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Marine Protected and Conserved Areas: Beneficial Uses of Artificial Intelligence

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MARINE PROTECTED AND CONSERVED AREAS: BENEFICIAL USES OF ARTIFICIAL INTELLIGENCE

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The ocean covers just over 70 percent of the surface of the planet and is full of life and natural resources, providing essential functions for the planet and its people.[1] For management purposes, the ocean surface is divided into two jurisdictions: national waters and areas beyond national jurisdiction.[2] In the United States, 26 percent of marine waters are protected, and less than 1 percent of marine waters in the European Union are under "true marine protection," defined as no-take zones.[3] The ocean environment is in grave danger and faces problems such as illegal, unreported, and unregulated ("IUU") fishing, land-based and sea-based pollution including toxins and plastics, and climate change.[4] One-third of worldwide fish stocks have been depleted beyond sustainability,[5]

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1 *Ocean*, NAT'L GEOGRAPHIC, https://education.nationalgeographic.org/resource/ocean/ (last visited Apr.1, 2024).

2 *See generally Maritime Zones and Boundaries*, NOAA, https://www.noaa.gov/maritime-zones-and-boundaries (last visited Apr. 1, 2024).

3 *See generally* BARBARA LAUSCHE, IUCN WCPA, GUIDELINES FOR PROTECTED AREAS LEGISLATION, 81 IUCN ENV'T POL'Y & L. PAPER 209 (2011); *Scientists Declare Support for the Banning of Destructive Industrial Fishing Methods in the European Union's Marine Protected Areas*, NAT'L. GEOGRAPHIC (Sep. 12, 2022), https://blog.nationalgeographic.org/2022/09/12/scientists-declare-support-for-the-banning-of-destructive-industrial-fishing-methods-in-the-european-unions-marine-protected-areas/; *Understanding Area-Based Management in U.S. Waters*, NOAA, https://marineprotectedareas.noaa.gov/gallery/understanding-area-based-mgmt-in-us-waters.html (last visited Apr. 1, 2024).

4 KIERAN BJERGSTROM & KEVIN FLEMING, SARGASSO SEA COMM'N, GOVERNANCE OF HIGH SEAS ECOSYSTEMS: BIG DATA & AI 40, 50 (2022).

5 *Reducing Harmful Fisheries Subsidies*, PEW TRUSTS, https://www.pewtrusts.org/en/projects/reducing-harmful-fisheries-subsidies (last visited Apr. 1, 2024).

with studies showing that "without government subsidies, as much as 54 percent of high seas fishing grounds would be unprofitable at current fishing rates."[6] The unsustainable use of these resources has become a "tragedy of the commons" in which the oceans lack regulation and are full of vast resources.[7]

The United States formally recognized the need for Marine Protected Areas ("MPAs") in 1972 and created the National Marine Sanctuary Act, overseen by the National Oceanic and Atmospheric Administration ("NOAA").[8] The movement picked up momentum in the 1980s after the third Word National Parks Congress and the formalization of Resolution 17.38 by the International Union for Conservation of Nature ("IUCN").[9] This resolution called for the development of national MPAs that further conservation goals and promote overall welfare.[10] The regulation of MPAs comes in the forms of both hard law and soft law. Hard laws include national statutes and international or regional treaties that have binding legal effect, whereas soft laws are not legally binding and include policy guidelines and other guidance that may be in response to hard law or may be stand-alone guidance where hard law has not been enacted.[11] The hard law approach was encapsulated in the United Nations Convention on the Law of the Sea ("UNCLOS"), which established "an unqualified general obligation on coastal states and other states to protect and conserve the marine environment," but does not include specific institutional authority or regulatory mechanisms for ensuring biodiversity conservation of marine waters outside national jurisdiction, which is the bulk of the ocean.[12]

There are currently over 18,000 MPAs in the world, spanning over 8.16 percent of the ocean.[13] A majority of these MPAs are found within national jurisdictions.[14] Because the existing MPA regulations are only related to areas within national jurisdictions, there is little hard law relevant to the high seas.[15] The high seas are "all parts of the sea that are not included in a country's internal

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6 *See generally* Ernesto Fernandez Monge, *Global Deal Will Help Reduce Overfishing and Improve Ocean Health*, PEW TRUSTS (Sept. 20, 2022), https://www.pewtrusts.org/en/research-and-analysis/articles/2022/09/20/global-deal-will-help-reduce-overfishing-and-improve-ocean-health; *Reducing Harmful Fisheries Subsidies*, *supra* note 5.

7 BJERGSTROM & FLEMING, *supra* note 4, at 11.

8 Sue Wells et al., *Building the Future of MPAs – Lessons from History*, 26 AQUATIC J. 101, 106 (2016).

9 *Id.* at 107.

10 *Id.*

11 LAUSCHE**,** *supra* note 3, at 67.

12 *Id.* at 223.

13 *Explore the World's Protected Areas*, PROTECTED PLANET, https://www.protectedplanet.net/en/thematic-areas/marine-protected-areas (last visited Jan. 28, 2024).

14 Emily Nocito et al., *Applying Marine Protected Area Frameworks to Areas beyond National Jurisdiction*, 14 SUSTAINABILITY 5971, 5971-5972 (2022).

15 LAUSCHE**,** *supra* note 3, at 224.

waters, territorial sea, EEZ or archipelagic waters," while national jurisdictions extend to a nation's exclusive economic zone ("EEZ"), which is 200 nautical miles beyond the territorial sea baseline.[16] The only institution dealing with the high seas is the International Seabed Authority ("Authority").[17]

Within a national jurisdiction, MPAs can be an important legal tool for biodiversity conservation. At the same time, there continue to be a number of shortcomings in the current MPA system that hinder meeting their conservation objectives, and these include three major weaknesses in the current MPA system: 1) historically, areas have been created by a window of opportunity (in other words, a path of least political resistance) and not by scientific analysis of which areas will have the most effective environmental impact on biodiversity value and ecological need; 2) the size considerations for an MPA are difficult because they deal with the regulation of fishing in areas that are constantly changing with the tide; and 3) MPAs can be difficult to enforce—how does an agency effectively keep out illegal fishing and pollution, or control and penalize other violations? Technology has become increasingly useful to help us advance to a stage where we can better identify these problems, but has not yet enabled us to eradicate them.

In a study of Great Barrier Reef National Park, researchers found that wildlife crime—specifically poaching—in marine protected areas significantly undermined the mission of protected areas.[18] With the development and use of new technologies using remote sensing and computers, artificial intelligence can now be employed to protect MPAs from illegal fishing by deploying officers in real time to undertake immediate enforcement actions. This new, technology-based approach provides conservation managers with tools to mitigate the challenges facing MPAs.[19] Solutions for creating resilient MPAs should include the consideration of ecological connectivity "which allows populations to thrive and biodiversity and ecosystem services to be maintained."[20] The Caribbean Regional Fisheries Mechanism ("CRFM") and the Caribbean Community ("CARICOM") announced in April 2022 that this new artificial intelligence technology would be instrumental in their goal of eradicating small arms

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16 *Id.*

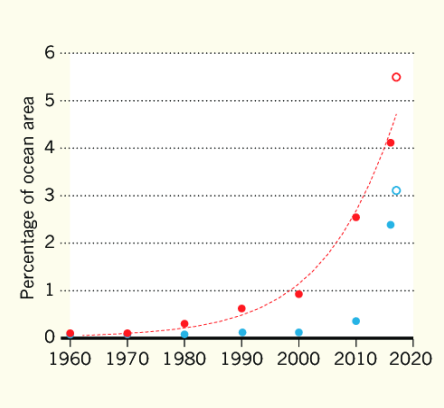
17 *See generally About ISA*, INTERNATIONAL SEABED AUTH., https://www.isa.org.jm/about-isa/ (last visited Apr. 7, 2024).

18 Damian Weekers et al., *Illegal Fishing and Compliance Management in Marine Protected Areas: A Situational Approach*, 10 CRIME SCI. 1, 1–2, 9 (2021).

19 Ellen M. Ditria et al., *Artificial Intelligence and Automated Monitoring for Assisting Conservation of Marine Ecosystems: A Perspective*, MARINE SCI. 1 (2022).

20 BARBARA LAUSCHE ET AL., IUCN WCPA CONNECTIVITY CONSERVATION SPECIALIST GRP'S MARINE CONNECTIVITY WORKING GRP, MARINE CONNECTIVITY CONSERVATION 'RULES OF THUMB' FOR MPA AND MPA NETWORK DESIGN 4 (2021).

trafficking and overfishing in the region.[21] This paper will discuss the background of marine protected areas, the emerging field of marine connectivity, marine management techniques, and the technology itself. Then, the discussion will highlight case studies and the current regulations guiding these principles. Finally, this paper will recommend updating the language of international treaties to include consideration of this new technology. The key focus of this paper is to explore how new technologies providing artificial intelligence can be used for marine conservation and argues that the technology should become an essential support tool if global protection targets are to be met and overall ocean health restored and sustained. To properly protect MPAs, governments need to adopt regulations that protect the use of artificial intelligence for conservation purposes. Artificial intelligence for marine conservation is an effective solution that nations should adopt to reflect recent World Trade Organization ("WTO") legislation, IUCN recommendations, and international data laws.



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[21] *See* Bruce Zagaris, *Caribbean Strengthens Response to Fisheries Crime, Gun Trafficking and Other Crime Issues*, 38 INT'L. ENF'T. L. REP. 23 (2022).

[22] Boris Worm, *Rapid Growth of Marine Protected Areas (MPAs)*, RESEARCH GATE, https://www.researchgate.net/figure/Rapid-growth-of-marine-protected-areas-MPAs-The-percentage-of-the-global-ocean-that_fig2_315500246 (last visited Apr. 7, 2024) (chart showing how MPAs have changed over time).

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I. AN OVERVIEW: REQUIREMENTS FOR MARINE PROTECTED AREAS AND OTHER CONSERVED AREAS

Protected areas were developed as a response to growing global concerns about the conservation of nature,[24] and this popular policy proposal has been embraced around the globe as an effective solution to conserve the ocean's biodiversity, including species, ecosystems, genetic resources.[25] In recent years, the Commission for the Conservation of Antarctic Marine Living Resources ("CCAMLR") has called for the "establishment of marine protected areas," a suggestion taken on wholeheartedly by various governments.[26] A marine protected area ("MPA") is defined by the IUCN as "[a]n area of land and/or sea especially dedicated to the protection of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means."[27] MPAs are also characterized as "any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment."[28]An MPA can include coastal land areas and islands, with varying degrees of protection, and can cover the seabed, flora, fauna, and the water column, and can protect historical sites such as wrecks.[29]

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23 *Protected Areas (WDPA)*, PROTECTED PLANET, https://www.protectedplanet.net/en/thematic-areas/wdpa?tab=WDPA (last visited Apr. 10, 2024) (showing terrestrial and inland waters protected areas in the green and marine protected areas in the blue).

24 BARBARA LAUSCHE, IUCN WCPA, GUIDELINES FOR PROTECTED AREAS LEGISLATION, 81 IUCN ENV'T POL'Y & L. PAPER 11 (2011).

25 *Id.*

26 Aymeric Houstin et al., *Juvenile Emperor Penguin Range Calls for Extended Conservation Measures in the Southern Ocean***,** 9 ROYAL SOC'Y OPEN SCI., 1–2 (2022).

27 GRAEME KELLEHER, WORLD COMM'N ON PROTECTED AREAS, GUIDELINES FOR MARINE PROTECTED AREAS, xvii (Adrian Phillips, Series No. 3. 1999).

28 *Id.* at xviii.

29 *Id.*

The IUCN has established six management categories for protected areas which apply to all protected areas, including MPAs: 1) wilderness areas (areas meant for science or wilderness protection); 2) national parks (designated for the protection of the ecosystem or recreation); 3) natural monuments (natural features that need specific protection); 4) species management areas (areas that requires conservation "through management intervention"); 5) protected seascape or landscape (meant to preserve the sea- or landscape for conservation or recreation); and 6) a managed resource protected area ("managed mainly for the sustainable use of natural ecosystems").[30] There are typically four models of governance for these protected areas: governance by national government, governance by state government, governance by private property owners, and co-management.[31] Each model has a different set of regulations and requires different management strategies.[32]

There are different zones and standards for each MPA.[33] Due to the increasing popularity of Marine Protected Areas, it is important to distinguish the different zones and the standards for an MPA. The ocean zones were defined by the United Nations Convention on the Law of the Sea ("UNCLOS").[34] Each of the different zones for ocean governance have their own independent regulations on MPAs.[35] Therefore, it is important to know the difference of each area. Areas are measured from "the baseline, which normally follows the low-water line along the coast," but differing geographical features in some areas can make this type of measurement difficult.[36] UNCLOS categorizes the ocean zones as the territorial sea, the contiguous zone, the exclusive economic zone, the continental shelf, the high seas, and lastly, the Area.[37] As guidance for design and management of an MPA at the practitioner's level, the IUCN

> recommends that an MPA should seek to meet the following standards: 1) conservation focus with nature as the priority, 2) defined goals and objectives which reflect these values, 3) suitable size, location and design that will enable conservation of values, 4) defined and agreed upon boundary, 5) management plan or equivalent, which addresses the needs for conservation of the site's major values and achievement of its social and economic goals and

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30 *Id.*
31 LAUSCHE**,** *supra* note 3, at 78.
32 *Id.* at 78.
33 *Id.*
34 *Id.* at 223.
35 *Id.*
36 *Id.* at 223.
37 *Id.* at 223–26.

> objectives, and 6) resources and capacity to implement.[38]

Territorial seas are controlled by each sovereign State and do not "exceed[ ] 12 nautical miles, measured from baselines determined in accordance with this Convention [UNCLOS]."[39] An example of an area within the territorial seas is Looe Key Sanctuary Preservation Area in the Florida Keys,[40] a 5.32 square nautical mile area which contains the Looe Key Sanctuary Preservation Area and the Looe Key Special-Use Research Only Area.[41]

The Exclusive Economic Zone ("EEZ") is

> an area beyond and adjacent to the territorial sea. It measures from the territorial sea baseline and extends to a maximum of 200 nm. The coastal state has sovereign rights for "exploring and exploiting, conserving and managing the natural resources, whether living or non-living, of the water superjacent to the seabed and of the seabed and its subsoil."[42]

The EEZ will be the primary focus of this paper, as this is where most of the current MPAs are located.

The Continental Shelf is the seabed and subsoil of the areas that extend beyond the territorial seas.[43] Coastal states have the right to exercise control over the natural resources of these areas, which extend 200 nautical miles from the baseline.[44] However, the state might not control the water column above the shelf, often considered part of the high seas.[45] This means that the state cannot exercise control over living resources in that column, such as fish.[46]

The high seas "comprise all parts of the sea that are not included in a country's internal waters, territorial sea, EEZ, or archipelagic water."[47] The high seas remain open for all states, whether they occupy a coastline or not.[48] Further, all states have the freedom to fish, conduct research, lay down pipes or cables, and navigate EEZs.[49] The high seas make up 64 percent of the ocean and are of

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38 JON DAY ET AL., IUCN, GUIDELINES FOR APPLYING THE IUCN PROTECTED AREA MANAGEMENT CATEGORIES TO MARINE PROTECTED AREAS 8 (2d ed. 2019).

39 U.N. Convention on the Law of the Sea, *opened for signature* Dec. 10, 1982, 1833 U.N.T.S. 397, art. 3 (entered into force Nov. 16, 1994).

40 *See Looe Key Sanctuary Preservation Area*, NOAA, https://floridakeys.noaa.gov/zones/spas/looekey.html (last visited Apr. 1, 2024).

41 *Id.*

42 BARBARA LAUSCHE, IUCN WCPA, GUIDELINES FOR PROTECTED AREAS LEGISLATION, 81 IUCN ENV'T POL'Y & L. PAPER 209, 224 (2011).

43 *Id.* at 225.

44 *Id.*

45 *Id.* at 224.

46 *Id.*

47 *Id.* at 225.

48 *Id.*

49 *Id.* at 224.

higher biological importance than the other ocean zones.[50] In addition, these areas—which lie beyond national jurisdictions—act as a climate regulator, "with half a billion tonnes of carbon dioxide captured by ABNJ [areas beyond national jurisdiction] per year."[51] The high seas are also crucial for marine connectivity, acting as highways for migratory species such as sharks and whales that cross the human-made boundaries.[52] When creating management plans, many governments unfortunately fail to consider the importance of connectivity to effective preservation of these areas.[53]

The Area is "[t]he seabed, ocean floor, and subsoil thereof, beyond the limits of national jurisdiction" beyond the continental shelf.[54] UNCLOS governs the Area and requires in Article 140 of Part XI that all activities be carried out with mankind's interests in mind.[55] UNCLOS then grants regulatory authority to "organize and control activities in The Area"[56] to the Authority.[57]

There are eighteen types of MPAs, each with distinct rules regarding fishing, boating, and other human use.[58] Some MPAs, like marine reserves (also known as no-take MPAs), prohibit the removal of any plant or animal from the area, compared with marine sanctuaries which limit human activity without prohibiting it completely.[59] Both are popular within the Florida Keys. A marine sanctuary "uses a strategy called 'marine zoning' to protect special habitat types, such as corals, to avoid conflict by user groups such as divers and anglers."[60]

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50 Fae Sapsford, *What Is High Seas Governance?*, NOAA OCEAN EXPLORATION (July 20, 2022), https://oceanexplorer.noaa.gov/facts/high-seas-governance.html.

51 MARIA-GORETI MUAVESI ET AL., ADVANCING ENVIRONMENTAL LAW IN THE PACIFIC, IUCN OCEANIA 82 (2022); *How MPAs Safeguard the High Seas*, PEW TR. (Aug. 19, 2019), https://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2019/08/how-mpas-safeguard-the-high-seas.

52 *How MPAs Safeguard the High Seas*, PEW TR. (Aug. 19, 2019), https://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2019/08/how-mpas-safeguard-the-high-seas.

53 *See id.*

54 LAUSCHE**,** *supra* note 3, at 226.

55 U.N. Convention on the Law of the Sea, *opened for signature* Dec. 10, 1982, 1833 U.N.T.S. 397, art. 139, ¶ 1 (entered into force Nov. 16, 1994).

56 *Id.* at art. 157, ¶ 1.

57 LAUSCHE**,** *supra* note 3, at 226.

58 *See* MICHELLE BENDER, AN EARTH LAW FRAMEWORK FOR MARINE PROTECTED AREAS: ADOPTING A HOLISTIC, SYSTEMS AND RIGHTS- BASED APPROACH TO OCEAN GOVERNANCE, EARTH L. CTR., 21–23 (2017) (referencing "Uniform Multiple-Use MPAs, Zoned Multiple-Use MPAS, Zoned Multiple-Use With No Take Areas, No-Impact MPA, No Access MPA, Marine Reserves, European Marine Sites, Marine Sanctuaries, Marine Conservation Zones, Ramsar Sites, Marine Conservation Areas, Marine Parks, Marine Wildlife Refuges, Marine Recreational Management Areas, Seasonal Closures/Temporary Closures, Monuments, Strict Nature Reserve, and Protected Seascape").

59 *Id.* at 21–22.

60 *Florida Keys National Marine Sanctuary Regulations*, NOAA, https://floridakeys.noaa.gov/regs/ (last visited Apr. 5, 2024).

For example, in order to preserve its marine habitats, the reef at Looe Key prohibits spearfishing, removing materials, crabbing, lobstering, and fishing.[61]

More common than no-take MPAs in many countries is the multiple-use MPA, "where different levels of activity are allowed in different zones."[62] An example of a multiple-use MPA is the Great Barrier Reef Marine Park in Australia.[63] The 348,000 square kilometer reef is a World Heritage site regulated by the Great Barrier Reef Marine Park Act of 1975 and has both fishing zones and no-take zones.[64] Commonly, a strictly protected MPA regulation type receives pushback from local populations who often rely upon the biodiverse areas for sustenance and tourism.[65] In the Florida Keys, for example, tourism and ocean recreation are a part of the lifestyle and provide for 58 percent of the local economy.[66] This includes 33,000 jobs and $2.3 billion in annual sales based around ocean recreation and tourism.[67] Approximately 400,000 visitors a year are estimated to spend over $270 million in recreational fishing in the Keys.[68] The harvest revenue for fishermen in the Florida Keys was estimated at $56.5 million, with sales totaling $92.2 million.[69] Needless to say, fishing, ocean tourism, and the jobs that the ocean provides are vital for ocean-based communities such as the Florida Keys.

Finally in this discussion of types of marine protection tools, it is important to briefly note a new protection concept recently recognized as one of the conservation categories relevant for biodiversity conservation. The category, applicable to both land and sea, is called "[O]ther effective area-based conservation measures" ("OECMs") which serve as another solution to conserve different areas of the ocean.[70] In broad terms, this includes any areas that are still governed in a way that ensures long-term conservation but do not qualify as a protected area.[71] Today, the Convention on Biological Diversity definition is "a

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61 *Id*.

62 *No-Take Zone*, NAT'L GEOGRAPHIC, https://education.nationalgeographic.org/resource/no-take-zone/ (last visited Apr. 5, 2024).

63 *See id.*

64 *Great Barrier Reef*, UNESCO, https://whc.unesco.org/en/list/154/ (last visited Apr. 5, 2024).

65 *See A Path to Creating the First Generation of High Seas Protected Areas*, PEW TR. (Mar. 31, 2020), https://www.pewtrusts.org/en/research-and-analysis/reports/2020/03/a-path-to-creating-the-first-generation-of-high-seas-protected-areas.

66 *Florida Keys National Marine Sanctuary Socioeconomics*, NOAA, https://sanctuaries.noaa.gov/science/socioeconomic/factsheets/floridakeys.html (last visited Apr. 5, 2024).

67 *See id*.

68 *Id*.

69 *Id*.

70 *IUCN WCPA Other Effective Area-Based Conservation Measures Specialist Group*, IUCN, https://www.iucn.org/our-union/commissions/group/iucn-wcpa-other-effective-area-based-conservation-measures-specialist (last visited Apr. 5, 2024).

71 *Id*.

geographically defined area other than a Protected Area, which is governed and managed in ways that achieve positive and sustained long-term outcomes for the in situ conservation of biodiversity, with associated ecosystem functions and services and where applicable, cultural, spiritual, socio-economic, and other locally relevant values[.]"[72]

An example of an OECM is the Offshore Pacific Seamounts and Vents Closure off the western coast of Canada.[73] The conservation target of this area is the irreplaceable seamounts and hydrothermal vents.[74] The management plan prohibits bottom contact, which could potentially damage these ecological structures.[75] Current legal and institutional frameworks that guide MPA managers and policymakers include the Convention on Biological Diversity, UNCLOS, IUCN *Guidelines on Marine Protected Areas*, and the Ramsar Convention.[76]

In summary, MPAs are dependent on location of the area of the sea, the type of governance applied, the categorization of the MPA, and the management category.[77] Each has their own management plan, their own regulations, and requires different legal considerations.[78]

II. WHAT IS ARTIFICIAL INTELLIGENCE AND BIG DATA?

In this paper, the definition of artificial intelligence ("AI") comes from 15 U.S.C. § 9401(3), which defines AI as "a machine-based system that can, for a given set of human-defined objectives, make predictions, recommendations or decisions influencing real or virtual environments."[79] As applied to marine conservation and marine resource management, the basket of AI includes technology that can transform the field of marine management. Big data is generally "used for the collection and analysis of a large amount of electronic data by using special and complex algorithms."[80] Since AI algorithms produce

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72 Conference of the Parties to the Convention on Biological Diversity, *Decision Adopted by the Conference of the Parties to the Convention on Biological Diversity*, U.N. Doc. CBD/COP/DEC/14/8 (Nov. 30, 2018).

73 *Offshore Pacific Seamounts and Vents Closure*, PROTECTED PLANET, https://www.protectedplanet.net/555651733 (last visited Apr. 5, 2024).

74 *See Offshore Pacific Seamounts and Vents Closure*, GOV'T OF CAN., https://www.dfo-mpo.gc.ca/oceans/oecm-amcepz/refuges/offshore-hauturiere-eng.html (last visited Apr. 5, 2024).

75 *See id.*

76 *See generally* LAUSCHE**,** *supra* note 3, at 224.

77 *Id*. at 211–13, 221.

78 *Id*. at 211–13, 219–22.

79 15 U.S.C. § 9410(3).

80 *Big Data Rules and Regulations – Part 1*, LAW OFF. OF SALAR ATRIZADEH: INTERNET

a large amount of data and require a large amount of data to produce accurate results, the two concepts go hand-in-hand.[81] One of the newest ways that the two work together is in the modeling of seabed resources, a hot button issue with the emergence of deep-sea mining.[82] This technology can detect the distribution of minerals within the Earth's crust and can indicate where mining would produce fruitful results.[83] The lack of marine laws to regulate the new technology and dated policies remain a significant issue.

The deep sea plays an essential role for achieving sustainable natural systems and a healthy planet, supporting life as we know it, both in policymaking and for sustainable resource management and conservation. The different applications and oversight approaches of AI today will affect how it is used in the deep sea tomorrow. The Massachusetts Institute of Technology's ("MIT") Department of Earth, Atmospheric and Planetary Sciences has started to use AI and machine learning to study patterns within the ocean.[84] The Stanford Robotics Lab is also using this technology to develop a remotely-operated system called OceanOne ROV to explore the deep ocean.[85] This technology is of interest to oil and gas giants such as ExxonMobil, which is working with MIT to develop technology to further their interests in the deep sea.[86] The Korea Institute of Ocean Science and Technology has developed an underwater robot to fix pipes for oil transport under the water.[87] How this technology is regulated now—closer to shore—will dictate how it will be regulated at greater depths in the future.

III. MARINE CONNECTIVITY

The emerging field of marine connectivity is rapidly gaining traction in discussions about effective marine management. This field is increasingly appreciated as a key aspect framing the future of marine protection and is

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L. BLOG (May 9, 2022), https://www.internetlawyer-blog.com/big-data-rules-and-regulations/#:~:text=May%209%2C%202022%20%7C%20by%20Law,would%20not%20make%20sense%20independently.

81 *See* Min Jiang & Zhiyuan Zhu, *The Role of Artificial Intelligence Algorithms in Marine Scientific Research*, 9 FRONTIERS MARINE SCI., May 2022, https://www.frontiersin.org/articles/10.3389/fmars.2022.920994/full.

82 *Id.*

83 *Id.*

84 EFY Bureau, *AI for Ocean Exploration: Is an AI Colony Possible in the Deep-Sea?*, ELECTR. FOR U (Apr. 17, 2021), https://www.electronicsforu.com/technology-trends/must-read/ocean-exploration-ai-colony-deep-sea#:~:text=First%20underwater%20AI%20colony&text=Chinese%20scientists%20are%20set%20to,the%20South%20China%20Sea's%20surface.

85 *Id.*

86 *Id.*

87 *Id.*

popular among both scientists and policymakers to show how much conservation is needed. In order for an MPA to be effective, ecological connectivity must be implemented. Implementation "allows populations to thrive and biodiversity and ecosystem services to be maintained."[88] Connectivity was defined when the Convention on Migratory Species "adopted a policy resolution in 2020 stating that '[e]cological connectivity is the unimpeded movement of species and the flow of natural processes that sustain life on Earth.'"[89] In 2012, the Commission for Environmental Cooperation, an organization established by Canada, Mexico, and the United States to implement the North American Agreement on Environmental Cooperation, produced a guide for designing resilient MPAs with climate change which explained that "MPA networks are especially suited to addressing spatial issues of connectivity[,] . . . habitat heterogeneity and the spatial arrangement and composition of constituent habitats, all of which can contribute to ecosystem resilience."[90] Connectivity conservation has a large impact on animals who migrate seasonally, such as basking sharks, which move from New England to the Bahamas every year, and require forethought in MPA implementation to account for their migratory lifestyle.[91]

Accordingly, marine connectivity is an intrinsic part of marine management and is an important consideration when making legal recommendations. There are two types of connectivity: functional and structural.[92] Functional connectivity focuses on how easily the different species move through an area, while structural connectivity describes how well the habitats thrive within an area to make it possible for the functional connectivity to be operative.[93] The areas that are managed for connectivity are called ecological corridors.[94] Ecological connectivity between the high seas and coastal areas "has been scientifically proven, as a growing body of literature and evidence suggests that both are tightly linked via two processes: ecological connectivity and ocean circulation connectivity, each exposing ecosystems of coastal waters to downstream influence of activities in ABNJ."[95] This paper focuses on marine

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88 BARBARA LAUSCHE ET AL., IUCN WCPA CONNECTIVITY CONSERVATION SPECIALIST GRP'S MARINE CONNECTIVITY WORKING GRP, MARINE CONNECTIVITY CONSERVATION 'RULES OF THUMB' FOR MPA AND MPA NETWORK DESIGN 4 (2021).

89 *Id.* at 5.

90 COMM'N FOR ENV'T COOPERATION, GUIDE FOR PLANNERS AND MANAGERS TO DESIGN RESILIENT MARINE PROTECTED AREA NETWORKS IN A CHANGING CLIMATE ix (2012).

91 Gregory Skomal et al., *Transequatorial Migrations by Basking Sharks in the Western Atlantic Ocean*, 19 CURRENT BIOLOGY 1019, 1019 (2009).

92 LAUSCHE**,** *supra* note 3, at 6.

93 *Id.*

94 *See id.*

95 Olivia Livingstone & John Paul Jose, *Connectivity of the High Seas to Coastal*

connectivity since "migratory species are increasingly exposed to the effects of a globalizing world,"[96] spanning from coastal areas beyond national jurisdiction.[97] It is estimated that most of the activity and life spans of marine species are "spent in [] 64% of the world's oceans that lie outside national jurisdiction."[98]

How does connectivity impact marine animals and their habitats? Much like the example of the basking sharks, many oceanic species are migratory and spend portions of their life cycles beyond the constraints of MPA-set nautical miles and depths.[99] Sharks serve as an excellent example of species with migratory routes and lives that extend far beyond protection.[100] Bull sharks, white sharks, whale sharks, and scalloped hammerheads offer conservationists examples of the importance of considering spatial marine planning.[101] Genetic connectivity is the observation of how populations interact with one another and considers factors such as movement of mating adults or exchange of larvae.[102] This theory is useful when translating scientific observations into tangible results, especially when relevant to determining the scope of an MPA. MPAs that protect large sharks and rays are currently using the theory of population and species interaction observed through the study of genetic connectivity; they often require "protection of a wide range of habitat types used by many shark species at different life stages; protect pelagic sharks whose home ranges extend beyond coastal areas of most MPAs; and encompass a mosaic of ecologically connected habitats beneficial for wide-ranging sharks."[103] This statement recognizes the difficulty of creating a safe habitat for larger ocean creatures, which are harder to protect than the reef dwellers. The chart below follows three bull sharks' migratory patterns, which span from the Gulf Coast to the Atlantic Ocean.[104] It also follows tiger sharks, and one shark documented in the study,

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Waters, HIGH SEAS ALL. (May 21, 2021), https://highseasalliance.org/2021/05/21/connectivity-of-the-high-seas-to-coastal-waters/.

96 Daniel C. Dunn et al., *The Importance of Migratory Connectivity for Global Ocean Policy*, 286 PROC. ROYAL SOC'Y B 1, 2 (2019).

97 *Id.*

98 *Id.*

99 Gregory Skomal et al., *Transequatorial Migrations by Basking Sharks in the Western Atlantic Ocean*, 19 CURRENT BIOLOGY 1019, 1019 (2009).

100 CASSANDRA L. RIGBY ET AL., WORLD WILDLIFE FUND, A PRACTICAL GUIDE TO THE EFFECTIVE DESIGN AND MANAGEMENT OF MPAS: FOR SHARKS AND RAYS 27 (2019).

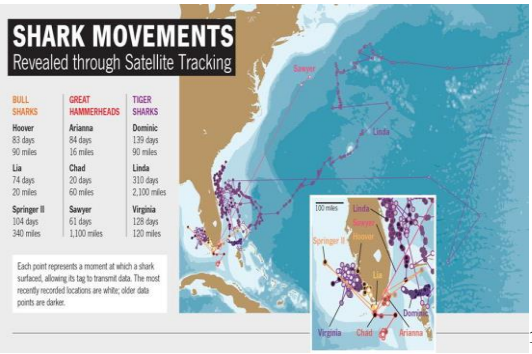
101 *Id.*

102 *See* Clara L. Mackenzie et al., *Genetic Connectivity and Diversity of a Protected, Habitat-Forming Species: Evidence Demonstrating the Need for Wider Environmental Protection and Integration of the Marine Protected Area Network*, 9 FRONTIERS MARINE SCI. 1, 3 (2022).

103 RIGBY *supra* note 101, at 11.

104 *Tracking Sharks – Shark Research & Conservation Program (SRC)*, UNIV. MIAMI, https://sharkresearch.earth.miami.edu/research/projects/gps-for-sharks/ (last visited Apr. 7,

named Linda, traveled a stunning 2,100 miles in 310 days, going far beyond the reach of just one MPA.[105]



[106]

Keeping this data in mind, MPAs must address these larger creatures and must be made with these migratory patterns in mind. This example demonstrates the impact that connected MPAs would have on a shark's lifespan and why connected MPAs remain important.

IV. MPA MANAGEMENT

Producing high-certainty evidence that meets the requisite threshold required for policy implementation is a significant initial barrier to effective marine management and ocean governance.[107] The idea behind marine management is that

> Ocean Governance is a strategy oriented towards sustainable use and ecological regeneration that is used to manage human activities. It is informed by, and includes, a whole range of economic, scientific, ecological, and financial activities and policies, covering all events in the ocean space at local, regional, national, and global levels.[108]

This strategy is vital when creating effective marine management strategies because it addresses the issues of human activity and marine activity.[109]

V. USING AI TO PROTECT MPAS/OECMS FROM ILLEGAL FISHING

AI technology currently, and increasingly in the future, may provide

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2024).

105 *Id.*

106 *Id.*

107 BJERGSTROM & FLEMING, *supra* note 4, at 7.

108 *Id.*

109 *See id.*

significant aid for the implementation of laws and regulations to further effective marine management. Through artificial intelligence and big data, marine connectivity[110] efforts can be realized, and fishing crimes can be eradicated. The development of AI technologies for vessel tracking includes the electromagnetic spectrum, which under the Automatic Identification System, "radio-borne data . . . is now mandated to be fitted to ships over 300 tonnes displacement to allow suitable safe separation from each other."[111] However, this technology can be made ineffective because it allows for human manipulation to display incorrect data and can even be disconnected. This would enable the ship to become a so-called dark vessel, which means it would not be shown on any map.[112] This could lead to illegal fishing activity, and the ship must be supplemented with different technology in order for regulation to become more effective.[113] Through the use of artificial intelligence and big data methods, these gaps can be filled.

Proposed solutions to address the issue of data gaps with such technology include the use of "an autonomous surface vehicle model system for the surveillance of marine areas by detecting and recognizing vessels through artificial intelligence-based image recognition services."[114] Accordingly, "AI methods can be used to automate statistical data analysis processes, intelligently responding to context based on pre-defined rules, and applying logically straightforward . . . strategies to self-improve analytic accuracy or performance."[115] The rise in popularity of this technology is due in part to the surprising affordability of the type of artificial intelligence used for automated monitoring. Because of its affordability, it serves as an attractive option for monitoring ecosystems using the relevant scales.[116] Big data can provide aggregated data points that create a larger picture, such as compiling photographs of the seabed.[117] The combination of AI and big data produces effective ocean governance techniques illustrated by the launch of the Marine Data Sharing and Preservation tool by the National Oceanography Centre and

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110 *See* ABIGAIL BREUER ET AL., ECOLOGICAL CONNECTIVITY POLICY COMPENDIUM: U.S. POLICIES TO CONSERVE ECOLOGICAL CONNECTIVITY 2007–2021 3 (2022) ("Ecological connectivity (or simply connectivity) is the unimpeded movement of organisms, species, and genes on a daily, seasonal, and/or annual basis and sustains critical ecological processes, such as the flow of nutrients and energy.").

111 BJERGSTROM & FLEMING, *supra* note 4, at 24.

112 *See id.*

113 *See id.*

114 J. Carlos Molina-Molina et al., *Autonomous Marine Robot Based on AI Recognition for Permanent Surveillance in Marine Protected* Areas, NAT'L LIBR. OF MED. Apr. 10, 2021, at 1.

115 *See* BJERGSTROM & FLEMING, *supra* note 4, at 33.

116 *See* Ditria et al., *supra* note 19, at 1, 3.

117 *See* Jennifer M. Durden et al., *Integrating "Big Data" into Aquatic Ecology: Challenges and Opportunities* 26 LIMINOLOGY AND OCEANOGRAPHY BULL. 101, 102 (2017).

the Scripps Plankton Camera System by the Scripps Institution of Oceanography.[118]

Examples of developing technology from the United States include a project from NOAA that has employed revolutionary practices of using artificial intelligence to monitor whale activity.[119] This technology, called Wild Me Flukebook matches whale photographs to track the migration of whales and dolphins to provide data to scientists to better support scientific research.[120] By using a machine learning server, Wildbook Image Analysis ("WBIA") provides a "multi-stage pipeline (PyTorch) for finding one or more animals of one or more species in photos and then routing each detected animal on to the correct individual ID algorithm."[121] NOAA has also been using satellites in combination with machine learning to track marine animals.[122] This AI can be used to inform government policymakers about which areas are frequented by migratory animals and can also be used to track the effect that different MPAs have on species.

Other tools include the Global Fishing Watch Marine Manager, which is a "freely available, innovative technology portal. . . . It provides near real-time, dynamic and interactive data on ocean conditions, biology, and human-use activity to support marine spatial planning, marine protected area design and management, and scientific research."[123] This includes using AI technology to track fishing and vessel activity.[124] For the fishing detection algorithm, this technology uses data collected through satellites and terrestrial receivers and inputs this data into the automatic identification system's server.[125] The fishing detection algorithm is then applied to the data "to determine 'apparent fishing effort' based on changes in vessel speed and direction."[126] Typically, boats are

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118 *Scripps Plankton Camera System*, SCRIPPS INST. OF OCEANOGRAPHY, https://spc.ucsd.edu/about-spc/ (last visited Apr. 18, 2024).

119 *Artificial Intelligence: Right Whale Photo Identification*, NOAA FISHERIES, https://www.fisheries.noaa.gov/new-england-mid-atlantic/science-data/artificial-intelligence-right-whale-photo-identification (June 9, 2022).

120 *Flukebook*, WILD ME, https://www.wildme.org/flukebook.html (last visited Apr. 12, 2024).

121 *IRCAI Global Top 100 List (2021)*, UNESCO, https://ircai.org/top100/entry/wildbook/ (last visited Mar. 21, 2024).

122 *Geospatial Artificial Intelligence for Animals*, NOAA FISHERIES, https://www.fisheries.noaa.gov/new-england-mid-atlantic/science-data/artificial-intelligence-detecting-marine-animals-satellites (Aug. 25, 2023).

123 *Welcome to Global Fishing Watch Marine Manager*, GLOB. FISHING WATCH, https://globalfishingwatch.org/map/marine-manager?latitude=19&longitude=26&zoom=1.5 (last visited Apr. 12, 2024).

124 *Id.*

125 *Id.*

126 *Id.*

tracked through the automatic identification system (AIS) MarineTraffic tool.[127] However, when "a vessel's operator decides to turn-off their AIS or VMS transmitter to hide their whereabouts and activity" these fallback technologies can still track the ships.[128] Therefore, this "sea blindness can be turned into sea vision."[129] This technology is reliant on Visible Infrared Imaging Radiometer Suite ("VIIRS"), Electro-optical ("EO") cameras, and Synthetic Aperture Rader ("SAR") arrays.[130] NOAA has collaborated with VIAME to create an automated image analysis strategic initiative through open-source computer vision software.[131] This will address the concerns brought forth by the Sargasso Sea Commission on the inability to govern ships that commit fishing crimes.[132]

VI. CASE STUDIES

The first case study is on an area that is beyond national jurisdiction, something that future regulations will have to tackle. The Governance of High Seas Ecosystems Project by the Sargasso Sea Commission is a relevant case study on the use of AI and big data in a marine protected area.[133] This project was funded by the Swedish government through the International Union for Conservation of Nature.[134] The Sargasso Sea is an area with international jurisdiction, which spans two million square miles. [135] It is the "only sea without a land boundary"[136] and is known for being a "vast patch of ocean named for a genus of free-floating seaweed called Sargassum," which is home to many species ranging from humpback whales to hatchling turtles.[137] Data from the project is reviewed by the Ocean Innovation Challenge, a project that invests in technology relevant for marine protection.[138] This paper proposes that through the use of AI methods and compilation of data through big data efforts, marine governance and marine spatial planning will have substantive examples of management tools to support legal and policy drafting.[139] It also illustrates a

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127 *We Value Your Privacy*, MARINE TRAFFIC, https://www.marinetraffic.com/en/ais/home/centerx:-43.9/centery:52.6/zoom:2 (last visited Apr. 12, 2024).

128 BJERGSTROM & FLEMING, *supra* note 4, at 25.

129 *Id.*

130 *Id.*

131 *A Do-It-Yourself AI System for Analyzing Imagery and Video*, VIAME, https://www.viametoolkit.org/ (last visited Apr. 6, 2024).

132 BJERGSTROM & FLEMING, *supra* note 4, at 51.

133 *Id.* at 5.

134 *Id.*

135 *Id.*

136 *What Is the Sargasso Sea?,* NOAA, https://oceanservice.noaa.gov/facts/sargassosea.html (Jan. 4, 2021).

137 *Id.*

138 BJERGSTROM & FLEMING, *supra* note 4, at 18.

139 *See id.* at 19.

recent program that is using technology to protect this area—"a major Ecosystem Diagnostic Analysis (EDA) financed by grants from the Global Environment Facility and the French Global Environment Fund."[140]

The Sargasso Sea is unique because of the habitats that it protects and because it is defined not by land boundaries but by ocean currents.[141] It is found closest to North America and spans down to South America.[142] The management of this area is the responsibility of the South Atlantic Fisheries Management Council, and "[a]lthough the Sargasso Sea does not lie within the U.S. EEZ, the management of sargassum areas within the U.S. EEZ is part of supporting the health of [the] high seas region."[143] The management plan defines how much sargassum can be harvested per year, which methods and tools are allowed for the harvest, and the environmental impacts.[144] Environmental impacts include the protection of federally protected sea turtles.[145] These sea turtles rely on the sargassum: "post-hatchling sea turtles migrate from on-shore beach nesting areas through State jurisdictional waters on their way to a pelagic existence, the *Sargassum* mats first encountered by the baby turtles are likely to be situated in State waters."[146] This case study serves as an example of areas that are biologically diverse, but the location of the area (or in this case, the roaming location of the area), makes it difficult for nations to regulate. AI could help with the regulation of this moving patch of seaweed, allowing for the existing regulations to become more effective.

A second case study concerning the Costa Rica Thermal Dome in the eastern tropical Pacific Ocean was recently highlighted in a paper by Pew Trusts.[147] This region is unique because of the "interaction of surface winds and surrounding ocean currents that drive deep, cold, nutrient-rich water up towards the warmer surface."[148] This nutrient-rich area of the ocean "attracts a high diversity of

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140 *Id.* at 5.

141 *What Is the Sargasso Sea?*, NOAA, https://oceanservice.noaa.gov/facts/sargassosea.html (Jan. 4, 2021).

142 Raj Bhattacharya, *Sargasso Sea*, BERMUDA ATTRACTIONS, https://www.bermuda-attractions.com/bermuda2_000142.htm (last visited Apr. 4, 2024).

143 *Sargasso Sea*, OCEAN FOUND., https://oceanfdn.org/sargasso-sea/ (last visited Apr. 4, 2024).

144 *Fishery Management Plan for Pelagic* Sargassum *Habitat of the South Atlantic Region*, SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL ix (Nov. 2002), https://oceanfdn.org/sites/default/files/SAFMC%2BSargassum%2B2002%2B%281%29.compressed.pdf.

145 *Id.* at xi.

146 *Id.*

147 *See generally A Path to Creating the First Generation of High Seas Protected Areas*, PEW TR. (Mar. 31, 2020), https://www.pewtrusts.org/en/research-and-analysis/reports/2020/03/a-path-to-creating-the-first-generation-of-high-seas-protected-areas.

148 *Id.*

species that feed on the readily available and abundant food."[149] This is a hot spot for migratory species.[150] Since this is an area abundant with ocean life, fishing is also popular here. Fishing is estimated to have "brought in approximately US$750 million" in 2009.[151] Locationally, this is "mainly located in the high seas, but also straddles the national waters of Costa Rica, Nicaragua, El Salvador, Guatemala, and México."[152] This area is a strong example of why marine connectivity is important and how to balance the regulation of MPAs that bleed into other zones.

Lastly, this paper looks at the waters within United States national jurisdiction. The third case study is the Florida Keys, an island chain off the coast of Miami that relies on the marine environment for its income.[153] According to *Keys Weekly*, 45 percent of the residents of the Florida Keys are either below the poverty line or barely above it, making the ocean a weighty economic and political issue.[154] Due to its location, many of these residents rely on tourism and the fishing industry to sustain themselves.[155] The Florida Keys National Marine Sanctuary covers over 2,900 square nautical miles.[156] It was established in 1960 with the creation of John Pennekamp Coral Reef State Park, and protections were bolstered in 1972 by the Marine Protection, Research, and Sanctuaries Act.[157] The creation of this sanctuary prohibited "oil exploration, mining, or any type of activity that would alter the seafloor and restrict[ed] large shipping traffic."[158] The most recent management plan is from 2007 and explains that the ecosystem "supports over 6,000 species of plants, fishes, and invertebrates, including the nation's only living coral reef that lies adjacent to the continent."[159] Despite the regulations, there is a lack of implementation. The

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149 *Id.*

150 *See id.* at 7.

151 *Id.* at 14.

152 PROTECTION AND MANAGEMENT OF THE CENTRAL AMERICAN DOME, MARVIVA FOUND. 6 (2013).

153 Leah Stockton, *Coral Reef Restoration in the Florida Keys*, UNITED WAY BLOG (May 6, 2022), https://www.unitedway.org/blog/coral-reef-restoration-in-the-florida-keys#.

154 Sara Mattis, *#Study: Almost 48% of Keys Population Living at, or Very Near, Poverty Level*, KEYS WEEKLY (Nov. 17, 2014), https://keysweekly.com/42/study-almost-48-of-keys-population-living-at-or-very-near-poverty-level/; *Florida Keys National Marine Sanctuary Socioeconomics*, NAT'L MARINE SANCTUARIES https://sanctuaries.noaa.gov/science/socioeconomic/factsheets/floridakeys.html (last visited Apr. 5, 2024).

155 *Florida Keys National Marine Sanctuary Socioeconomics Factsheet*, NOAA, https://nmssanctuaries.blob.core.windows.net/sanctuaries-prod/media/archive/science/socioeconomic/pdfs/fk_final.pdf (last visited Apr. 5, 2024).

156 *History of Florida Keys National Marine Sanctuary*, NOAA, https://floridakeys.noaa.gov/history.html (last visited Apr. 5, 2024).

157 *Id.*

158 *Id.*

159 FLORIDA KEYS NATIONAL MARINE SANCTUARY REVISED MANAGEMENT PLAN, NOAA i (2007).

use of AI could alleviate the burden of policing fishing crimes and allow agencies to focus on other problems that face the area.

VII. CURRENT SOVEREIGN REGULATIONS

The question remains as to how best to regulate the ocean and what we put in it. There is no straight answer. This paper focuses on U.S. sovereign territory and will look toward the future of MPAs and the high seas. For there to be effective regulation on the high seas, there must be groundwork laid in the sovereign regulation of the marine areas.

One of the major issues that faces every coastal country is overfishing and other harmful fishing practices. In recognition of this, UN Sustainable Development Goal 14.4 committed countries "to end overfishing and illegal, unreported and unregulated (IUU) fishing."[160] Unfortunately, these goals have not been accomplished.[161] In June of 2022, President Biden signed a National Security Memorandum with the purpose and intention to create sustainable and long-lasting solutions to IUU fishing practices and other related fishing harms.[162] The Memorandum on Combating Illegal, Unreported, and Unregulated Fishing and Associated Labor Abuses established that the

> Secretaries of State and Defense and the Administrator of USAID shall work with partners to use all available tools to increase maritime domain awareness to combat IUU fishing, including increasing the use of vessel tracking systems, aerial surveillance, and radio frequency data, as well as utilizing emerging technologies such as advances in machine learning paired with synthetic aperture radar, as appropriate.[163]

This is a historic recognition of the need for technology in marine protected area implementation.

Typically, fishing has been regulated internationally by Regional Fisheries Management Organizations ("RFMOs").[164] These are treaty-based organizations with a main goal of ensuring sustainability in the shared fish

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160 Tony Long et al., *Approaches to Combatting Illegal, Unreported and Unregulated Fishing*, 1 NATURE FOOD 389 (2020).

161 *Id.*

162 Press Release, The White House, Fact Sheet: President Biden Signs Nat'l Sec. Memorandum to Combat Illegal, Unreported, and Unregulated Fishing and Associated Lab. Abuses (Jun. 27, 2022) (on file with author).

163 Memorandum from The White House on Combating Illegal, Unreported, and Unregulated Fishing and Associated Labor Abuses (Jun. 27, 2022) (on file with author).

164 *International and Regional Fisheries Management Organizations*, NOAA, https://www.fisheries.noaa.gov/international-affairs/international-and-regional-fisheries-management-organizations (Nov. 8, 2023).

stocks.[165] Interestingly, these fisheries are a cooperative effort of all nation-states interested in the fishing industry—membership is not exclusive to nation-states with access to the ocean.[166] There are nineteen RFMOs in total.[167] The United States is party to or at least an official observer of many of these organizations.[168] Typically, these RFMOs focus solely on fish that have large migratory patterns or are commercially valuable, the perfect example being the tuna fish.[169] However, although the RFMOs draft proposals, they lack ways to enforce compliance with those proposals.[170] There are technologies available, such as catch documentation systems, but they have not been implemented throughout the organizations yet.[171] Furthermore, there is a lack of communication within the fishing industry about who to register boats with and who is regulating what.[172] The next steps forward using AI will be important to create methods of compliance, but administratively, the organizations will need to become more open and communicative.

President Biden signed an agreement during the Summit of Americas that established the groundwork for a network of MPAs focusing on ecological marine connectivity, resulting in a network spanning from Alaska to Patagonia.[173] As a signatory to the Joint Declaration on Americas for the Protection of the Ocean, the United States joined and established the coalition Americas for the Protection of the Ocean, "which has the main objective of creating a space for collaboration, cooperation and coordination at a political level on Marine Protected Areas and Other Effective Area-Based Conservation Measures in the Pacific."[174] This agreement also reinforced Biden's 30x30 plan

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165 *Id.*

166 *Regional Fisheries Management Organisations (RFMOs)*, EUROPEAN COMM'N, https://oceans-and-fisheries.ec.europa.eu/fisheries/international-agreements/regional-fisheries-management-organisations-rfmos_en (last visited Apr. 14, 2024).

167 *See id.*

168 Office of Marine Conservation, *International Fisheries Management*, U.S. DEP'T OF STATE, https://www.state.gov/key-topics-office-of-marine-conservation/international-fisheries-management/ (last visited Apr. 14, 2024); *FAQ: What is a Regional Fishery Management Organization?*, PEW TR. (Feb. 23, 2012), https://www.pewtrusts.org/en/research-and-analysis/fact-sheets/2012/02/23/faq-what-is-a-regional-fishery-management-organization.

169 *FAQ: What is a Regional Fishery Management Organization?*, PEW TR. (Feb. 23, 2012), https://www.pewtrusts.org/en/research-and-analysis/fact-sheets/2012/02/23/faq-what-is-a-regional-fishery-management-organization.

170 *Id.*

171 *Id.*

172 *Id.*

173 Bruce Zagaris, *Caribbean Strengthens Response to Fisheries Crime, Gun Trafficking and Other Issues*, 38 INT'L ENF'T L. REP. (2022), https://ielr.com/content/caribbean-strengthens-response-fisheries-crime-gun-trafficking-and-other-crime-issues.

174 *Joint Declaration on "Americas for the Protection of the Ocean" During the Ninth Summit of the Americas*, GOV'T OF CANADA, https://www.dfo-

by establishing that the group wants to conserve "at least 30% of the ocean by 2030 including through the declaration and effective implementation of a network of Marine Protected Areas."[175]

In the United States, the Biden-Harris Administration published Executive Order 14008, "Tackling the Climate Crisis at Home and Abroad," which mandated the conservation of 30 percent of U.S. land and water by 2030.[176] The order dictates that the Secretary of the Interior will develop a report "recommending steps that the United States should take . . . to achieve the goal of conserving at least 30 percent of our lands and waters by 2030."[177] The report announced eight key principles for successfully creating these protected areas, including "Principle 7: Use Science as a Guide."[178] This principle emphasizes that "[c]onservation efforts are more successful and effective when rooted in the best available science and informed by the recommendations of top scientists and subject matter experts."[179]

Currently, the United Nations General Assembly is in negotiations to discuss a legally binding instrument concerning 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."[180] Criticism of this agreement by the Earth Law Center stresses the need for a framework that creates stronger protections for the high seas to protect it from those who view it as a resource to exploit.[181] Since most of the ocean comprises areas beyond national jurisdiction ("ABNJ"), intellectual property rights "remain an issue for the scientific community as many activities pertaining to the deep-ocean ecosystem will take place within national borders or indeed on land."[182] This agreement is the newest

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mpo.gc.ca/oceans/collaboration/declaration-eng.html (Oct. 5, 2023).

175 *Id.*

176 Exec. Order No. 14,008, 86 Fed. Reg. 7619, 7627 (Jan. 27, 2021).

177 Exec. Order No. 14,008, 86 Fed. Reg. 7619, 7627 (Jan. 27, 2021).

178 U.S. DEP'T OF THE INTERIOR, CONSERVING AND RESTORING AMERICA THE BEAUTIFUL 15 (2021).

179 *Id.*

180 Intergovernmental Conference on an International Legally Binding Instrument under the United Nations Convention on the Law of Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction, *Agreement Under the U.N. Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction*, U.N. Doc. A/CONF.232/2023/4 (June 19, 2023).

181 Letter from Michelle Bender, Earth Law Center, to 5th Session of the Intergovernmental Conference on Marine Biodiversity of Areas Beyond National Jurisdiction (BBNJ IGC5) (Aug. 14, 2022) (on file with author).

182 *Intellectual Property Rights: Implications for Deep-Ocean Stewardship*, DEEP-OCEAN STEWARDSHIP INITIATIVE 1, https://www.dosi-project.org/wp-content/uploads/070-DOSI-Policy-brief-Intellectual-Property-Rights-V2-web1.pdf (last visited Apr. 7, 2024).

legal framework for creating data protections for MPAs and creates avenues for the use of AI and big data in ABNJs.

Other international agreements that relate to marine protected areas include the International Declaration on Transnational Organized Crime in the Global Fishing Industry,[183] the Convention on Migratory Species,[184] and the Convention on Wetlands of International Importance Especially as Waterfowl Habitat.[185] The most important international agreement is UNCLOS.[186] UNCLOS establishes the legal status of the territorial sea.[187] The current legal status of the territorial sea (or ABNJ) is under existing national law and the Convention.[188] This Convention has an accompanying Resolution on Development of National Marine Science, Technology and Ocean Service Infrastructures, which briefly sets forth the framework for establishing law for emerging marine technology and its financing.[189]

The Kunming-Montreal global biodiversity framework, one of the final publications of 2022, acknowledged that "[b]iodiversity is fundamental to human well-being and a healthy planet, and economic prosperity for all people."[190] The purpose of this framework is to implement the three objectives of the Convention on Biological Diversity[191] which are: "[1] the conservation of biological diversity, [2] the sustainable use of its components and [3] the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies."[192] The target of the framework is to conserve 30 percent of water, including inland, coastal, and marine waters, as well as terrestrial areas.[193]

In March 2023, another major international event occurred when countries

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183 *See* The International Declaration on Transnational Organized Crime in the Global Fishing Industry, Oct. 2016, E/CN.15/2017/CRP.3.

184 *See* Environment Programme, UNEP/CMS/Resolution 12.26 (Feb. 2020).

185 *See* Convention on Wetlands of International Importance Especially as Waterfowl Habitat, *opened for signature* Feb. 2, 1971, U.N. No. 14583 (entered into force Dec. 21, 1975).

186 *See generally* U.N. Convention on the Law of the Sea, Dec. 10, 1982, 1833 U.N.T.S. 397.

187 *Id.* at art. II.

188 *Id.*

189 *Id.* at 207.

190 *Introductory Sections of the GBF*, CONVENTION ON BIOLOGICAL DIVERSITY, https://www.cbd.int/gbf/introduction/ (Feb. 21, 2024).

191 *Introductory Sections of the GBF*, CONVENTION ON BIOLOGICAL DIVERSITY (Dec. 7, 2023), https://www.cbd.int/gbf/introduction/.

192 *Article 1. Objectives*¸ CONVENTION ON BIOLOGICAL DIVERSITY (Nov. 2, 2006), https://www.cbd.int/convention/articles/?a=cbd-01.

193 *Target 3: Conserve 30% of Land, Waters and Seas*, CONVENTION ON BIOLOGICAL DIVERSITY, https://www.cbd.int/gbf/targets/3/ (last visited Apr. 14, 2024).

adopted a new convention dealing with biodiversity conservation on the high seas, formally titled the U.N. Convention on the Law of the Sea.[194] There are several provisions including the newest guidelines on the designation of Marine Protection Areas, including the Costa Rica Thermal Dome and the Sargasso Sea.[195] It also included a section on the use of marine technology, which addressed "computer and computer software, including models and modelling techniques."[196] This technology is included in the scheme of AI.

VIII. LEGAL PROPOSAL

In Hawaii, Steven Jay Pincus Hueter, Faamuli Fete Faamuli, and Michael "Candyman" Kirk brought the attention of the federal government to major issues with the current regulation meant to address the problem of overfishing of the threatened parrotfish.[197] The men were concerned about the lack of government response to fishermen who illegally caught parrotfish, despite existing regulation meant to prevent this.[198] Currently, "IP rights do not apply in areas beyond national jurisdiction [and] they remain an issue for the scientific community as many activities pertaining to the deep-ocean ecosystem will take place within national borders or indeed on land."[199] It is up to legal drafters to produce legal recommendations to this problem.

The 1982 United Nations Convention on the Law of the Sea discussed the regulation of marine technology in Part XIV.[200] In 1994, the Implementing Agreement "laid the foundations for a broad interpretation of technology transfer, not as a bilateral hardware donation, but as a multi-way exchange of

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194 Jeffrey Marlow, *The Inside Story of the U.N. High Seas Treaty*, NEW YORKER (Mar. 9, 2023), https://www.newyorker.com/news/daily-comment/the-inside-story-of-the-un-high-seas-treaty#:~:text=A%20new%20global%20agreement%20protects,have%20been%20unable%20to%20reach.&text=The%20open%20ocean%2C%20which%20is,is%20a%20mostly%20lawless%20place.

195 *Id.*

196 Draft Agreement Under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond Nat'l Jurisdiction, Resumed on its 5th Sess., Feb 20–Mar. 3, 2023, U.N. Doc. A/CONF.232/2023 (Mar. 4, 2023).

197 Hueter v. Haaland, No. 21-00224 LEK-WRP, 2021 U.S. Dist. LEXIS 152893, at *1 (D. Haw. Aug. 12, 2021).

198 *Id.* at *3.

199 *Intellectual Property Rights: Implications for Deep-Ocean Stewardship*, *supra* note 182.

200 Aline Jaeckel & Harriet Harden-Davies, *New Technology, Equity and the Law of the Sea*, ILA REP. (Sep. 16, 2021), https://www.rifs-potsdam.de/en/blog/2021/09/new-technology-equity-and-law-sea.

knowledge, skills, and technology."[201] The first major problem that faces MPA management and legal drafting is that most MPAs fall within an area beyond national jurisdiction; "[i]n the marine environment, areas beyond national jurisdiction and areas within national jurisdiction share biophysical processes and living resources, and can influence each other. As such, they cannot be treated as separate and isolated zones for management purposes."[202] The second major problem for legal drafters is the nature of marine environments and the fact that there are different levels to this three-dimensional space, leading to the question of how to account for this.[203] This has led to the implementation of vertical zoning.[204] Vertical zoning regulations are defined by the depth of the water itself.[205] An example of this would be no crab traps on the ocean floor, but trolling at the top for fish would be allowed.[206] These problems that legal drafters face can be implemented into the newest versions of the United Nations Convention on the Law of the Sea, especially when discussing the problem of regulating the high seas.[207]

The Earth Law Center recommends that "[g]uardians [for the ocean] have a legal responsibility to protect and act on behalf of the marine ecosystem" meaning that there will need to be a defined legal personality for the ocean.[208] This idea of a legal personhood for nature comes from rulings in Ecuador that granted the Vilcamba River legal personhood by the Provincial Court of Loja.[209] Combined with the mandate that UNCLOS "places an unqualified general obligation on coastal states and other states to protect and conserve the marine environment, regardless of zone," this idea of nature rights could be revolutionary for the field of marine law.[210] It would be a revolutionary concept that would allow the ocean or the MPAs to be party to a case, making it easier to bring these cases to trial.

The next concept is to recognize the various interests in the ocean. Therefore, when a legal drafter is considering how to approach the mandates and

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201 *Id.*

202 Barbara Lausche, *Guidelines for Protected Areas Legislation*, IUCN ENV'T POL'Y & L. PAPER NO. 81, at 213 (2011).

203 *Id.* at 217, 222.

204 *Id.* at 222.

205 *Vertical Zoning in MPAs and Understanding Benthic-Pelagic Linkages*¸ NAT'L MARINE PROTECTED AREAS CTR., https://nmsmarineprotectedareas.blob.core.windows.net/marineprotectedareas-prod/media/archive/pdf/helpful-resources/factsheets/vert-zoning-n-bpl0306.pdf (last visited Apr. 14, 2024).

206 *Id.*

207 U.N. Convention on the Law of the Sea, art. CXVII, Dec. 10, 1982, 1833 U.N.T.S. 397.

208 BENDER, *supra* note 58, at 14.

209 *Id.* at 50.

210 Lausche, *supra* note 202, at 223.

agreements that the international community has undertaken, it is important to recognize all the stakeholders, including fishing groups.[211] Both environmentalists and those who profit from the fishing industry have a stake in seeing the longevity of reefs and ecosystems. Accordingly, no-take zones are not always an attractive option when considering MPA implementation in the high seas or the EEZ, which are extremely biodiverse and provide sustenance to both fish and humans.[212]

What would a legal framework look like? Barbara Lausche provides three approaches that legal frameworks can take:

> (1) umbrella provisions for the MPA network or system overall, with authority to designate specific sites within that framework; (2) specific legislation for each area or group of areas; or (3) some combination of these two approaches. Whatever approach is selected, it should be linked to the overall protected areas legal framework, and be guided by the nature of the sites protected, the state of existing sites, and the strategy and objectives for declaring future sites for an MPA network.[213]

Implementing these ideas into the language of legally binding instruments 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 ("BBNJ") would assist in the creation of regulations that would account for the complexities of the marine environment as well as the technology that will go into the creation of these MPAs.[214]

The BBNJ agreement aims to regulate MPAs and biodiversity conservation in ABNJ, also known as the high seas.[215] It refers to Resolution 69/292, which mandated the development of such an instrument, "[s]tressing the need for the comprehensive global regime to better address the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction and having considered the feasibility of developing an international instrument under the Convention."[216] This convention will have four themes: "area-based management tools," "environmental impact assessment," "marine genetic resources," and "capacity building and transfer of marine technology."[217] It will be a legally binding text that will account for the regulation of resources in the

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211 *Id.* at 243.
212 Sapsford, *supra* note 50.
213 Lausche, *supra* note 3, at 243 (2011).
214 *See generally* G.A. Res. 72/249 (Dec. 24, 2017).
215 *Id.* at 1–2.
216 *Id.* at 1 (citing G.A. Res. 69/292 at 2 (June 19, 2015)).
217 CAITLIN KEATING-BITONTI, CONG. RSCH. SERV., IF12283, THE BIODIVERSITY BEYOND NATIONAL JURISDICTION AGREEMENT 1–2 (2023).).

high seas, hopefully grounded on the preceding legislation.[218]

The recommended legal framework will need to account for the spatial and temporal issues that face MPAs, but it will also need to account for all of the competing interests. Recognition of legal personhood for the high seas will make these regulations easier to create. Only when strong regulations are put into place can the technology be implemented to resolve the problems that face the MPAs, such as unregulated and unreported overfishing.

IX. CONCLUSION

The ocean is an invaluable tool to the survival of humankind and "produces half of the world's oxygen, absorbs and sequesters one third of the carbon dioxide human activities emit, provides protection from extreme weather events, and provides a source of food and livelihoods."[219] Without it, communities would suffer, animals would die off, industries would disappear, and the world would be much worse off. The recommendations made here reflect the growing concern the world has adopted regarding the climate crisis. This concern is warranted as many animals have already disappeared, plants are dwindling, and the once wild areas of the world have become urbanized. Showing that MPAs are invaluable to resolving these problems is the easiest part of the journey ahead; it is the regulation and protection of these areas from overfishing and other environmental crimes that will be more difficult.

Using AI and big data, governments will be able to fill the governance gaps that have been present and will be better able to reach the lofty goals they have set for themselves. This paper recommends including connectivity language into the new high seas treaty that reflects the importance of these larger marine systems. Cases such as the Sargasso Sea should be the leading example of how this can be effective,[220] and cases such as the Costa Rica Thermal Dome illustrate the continuing challenges for legal drafters concerning marine protected areas that are not only in the high seas, but which also leak into other zones like the EEZ or coastal areas.[221] Legal drafters should approach these new legal personhoods with an understanding of the complexity of the different levels of ocean zones and allow science to guide the legal interpretations.

Legal frameworks must rely on the recommendations from organizations such as the IUCN and the Earth Law Center, which stress that "[w]e can ensure effective management and protection of marine areas by evolving the framework

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218 *Id.* at 1.

219 BENDER, *supra* note 58, at 3.

220 BJERGSTROM & FLEMING, *supra* note 4, at 5–6.

221 PEW CHARITABLE TRUSTS, A PATH TO CREATING THE FIRST GENERATION OF HIGH SEAS PROTECTED AREAS 16–17 (2020).

we choose to deploy. This ultimately requires us to change our worldview and values, because our values shape the framework, and in turn determine the level of human activity regulation."[222] This shared duty requires a recognition of ocean rights, a recognition of the importance of marine connectivity, and an understanding of the interdimensional spaces in which marine protected areas occupy. This can only be accomplished if agreements recognize the use of AI and big data in areas beyond national jurisdiction and the data protections that are needed to ensure that the governance gaps are filled.

[222] Bender, *supra* note 58, at 8.