseline from which the breadth of the territorial sea is measured.”¹⁸³ Given that states’ territorial seas extend from the mean high tide line outward three nautical miles, only those with the capacity to farm *offshore* will immediately benefit from the AQUAA Act.¹⁸⁴ While the grant programs make offshore ROFs more accessible, doing anything offshore has increased costs, if only due to the extra time and fuel it takes to travel three nautical miles. The distance from shore can also be psychologically intimidating to those unaccustomed to a life at sea. However, for fishers who regularly work offshore, they already have the boats, experience, and many skills to quickly enjoy the benefits of the AQUAA Act.

180. See, e.g., *The Promise of a Blue Revolution*, ECONOMIST (Aug. 7, 2003), <https://perma.cc/7R4Q-WNUY>.

181. AQUAA Act § 203(a)(5)–(7).

182. *Id.* at § 3(8) (defining “Multi-trophic Aquaculture” as “an assemblage of cultured species grown in close proximity to one another so that they provide ecosystem services to one another.”).

183. AQUAA Act § 3(5)(A).

184. See NAT’L OCEANIC & ATMOSPHERIC ADMIN., MARITIME ZONES AND BOUNDARIES, <https://perma.cc/4K8X-F48K> (last visited May 21, 2023).

The AQUAA Act addresses many environmental concerns from the beginning stages of establishing this industry to its operation and enforcement. The National Standards require that designated and established aquaculture opportunity areas must “encourage development of United States offshore aquaculture while remaining consistent with environmental requirements established by law” and use the best scientific information available, while “taking into account traditional knowledge” and preferring native or historically naturalized species to each region and prioritizing the health of the cultured species.¹⁸⁵ When assessing aquaculture opportunity areas, the Secretary must base designations on the totality of the circumstances, including “scientific, social, and economic data, as well as engagement with aquaculture stakeholders and the public.”¹⁸⁶ “Aquaculture stakeholders” is a broad term, including “owners and operators of offshore aquaculture facilities, Regional Fishery Management Councils, interstate fisheries commissions, conservation organizations, fisheries associations, State, county, and federally recognized Indian Tribes, and other interested parties.”¹⁸⁷ Specifically relevant to ROFs, the factors for assessment of these areas include “potential benefits from multi-trophic aquaculture, where cultured species provide ecosystem services to one another” and “expected socioeconomic impacts from operations on adjacent coastal communities.”¹⁸⁸

The AQUAA Act shows potential to ensure socio-economic equity by requiring the Secretary to “develop and manage a grant program to support the education and training of individuals with the skills needed to manage and operate aquaculture facilities” as well as a grant program “to support the sale and public perception of cultured species domestically and internationally.”¹⁸⁹ Accessible job training programs will make this practice more widely available. Additionally, the AQUAA Act provides for States, territories, or Tribal governments in a fisheries management region to petition the Secretary to locate an aquaculture opportunity area within reasonable distance to their location.¹⁹⁰ This increases the ability of local voices to be considered during the designation process. In an ideal world, the needs of local governments and the ability to farm offshore will align in mutually beneficial relationships between communities and their ecosystems, but this will only work if the National Standards are taken seriously and polyculture is a key element in every ocean farm.

Even if the AQUAA Act’s grant programs discovered best practices for ocean farming that result in only environmental benefits and no harms, socioeconomic equity is still critical for the country. One element of the AQUAA Act that may impede equity is the ability of non-government

185. AQUAA Act § 101(b)(1)–(5).

186. *Id.* at § 102(c).

187. AQUAA Act § 3(2).

188. *Id.* at § 102(d)(6)–(8).

189. *Id.* at § 402(b)–(c).

190. *Id.* at § 102(f)(2).

entities to apply for aquaculture permits outside the designated aquaculture opportunity areas.¹⁹¹ There are some restrictions, and such entities must complete their own assessments and create management plans at their own expense.¹⁹² However, this raises the concern that only large corporations with deep pockets will have the funds to submit such applications, and if erroneously approved, could cause both economic and environmental harms. The Secretary should strongly consider why the entity's proposed area was not originally included in the inventory of aquaculture opportunity areas. It is possible that the inventory of aquaculture opportunity areas is not complete at the time of application because the Secretary is allowed to designate areas before the inventory is complete.¹⁹³ This could easily give large corporations a head start against small-scale ocean farmers. Too many large facilities (within or outside of designated areas) would undercut the market for small-scale, independent ROFs, reducing socio-economic benefits to the communities who need them most.¹⁹⁴ These issues can be averted with a meaningful application of the National Standard focused on socio-economic impacts, prioritizing small-scale ocean farms.

The fate of the AQUAA Act is questionable, as it is one in a long line of recently failed ocean legislation. Previously, the Oceans-Based Climate Solutions Act of 2020 and 2021 had the admirable goal “to provide for ocean-based climate solutions to reduce carbon emissions and global warming; to make coastal communities more resilient; and to provide for the conservation and restoration of ocean and coastal habitats, biodiversity, and marine mammal and fish populations.”¹⁹⁵ The bill was extensive, including titles that addressed blue carbon, marine protected areas, climate ready fisheries, offshore energy, Coastal Zone Management Act amendments, international Agreements, coastal resilience and adaptation, ocean acidification, and more.¹⁹⁶ The Oceans-Based Climate Solutions Act would have been an excellent start for ROFs, which it called Restorative Ocean Aquaculture, defining it as “ocean and coastal propagation of seaweed or shellfish farming that generates positive ecological and social impact.”¹⁹⁷ The Oceans-Based Climate Solutions Act had a deeper understanding of the benefits of ROFs, as well as an implementation approach which benefited both the environment and the economy.

191. *Id.* at § 103.

192. *Id.*

193. AQUAA Act § 102(b)(2).

194. Martin Rowinski, *How Small Businesses Drive the American Economy*, FORBES (Mar. 25, 2022 9:15 AM), <https://perma.cc/9LM6-GDPK> (“Not only do small businesses provide more jobs, they also bring careers and opportunities. Successful small businesses put money back into their local community through paychecks and taxes, which can support the creation of new small businesses and improve local public services. No matter how small it starts—one, two, five, 10 employees—within that town, the city or the county, your small business creates new economies where once there was nothing.”).

195. H.R. 8632.

196. *See generally id.*

197. *Id.* at § (2)(6).

The Oceans-Based Climate Solutions Act required the establishment of an Ocean Aquaculture Research and Policy Program to address opportunities, challenges, and innovation in restorative ocean aquaculture development, siting, and operations in the coastal waters and exclusive economic zone through various means.¹⁹⁸ Perhaps most importantly, the first three priorities within the program were (1) to maximize ecosystem benefits while avoiding adverse impacts to the marine environment, (2) to use spatial analysis to understand and evaluate how siting ROFs can minimize impacts on migratory birds, marine mammals, endangered species, etc., and (3) to monitor both the individual and cumulative effects of small-scale ROFs to inform potential impacts of large-scale operations and siting.¹⁹⁹ Additionally, within one year, a report from the National Academies was to detail many aspects of the program, including the ability to sequester carbon as climate change mitigation, blue carbon potentials, regional recommendations, assessments of ecosystem services derived from ROFs (including their design and siting), and a “sustainability classification system to assess the various types of restorative aquaculture on a range of life cycle ecological and social benefits and provides a composite score with which to rank such types of restorative aquaculture.”²⁰⁰ This last requirement would have gone beyond “organic” and created a more reliable “sustainability” label.²⁰¹ Essentially, this bill would have likely provided all the ecological and economic benefits (and more) outlined in the above sections. However, the Ocean-Based Climate Solutions Act of 2020 and 2021 failed to pass.

Recently, on September 29, 2022, the Ocean Restoration Research and Development Act of 2022 was introduced to the House of Representatives.²⁰² Unfortunately, the name of this act is the most exciting thing about it. In what is likely an attempt appeal to a broader base in Congress, the Ocean Restoration Research and Development Act of 2022 is notably vague and brief compared to its predecessors. While it does seem to be focused on ROFs, it only establishes the “Ocean Fertilization Research and Development Program.”²⁰³ Frustratingly, the stated goals and objectives of the Act are to develop goals and objectives.²⁰⁴ The program is to prioritize projects that take place in pelagic waters and do not cause harmful algal blooms in coastal waters.²⁰⁵ Pelagic waters are defined as “the part of the

198. *Id.* at § 409(a).

199. *Id.* at § 409(d)(1)–(3).

200. *Id.* at § 409(e)–(f).

201. See generally, Jillian Guernsey, *The ‘Natural’ Disaster: How Americans’ Obsession with ‘Natural’ Foods Encourages Misinformation, Stifles Innovation, and Harms the Planet*, 29 HASTINGS ENV’T L.J. 81, 81–108 (2023) (explaining the harms of organic labeling and the need for a sustainable label).

202. H.R. 9027.

203. *Id.* at § 2.

204. *Id.* at § 2(d).

205. *Id.* at § 2(e).

open sea or ocean other than coastal waters”²⁰⁶ and coastal waters means “the land and sea areas bordering the shoreline where hypoxic conditions exist or are likely to occur due to excess nutrients.”²⁰⁷ These definitions bear no resemblance to legal terms already in use, such as EEZ or territorial seas. Regardless of any potential confusion from these vague terms, this Act is a knee-capped version of what came before: it is unlikely to support coastal Restorative Ocean Farmers and it has virtually no goals or objectives. Is this what it takes to pass legislation today? The only hope is that this bill might be bland enough to sneak past conservatives and then have the potential to be executed in the spirit of the Ocean-Based Climate Solutions Act, but no requirements hold anyone accountable and agencies would remain at the whim of the White House every four years.

These previous and current efforts at ocean legislation indicate that at least some in Congress are thinking about our relationship with the ocean and see the potential to change that relationship for the better. The desire to improve the relationship with the ocean was evident in the Oceans-Based Climate Solutions Acts, but it is yet to be seen if symbiotic relationships will be included in future federal legislation. Either way, we will likely see more attempts at national aquaculture legislation and policy. As of this year, an Aquaculture Caucus was formed in Congress, made up of thirteen bipartisan members.²⁰⁸ The caucus was established to be a forum and resource to educate Congress members about the economic opportunities of expanding U.S. aquaculture.²⁰⁹ While many of the economic benefits are tied to ecological benefits, we can only hope this caucus recognizes that integrated aquaculture like ROFs are a better for long-term investment than massive corporations engaged in mono-culture finfish farming.²¹⁰ Currently, we do not know about the environmental impacts of massive monoculture kelp or shellfish farming. But, as discussed above, the science supporting polyculture ocean farms is strong. Therefore, we should focus on the solution that we already have and can easily implement.

A statement from Aquaculture Caucus member Congresswoman Cammack could offer a glimmer of cautious optimism:

Aquaculture should be one of the United States’ priorities as we grow our focus on food security. In Florida, we’ve seen the benefits of aquaculture firsthand, breeding, raising, and harvesting shellfish, fish, and aquatic plants in our waters. We’ve demonstrated that it’s possible to provide

206. *Id.* at 2(3).

207. *Id.* at § 2(1).

208. *US House Aquaculture Caucus Founded With 13 Bipartisan Members*, AQUAFEED (Oct. 10, 2022), <https://perma.cc/MB2X-T2BY>.

209. *Id.*

210. *Fish Farming Is Not as Sustainable as We Thought*, SENTIENT MEDIA (Jan. 13, 2021), <https://perma.cc/NV6L-MHV4>; see also SMITH, *supra* note 103 at 76 (“Mother Nature abhors a monoculture.”).

healthy, fresh food that's produced sustainably at home to support our growing population.²¹¹

Clearly, Florida has had success with more than just finfish. How future federal legislation plays out in practice will be determined by the forethought and efforts of local agencies and regional cooperation; the Aquaculture Caucus is in a good position to ensure meaningful forethought at the planning stage of such legislation. However, state legislators need not wait for federal legislation to pass their own laws.

B. REGIONAL COOPERATION: BIOREGIONS ARE THE NEW JURISDICTIONS

Human beings have created state lines, federal jurisdictions, and international agreements, but "nature doesn't read the contract."²¹² Migratory species, the water cycle, ocean currents, rivers, and more regularly traverse legal jurisdictions. If environmental laws and agencies tasked with environmental stewardship are to be effective, the focus must shift toward bioregions. Indeed, environmental laws and management are already trending in this direction, however a massive shift it needed to make it effective on national and global scales.²¹³ In the meantime, communities tied together in the same bioregion can start right away. Given that ROFs provide regional (and collectively, global) benefits, planning and coordination based on bioregions will be critical to optimizing those ecological and economic benefits.

In the past, legislation has made strides in this direction. For example, the California Marine Life Protection Act divided California into three "biogeographical regions."²¹⁴ Additionally, the AQUAA Act currently in Congress alludes to aquaculture management that "plan[s] for multiple aquaculture opportunity areas where such areas are within reasonable proximity to each other and sufficiently similar."²¹⁵ This language has the potential to encourage focus on bioregions, however implementation is difficult to anticipate given the bill has yet to pass.

Fortunately, we do not have to wait for federal legislation to address our environmental issues with regional cooperation. Fostering regional cooperation now can streamline future efforts when federal legislation finally passes that addresses ocean-based solutions and promotes the aquaculture

211. AQUAFEED, *supra* note 207.

212. Quote attributed to Professor David Takacs, Video recording: Class on Biodiversity Law and Environmental Statute, held by Professor Takacs, and the University of California, Hastings College of the Law (Spring 2021) (notes on file with author).

213. See, e.g., CAL. COASTAL COMM'N, <https://perma.cc/4T3H-JRST>, (an agency that manages development in all of California's coastal bioregions); BAY CONSERVATION AND DEV. COMM'N, <https://perma.cc/3FY7-X7YF> (an agency that manages development in the San Francisco Bay).

214. See generally, Marine Life Prot. Act, Cal. Fish & Game Code § 2850–63.

215. AQUAA Act § 201(b).

industry. The California Ocean Acidification Action Plan (COAAP) is an excellent example of cooperation that transcends legal jurisdictions to unite people based on a large-scale bioregion.²¹⁶ The COAAP states that, while local efforts are essential, state-focused strategies and actions are not enough because OA is playing out on the global scale.²¹⁷ “By working beyond state boundaries, California can learn much from experiences in other jurisdictions and geographies and accomplish more than it could on its own.”²¹⁸ Via membership in the Pacific Coast Collaborative, California, Oregon, Washington, Alaska, and British Columbia are already working cooperatively on climate change issues including emissions reduction.²¹⁹ They plan to expand to include Mexico because “it makes good sense . . . to build technical capacities for observing and understanding OA at this regional scale.”²²⁰ Clearly, the size of bioregions can vary depending on the ecosystem or the impact. Thus, a strong understanding of both will be necessary in the detailed forethought of any environmental management plans.

The COAAP includes “Action Items” that focus on effective, positive regional cooperation and partnerships. For example, the COAAP seeks to improve alignment between California’s actions and actions of other West Coast jurisdictions to improve the entire region’s cumulative impacts and efficiency.²²¹ Importantly, the COAAP does not leave out the federal government: it acknowledges that the federal government will have significant influence upon how and whether California achieves many of the COAAP goals due to management of fisheries and ecosystems in federal waters.²²² Several Action Items anticipate and address this by (1) collaborating with West Coast states to speak with one voice in identifying priority needs and partnering opportunities with the federal government; and (2) building national-level partnerships that simultaneously improve California’s success at implementing the COAAP.²²³ In addition, the COAAP seeks to build an international coalition to increase understanding of OA and spur actions that adapt to and reduce the causes of it.²²⁴ This brings the issue to the global stage, as it impacts the global oceans, but also allows for idea sharing and localized solutions via smaller levels of bioregional cooperation. This is a robust policy guide for many environmental issues that have trans-jurisdictional effects.

Of particular relevance to ROFs, the COAAP looks to multiple nature-based solutions and supports the use of ROFs. Strategy Four is to deploy

216. See generally CAL. OCEAN ACIDIFICATION ACTION PLAN, *supra* note 10.

217. *Id.* at 3.

218. *Id.* at 42.

219. *Id.* at 43.

220. *Id.*

221. *Id.* at 45.

222. *Id.* at 43.

223. *Id.* at 44.

224. *Id.*

living systems to slow OA and store carbon.²²⁵ This includes evaluating and advancing “aquaculture approaches that optimize OA amelioration and carbon storage, while benefiting shellfish production.”²²⁶ Action Item 4.2.3 states we should “continue to develop, evaluate, and refine kelp-farming aquaculture as a way to locally ameliorate OA while producing commercial products, such as food, biofuels, agricultural amendments, and water pollution treatment services.”²²⁷ As discussed above, it is highly likely the architects of COAAP would find that ROFs also support Action Item 5.3 which includes “adaptive fisheries management under changing and uncertain conditions.”²²⁸ Climate change is causing fluctuating and uncertain conditions and ROFs are a safe response to that.

Given everything discussed thus far, successful legal frameworks to permit and regulate ROFs will include the following elements: (1) inclusive regional cooperation for siting and cross-ecosystem benefits; (2) ecologically and socially appropriate size limits on ROFs, including average and number of employees; and (3) grant programs to help train new ocean farmers and jumpstart improvements to port and processing facilities. The Ocean-Based Climate Solutions Act is a good starting point for individual states to consider what will work best for them and California’s Ocean Acidification Action Plan has transferrable action items that promote regional cooperation.

States have their own laws governing the territorial seas and each will need to consider the Coastal Zone Management Act. Perhaps most importantly for legislation and policy to be effective, it should be specific to ROFs—the name itself requires that the ocean farms are *restorative*, and realizing all the benefits requires polyculture. Not only does polyculture ensure many ecological benefits, but it helps maintain smaller, more socially equitable ROFs that provide the most benefit to local economies because polyculture requires more hands-on work than monoculture. Thus, huge corporations will have a more challenging time creating massive areas of machine-harvested crops. “Food should be centered on people and place,” which is what restorative farming, on land or sea, does.²²⁹ ROFs go beyond food security and jobs, ecosystem services and economy: they create culture and relationships, building more resilient communities.²³⁰

VI. CONCLUSION

Restorative Ocean Farms will soon be a reality in the United States, and now is the perfect time for environmentalists, fishers, tribes, and other

225. *Id.* at 32.

226. *Id.* at 35.

227. *Id.*

228. *Id.* at 40; *see infra* Part III.

229. SMITH, *supra* note 103 at 236.

230. *See generally id.* (the author started a Community Supported Produce and now runs a nonprofit called Greenwave that trains ocean farmers).

community members to rally around them to ensure optimal benefits. Scientific evidence supports a long list of direct and indirect benefits, and economic estimates show that ROFs will boost the economy on the local, regional, and national scale.

Optimization of this new-to-the-U.S. industry requires all voices have a seat at the table. Given the urgency of climate change, ocean acidification, fishing pressure, and the ever-shrinking American middle class, it may feel like a legal revolution is required.²³¹ However, with careful forethought and open minds, states can start supporting ROFs and be prepared for any national legislation that eventually arrives. Looking to previous attempts at legislation will help states determine the best method for them to start supporting ROFs and can give them an idea of what may pass nationally in the future, allowing them to prepare for that eventuality. By beginning regional cooperation now, communities can have a strong voice in forming not only their local ROF policies, but also by making their wishes clear to their representatives who work on national legislation.

Most importantly, the emergence of ROFs in the United States signals that we may be changing our relationship with our ecosystem. As humanity experiences a collective loss of biodiversity, habitat, and community, the non-Indigenous interest in seaweed farming “maybe is an indicator of re-centering relationship—what each of our places wisely has to feed us, and what we wisely have to give to our places in turn.”²³² Industrialized nations have consistently viewed “nature” as a thing from which we extract “resources.” Mass environmental destruction and climate change are evidence that this approach only harms us, as humans are clearly dependent on “nature,” and thus, there is no separation between “nature” and people. Where else does our economy come from? This collective consciousness shift can be seen in ROFs. The first Restorative Ocean Farm in the U.S. was made by a concerned fisherman who asked himself: “[w]hat does the ocean want us to grow?”²³³ This perspective shift looks at the ecosystem as our partner in life. This perspective shift asks how agriculture, fishing, building, and everything else we do, can be done in harmony with the ecosystem. Our interactions with the world will be completely different if we start asking the right questions. How does this ecosystem want to support us? How can my legal practice be a healing practice?

231. *America’s Shrinking Middle Class: A Close Look at Changes in Metropolitan Areas – Report*, PEW RSCH. CTR. (May 11, 2016), <https://perma.cc/ALR5-M7WS>. (“From 2000 to 2014 the share of adults living in middle-income households fell in 203 of the 229 U.S. metropolitan areas examined in a new Pew Research Center analysis of government data. The decrease in the middle-class share was often substantial, measuring 6 percentage points or more in 53 metropolitan areas, compared with a 4-point drop nationally. The shrinking of the middle class at the national level, to the point where it may no longer be the economic majority in the U.S., was documented in an *earlier analysis* by the Pew Research Center”).

232. Claudia Geib, *By Cultivating Seaweed, Indigenous Communities Restore Connection to the Ocean*, MONGABAY (Jan. 14, 2022), <https://perma.cc/3FTN-XUWU>.

233. Important, Not Important, *supra* note 3 at 49:27.
