BLOCKCHAIN FOR SAVING OUR SEAS

How the Ocean Currency Network Is Protecting Life Below Water

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Blockchain Research Institute

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A BLOCKCHAIN RESEARCH INSTITUTE LIGHTHOUSE CASE STUDY

Realizing the new promise of the digital economy

In 1994, Don Tapscott coined the phrase, "the digital economy," with his book of that title. It discussed how the Web and the Internet of information would bring important changes in business and society. Today the Internet of value creates profound new possibilities.

Don and Alex Tapscott launched the Blockchain Research Institute to help realize the new promise of the digital economy. We research the strategic implications of blockchain technology and produce practical insights that will guide our members in achieving success.

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Our findings, conclusions, and recommendations are initially proprietary to our members and are ultimately released under a Creative Commons license to help achieve our mission. Each research publication includes a video introduction by Don and an infographic for members' use in communicating these ideas throughout their organizations. To find out more, please visit www.blockchainresearchinstitute.org.

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Foreword

At the Blockchain Research Institute, we firmly believe that the most compelling blockchains will benefit all of humanity—not just those interested in cryptocurrencies and financial services. In *Blockchain Revolution*, Alex Tapscott and I discussed autonomous weather agents that could monitor air and water quality and issue alerts to reduce pollutants or stay indoors. These devices, powered by blockchain technology, could escalate from mere monitoring to enforcement, identifying and punishing wrongdoers. But such devices won't be enough, if not deployed globally, holistically, and systematically as part of a comprehensive multinational strategy.

Many species on this planet—human beings included—are facing human-caused ecological challenges on a massive scale. Sixteen-year-old Greta Thunberg underscored as much in her impassioned speech to the United Nations General Assembly in September:

> *People are suffering. People are dying. Entire ecosystems are collapsing. We are in the beginning of a mass extinction … . For more than 30 years, the science has been crystal clear. … The popular idea of cutting our emissions in half in 10 years only gives us a 50 percent chance of staying below 1.5 degrees [Celsius], and the risk of setting off irreversible chain reactions beyond human control. … But those numbers do not include tipping points, most feedback loops, additional warming hidden by toxic air pollution or the aspects of equity and climate justice.*[1]

The stakes are high: if we continue to ignore or exacerbate the problem, then we will continue to diminish the diversity of life on earth, as one species after another disappears. We will further imperil our children and our grandchildren, as subsequent generations struggle to survive.

This battle requires an all-hands-on-deck approach. Since life on earth originated in our oceans, let's look at how blockchain technology could help us clean up these vital ecosystems, from shorelines and coral reefs to Arctic sea ice platforms. This lighthouse case covers a diverse group of characters, ranging from Harvard University to the Alligator Head Foundation. Its project leader is Hilary Carter, managing director of the BRI. In addition to shepherding each research deliverable, she has authored or co-authored several of our most provocative pieces, including "The Networked Hotbeds of Blockchain," "Social Media on the Blockchain," and the forthcoming "Journey to Blockchain: A Non-Technologist's

Climate change, overfishing, and pollution threaten the ecosystem responsible for producing half of the world's oxygen.

Guide." Her areas of interest include blockchain and sustainability, and she recently presented her ideas at the United Nations in New York.

The time to address our climate crisis is now. As Thunberg said to world leaders, "Right here, right now is where we draw the line. The world is waking up. And change is coming, whether you like it or not."[2] Blockchain solutions like those described in the following pages are part of this change, and enterprise executives have a responsibility to enjoin their organizations in the effort.

◇ DON TAPSCOTT
Co-Founder and Executive Chairman
Blockchain Research Institute

Case in brief

» The state of the world's oceans is at a crisis point. Climate change, overfishing, and pollution threaten the ecosystem responsible for producing half of the world's oxygen. If left unaddressed, the environmental, social, and economic impact could be catastrophic.

» A change in the way that ocean resources are perceived and managed is necessary. While education and awareness are important first steps to combating the problem, data about the economic value of our oceans is needed to energize stewardship and convert nation-states into ocean protectors. By measuring the variety and number of marine life-forms in a given area, and putting an economic price on those life-forms, countries can set improved milestones for protecting and sustaining their ocean-based economic resources. It is here that blockchain technology can play a role.

A blockchain-based solution that reframes the opportunity from environmental to economic may be the differentiator that succeeds in creating much-needed change.

» Ocean Marine Blockchain Solutions, in collaboration with the Girguis Lab at Harvard University and Jamaican agency Alligator Head Foundation, is working to ignite stewardship at the national level. Using blockchain technology in combination with ocean-faring drones, Ocean Marine is creating a digital and economic data framework needed to compel policy makers and heads of state to protect marine life. Where ocean preservation might have been seen as a high-cost, low-return activity, through enhanced data and new incentive models, safeguarding the ocean's fish can now be seen as a means to protect an asset vital to national food sovereignty and economic growth.

» Replicating the Jamaican model around the world will require a combination of adequate funding, awareness and education, as well as leadership by individuals and nations themselves. A blockchain-based solution that reframes the opportunity from environmental to economic may be the differentiator that succeeds in creating much-needed change.

Oceans as life-support systems

Life on earth requires the presence and balance of fundamental chemical elements, oxygen being one of them. Trees produce half of the earth's oxygen, and the other half comes from phytoplankton, a single-celled plant that lives on the ocean's surface. One out of every two breaths can be attributed to the ocean.

Not only is phytoplankton a vital source of oxygen, but it forms the foundation of the oceanic food chain, feeding the herbivorous marine creatures that are then eaten by larger fish, marine mammals, and top predators.[3] Ocean life also provides humans, land mammals, and birds with a primary food source, and jobs for 200 million people who fish or work in fisheries.[4] For the air we breathe and the food we eat, the ocean is quite simply a life-support system for the planet, and a resource that needs careful stewardship.

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An abundance of threats

The world's oceans, and the life-forms within it, face a number of serious threats. The following are among the gravest.

Dead zones

Several of the earth's bodies of water are classified as dead zones: low-oxygen environments devoid of aquatic life. The Baltic Sea is one such region. The Gulf of Mexico is another. Fertilizer runoff from the Mississippi River has turned the Gulf into one of the world's largest dead zones, the extent of which can worsen after heavy rains. For marine life in or on the periphery of this zone, extended exposure to low-oxygen environments—a condition called *hypoxia*—can have long-term physiological consequences. Shrimp, for example, grow smaller when subjected to polluted, hypoxic waters, while larger life-forms swim away to find waters with higher concentrations of oxygen.[5] This has economic consequences for coastal fisheries, but it also affects the entire ecosystem. Not every creature can flee.

In 2018, the World Economic Forum reported that 90 percent of fish stocks are depleted as a result of subsidies to fisheries, primarily in the form of cheap engine fuel for fishing vessels.
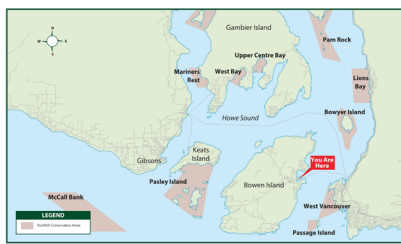
Overfishing

Overfishing is also a factor in threatening ocean health. In 2018, the World Economic Forum reported that 90 percent of fish stocks are depleted as a result of subsidies to fisheries, primarily in the form of cheap engine fuel for fishing vessels.[6] Part of the problem is lack of regulatory oversight and lack of clarity over what exactly constitutes overfishing of a given fish stock, and who has the authority to determine it: governments, the United Nations, or a watchdog network?[7] In her work on managing common pool resources, Nobelist Elinor Ostrom acknowledged that fisheries are an excellent example of the tragedy of the commons, and that establishing a boundary on fishing waters is challenging.[8]

The plastics tsunami

In addition to overfishing, plastic pollution in the form of discarded fishing gear, bottles, bags, and microplastics is choking aquatic life. According to the United Nations Educational, Scientific, and Cultural Organization, more than 100,000 marine mammals die each year from plastic waste contamination.[9] According to research by the Ellen MacArthur Foundation, by the year 2050, the world's oceans will contain more plastic bottles than fish.[10] This crisis stems from improper waste disposal by both individuals and communities, who have not provided the necessary infrastructure for either the recycling of plastic packaging or the disposal of plastic and other refuse into land-based dump sites.

Between California and Hawaii, in what has come to be known as the Great Pacific Garbage Patch (or trash vortex), is the world's largest concentration of ocean-based plastic. While the largest individual objects within the trash vortex consist of abandoned fishing gear, microplastics account for 94 percent of the estimated three trillion pieces afloat in the Pacific.[11] Much plastic breaks down into microscopic beads, contaminating fish and birds that mistake the plastic for food, and posing a risk to human health.[12]

By the year 2050, the world's oceans will contain more plastic bottles than

The plastic pollution problem is not limited to ocean surfaces. Single-use plastic bottles fill with sea water and can be found on ocean floors in all parts of the world. In December 2018, Fabien Cousteau and Sir Richard Branson reported finding plastic at the bottom of the world's largest sinkhole, the Great Blue Hole, located off the Belize coast.[13]

Recycling, at the intersection of art, the economy, and the environment

"The hunter-gatherer roots of recycling are still present in the memory of many Zimbabwean artists today," according to Professor Tony Mhonda. "*Kuzvarwa patsva*, literally meaning to be born again, is part of an instinctive design mentality." In the absence of new art supplies, contemporary Zimbabwean artists have worked with found objects, *l'Art trouve*. "It is in recycling that one sees a meeting point between art, the economy, and the environment," Dr. Mhonda explained.[14]

Johnson Zuze is such an artist. "'I work with waste material, which I recycle to create different pieces of art. The idea behind my style is to convey different social messages,'" Zuze told Reuters. "By collecting junk in the street, Zuze attests to promoting a clean environment and recycling culture."[15]
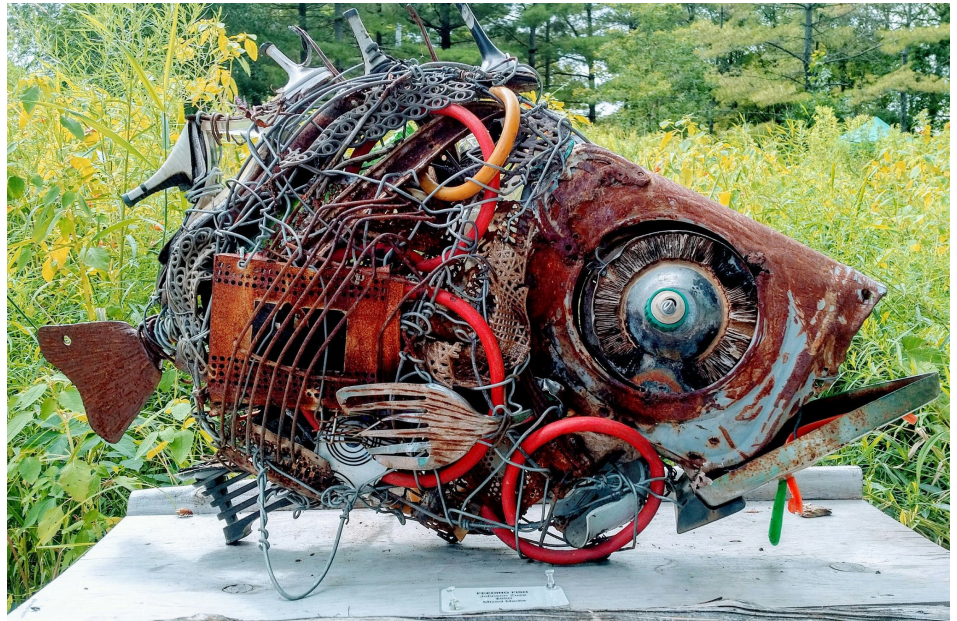
Feeding Fish © 2017 Johnson Zuze. Photograph by Hilary Carter, used with artist's permission. All rights reserved.

If carbon dioxide levels remain constant, tropical ocean surface temperatures are expected to rise by 2.7 degrees Celsius by the end of the century.

Warming waters

According to NASA reports, if carbon dioxide levels remain constant, tropical ocean surface temperatures are expected to rise by 2.7 degrees Celsius by the end of the century.[16] The Intergovernmental Panel on Climate Change research estimates that atmospheric temperatures could rise up to 5.8 degrees Celsius by the end of the century, bringing about the "knock-out punch for many species" already under threat.[17] Research points not only to the decline of phytoplankton due to warming waters and pollution, but simultaneously to the rise of more toxic strains of phytoplankton, blooming in warmer ocean waters and proving problematic to the aquatic life-forms dependent upon them.[18]

Under so many threats, urgent action is required. Only seven percent of the world's oceans are under protection of one kind or another.[19] Expanding these protection areas, implementing sustainable fishing practices, and encouraging biodiversity and pollution controls will help preserve marine life-forms and combat the impact of overfishing. To some, the priority is to save fish themselves as a singular goal within the broader aim of creating a sustainable planet.

Because green-friendly initiatives often clash with economic growth, long-term solutions need to create positive economic outcomes.

Because green-friendly initiatives such as sustainable fishing often clash with economic growth, long-term solutions need to create positive economic outcomes. The challenge comes with assigning an economic value to things like clean air and clean water that form part of the global commons. According to the late conservationist Bruce Smart, "because many resources seem 'free,' access to them is regarded as an entitlement."[20]

But where fish are concerned, the market price for many species is easily enough determined, and herein lies a unique opportunity to save them. What's required is an accounting exercise to evaluate the resource's prevalence.

At the heart of this opportunity is blockchain technology, a new digital backbone to underpin and record data specific to the protection of environmental resources, now including fish stocks.

Blockchain's unique value proposition

Originally intended to facilitate the transfer of peer-to-peer (P2P) electronic cash, blockchain is a disruptive technology, transforming business models across a number of industries. Its unique design features have firmly established it as the layer of the Internet that enables the secure transfer of units of value, and the framework to store and exchange digital assets of all kinds, including data. In being decentralized with no single server and incorporating asymmetric cryptographic signatures, blockchain has proven to be highly resistant to vector attacks, and with features such as transparency and immutability, it has established itself as a trusted transactional ledger.

With blockchain enabling market forces to transform environmental causes into economic plays, opportunities abound.

Blockchain technology is particularly effective because it provides a mechanism to align the incentives of different stakeholder groups around issues and activities, changing patterns of behavior in the process. It facilitates a new digital marketplace for assets of all kinds, with added layers of transparency and trust built into the program. Now, physical objects have a new digital platform on which to trade. With blockchain enabling market forces to transform environmental causes into economic plays, opportunities abound. As *CoinDesk* advisory board chair and MIT Digital Currency Initiative senior advisor Michael Casey stated, "Hope lies in what some people call *crypto-impact economics*, an effort to hard-code into tokens the objectives of fighting environment degradation."[21]

A new blockchain-based solution has been launched to map and tokenize fish as physical assets and to realign the incentives needed to protect them.

There are numerous examples of blockchain technology being used as a tool to tokenize physical assets such as gold, real estate, or collectibles, and providing a digital framework for their exchange. There are also projects underway that use blockchain technology to incentivize new behaviors that align with the United Nations' Sustainable Development Goals, such as climate action, affordable and clean energy, and clean water and sanitation. Now, a new blockchain-based solution has been launched as a means to achieve both: the mapping and tokenization of fish as physical assets, and a framework to realign the incentives needed to protect them.

Ocean Marine Blockchain Solutions

The Texas-based organization, Ocean Marine Blockchain Solutions for Global Impact, is pioneering a near-term ocean protection strategy on the premise that "if it can be measured, it can be improved."[22] The idea is that by recording and storing new data about fish stocks on a blockchain platform, and assigning a monetary value to those stocks in the form of a digital token, this will provide the economic infrastructure to speed the preservation of marine life. By tokenizing life below the ocean's surface, nation-states can quickly understand the economic value of their coastal waters and move to protect it over the long term.

For Jeremy McKane, founder of Ocean Marine Blockchain Solutions, the inspiration for the model came from the indigenous traditions of Polynesia. Sailing through the Lau Group of Fiji and visiting the site of the very first *tapu*—the Polynesian word for *forbidden*, applied to a fishing zone—he learned that fish in these zones have been routinely counted for centuries.[23] According to McKane, "These protected areas would get low on fish and so they would go and count fish. Seems like the most logical response to me. How do you know your protected area is doing its job? You count the fish. So simple it's genius."[24] To turn his vision into reality, McKane assembled the best people he knew and created the Ocean Currency Network to "financially incentivize nation-states to protect their waters."[25]

The OCN token

By tokenizing life below the ocean's surface, nation-states can quickly grasp and move to protect the economic value of their coastal waters.

The Ocean Currency Network is both a technology play and a token strategy. McKane and his team set about building a series of smart contracts on the Ethereum blockchain and using the ERC-721 non-fungible token standard to deed all 360 million square kilometers of ocean. While it is surface area only, McKane said that "it's a starting point. Each smart contract represents a nation-state, with the ERC-721 token representing the size of the country's exclusive economic zone."[26] Each non-fungible token represents one square kilometer of ocean space; the data acquired from the ocean is directly linked to the specific token, to keep track of geolocation. As different countries have different sets of aquatic life within their zones, and unique legislation governing them, the tokens will each need to reflect these distinctions and nuances.

Most valuable is the data about a country's waters. The data are currently stored on the InterPlanetary File System and linked to the Ethereum blockchain, which serves as a permanent record of a nation's aquatic market cap. But other types of information will add value. According to McKane, "Perhaps a healthy coral reef is of some value. Whatever we find, we cross-reference its relationship to the ecosystem and try to determine value. If we have reliable and recent data, we can predict potential threats before they become catastrophic."[27]

"If we have reliable and recent data, we can predict potential threats before they become catastrophic."

JEREMY MCKANE
Founder
Ocean Currency Network

The blockchain infrastructure was soon integrated with water-based drones, enabling each area to be assigned a score reflecting the market capitalization of the fish contained within it. The more fish, the higher the market cap, and so the sooner that baseline populations could be established, the sooner sustainable fishing could return to a given area. If nothing is done and fish populations decline, then at a minimum, the solution increases transparency around the opportunity cost of overfishing.

Mako, a water-based drone © 2018 iSENSYS LLC. Reprinted with permission from copyright holder. All rights reserved.

Mapping marine eDNA

To give greater specificity to the mapping activity, McKane recruited Dr. Peter Girguis of the Girguis Lab at Harvard University. A professor of organismic and evolutionary biology, Dr. Girguis added expertise around measuring environmental DNA (eDNA). Said McKane, "The field of eDNA is fascinating to me and I want to miniaturize the sequencing process so I can fit these on my drones at sea to live stream genomes from the ocean. Dr. Girguis agreed this was an exciting angle and we've been working together ever since."[28]

With greater ability to report on specific life-forms (as well as microplastic levels using green laser refraction sensors) from water samples alone, and to do so in real time, McKane believed that he was well equipped with a platform that could help to meet Sustainable Development Goal 14 (SDG14) targets for Life Below Water and adapt to the International Union for Conservation of Nature mandate to protect 30 percent of the world's oceans by 2030.[29]

Mesh networks and other benefits

Like mesh networks, ocean-based P2P connectivity via drones and buoys can establish a new kind of communication network on the sea.

The more tracking activity that can take place within or around the perimeter of protected waters, the safer the marine life can potentially be. Just as mesh networks create new opportunities for sharing connectivity from mobile phone to mobile phone, ocean-based P2P connectivity via drones and buoys can establish a new kind of communication network on the sea. In this scenario, a robust network of interconnected drones and marine protected area (MPA) markers could enhance the detection of poaching vessels, and alert coast guards and rapid responders to intervene in shorter time frames.

The Jamaican pilot

Jamaica's 886-kilometer coastline is a diverse ecosystem, responsible for much of the island's economic activity, especially tourism and fishing. According to the country's 2015 Climate Change Policy Framework report, "Jamaica's reef-related fisheries provide valuable jobs and revenue for the country, contributing $34 million US per year."[30] That same report describes the extent to which the country's beaches, coral reefs, fisheries, and various other resources vital to the Jamaican economy are under threat.

The Alligator Head Foundation's approach to conservation is collaborative—leveraging the talents of creative artists, scientists, and others in the local community.

The loss of biomass in a matter of a few decades was the inspiration behind the formation of Jamaica's Alligator Head Foundation (AHF), an ocean conservation initiative responsible for administering Jamaica's numerous fish sanctuaries. Less than a decade ago, the absence of fish in the waters off of the East Portland Parish was obvious. AHF founder Francesca Thyssen-Bornemisza once dove in the East Portland waters as a child. According to AHF Secretary Tristan Acutt, "she fondly remembers being taken out to the reef by her mother to see all the fish. Years later when Francesca took her own children to explore the same reef, they didn't want to dive because there wasn't much to see. It was heartbreaking for her to see this decline."[31] To revitalize and restore fish habitats, she founded Alligator Head.

The group's approach to conservation is collaborative—leveraging the talents of creative artists, scientists, and others in the local community—to raise awareness of the MPA and to work alongside the community that the MPA will affect the most. For example, AHF trains people who fish for a living to become ecotourism or scuba guides.

The informal partnership between AHF and Ocean Marine kicked off in 2018 and remains anchored in shared ideology.

In addition to patrolling and warning Jamaica's fishing community to stay outside of the six-square-kilometer protected zone, which is identified by glaring red markers, AHF started working with Ocean Marine Blockchain Solutions to add a new technical dimension to its conservation work. At the United Nations Climate Change Conference (COP21) in 2015, McKane first met AHF Director Markus Reymann. During later conversations around ocean conservation, they experienced what could only be described as a "ya, man" moment. The informal partnership between AHF and Ocean Marine kicked off in 2018 and remains anchored in shared ideology. According to Acutt, the work of the AHF has been a success:

> *We were told it would take initially five to seven years to start seeing some results. But within three years, we've got the most incredible results already. A 200 percent increase in biomass, 16 percent increase in biodiversity. We're seeing the return of the bull shark, something we haven't seen in years. It's going really, really well.*[32]

Now, in collaboration with the Ocean Currency Network, these results and the tokenization of East Portland's aquatic assets will be permanently recorded on a blockchain. McKane's intention is to use this framework as a model for other regions.

The results of the pilot are not ready for public dissemination, but McKane's team has proven the concept. While the East Portland project focuses singularly on life below water, the whole ecosystem benefits. More fish means more food for birds and coastal mammals. Jamaica's East Portland fishing community is happy, too. They know that when the MPA is full of fish, it gets crowded, and so the fish seek out waters beyond the MPA perimeter, making it possible to spend far less time and fuel chasing them.

Overcoming implementation challenges

Getting governments and multinational organizations on board is vital, and to do so requires greater awareness of the risks of inaction coupled with the economic opportunities for collaboration.

The future vision of the Ocean Currency Network is to expand from Jamaica to MPAs in other parts of the world. Getting governments and multinational organizations on board is vital, and to do so requires greater awareness of the risks of inaction coupled with the economic opportunities for collaboration. The approach is decidedly top-down, and one that requires high-level coordination of the various governing bodies.

Ocean Currency Network is not the first blockchain-based project with a mission to save the world's oceans. In 2017, Ocean Health Network was an initiative that held great promise—based on the optimistic reference in Michael Casey and Paul Vigna's book, *The Truth Machine*.[33] Unfortunately, there is little evidence to suggest it was able to get off the ground. Big opportunities often face seemingly insurmountable hurdles, be they financial, ideological, or other. McKane is realistic about overcoming the following implementation challenges.

In mapping MPAs using blockchain, McKane has created intellectual property in the form of field knowledge in the ocean genomics space, with new opportunities for markets in the future.

Attracting sufficient funding

Like so many blockchain projects, funding plays a role in their long-term viability. As many promising blockchain initiatives have run out of capital, McKane will act prudently, expanding the Jamaica pilot only as funding allows. In the process of mapping MPAs using blockchain, McKane has discovered new value in terms of the intellectual property gained by field knowledge in the ocean genomics space, creating new opportunities for markets in the future.

Raising awareness and motivating action

To support this vision, McKane, along with professional athlete Susi Mai, launched the Ocean Summit in early 2019. Leading ocean advocates, researchers, and other stakeholders were summoned to Necker Island in the British Virgin Islands to discuss solutions to the ocean crisis.[34] Among the luminaries were Necker Island owner Sir Richard Branson; Dr. Sylvia Earle, ocean advocate and president of Mission Blue; actor Shailene Woodley; and Anote Tong, former president of Kiribati, a chain of islands in the South Pacific under threat by rising ocean levels. Francesca Santoro, a UNESCO representative, also attended.[35] The purpose of the Ocean Summit was to move beyond discussion and to inspire action for change, extending the world's understanding of the ocean and the dangers facing it by all means necessary, and to make advancements toward its preservation.

Coordinating global policy change

National and intergovernmental policies play a fundamental role in achieving sustainable development goals such as SDG14. At the Blockchain for Impact Summit at the United Nations in June 2019, EY global lead partner for public financial management Mark MacDonald stated, "There is nothing more important to the ability to drive social impact than through the important instrument of public policy. In every jurisdiction, the conditions around achieving SDGs will rely on governments to effect better and more successful public policies."[36]

Getting governments on board is part of the strategy. Because money talks and blockchain follows the money, the idea is that policy change can come sooner than it would otherwise.

Getting governments on board is part of the strategy, and because money talks and blockchain follows the money, the idea is that policy change can come sooner than it would otherwise. The challenge for McKane is to get in front of as many governments as possible to discuss the economic value of a country's natural capital assets, hoping that this ignites the much-needed protective policy change throughout the world.

Said McKane, "If we collectively do this, we would be able to allow the ocean to regenerate to the point our oceans would have enough food for the next 250 years. We need to make the sacrifice now."[37] The challenges to implement a singular solution are clear but not insurmountable.

Implications of the transformation

Imagine if we get this right. Imagine if nations are successful in repopulating fish stocks in protected zones as a singular item. Then imagine if the ocean's other threats, climate change and pollution, are addressed in tandem. Does anyone really stand to lose?

The answer is no. The question then becomes how we coordinate all of the necessary elements and stakeholders to create a sustainable planet in tandem, how these initiatives are governed, and whether these elements gain traction.

Repopulating the ocean's dead zones is but one of the necessary elements in a broader collaboration around climate change. Even in an environment where fish stocks were not threatened by chemical runoff, overfishing, or plastic pollution, warming waters and coral bleaching could outpace efforts to address the crisis.

If water temperatures remain steady or fish and marine ecosystems quickly adapt to warmer environments, then creating sustainable ocean fish stocks could be a singular and successful initiative. But current global weather trends indicate that this scenario is unlikely.

Yet the absence of initiatives working in tandem is no reason not to push forward with the individual parts. Ideally, the initiative must be part of a larger global initiative to meet the objectives of the Paris Agreement on Climate Change. This we know to be true: that renewable ocean ecosystems will provide a resource for coastal communities the world over, and greater health for the environment at large, for generations—if we act now.

Renewable ocean ecosystems will provide a resource for coastal communities the world over, and greater health for the environment at large, for generations—if we act now.

Table 1: Ocean governance

Scope	Organization
Global Treaties	United Nations Convention on the Law of the Sea United Nations Framework Convention on Climate Change Conservation of Antarctic Marine Living Resources Convention
Global Organizations	Greenpeace World Wildlife Fund Mission Blue UNESCO Intergovernmental Oceanographic Commission
Regional Organizations	Pacific Islands Marine Protected Areas Community North American Marine Protected Areas Network Partnership for Regional Ocean Governance Florida Oceanographic Society
National Marine Protected Areas	US National Marine Sanctuary, USA Great Barrier Reef Marine Park, Australia St. Anns Bank, Canada
Community Organizations	Alligator Head Foundation, East Portland, Jamaica Bay Ecotarium, San Francisco, USA Blue Ventures, Madagascar

Key takeaways

According to McKane, "It's your execution that you get paid for."[38] So now that we know that marine protection is a team sport, and that through collective ocean protection comes collective benefit, here are actionable next steps toward expanding the world's MPAs, and enhancing their efficacy through blockchain.

Get involved. Implementing the change required to address the various threats to the ocean is hard, but regenerating a dead ocean will be harder. Understand what your country, community, or organization stands to lose by sitting on the sidelines, and in the words of Dr. Sylvia Earle, "use all means at your disposal—films, expeditions, the web, new submarines—to create a campaign to ignite public support for a global network of marine protected areas."[39]

Demonstrate leadership. Whether you're a CEO, a government minister, or a private citizen, there's a role for you to play, and the time for you to step up is now! Foster a culture that prioritizes sustainability within your organization, political jurisdiction, or daily life. If one doesn't exist, help to build it.

Legislate for change. Advocate for the creation of public policy, both domestic, and at the international and global governance levels. If preserving life below water is a win-win, then new legislation and multistakeholder collaboration should make for a rewarding and mutually beneficial pursuit.

Experiment. While blockchain is a new technology, the 3,000-year-old Polynesian practice of protecting marine zones from overfishing is tried and true. Iterate, test, and be patient as token technologies and platforms continue to evolve.

While blockchain is a new technology, the 3,000-year-old Polynesian practice of protecting marine zones from overfishing is tried and true. Iterate, test, and be patient as token technologies and platforms continue to evolve.

Islets Lagoon Polynesia by laurentriem, 2017, used under Pixabay license, as of 21 Oct. 2019.

About the author

Hilary Carter is managing director at the Blockchain Research Institute where she works closely with more than 50 blockchain thought leaders to conduct the definitive investigation into blockchain transformations in enterprise, government, and society. She is the author and co-author of a number of Blockchain Research Institute projects including *Social Media on the Blockchain: AKASHA Ushers in a New Era of Censorship-Resistant Communications*, and *Networked Hotbeds of Blockchain: Creating Global Hubs for the Internet's Second Era* with Don Tapscott and Jill Rundle. Her recent focus is on blockchain and sustainability, in particular how the technology can be used to help advance the United Nations Sustainable Development Goals. Hilary is a speaker and a management graduate of the London School of Economics and holds the Certified Bitcoin Professional designation.

Acknowledgments

Just as blockchain is a team sport, so too is blockchain research. Many people contributed their time, talent, generosity, and vision, culminating in this report and its related deliverables. Notable among them are MMH Blockchain Group founder Emma Todd, whose invitation to speak at the UN Blockchain for Impact Summit in 2019 proved to be the spark that lit the research bonfire; Don Tapscott, whose support of my research pursuits has enabled me to lead a life of consequence; and Jeremy McKane of Ocean Marine Blockchain Solutions, my primary collaborator on this project, for living the motto "it's your execution that you get paid for." Thanks to Tristan Acutt of Alligator Head Foundation, Mark MacDonald of EY, Michael Casey of *CoinDesk*, Chandler Griffin of iSENSYS, artist Johnson Zuze, and Madeleine Ankenman of Galiano Conservancy Association. Last but not least, a round of applause to BRI editorial and production team Mary-Jane Pilgrim, Yuliya Samoylova, Mike Dover, Donna Ng, and especially to the talented Kirsten Sandberg, BRI editor-in-chief, for always asking the right questions.

Notes

1. "Transcript: Greta Thunberg's Speech at the UN Climate Action Summit," *NPR.org*, National Public Radio Inc., 23 Sept. 2019. www.npr.org/2019/09/23/763452863/transcript-greta-thunbergs-speech-at-the-u-n-climate-action-summit, accessed 2 Oct. 2019.

2. "Transcript: Greta Thunberg's Speech at the UN Climate Action Summit."

3. John Roach, "Source of Half Earth's Oxygen Gets Little Credit," *National Geographic*, National Geographic Society, 7 June 2004. www.nationalgeographic.com/news/2004/6/source-of-half-earth-s-oxygen-gets-little-credit, accessed 11 June 2019.

4. Mukhisa Kituyi and Peter Thomson, "90 Percent of Fish Stocks Are Used Up—Fisheries Subsidies Must Stop Emptying the Ocean," *Weforum.org*, World Economic Forum, 13 July 2018. www.weforum.org/agenda/2018/07/fish-stocks-are-used-up-fisheries-subsidies-must-stop, accessed 17 June 2019.

5. Sarah Gibbens, "Massive 8,000-Mile 'Dead Zone' Could Be One of the Gulf's Largest," *National Geographic*, National Geographic Society, 10 June 2019. www.nationalgeographic.com/environment/2019/06/massive-dead-zone-predicted-to-be-one-of-largest-gulf-of-mexico, accessed 11 June 2019.

6. Mukhisa Kituyi and Peter Thomson, "90 Percent of Fish Stocks Are Used Up—Fisheries Subsidies Must Stop Emptying the Ocean," *WEForum.org*, World Economic Forum, 13 July 2018. www.weforum.org/agenda/2018/07/fish-stocks-are-used-up-fisheries-subsidies-must-stop, accessed 10 June 2019.

7. Mukhisa Kituyi and Peter Thomson, "90 Percent of Fish Stocks Are Used Up."

8. "Elinor Ostrom on Managing 'Common Pool' Resources," *OECD Channel*, Organisation for Economic Co-operation and Development, 28 June 2011. www.youtube.com/watch?v=D1xwV2UDPAg, accessed 20 Aug. 2019.

9. "Facts and Figures on Marine Pollution," *UNESCO.org*, United Nations Educational, Scientific, and Cultural Organization, n.d. www.unesco.org/new/en/natural-sciences/ioc-oceans/focus-areas/rio-20-ocean/blueprint-for-the-future-we-want/marine-pollution/facts-and-figures-on-marine-pollution, accessed 10 June 2019.

10. "The New Plastics Economy Rethinking the Future of Plastics," preface by Dame Ellen MacArthur, Dominic Waughray, and Martin R. Stuchtey, and foreword by H. E. Mogens Lykketoft, *EllenMacArthurFoundation.org*, Ellen MacArthur Foundation, World Economic Forum, and McKinsey Center for Business and Environment, 19 Jan. 2016. www.ellenmacarthurfoundation.org/assets/downloads/EllenMacArthurFoundation_TheNewPlasticsEconomy_Pages.pdf, accessed 10 Oct. 2019.

11. Laurent CM Lebreton, Boyan Slat, Francesco Ferrari, et al., "Evidence that the Great Pacific Garbage Patch Is Rapidly Accumulating Plastic," Scientific Reports, *Nature.com*, Springer Nature Ltd., 22 March 2018. www.nature.com/articles/s41598-018-22939-w, accessed 21 Jan. 2019.

12. Damian Carrington, "Microplastic Pollution in Oceans Is Far Worse than Feared, Say Scientists," *The Guardian*, Guardian News & Media Ltd., 12 March 2018. www.theguardian.com/environment/2018/mar/12/microplastic-pollution-in-oceans-is-far-greater-than-thought-say-scientists, accessed 21 Jan. 2019.

13. Hannah Osborne, "Belize's Great Blue Hole Has Plastic at the Bottom of It," *Newsweek*, Newsweek Media Group, 22 Jan. 2019. www.newsweek.com/richard-branson-belize-great-blue-hole-sinkhole-plastic-pollution-1299764, accessed 11 Oct. 2019.

14. Dr. Tony Mhonda, "Art of Recycling: How It All Began [opinion]," *The Herald* (Harare), AllAfrica Global Media, 11 Oct. 2013. advance.lexis.com, accessed 12 Oct. 2019.

15. Reuters, "Zimbabwean Sculptor Transforms Waste into Valuable Art," *Africanews*, Malagasy Group Sipromad, 10 Feb. 2017. www.africanews.com/2017/02/10/zimbabwean-sculptor-transforms-waste-into-valuable-art, accessed 12 Oct. 2019.

16. "Warming Seas May Increase Frequency of Extreme Storms," *Climate.NASA.gov*, NASA Global Climate Change, 28 Jan. 2019. climate.nasa.gov/news/2837/warming-seas-may-increase-frequency-of-extreme-storms, accessed 10 June 2019.

17. "Climate Change," *WWF.panda.org*, World Wide Fund for Nature, n.d. wwf.panda.org/our_work/oceans/problems/climate_change, accessed 10 June 2019.

18. Jennifer Chu, "Study: Much of the Surface Ocean Will Shift in Color by End of 21st Century," *MIT News*, Massachusetts Institute of Technology, 4 Feb. 2019. news.mit.edu/2019/study-ocean-color-change-phytoplankton-climate-0204, accessed 11 June 2019.

19. Johnny Briggs, "How Much of the Ocean Is Really Protected?" *PewTrusts.org*, Pew Charitable Trusts, 22 Feb. 2018. pewtrusts.org/en/research-and-analysis/articles/2018/02/22/how-much-of-the-ocean-is-really-protected, accessed 24 June 2019.

20. Richard A. Clarke, et al., "The Challenge of Going Green," *Harvard Business Review* (July-Aug. 1994). Harvard Business Publishing, hbr.org/1994/07/the-challenge-of-going-green, accessed 17 June 2019.

21. Michael J. Casey, "The Token Economy: When Money Becomes Programmable," foreword by Don Tapscott, Blockchain Research Institute, 28 Sept. 2017, rev. 28 March 2018, p. 46.

22. Ocean Marine Blockchain Solutions for Global Impact, "Our Approach," n.d. www.ocn.ai, accessed 24 June 2019.

23. "taboo | tabu, adj. and n.," *OED Online*, Sept. 2019. Oxford University Press, www.oed.com, accessed 11 Oct. 2019. In 1777, Captain James Cook recorded the word as *taboo* in his journal on his visit to the main island of Tonga, Tongatapu, which he spelled *Tongataboo*.

24. Jeremy McKane, e-mail message to Hilary Carter, 3 June 2019.

25. Ocean Marine Blockchain Solutions for Global Impact, "Our Approach," n.d. www.ocn.ai, accessed 24 June 2019.

26. Jeremy McKane, e-mail message to Hilary Carter, 3 June 2019.

27. Jeremy McKane, e-mail message to Hilary Carter, 4 Sept. 2019.

28. Jeremy McKane, e-mail message to Hilary Carter, 3 June 2019.

29. Jeremy McKane, e-mail message to Hilary Carter, 4 Sept. 2019.

30. Government of Jamaica, "Climate Change Policy Framework for Jamaica," foreword by Robert Pickersgill, Grantham Research Institute on Climate Change and the Environment, Sept. 2015. www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2016/05/Jamaica-Climate-Change-Policy-fwL-2015.pdf, accessed 9 Oct. 2019.

31. Tristan Acutt, interviewed by Hilary Carter, 26 July 2019.

32. Tristan Acutt, interviewed by Hilary Carter, 26 July 2019.

33. Michael J. Casey and Paul Vigna, *The Truth Machine: The Blockchain and the Future of Everything* (New York: St. Martin's Press, 2018).

34. Jeremy McKane, "Ocean Summit 2019 - Necker Island," video, directed by Ludo Brockway, *Vimeo.com*, 1 Feb. 2019, uploaded 3 April 2019. vimeo.com/328328531, accessed 11 Oct. 2019.

35. The Ocean Summit ONE Attendees, Necker Island, British Virgin Islands, Ocean Marine Blockchain Solutions for Impact, 1-3 Feb. 2019. www.ocn.ai/os1, accessed 11 Oct. 2019.

36. "Part 3: Blockchain for Impact 2019 Global Summit: Frontier Technologies Powering Blockchain," *UN Web TV*, Blockchain for Impact Summit, United Nations, 2:13:00, 4 June 2019. webtv.un.org/meetings-events/other-meetingsevents/watch/part-3-blockchain-for-impact-2019-global-summit-frontier-technologies-powering-blockchain/6044654794001/?term=#t=1h33m5s, accessed 20 Aug. 2019.

37. Jeremy McKane, e-mail message to Hilary Carter, 3 June 2019.

38. Susi Mai, "Ocean Summit 2019—Necker Island," *YouTube.com*, Jeremy McKane, 02:48, Ocean Summit, 1 Feb. 2019. youtu.be/EoXAi_uX79w, accessed 9 Oct. 2019.

39. Mission Blue: Sylvia Earle Alliance, "About Us," *Mission-Blue.org*, Mission Blue, n.d. mission-blue.org/about, accessed 19 Aug. 2019.