WORLD OCEAN JOURNAL

WORLD OCEAN OBSERVATORY

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SOLUTIONS PART TWO

World Ocean Journal
volume 7, part 2
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WORLD OCEAN JOURNAL
is a publication of the World Ocean Observatory. A digital magazine on ocean culture and solutions to today's ocean issues, each volume includes essays, articles, interviews, art, exhibits, and performances profiling the vital impacts of the ocean on our lives. Each edition focuses on a particular theme. This volume is based on *solutions*.

WORLD OCEAN OBSERVATORY
is a major utility for ocean communication as a means to advance public awareness and political will, and is dedicated to providing information and education about the health of the ocean. It is our belief that the sea connects all things.

CONTACT
director@thew2o.net

Surveying the ocean-scape today brings to mind conflicting reflections on its steady state as the most essential natural system for the future of human survival. One can easily despair. The continuing unresolve regarding any effective global response to climate change–on land and sea–signals confusion, if not deliberate indifference, to the well-documented conditions in the atmosphere, on the mountaintops, along the watersheds, and to the coastal zone and deep sea–every place affected by emissions, acid, pollution, waste, erosion, sprawl, and more. Governance at its best focuses on policy, regulation without some accountability and little enforcement, and a tyranny of consensus that dilutes and prolongs both the actions to be taken and the urgency for such action. It is easy to be pessimistic.

But despair is not a true option. The science will not be denied. And the impact, now, and for the future, is obvious. If one generation is the cause of such conditions, then the next must accept the responsibility for redress–for adaptation, mitigation, and invention of meaningful, tenable goals, structures, and behaviors that will transform societal response–in itself a powerful, inexorable expression of optimism and confidence in the human spirit and the essence of civilization.

In previous editions of *World Ocean Journal*, we have addressed various ocean themes and organizations that represent a perspective that "the sea connects all things," and that the world ocean is a unifying natural presence and process that conjoins us at all levels by its undeniable relation to climate, freshwater, food, energy, health, technology, finance, development, growth, equity, justice, community well-being and cultural traditions. The ocean can, and will, save our world if we have the imagination to protect and sustain it for that penultimate purpose.

And so, we must turn to solutions. In our last edition we began to assemble and profile many initiatives and nascent projects that best express a forward-looking alternative perspective and plan of action. We discovered that one issue was not enough to describe the many new ideas and processes that are coming on line as revolutionary steps, each perhaps small in itself, but collectively representing a wave of ingenuity and determination that must command our awareness, financial investment, and public and private engagement from this day forward.

Every concept described herein is making waves, and every one of the people involved–the entrepreneurs and the mad inventors, the impact financiers and investors in transformational enterprise, the research scientists and oceanographers, the marine educators and proponents of ocean literacy, the determined bureaucrats and politicians, and the growing number of *citizens of the ocean* worldwide–are wave-makers too. Reading and sharing makes you one too, and my hope is that it will bring awareness and reward for us all as we ride this wave of optimism, solutions, and success.

Thanks for your interest and support of the World Ocean Observatory and all the other ocean organizations that we celebrate here, for their energy and impact for the future of our ocean world.

PETER NEILL is founder and director of the World Ocean Observatory and is author of many non-fiction and fiction books including *The Once and Future Ocean: Notes Toward a New Hydraulic Society* published in 2016. His new book, *Aqua/Terra: Reflections on the World Ocean* was published in April 2021.

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1 ARTS AND CULTURE

CREATIVE EXAMPLES OF OCEAN SOLUTIONS THROUGH DIFFERENT PERSPECTIVES AND MEDIA

Art and culture affect our lives in countless ways every day: as a source of identity, of conflict and crisis, as a context for civil discourse, and for development of community and spiritual development. At times, art challenges us to explore new and expansive ways of thinking and creating solutions to complex problems.

INDIGENOUS CULTURAL PRACTICES

THE CLAM GARDENS OF CANADA'S COAST
Archaeological beach terraces along the intertidal zone of British Columbia encompass social, economic and spiritual beliefs of coastal First Peoples

ESTUARINE ROOT GARDENS
Revitalizing the Nuu-Chah-Nulth root gardens of Clayoquot Sound to promote and maintain traditional knowledge about health, food, and the environment

HERRING EGG HARVEST IN SITKA ALASKA
Traditional gathering of herring eggs on hemlock branches: a subsistence harvest and sign of spring

OCEAN ART

VISUAL ARTISTS
Zaria Forman • Monet and the Sea • Washed Ashore Project
Jason deCaires Taylor • The Human Origin Project

MUSIC AND FILM
The Underwater Dance • Polynesian Voyaging: Our Vaka • Danish Underwater Concert • The Outlaw Ocean Music Project

FURTHER READING
A vast library of ocean solutions awaits. Here are several reading recommendations by our editors: fiction and non-fiction

Cannes Underwater Museum, Île Sainte-Marguerite, France
artist: Jason deCaires Taylor

OCEAN ART AND CULTURE

CREATIVE EXAMPLES OF OCEAN SOLUTIONS
THROUGH DIFFERENT PERSPECTIVES AND MEDIA

In such disparate places as Indonesia, Sweden, Australia and South Africa, carvings and drawing of boats, fishers, and sea creatures indicate our engagement with the ocean and date back to pre-historic times. Indeed, the ocean precedes even the land from which all living things evolve. From the first the sea has provided and nurtured our living and our beliefs worldwide over time, expressed as documentation and evocation through art. Whether crudely drawn in charcoal or ochre, painted on walls or carved in stone, captured in charts and journals, seaside views, portraits of ships at sea, or photographed as document of exploration and science, artists have presented an historical record of civilization shaped by the ocean from our beginning. The connection is immediate, intimate, and enduring, and transcends space and time.

INDIGENOUS CULTURAL PRACTICES

CLAM GARDENS
Abundance in the Tidal Zone

Indigenous people on the west coast of North America used a range of techniques and practices to maintain or increase the production of culturally important foods. These practices are encompassed within age-old social, economic, and spiritual beliefs of coastal First Peoples. One such long-lasting and visible practice was the building of clam gardens in the intertidal zone.

Clam gardens are ancient intertidal mariculture features constructed by the coastal First Nations of British Columbia and Native Americans of Washington State and Alaska. Clam gardens are made by constructing rock walls at the low tide line along the edges of bays and inlets, creating a terraced landscape that expand the zone where clams thrive. This coastal management system, used principally by Coast Salish peoples, created an optimal habitat for clams.

Clam gardens were a food source for both First Nations peoples and animals, providing food security as clams are a food source that can be readily harvested when needed. There are likely hundreds if not thousands of clam gardens that have yet to be recorded along the northwest coast.

Traditional clam harvesting allowed for intergenerational knowledge transmission, with elders passing down knowledge about clam gardens to the next generation. Clam gardens were similar to an outdoor classroom, where traditional knowledge, language and cultural practices could be learned by the community.

ESTUARINE ROOT GARDENS
Promoting and maintaining traditional knowledge about health, food, and the environment

Many generations of Nuu-chah-nulth First Nations have relied on local resources to provide a healthy and sustaining diet. Root vegetables growing in tidal flats and at river estuaries were an important part of that traditional diet. Root gardens were historically important to First Nations all up and down the BC coast, and while the Nuu-chah-nulth diet has changed, many of these historical root gardens are being restored, such as the Tl'aaya-as project in British Columbia, engaging students and community members to research and recreate root gardens containing northern riceroot, Pacific silverweed and springbank clover.

For the Nuu-chah-nulth, the gardens were part of the hahuulthi system of ownership and Chiefly responsibilities. The cultivated roots were highly valued as an important food source. To produce enough of these roots to feed and sustain the communities, the Nuu-chah-nulth would carefully tend the gardens, weed out other plants, churn the soil and selectively harvest and replant to grow for the next years' harvests. Like most Nuu-chah-nulth food practices, this type of gardening was sustainable, producing an abundance of food without degrading the land. River estuaries and tidal marshes are one of the most productive types of habitat and are ideal for root gardens.

HERRINGS EGGS & HEMLOCK
The Sitka herring harvest is a long-standing cultural tradition for the tribal people of Southeast Alaska

Alaska's Native people have been harvesting herring eggs for thousands of years. Tribal harvesters gather herring eggs on kelp, seaweed and hemlock branches with the majority of the harvest coming from hemlock branches. The eggs are sticky and adhere easily to whatever substrate is used.

As part of their traditional foods program, members of the Sitka Tribe of Alaska harvest herring eggs each year for distribution to elders and other tribal members, as well as to put up for future gatherings and events.

Herring typically return to Sitka Sound in March of each year to spawn. Signs of the herrings' return are whales surfacing offshore, large numbers of seals and sea lions and birds flocking to feast on the small fish. It is not clearly known why the herring spawn when and where they do, but they come in great abundance and their eggs are harvested traditionally using seaweed and freshly cut hemlock branches.
In the current subsistence fishery, the majority of harvesters come from the Sitka area. Most everyone who harvests herring eggs from Sitka Sound shares them with family or neighbors within Sitka, sometimes shipping eggs to family or trading partners elsewhere.

Harvesting herring eggs is a specialized activity and to do it successfully requires a special set of skills and traditional knowledge.

Watch Gáax'wa Haaw (Herring Eggs & Branches) by director Ellie Schmidt at ellieschmidt.com. Winner of the Short Film Grand Prize at the International Maritime Film Festival 2020: maritimefilmfestival.com.

OCEAN ART AND CULTURE

Artists are historians and truthtellers, with seemingly infinite energy and imagination by which to capture the essence of ocean experience. Deep sea high resolution video, big screen film, assembled detritus and driftwood collage, formal watercolors, coastwise plein air painting, underwater dance and sculpture, poetry and song, epic tales of adventure and moral quandary – all forms of oceanic feeling that never fails to exult and inspire. Access to the sea is essential, for there each of us becomes a maker of our personal history and truth, each of us becomes an artist in her/his own right, old or young, on whichever shore.

CLASSIC OCEAN ART: Monet and the Ocean

from theartwolf.com

The relationship between Monet and the sea began as soon as the young artist moved, along with his family, to the coastal town of Le Havre, Normandy, in the mid-1850s. While he did not have an immediate affinity for *plein air* painting, another local painter, Eugene Boudin, encouraged Monet to paint outdoors. He was further influenced by other painters' effects of light and atmosphere in seascape paintings and studied the horizontal representation of sky and atmosphere. Monet painted wild seascapes, bourgeois scenes by the sea, contemplative works of the boats and windmills of the Netherlands, and the rugged and dramatic coastal landscapes from the cliffs of Normandy.

One of Monet's most compelling and atmospheric works is *Impression, sunrise* painted in 1873 and now on display at the Musée Marmottan in Paris. In *The Manneporte* painted in 1886 and exhibited at the Metropolitan Museum in New York (pictured), the meeting point of rock and sea on the left side is very diffuse, so it is very difficult to guess where one begins and the other ends. In these paintings we can sense a traces of abstraction, which Monet would further develop in the next decade.

In the late 1880s Monet briefly rented a small castle in Antibes in the French Riviera. He immediately fell in love with the landscape of the Mediterranean, "so full of light", and its turquoise and pink tones. It was here in the Antibes that Monet's relationship with the sea comes largely to a close. While he continued to paint some seascapes during the dext decade, they did not represent a key point in his career, already focused on haystacks and water lilies. Yet even in those works, the results of his experiments developed in his seascape paintings are easily visible.

Claude Monet:
"The Manneporte"
(1883)
Metropolitan Museum of Art
New York

The Manneporte seems a colossal column of rock that emerges from the raging sea. In this work and others of the time, we can sense a traces of abstraction, which Monet would further develop during the next decade.

CLASSIC OCEAN ART: Hokusai's *The Wave*

from artst.org

Painted in 1831, Katsushika Hokusai's *The Wave* was one that quickly garnered attention around the world despite Japan being under a strict period of isolation.

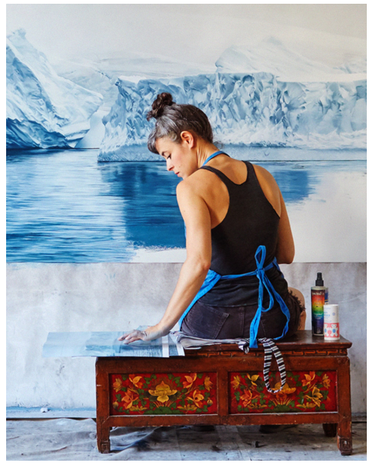
This painting is also known as *The Great Wave off Kanagawa* and focuses on the unpredictable and often turbulent seas near Japan's Mount Fuji in Yamanashi and Shizuoka ken prefectures.

Hokusai painted this work as a series of scenes he labeled "Thirty-Six Views of Mount Fuji". *The Great Wave* was the most famous of the series.

Hokusai chose to paint the work in a gripping blue coloration that primarily features the giant, roaring waves rising and crashing. Mount Fuji is visible in the crest of the largest wave as a small, distant landscape that can barely be discerened as a mountain among the ocean waves; it is depicted as a snow-capped peak that looks much like the waves in the sea. The artist also includes ships that are also dwarfed by the huge waves. The vessel that is in the center of the painting appears to be on the verge of being swallowed by an incoming rogue wave.

CONTEMPORARY OCEAN ART: Zaria Foreman

from artsy.net



Zaria Forman's pristine, photorealist paintings of the ocean and remote, icy landscapes are painted by hand – quite literally using her fingertips to render marks in paint and chalk, rather than brushes. Traveling to far-flung corners of the globe affected by climate change, in order to source inspiration for her large-scale compositions, Forman takes photographs and creates sketches, working from these and her memory after she returns to work in her studio in the United States. Past expeditions have included one to Greenland in which Forman retraced the 1869 journey of the American painter William Bradford. "In my work I explore moments of transition, turbulence and tranquility in the landscape and their impact on the viewer," she has said. "In this process I am reminded of how small we are when confronted with the powerful forces of nature." Her work has been featured in the set design for the Netflix series "House of Cards", as well as in set designs for ballet performances.

zariaforman.com

"As soon as we sink them, they belong to the sea."

Jason deCaires Taylor

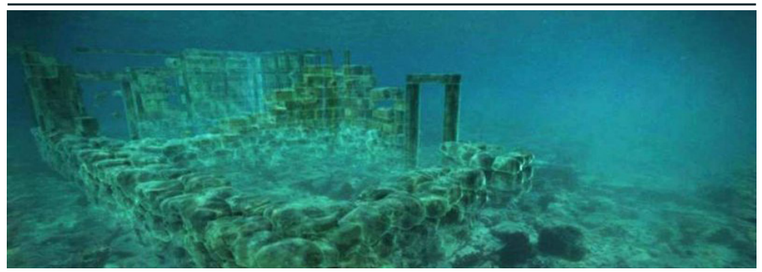
CONTEMPORARY OCEAN SCULPTURE: Jason deCaires Taylor

Jason deCaires Taylor is a sculptor, environmentalist and professional underwater photographer. His permanent site-specific sculptural works are predominately exhibited underwater in submerged and tidal marine environments, exploring modern themes of conservation and environmental activism. Taylor gained international notoriety in 2006 with the creation of the world's first underwater sculpture park, situated off the west coast of Grenada in the West Indies. The formation of the park was instrumental in the government declaring the site a National Marine Protected Area. Taylor has gone on to produce 1,000-plus public terrestrial and underwater sculptures worldwide: in Mexico, The Bahamas, Spain, the United Kingdom, Indonesia, Norway, the Maldives, Australia and France.

Taylor's pioneering public art projects are not only examples of successful marine conservation, but works of art that seek to encourage environmental awareness, instigate social change and lead us to appreciate the breathtaking natural beauty of the underwater world.

underwatersculpture.com

Vicissitudes, 2007
Jason deCaires Taylor



Pavlopetri. Greece.

CLASSIC OCEAN SCULPTURE: Lost Cities Beneath the Sea

Dwarka. India.
According to folklore, Dwarka was a mythical city, home of Lord Krishna. Its existence was a tale of folklore until archaeological ruins were discovered 131 feet below the surface of the sea in the Gulf of Cambay. The search for its submerged parts began in the 1930s, and the first archaeological excavation took place in 1963.

Port Royal. Jamaica.
Comprised of four forts and 2,000 buildings, Port Royal was a hotbed for pirate activity in the 17th century. Blackbeard would often make Port Royal his base to raid treasure ships. That was, until 1692 when an earthquake dragged it into the Caribbean sea. Most of the remains of the city now lie under 40 feet of water. Up until the 1900s visitors reported seeing parts of the city still visible below the waves.

The Pyramids of Yonaguni Jima Japan. They mysterious pyramids of Yonaguni in the Jima Ryukyu archipelago, about 75 miles (120 kilometers) off the eastern coast of Taiwan, are fraught with mystery: the structures may be the remains of a 5,000-year-old city, complete with stepped pyramids that rise 82 feet from the depths of the sea floor, while others believe them to be a naturally occuring phenomenon.

Pavlopetri. Greece. Having sunk 5,000 years ago, the underwater city of Pavlopetri off the coast of Laconia in Southern Greece is one of the oldest submerged Lost Cities in the world. Believed to be part of the Minoan dynasty, it was discovered in 1967 and is unique in that it has an almost complete town plan, including streets, buildings and tombs.

WASHED ASHORE PROJECT

Fact: there is a lot of trash in the ocean. It's been found on remote islands around the globe, at the two Poles, and deep on the sea floor. Of the trash that washes up on the beach, Angela Haseltine Pozzi and her team are converting it into beautiful sculptures as a means of advocacy, teaching children about ocean health through workshop, and building community with volunteer-led trash beach cleanups and construction of sculptures by community groups. Through the work of the Washed Ashore Project, Pozzi and her team try to convey the diversity of ocean trash while working to inform viewers about an array of ocean issues related to marine trash. They are fulfilling their mission to build and exhibit aesthetically powerful art to educate a global audience about plastic pollution in the oceans, and to spark positive changes in consumer habits.Since 2010 the Washed Ashore community has constructed more than 65 sculptures, each telling a story of the dangers of over-consumption and waste.

washedashore.org

Detail of Lidia the Seal
Washed Ashore Project

LIDIA THE SEAL
Credit: Washed Ashore
Lidia the Seal sits atop of a pile of netting, rope, buoys and other marine debris. The sculpture itself is colorful and whimsical—but asks us to question the many ways that discarded plastics and trash are harmful to marine life.

MUSIC

THE OUTLAW OCEAN MUSIC PROJECT
Making Music from Journalism

Musicians and journalists are both storytellers. One uses sounds, the other leverages words. The Outlaw Ocean Music Project is a first-of-its-kind collaboration of such creators. In combining their mediums, these narrators have conveyed emotion and a sense of place in an enthralling new way. The result is a captivating body of music based on *The New York Times* best-selling book by Ian Urbina entitled *The Outlaw Ocean*, which chronicles a lawless realm that few of us realized existed.

While reporting for more than five years at sea, Urbina built an audio library of field recordings featuring a variety of textured and often rhythmic sounds such as machine-gun fire off the coast of Somalia and chanting of captive deckhands on the South China Sea. Using the sound archives and inspired by the *Outlaw Ocean* reporting, hundreds of artists from more than forty countries produced EPs in their own interpretive musical styles — including electronic, ambient, classical or hip hop.

theoutlawoceanmusic.com

All the music in this project is based on *The Outlaw Ocean*, a *New York Times* Best-Selling book by Ian Urbina that chronicles lawlessness at sea around the world. The reporting touches on a diversity of abuses: illegal and overfishing, arms trafficking, human slavery, gun-running, intentional dumping, murder of stowaways, thievery of ships and more.

DANISH UNDERWATER CONCERT
Musicians Create an Ethereal Underwater Concert Experience

Danish ensemble Between Music sing and play custom-made instruments completely submerged in water tanks. A project of more than ten years in the making, the musicians worked closely with researchers and inventors to develop special instruments that could produce the ideal sound for underwater acoustics, and they developed a special technique for underwater singing. They created an underwater concert installation called *Aquasonic* in which they submerge themselves in aquariums to perform. The video link here is from a performance at the SPOT Festival in Aarhus, Denmark. The band has performed 36 concerts in seven countries since its premiere in 2016.

The artists wear no diving gear to aid their breathing underwater, the timing for taking in breath is often written into the composition. The results of their work are eerie, sensual, haunting and ethereal. It's like nothing you will have ever heard before.

ELEGY FOR THE ARCTIC

In 2016 acclaimed Italian composer and pianist Ludovico Einaudi performed an original composition on a floating platform in the Arctic Ocean, against the backdrop of the Wahlenbergbreen glacier in Svalbard, Norway.

The composition, *Elegy for the Arctic*, was inspired by eight million voices from around the world calling for Arctic protection. The Greenpeace ship *Arctic Sunrise* carried Einaudi, the grand piano and eight million voices to Svalbard for the performance.

FILM

POLYNESIAN VOYAGING SOCIETY: OUR VAKA
We The Voyagers

Directed by Marianne "Mimi" George, Heuionalani Wyeth, Jacob Penchansky. Anahola, Hawaii

The living crew of Lata, the Polynesian culture hero who built the first voyaging canoe and navigated across the Pacific, tells the story of ancient designs, materials, and methods as a means to reconnect with ancestors and sustainable lifeways. *We, the Voyagers* tells of an isolated Polynesian community living the story of their ancestor, Lata.

To make an ocean voyage, Lata needs crew. He welcomes men, women, children, hard workers with skills and applicants of dubious character, including a sailing anthropologist named Mimi George. The community learns to sail the open ocean, interacting with wind, waves, stars, and other signs that their ancestors show them when they are needed. When they arrive at their destination viewers learn what happened to family members since their last voyage, generations earlier.

We, The Voyagers is a story of reconciliation, love for community, and a collective looking forward toward a future together.

vaka.org

OCEAN ART AND CULTURE

RECOMMENDED OCEAN AND FRESH WATER READING COMPILED BY OUR EDITORS

The library of ocean reading is as vast and complex as the sea itself.
See our full list of recommended reading at worldoceanobservatory.org/further-reading

WATER

Troubled Water: What's Wrong With What We Drink? by Seth Siegel (Thomas Dunne Books October 1, 2019)

Urban Water Security, Challenges in Water Management by Robert C. Brears (Wiley, 2016)

The End of Abundance: Economic Solutions to Water Scarcity by David Zetland (Aguanomics Press 2011)

Water Wars: Privatization, Pollution, and Profit by Vandana Shiva (South End Press, Cambridge, MA. 2002)

SUSTAINABILITY

Ocean of Life: The Fate of Man and the Sea by Callum Roberts (Penguin Group, New York, 2012)

Bottomfeeder: How to Eat Ethically in a World of Vanishing Seafood by Taras Grescoe (Bloomsbury, New York, 2008)

Sustainable Sushi: A Guide to Saving the Oceans One Bite at a Time by Casson Trenor (North Atlantic Books, Berkeley, CA, 2009)

CLIMATE AND GLOBAL WARMING

The Archipelago of Hope: Wisdom and Resilience from the Edge of Climate Change by Gleb Raygorodotsky (Pegasus Books, New York, 2017)

Nature's Trust: Environmental Law for a New Ecological Age by Mary Christina Wood (Cambridge University Press, 2013)

Eaarth by Bill McKibben (St. Martin's Griffin, 2011)

OCEAN POLICY, ECONOMICS AND ZONING MANAGEMENT

The Ocean: Our Future by Independent Commission on the Ocean, edited by Mario Soares (Cambridge University Press, UK 1998)

Oceans 2020: Science, Trends, and the Challenge of Sustainability edited by John G. Field, Gotthilf Hempel, and Colin P. Summerhayes (Island Press, Washington, DC 2002)

Ocean Zoning, Making Marine Management More Effective by Tundi Agardy (Earthscan Publications Ltd., London 2010)

IDEAS AND NEW SYSTEMS

Natural Capitalism: Creating the Next Industrial Revolution by Paul Hawken, Amory Lovins and L. Hunter Lovins (Back Bay Books/Little, Brown & Company, New York, 1999)

Moral Ground: Ethical Action for a Planet in Peril Edited by Kathleen Dean Moore and Michael P. Nelson (Trinity University Press, San Antonio, 2010)

This Changes Everything: Capitalism vs the Climate by Naomi Klein (Simon & Schuster, New York, 2014)

Green Growth That Works: Natural Capital Policy & Finance Mechanisms Around the World Edited by Lisa Mandle, Zhiyun Ouyang, James Salzman & Gretchen C. Daily (Island Press, Washington DC, 2019)

Mirroring Effects: Tales of Territory by Marc Angelil and Cary Siress (Ruby Press, Berlin, 2019)

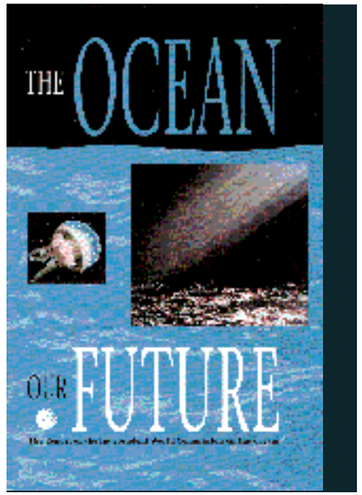
The New Systems Reader: Alternatives to a Failed Economy Edited by James Gustave Speth & Kathleen Courrier (Routledge, New York, 2021)

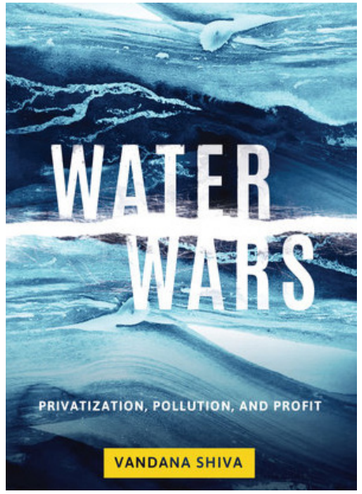
A Blueprint for Coastal Adaptation: Uniting Design, Economics, and Policy Edited by Carolyn Kousky, Billy Fleming, and Alan M. Berger (Island Press, Washington, DC, 2021

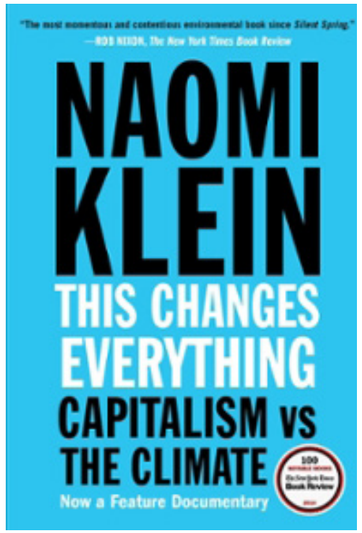
Moving to Higher Ground: Rising Sea Level and the Path Forward by John Englander, (The Science Bookshelf, Boca Raton, FL, 2021)

Rescuing the Planet: Protecting Half the Land to Heal the Earth by Tony Hiss, (Alfred A. Knopf, New York, 2021)

Global Challenges and the Law of the Sea Edited by Marta Chantal Ribeiro, Frenando Loureiro Bastos & Tore Hennriksen (Springer Academic Publishing, New York, 2020)







ART, CULTURE AND THE OCEAN

Images of sailors and vessels have long appeared in the traditional media of painting and drawing. Museums are predictable sources for some of the finest works of history, but we also find the ocean in the decorative arts, in utilitarian items, as ephemeral objects, even carved in rock walls of mountains and deserts.

The ocean in her mystery, her utility, her inspiration and her peril have long been used as a medium for expression, art form and for advocacy. We find ocean expression in popular culture, past and present, in fiction and non-fiction, in nature, films, poetry, song, in photograph, in sculpture and in the detritus pulled from the ocean.

A Faint Resemblance
Antarctic Peninsula
Jan Eric Waider
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Jan Erik Waider is a visual artist and fine art photographer based in Hamburg, Germany. His focus is atmospheric and abstract landscape photography of some of the most remote parts of the world.

Jan's desire to explore remote and rarely seen places provides unique opportunities to shoot magnificent vistas and landscapes. His meticulous and well-planned approach to his projects immerses him in his surroundings.

These quiet, mesmerizing moments of contemplation and reflection are what inspire Jan the most. These are the moments where he feels connected and "at home." His photography is a way of preserving these fleeting memories.

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2 OCEAN CLUSTERS: BUILDING BRIDGES

In Nature, things cluster to feed, to defend, and to create. In an era where competition reigns as a fierce, determining ethos, clustering may seem unrealistic and ineffectual. But in a time of disruption and change, of transformation of old ways into new, small ideas and start-up enterprise needs the shelter and support of a cluster relation that provides economies of scale, creative exchange and feedback, financial and administrative efficiencies, and the enthusiasm of a creative community.

Thus, the clustered work space was conceived: an innovation, now a predicable convention as individual entrepreneurs and small businesses find post-pandemic ways to economize and invest limited capital to advantage.

The thriving Ocean Cluster movement is a primary example. Now located in Iceland, Norway, Singapore, Canada, the United States, with new clusters forming as places where the feeding, defending, and creating of novel ocean-related products, processes, and relationships begin.

The World Ocean Observatory has found such a nurturing place within the New England Ocean Cluster in Portland, Maine. There we experience motivating and inspiring connection with ocean innovators at the local level, regionally, and worldwide.

SINCE THE CREATION OF THE ICELAND OCEAN CLUSTER MODEL IN 2011, SEVERAL PARTNERING CLUSTERS OPENED GLOBALLY USING THE ORIGINAL MODEL TO BUILD THEIR OWN. THESE PARTNERSHIPS HAVE ENCOURAGED CROSS-POLLINATION AND COUNTLESS CROSS-SECTORAL RELATIONSHIPS.

BUILDING BRIDGES

THE OCEAN CLUSTER MODEL

A SUSTAINABLE WAY FORWARD FOR THE BLUE ECONOMY

BY BOBBY FOOSE

Creating collaborative spaces globally, designed to enhance the value of a region's seafood industry.

In an economic climate hindered by the COVID-19 pandemic, business start-ups have been slowed and industries have struggled. At the same time, a search for climate change solutions is surging as we try to mitigate the effects that it is having on our earth and, in particular, our oceans.

The Blue Economy is defined by the World Bank as the "sustainable use of ocean resources for economic growth, improved livelihoods and jobs, and ocean ecosystem health." It is a massive contribution to the world economy every year, and in certain places economies depend entirely upon it.

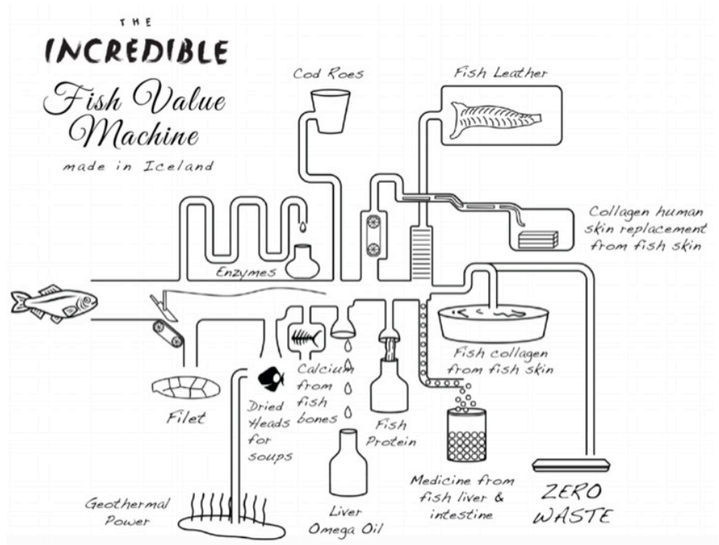
Formed in 2012, the Iceland Ocean Cluster (IOC) was created by Dr. Thor Sigfússon to establish a network for ocean resource-oriented companies to develop and innovate together through a unique platform. Sigfússon was inspired by his studies of social capital and its effects on development and innovation and noticed a trend in the industry of the Blue Economy. In a small country like Iceland with an economy dependent on fish, the industry was somewhat complacent and habitual for years, with a weak startup culture and many opportunities to expand the innovation network. The lack of collaboration made it difficult to create added value and move up the value line in seafood byproducts. This is something that we still see today in a large majority of the world. In his 2020 book, *The New Fish Wave*, Sigfússon explains that a collaborative effort to grow the industry was "central to raising both creativity and efficiency". Since forming nearly 10 years ago, the Iceland Ocean Cluster has expanded from a small community of 12 companies to more than 70 companies that represent many parts of the Iceland ocean value chain. The companies within the cluster range from fish sales to seafood biotechnology companies, cosmetics, consulting, research, education and much more. Their secret to success? Face to face dialogue in the office place and collaboration between companies to create new value.

In 2012, the IOC opened the Ocean Cluster House in Reykjavik to enhance face-to-face interactions between cluster members. The OC House has become known worldwide and is now a prototype for similar innovation activities in harbors around the globe. In a recent study, it was found that over 70% of the companies in the Ocean Cluster have collaborated with another company in the OC House. The value of connections and collaboration in the cluster has proven to be very successful and has had a profound effect on the number of blue startups in Iceland, shown by a 150% increase in the number of blue startups in Iceland since 2011. In making their mark on the Blue Economy, the Iceland Ocean Cluster did not orient their approach towards leveraging ocean resources in the old, linear "take-make-waste" method. Their unique projects and methods promote substantial economic growth and social inclusion while using increasingly sustainable practices in the oceans and the production of their goods and services. They are active leaders and promoters of the concept of the circular economy and have used this model to innovate and expand. At the center of their mission is one of their most widely known and successful initiatives, the 100% Fish Project. The IOC created a model for producers in the blue economy that gives products for every part of the fish, reducing waste to the point where 100% of the fish is used. They created a graphic titled *The Incredible Fish Value Machine*, (shown below) that displays ways to make products with each specific part of the fish. This revolutionary model is being used globally to eliminate waste from fish parts.

With the current global and domestic problems with overfishing, a method to use the current supply and create more value with what is already caught while decreasing the total catch of fish to restore life is very necessary. In order to increase biodiversity and prevent overfishing, the total catch of fish in Iceland since 1981 has declined by 45% from 460,000 tons to 252,000 tons in 2018 and the present value in millions of dollars has only dropped by about 16%. This proves the efficiency of the system due to the utilization of all parts of the fish. The Iceland Ocean Cluster has transformed the Blue Economy in Iceland and changed the way that the world can think about ocean resources and economics. Their model is now being used in many other places and the idea is expanding globally.

THE CLUSTER MOVEMENT

Since the creation of the Iceland Ocean Cluster model in 2011, there have been several partnering clusters opened globally using the model to build their own. These partnerships have encouraged cross pollination and countless cross sectoral relationships,



Patrick Arnold, co-founder and CEO of the New England Ocean Cluster with Chris Cary, chief operating and marketing officer. The pair have big plans for the Ocean Cluster House that opened in the midst of the pandemic in early 2020. The Hús, located at 68 Commercial Street on the working waterfront in Portland, Maine, is a member-based, marine-focused consultancy, business incubator and accelerator.

benefitting all parties involved. In this article, we will explore how the cluster model has been expanded globally. To do so, we researched several Ocean Clusters that are a part of the Iceland Ocean Cluster network and interviewed influential leaders within them, asking about the community response to the cluster initiative, success stories, and collaboration with other Clusters.

New England Ocean Cluster Portland, Maine, USA

Founded in 2014 by Port Development and Transportation Consultant, Patrick Arnold, and Thor Sigfússon as the first partnering cluster to the Iceland Ocean Cluster, the New England Ocean Cluster (NEOC) has rapidly expanded. It has demonstrated how the cluster model can be implemented in many places and how each place can thrive in a completely different way. In speaking with Chief Operating and Marketing Officer Chris Cary, he emphasized the amount of dedication and organization it takes to successfully implement the cluster model:

"The Cluster model is a loaded initiative, as it is new and not broadly communicated. We are selling a vision, and a lot of education is required for people to understand it. The model requires personal investment in time, self-education, and financial resources, and this makes it very hard to launch overnight. It is easy to be on board with an organization that helps businesses become more sustainable, economically efficient, and connected, but the reality of implementing it is contingent upon the ability to gain trust and gather capital."

Cary highlighted the difference and intersection between working laterally and working vertically. Company leaders and entrepreneurs are typically vertically integrated, meaning they focus mainly on the responsibilities required to sustain the business. This approach makes it hard to build relationships, or work laterally, which is where the unique approach of the cluster comes in. Clusters, on the other hand, act laterally and allow the businesses to maintain their focus vertically.

"What a cluster does is connect organizations: if one organization has a problem, another organization within the cluster has the solution and the cluster connects the two of them. The job is to know who the vertical operators are and build relationships with them, while staying clear of every internal matter so that you know and connect a wide variety of people."

With more than 45 member organizations, a collaborative work environment with 20 offices and 14 workstations called The HUS, and a highly renowned pilot study program with the University of Maine, the NEOC has done a spectacular job connecting those businesses and forming relationships. The stories of their collaboration go way past just their local involvement, too and are illustrated in their relationship with the Iceland Ocean Cluster.

"Each cluster is very different. We do things differently based on who we are, what we are near, and who we work with. The value of cluster collaboration is centered around the sharing of best practices, developmental experiences, and outward looking innovators and workforces. What Iceland has done in terms of full utilization of the cod can be applied globally and create significant opportunities in worldwide seafood processing. Getting places like Maine to dive into full utilization projects using the example of Iceland is crucial," Cary said.

The NEOC does much more than just collaborate internally: their leadership has proven to be very helpful in forming relationships abroad with organizations in other clusters:

Cary continues, "Through knowing the Iceland Ocean Cluster and partnering with their team, we have a system of collaboration. At the NEOC we log design or entrepreneurial questions so that if an organization within our cluster has a question or are looking for a better method, we can take note of this and connect them quickly with other companies."

There is a lateral knowledge of the network between the Ocean Cluster organization and its companies. In a matter of minutes, a bridge is built between two vertically integrated companies who don't have the time to seek out these people.

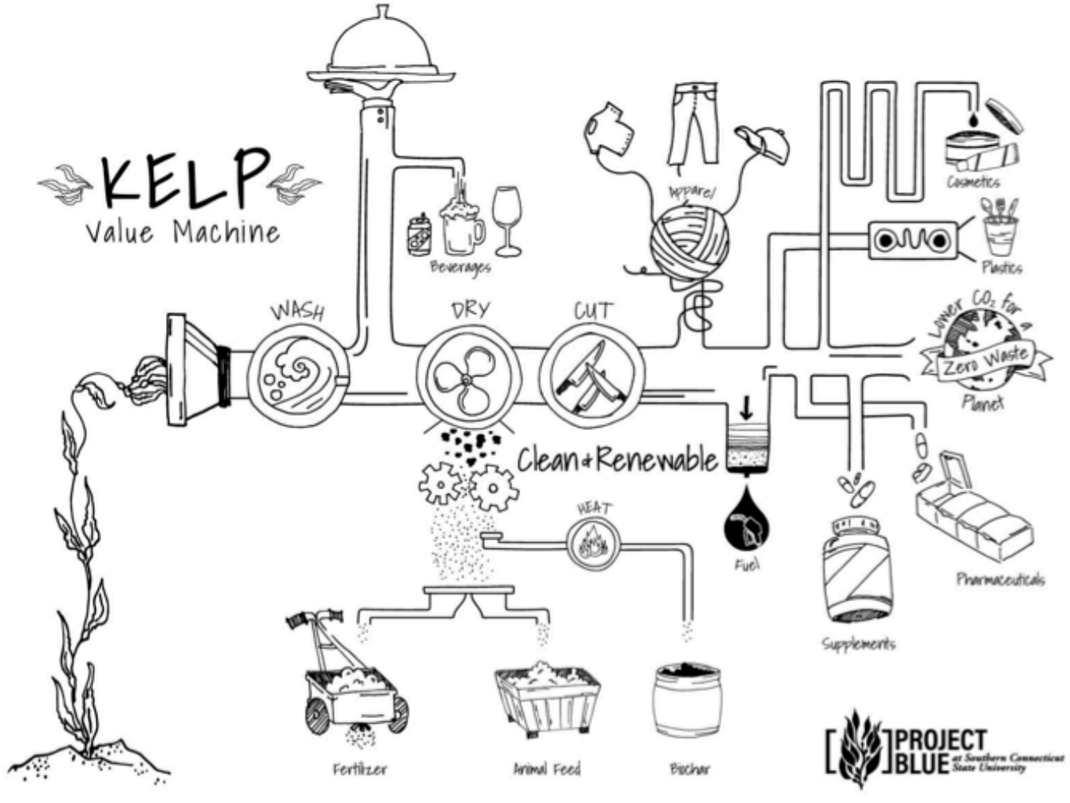
In 2019, a NEOC member company called Ready Seafood was in a new innovation phase. They were searching for a better flavor extraction method for crustaceans, and almost immediately the cluster leadership put them in touch with a company that specialized in these methods in Iceland. Through the Iceland Ocean Cluster they were connected with NorthTaste All-Natural Seafood Flavorings, formerly Norður and they inquired about their methods. The NEOC company then used the details and knowledge from Norður to integrate it into their business.

This helpful process was done so efficiently thanks to the cluster model, and relationships such as these have led to the success of many companies. Even though these clusters operate in completely different regions with different focuses in the Blue Economy, they have found ways to collaborate. The Cluster model has exceeded expectations in terms of collaboration, and this framework also exists at the academic level.

"Our opportunities are not fully based on profit, there is a lot of social entrepreneurship and necessary academic development that needs to occur. We now have relationships with Presidents of Universities all across the US and Scandinavia."

One of the pinnacle success stories of the New England Ocean Cluster is their engagement with the University of Maine system. They have paired more than 100 students with industries and academic exchange programs and have brought them to international events focused on the ocean economy. Multiple students have been hired or gone on to graduate school as a result of this, whether it is domestically through the University of Maine program or abroad in one of the many universities in Scandinavia that they have relationships with. The NEOC has followed in the footsteps of the Iceland Ocean Cluster, creating their own individual organization with unique differences, and succeeding in the same way. They are a prime example of the success of the model.

newenglandoceancluster.com



Long Island Sound Ocean Cluster
New Haven, Connecticut, USA

The Long Island Sound Ocean Cluster (LISOC) is brand new, having started in January 2021, but its plans have been a long time coming. The initiative stemmed from a 2020 internship with the IOC, and CEO Michaela Garland has been dedicated to the building of this Cluster since, with the help of Professor of Geography at Southern Connecticut State University, Patrick Heidkamp. The LISOC immediately submerged themselves in the local Blue Economy, building relationships with environmental leaders, local government, maritime entrepreneurs, and many others. Their initial focus was getting young students involved into the innovative Blue Economy ecosystem. They built a relationship with Southern Connecticut State University and created *Project Blue* to increase student engagement and create opportunities through internships. They also got involved in the emerging kelp industry, one that was in major need of help getting off the ground. The LISOC built close relationships with kelp farmers in the area and are continuing to develop those relationships.

"This has been one of our biggest successes. Americans usually ship in kelp from Iceland or Asia and don't use our local supply. Kelp farmers have a very hard time getting their product on the market in the U.S. and they get very low value for it," Garland said.

Eager to start an initiative helping these kelp farmers and the local economy, the LISOC partnered with farmers and more than 40 restaurants along the entire coastline of Connecticut to help create New England Kelp Harvest Week. Locally farmed kelp was the main ingredient in each dish and the event was a huge success. Since the end of the festival, the LISOC has received tremendous feedback from the community and a lot of interest from other cities such as Philadelphia and New York. In addition to their quickly growing relationships, the LISOC is incorporating the best practices of other clusters as well. Using the Iceland Ocean Cluster's Incredible Fish Value Machine, the LISOC is working to develop a similar model for kelp.

"We decided to put this model of a machine into our geographical context, and we developed the *Kelp Value Machine*, molding and adapting it to a different industry than fish."

They are also working with the IOC to bring the 100% Fish Utilization Model to the recirculation of aquaculture inland. They have formed partnerships with fish farmers growing branzino, presented the model, and explained their partnership with the Ocean Cluster network. Together, they are working to use all parts of the fish to boost business and eliminate waste. Still in the early stages of starting up the cluster, the LISOC is off to a great start and is making a positive impact on their economy and environment.

longislandsoundoceancluster.com

Ocean Cluster Rio of Usina de Startup
Rio de Janeiro, Brazil

Founded in June 2019 by Leonardo Neto, the CEO and Founder of investment management company Usina de Startup, Ocean Cluster Rio is working to develop a network in Brazil to strengthen new business and entrepreneurship in the Blue Economy.

"Inserting this idea in the ecosystem was the most complicated process of our project, but today we have community engagement with our actions, entrepreneurs seek us out to be part of our cluster, and governments have institutionally supported our initiatives."

Rather than focusing on a specific element of the Blue Economy, the Rio cluster has projects in the fishing industry, oil and gas, offshore renewable energy, polymer recycling, beach cleaning, professional education, and the port operations/shipping industry. Aside from their numerous successful partnering businesses, they have expanded into education and community engagement. They are very open to questions from the public and per request of their community and companies, they created a networking course that will begin in August.

Neto states, "Our first course will teach how the artisanal fishing communities can empower themselves to sell and promote their products and services to the community. In September, we will start a week of webinars about ocean clean energy opportunities."

Ocean Cluster Rio is a catalyzing force in its local economy, but their contributions and interactions do not end there. In creating the cluster, they partnered with the IOC to develop partnerships between the maritime entrepreneurs in Iceland and Brazil. They have used this partnership to build business connections all over Scandinavia and South America. They have spread the IOC's 100% Fish Utilization Model to Brazil and learned

and adapted innovations in the field of clean ocean energy from the Ocean Opportunity Lab in Norway. In just a short amount of time, they have expanded globally and applied their learned practices to their local communities in Brazil. They are looking forward to expanding the cluster model into many other places in South America and continuing the development of their global business network.

@usinadestartup

Pacific Islands Ocean Cluster
Pacific Islands

Tuna is a massive contributor to the Pacific Islands regional economy. It supports more than 23,000 jobs, provides an average of 37% of government revenue for 10 countries and territories, and is necessary to fill future protein requirements for the region's rapidly growing human population. With the increasing threats of climate change and overfishing, a creative approach and solution to the declining population of tuna is needed, and the creation of the Pacific Islands Ocean Cluster comes at a great time. Their goal is to bring innovative technology efforts to follow the Iceland Ocean Cluster's 100% Fish Utilization Model and add value to each fish. They have put together a team full of leaders from all over the Pacific Islands. Linda Bercusson, Manager of the Pacific-Arctic Partnership for 21st Century Fisheries for Conservation International, was greatly involved in the creation of this cluster. She partnered with Iceland Ocean Cluster CEO Berta Danielsdottir, who has guided the development of their business model and ambitions. Bercusson had this to say about the group of leaders spearheading the initiative:

"The caliber of the Pacific Islands Ocean Cluster's Advisory Group demonstrates a recognition of the impact this venture can have in the region. Agencies, NGOs, and community influencers have embraced the Pacific Islands Ocean Cluster because the need for innovation, collaboration and transparency in fisheries is more important than ever. "
With their new group they are aiming to create employment opportunities and create additional revenue through added value for the countries that are economically dependent on tuna. Early in the process they have gone far and wide to collaborate with the Iceland and New England Ocean Clusters, gaining valuable strategic advice and becoming a part of the Ocean Cluster Network.

New Bedford Ocean Cluster
New Bedford, Massachusetts, USA

The New Bedford Ocean Cluster (NBOC), founded in 2017, was created with the intention of becoming leaders and spurring growth in the offshore wind industry. Shortly after they joined the IOC Network to expand and "convene a network of growers, suppliers, educators and others in the commercial aquaculture space to facilitate best practices, innovation and integration of aquaculture businesses into our world-class commercial fishing harvesting and processing supply chain". They also connected with "commercial fisherman, professors, regulators, academics and other businesses to derive more value from the seafood caught in the region." The NBOC Cluster is working collaboratively to expand their knowledge of the blue economy while also establishing New Bedford as "the central cluster of the offshore wind industry on the East Coast." The Board of the NBOC includes prominent representatives from the ocean economy in New Bedford, among them Mayor Jon Mitchell. It is vital for clusters to have such leaders as a part of their activity. The cluster's activity includes major facets of the industry such as "port services, construction, training, research, engineering, front office and manufacturing." Their knowledge and entrepreneurial focus have added a unique strength to the Iceland Ocean Cluster Network.

newbedfordoceancluster.org

Alaska Ocean Cluster
Anchorage, Alaska, USA

Alaska is vital to the United States Blue Economy, producing 60% of the country's seafood and possessing over half of the coastline and potential ocean energy resources. This has made it a key spot for a cluster. Created in a struggling, declining 2017 Alaskan economy, the Alaska Ocean Cluster has been a brilliant initiative that came at the right time. Partnering with the Iceland Ocean Cluster, they have been extremely active and successful in a "uniquely Alaskan" way. They have built relationships with private industries, academia, nonprofits and public entities, adding leadership and connecting them with others. Their entrepreneurship program, the Blue Pipeline Incubator, is growing very quickly. In speaking with the former Director of the program, Justin Sternberg, he said:

"The 2019 Cohort of the Blue Pipeline Incubator in Seward graduated four companies hailing from a range of ocean industries, including mariculture, coastal tourism, seafood processing, and ocean energy. During the program, member companies raised $1.6 million."

The Blue Pipeline startups have been very successful in their ventures. Their products and services are growing in demand as their connections grow through the incubator and cluster. The Alaska Ocean Cluster and Blue Pipeline Incubator will continue to expand over the next year, bringing on more partners and expanding the model.

alaskaoceancluster.com

Louisiana Ocean Cluster
New Orleans, Louisiana, USA

For ages, Louisiana has been known for their amazing seafood and the culture surrounding it. Due to the effects of global warming such as coastal erosion, floods, storm damage, and restaurant closures, they are in dire need of a sustainable and economically effective solution. Brand new and still in the process of creation, the Louisiana Ocean Cluster (LOC) will be a prime solution to these issues. They have gathered support statewide through the Louisiana Seafood Board, Wildlife and Fisheries, state legislators, higher education, and numerous successful incubators. They have gathered a knowledgeable base of people who are committed to bringing the Cluster model to Louisiana. Karen Profita,

"Being a part of the Ocean Supercluster we've gotten to know companies that we wouldn't have known before. Through both the connectors and some of the networking events… part of that is being able to develop new products that can help us explore the ocean better."

Niru Somayajula, Sensor Technology
Canada's Ocean Supercluster

Executive Director of the Louisiana Seafood Promotion and Marketing Board, has played a large role in the creation of the cluster. While the cluster is not formally established yet, they have made progress with gaining capital and building ideas.

"There is a product in development that will hopefully demonstrate proof of concept, attract publicity, and help to attract funding for launch. There are venture capitalists who have expressed interest but would like to see progress on potential products and support from the state before investing."

The LOC organization has been doing a great job building connections within the state, but they have also inserted themselves in the global ocean cluster network. With the help of Iceland Ocean Cluster Founder Thor Sigfússon, they have generated ideas and facilitated connections that will be valuable down the road. "The other clusters have been a great source of support and inspiration. It has been wonderful to be able to reach out to others that have been down this path and see how they have overcome the initial hurdles. Companies housed within the clusters have also been a great source of support and information."

Profita and the Louisiana Ocean Cluster are hoping to build on their connection with the New England Ocean Cluster and Marin Skincare, a partner of the NEOC, that specializes in the extraction of minerals from lobster shells. The LOC are hoping to use similar techniques with crawfish shells. The seafood of Louisiana has long been praised for its taste and fame. The Louisiana Ocean Cluster is working to ensure that this continues, while utilizing other resources from seafood that have previously been thrown to waste. We look forward to seeing their progression.

Canada's Ocean Supercluster Newfoundland and Labrador, Canada

Canada's Ocean Supercluster (COS) was founded in 2017 with the Iceland Ocean Cluster as a partner at the initial stages. Alongside the support of many Canadian organizations, the IOC expressed their full support of the initiative to the Minister of Innovation, Science and Development in Canada. COS's motivation was unwavering to continue expanding the cluster model into more countries and utilizing it in places where the blue economy could be further developed. At this point, they had furthered their model to two other spots in the United States, but the model had never been used on an area this large. 4 years later, the COS has over $300 million in total funding, more than 410 members across all of Canada, $250 million in total project value commitments, 50 projects approved, 32 new projects announced, and more than 4,300 jobs created from their projects. Their cluster has fostered connections country-wide in the blue economy, leading to unprecedented success. Niru Somayajula, President & CEO of Sensor Technology, a COS partner, had this to say:

"Being a part of the Ocean Supercluster we've gotten to know companies that we wouldn't have known before. Through both the connectors and some of the networking events… part of that is being able to develop new products that can help us explore the ocean better."

The Canada Ocean Supercluster has done something unique with the model and expanded throughout a vast area, unlocking successes that were not previously possible. Their network and projects will continue to grow well in the future, and they are a prime example of the major success of the model.

oceansupercluster.ca

Ocean Cluster Faroes Faroe Islands

A very new addition to the Iceland Ocean Cluster Network, Ocean Cluster Faroes was established in 2020. The Cluster is a network of seafood companies, service providers and knowledge institutions focusing on innovation within the seafood sector.

Several of the largest seafood companies, research centers and service providers to the industry are members of Ocean Cluster Faroes already, and the list of members is expanding. In their agreement of cooperation, the Iceland and Faroe Island clusters intend to strengthen their cooperation and promote closer cooperation between the kinship nations in matters concerning the blue economy. The Ocean Cluster Faroes has already in its short history and in COVID times been active in promoting full-fledged products, seafood start-ups and innovation.

THE STRENGTH OF CLUSTER COLLABORATION

At the initiation of the Ocean Cluster Faroes, Unn Laksa, the spokesperson for the Faroese's cluster, said: "I believe there is great potential in a collaboration with the Iceland Ocean Cluster and other Ocean Clusters in the world." As the Ocean Cluster network expands, the possibilities of cross-border collaboration increase. Each cluster has its strengths and by sharing knowledge and best practices, the Ocean Cluster network will strengthen further.

In the modern day with major problems such as the pandemic and climate change's effects on the economy, there are solutions. In order to enhance economic growth and build more sustainable practices, our blue economies must create more value with what we already have rather than what we will create in the future.

Many people have great ideas for the ocean economy, but they don't know where to start. The Ocean Cluster model serves as a matchmaker to connect them with capital and expertise, and the expansion of the model will contribute to major improvements and achievements. The industry must be inspired to use our resources fully and to promote the circular economy, as the future of our oceans and blue economies rely on it.

THE OCEAN CLUSTER MODEL:

A SUSTAINABLE WAY FORWARD FOR THE BLUE ECONOMY

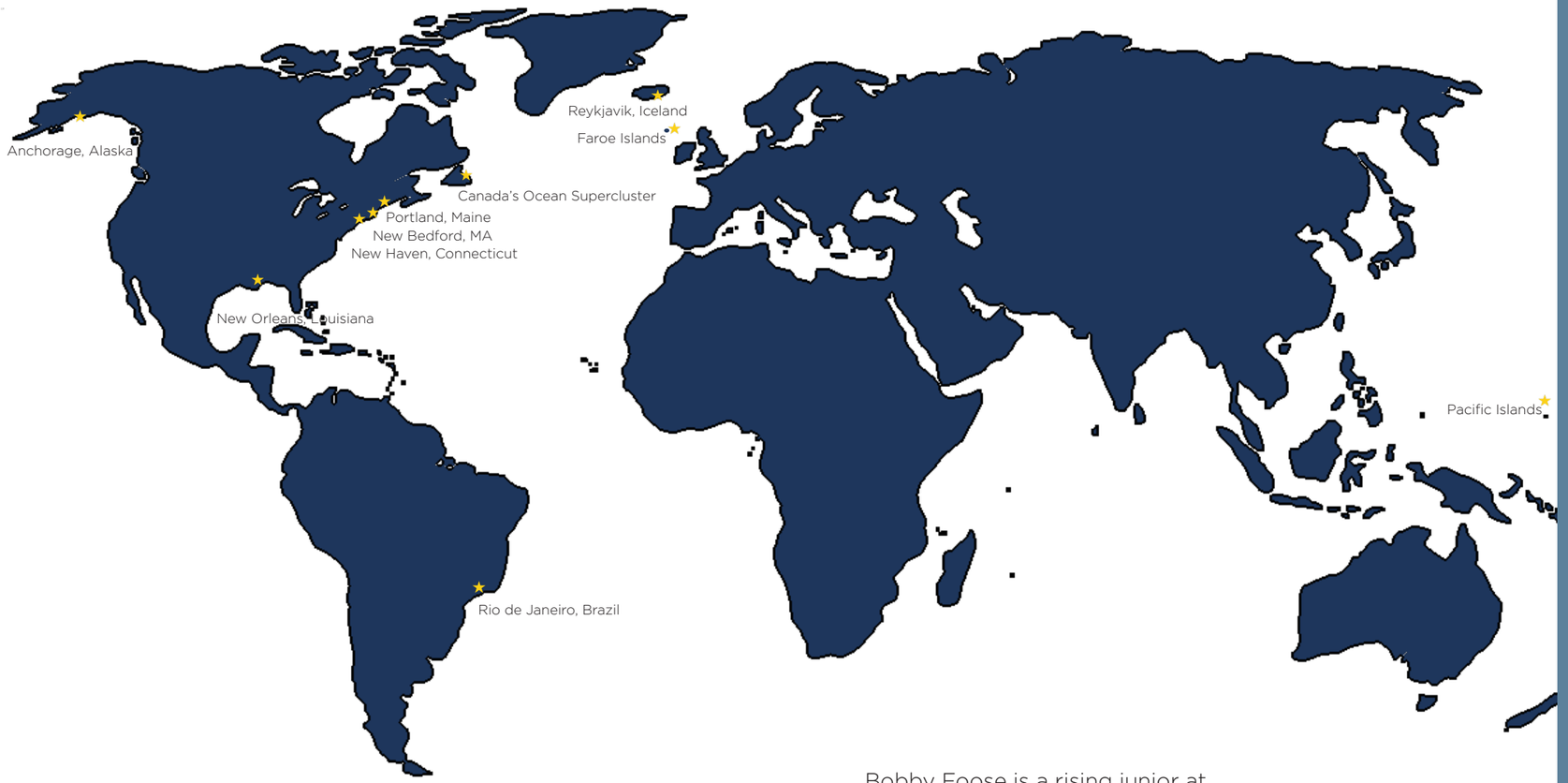
The shared goal of the OCEAN CLUSTER MOVEMENT is to connect people within the ocean economy, and to encourage an innovative and sustainable approach to realizing economic opportunity. Core to the Clusters' efforts is the firmly held belief that new ideas must be transformational; they must inspire the development of unique products, they must improve existing services, and they must create new opportunities for exchange between communities and cultures.

"I believe we can extend the ocean cluster network significantly in the years to come. Our ideology of 100% fish utilization and our emphasis on the Blue Economy as a great opportunity for the startup world, has been very well received and will only grow in the years to come," says Thor Sigfusson founder of the Iceland Ocean Cluster.

The underlying interest in the Blue Economy and the sustainable use of ocean resources is the thread which ties the clusters and their leadership together. The challenge for this network will be to make sure the knowledge is shared. The importance of physical facilities such as the Ocean Cluster House (Sjavarklasinn) in Reykjavik and The Hús in Portland, Maine will definitely play an important role in opening doors for startups and companies to share space and be a part of an ecosystem in more than one region.

"It is very gratifying to see how circular thinking regarding ocean resources is spreading with the Ocean Cluster model," says Thor Sigfusson. "We now see our cluster in Maine taking a leadership role in the full utilization of lobster, Connecticut emphasizing opportunities with sea kelp, Alaska focusing on 100% Alaskan pollock, The Pacific Islands exploring how to use byproducts of the Tuna, and many more examples."

As time goes on, the Ocean Cluster Model will continue expanding its effects on innovation, ocean sustainability, environmental preservation and economic circularity in the Blue Economy.



Bobby Foose is a rising junior at Colgate University in Hamilton, New York; he is interning with the Iceland Ocean Cluster for the summer of 2021.

3 WORLD OCEAN FORUM

DEDICATED TO PROPOSALS FOR CHANGE IN OCEAN POLICY AND ACTION WORLDWIDE, OFFERING A KNOWLEDGEABLE OUTLET FOR RESEARCH, OPINION AND STORYTELLING

Who, what and how do we want to be on the other side of the Covid crisis?

This was a question we posed to our readers in spring of 2020—our network of thinkers, scientists, decision-makers, activists and global citizens—to enable a conversation about new ideas to those that proved ineffectual and unsustainable in the face of a pandemic. As the sea connects all things, we expected this conversation to be as wide-ranging as there are ocean issues. In this chapter we provide a selection of responses--visions for our collective future.

AQUAPONICS
Alternative methods of agriculture and aquaculture are the way of the future, offering new opportunities for growth, innovation and sustainability in a changing world.
Christopher Williams

CIVILIAN CONSERVATION CORPS
A jobs program in the wake of covid-19 could make nature as resilient as possible.
Paul Baicich

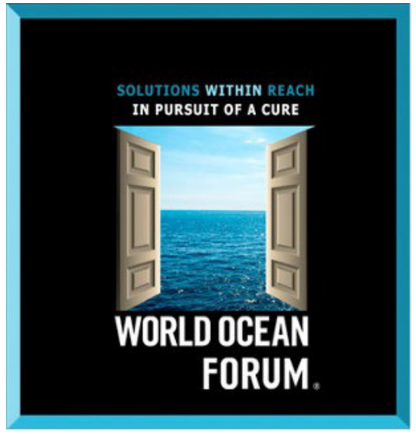
A BLUE RENAISSANCE
The value of ecosystem analysis in a post-covid world.
Peter Neill

THE BLUE ECONOMY
Will its siren call lure us to our demise?
Tundi Agardy

OCEAN SEABED MINING
The COVID-19 crisis has been a wake-up call for global governance.
Will ocean mining delay the discovery of new vaccines?
Nishan Degnarian

AQUAPONICS: AN ALTERNATIVE WAY FORWARD

BY CHRISTOPHER WILLIAMS, ENVIRONMENTAL CONSULTANT



Aquaponics by Christopher Williams is a contribution to the *Solutions Within Reach* initiative, a 2020 focus of the World Ocean Forum in the midst of the Covid-19 crisis. World Ocean Forum is designed to engage with thinkers, scientists, decision-makers, activists and global citizens as a means to enable a conversation about new ideas to those that are proving ineffectual and unsustainable in the face of a global pandemic.

Alternative methods of agriculture and aquaculture are the way of the future, offering new opportunities for growth, innovation and sustainability in a changing world

It will come to no surprise to discover that our world is in danger. Overfishing, aggressive food production practices and poor resource management have drastically strained our available resources. Alternative methods of agriculture and aquaculture are the way of the future. Food production no longer solely takes place on the homestead; instead we can grow in controlled environments in otherwise in-arable land. In turn, commercial fishing can also facilitate much more sustainable practices that offer less strain on our oceans and mitigate threats to other species. Considerably, a hybrid of these practices exists in a discipline known as aquaponics. At its core, aquaponics is simply a system where we use the nutrient-dense water from fish tanks for plant production, which often gives back nitrogen-rich water for the fish. This is mainly achieved in a closed or semi-closed system where the water is cycled through a hydroponic system.

Aquaponics is still a practice in its earlier stages of commercial applications and is often mistakenly considered as an analogue to hydroponics. Whereas the practices are similar, it would be a disservice to categorize aquaponics as "hydroponics, but with fish". The appeal of aquaponics is that it is extremely customizable, safer, efficient and with enough knowledge limitless in its applications. At first blush, many people feel that aquaponics is solely ideal for cannabis production and permaculture practices. Whereas it is not untrue that aquaponics is beneficial in either of these domains, it is shortsighted to relegate to those two capacities.

This practice is scalable between hobbyist and commercial levels and hosts a wide multidisciplinary range of applications extending from early education through urban agriculture schemas. The systems can even operate on a decoupled system, allowing for independent growth of the fish and plant systems.

Initially, aquaponics can seem as overwhelming as it is exciting. The most challenging part of the experience is design production. Although there are countless ways to structure a system, the easiest way to categorize them are as raft systems, nutrient film techniques (NFT), and media grow beds. Naturally, there are other options including vertical setups or decoupled systems that use fish waste as a control, etc. Raft systems work just as the name implies: the vegetables are set up on raft boards, with the roots free-floating in the water. The design is easy to adopt and allows for efficient, even growth. NFT designs work as you would expect in a hydroponic system: transposing water through various channels. This model has a great range of customization and is extremely beneficial for adapting a wider array of plants. Media grow beds are the key design for hobbyists, where the water from the fish tank is flushed through a grow bed in either a flood-and-drain or a constant flow cycle. Ultimately, aquaponic designs are closer to working with Legos than anything. Creation is based on the synthesis between aesthetics, the purpose of the system and choice products to produce.

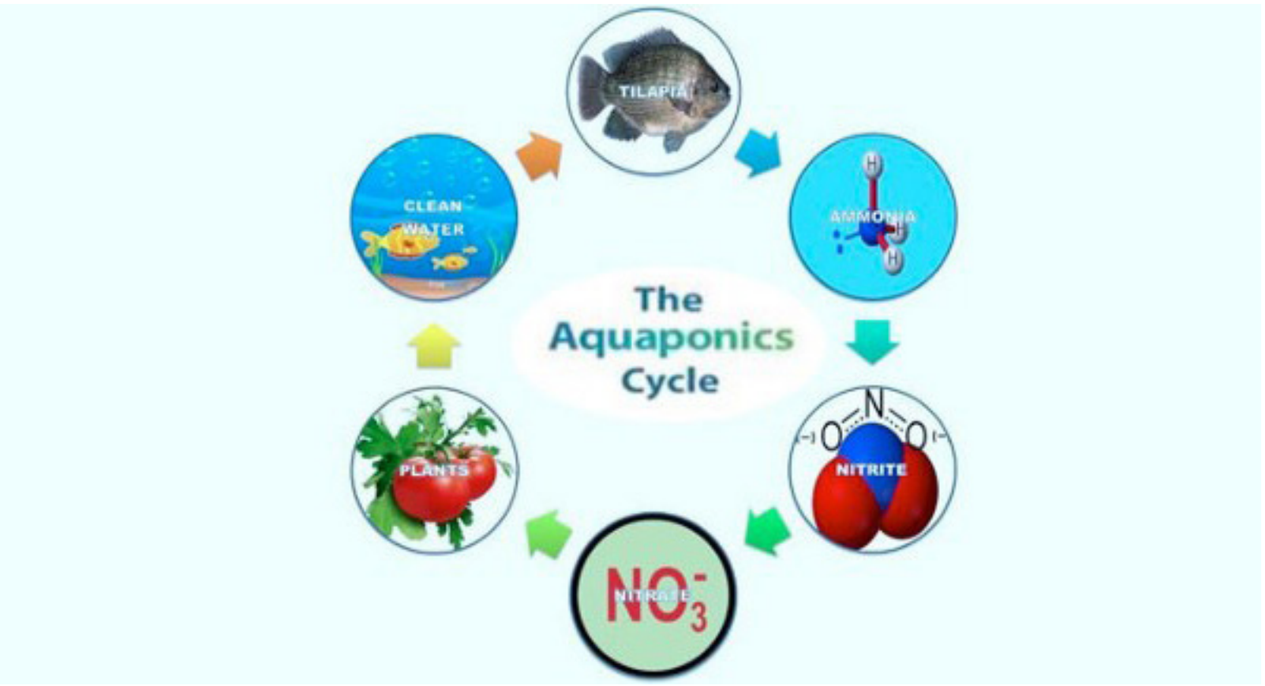
Needless to say, this is just the beginning. Maintaining chemical balances, finding the right stocking densities and balancing labor are important considerations to maintain. This is the key selling point and the point of divide in aquaponics. A question arises as to what benefits these systems provide that are (1) worth the extra investment in dual propagation of crops, and (2) couldn't be facilitated through easier-to-maintain systems. Entrepreneurs have found themselves frustrated in maintaining a sustainable market base; the large learning curve in development has turned potential enthusiasts off; and the always developing catalogue of information may not be robust enough to secure confidence for consumers. Some have sworn off aquaponics due to the ever-present gap between hobbyist success and industry success, which does not necessarily scale. In my 10 years of aquaponics research, I can say that I understand, and that it doesn't get easier. Aquaponics is a small subset of a larger scale of urban agriculture; in fact, it isn't for everyone. However, this should not take away from the promise that this practice holds, as long as one can demystify the practice and orient expectations and communications properly in the industry. With the right understanding, aquaponics offers a discipline in a changing world, with new opportunities for growth and innovation. Proper integration of the discipline necessitates awareness and education just as much as it requires constant innovation.

Various strength, weakness, opportunity, and threat (SWOT) analyses have resulted in different results regarding aquaponics, mainly with considerations of the system's goals. One of the most consistently effective uses of aquaponics, however, is in education. The primary reason for this is that the practice can host a multidisciplinary curriculum and strongly accents many different lesson plans. A system can be used in early childhood education to discuss the life cycle of plants and fish, how environments rely on the various species within and general biology applications. Having actual vegetative growth in a controlled environment is instrumental for a hands-on display for the children. From that point forward, nothing is off limits. Food transparency, engineering and design, evapo-transpiration, water quality testing, energy allocations and even micro-nutrient composition are all within the realm of possibility for an aquaponics-based curriculum. Even critics of aquaponics can agree on the classroom merit from the practice. Furthermore, the initial costs of a system are marginal at its most basic structure. Because

this practice is still in its academic infancy, any level of testing is invaluable to the industry. Grade school projects are not restricted to the rigid standards that are set in collegiate grant proposals, and any properly conducted survey will at minimum help to raise awareness and increase participation. The greatest benefit that can be achieved from any curriculum course is an increase in practice and discoveries of new methodologies. This is what will help develop the industry and increase consumer trust.
In the way that the educational applications are wide-ranging, so are the commercial applications. Because the practice has so many unique perspectives and points of focus, we can yield a multitude of market strategies. Aquaponic systems do not scale in a linear fashion; the output requires a delicate balance. Because of this, it is integral for entrepreneurs to secure a point of distribution early if they want to succeed commercially. There is a high financial overhead and mixed public opinion on the practice.

A novelty factor or an organic appeal alone isn't enough to satisfy routine customer purchases, in particular with B2C sales. Instead, a focus on secondary products, B2B distribution or finding niche markets that could benefit from the narrative that comes into aquaponics is imperative. Furthermore, fish sales are usually operating for a break-even return, requiring an increase in premiums in the plant products. Fortunately, these obstacles are more opportunities for finding a way to solidify a product narrative and increase a personalized level of communication with consumers. Currently we can begin to see aquaponics as a successful practice relies on increased intelligences, data collection and promotion. Consumers carry a small understanding of the practice and could very likely be unaware of the health, safety and environmental qualities aquaponics provides. Aquaponics is safer than most soil-based agriculture with regards to a more controlled environment and less opportunities for cross-contamination. The water system will normally only touch the root structures, omitting the possibility for the spread of salmonella. There is a much more efficient use of water as well, with the cycling allowing for optimized nutrient concentrations and less of a strain on use of chemical solutions to add to the water system. Because the size of a system is extremely variable, fostering a system in space intensive areas is possible.

This can be a great way to facilitate



community supported agricultural (CSA) practices in food deserts as well as offering outreach and skill training to the marginalized citizens of these communities. The aesthetic appeal in addition to the variance in applicability allots for strong promise in agri-tourism and hands-on activity centers, especially in already-established aquaculture and agricultural facilities. Aquaponics is also not a new concept historically and typically has some iteration in cultivation that ties to heritage sites. This admits participation in cultural sites, where aquaponics can accent a localized narrative. It is very fortunate for aquaponics to have few regional restrictions, aside from energy costs. Even these obstacles can be circumvented in addition to synergistic opportunities with alternative energy production. This is naturally tailored to the specific model's purpose and desired output. Inquiries have been presented to using aquaponics as a way to foist a sustainable/environmental overhaul on current agriculture or aquaculture operations.

Cursory investigations would consider this to be quite obvious; if you already are maintaining one half of the product, why not capitalize on it for an increase in efficiency? This, however, is often developed to mixed results. Certainly, a consultation is not out of the question; nevertheless, this approach may be too costly with a high demand on energy, labor or compromising regulatory practices and optimal farm conditions. Currently, aquaponics is pitted against strong compliance regulations as is and the overall environmental benefits may not be furtive enough to justify the expenses. This is, once more, contingent on a case-by-case basis.

As stated previously, the divide between consumer and hobbyists' perceptions on aquaponics versus the academic knowledge is staggering. Research into keyword searches, sentiment analyses and trends indicate a very low knowledge base with a lack of technical understanding coupled with a high interest in the practicality. This is in tandem with a rising popularity in at-home kits that utilize an aquaponic principal but are not large enough to provide for a successful system. Increasing channels of aquaponics integration while extending opportunities into niche markets would help to address this gap; however, an increase in successful market representation is key. Consumers show neutral to positive outlooks with few ties to any specific industries.

The multifaceted aspect of aquaponics applications is fortunate to help provide for satisfying this wide demand. Research has shown a perceived concern on the organic and natural qualities of aquaponics, albeit the regulatory standards often differentiate from the normative demands. Aquaponics produce typically satisfies aesthetic demands for color and sheen, hardiness and root structure.

The typical formula for most systems is tilapia and lettuces.

Tilapia are very tolerant and can maintain well under pH fluctuations (which are to be expected) and chemical imbalances. They also carry an ideal growth period and are very efficient at producing waste. Lettuces have an easy time with transpiration and nutrient uptake and their ideal water conditions often coincide with the same parameters for fish. This is not to impose any limitations on a system. Walleye, catfish, sea bream and ornamentals can succeed just as well. Kale, peppers, cucumbers, tomatoes, basil and strawberries have also been effective in aquaponics cultivation. The limitations are only imaginative; the practicality once again comes to scale, costs and purpose. If the overall cost of a system coerces one to selling Thai basil at a price point 30% higher than the current market to facilitate for operational costs, the operations will most likely fail. The novelty factor and the commercial applications are two distinct subsets.

Ultimately, commercial aquaponics becomes an ambitious project with high potential but is subject to environmental factors and design. Infiltrating a novel product into a market schema for sustained purchases is no easy task. It is not enough to market a product off hedonistic rewards alone, as the willingness to pay declines over periods of high-premium purchases. The industry can thrive through diversifying the practice whilst magnifying the consumer contribution. Success relies on facilitating a community interface, regardless of scale. Of the UN Sustainable Development Goals, aquaponics has the opportunity to contribute towards all seventeen.

Additionally, aquaponics can progress remediation in seven of the nine planetary boundaries. This is particularly effective insofar as aquaponics satisfies niche roles as either an accent or a lynch pin for operations. Aquaponics has showcased a strong presence in schemas for aiding inner city communities and can be a beneficial agent in the quest for social justice and equality.

In addition to mitigating environmental stress, educational quality, offering transparent CSR models and healthy and safe production is the overall quality in products. Ongoing research in measuring aquaponics against hydroponics and soil production has resulted in invaluable information on how and where to optimize production. Although there are issues in establishing a baseline between the three production systems, the result consistently indicated nutrient-rich products with a high yield and mitigated growth periods.

Research continues to explore the various food products that can be supported for commercial production in aquaponics. Isolated regions also benefit from easy to maintain domestic production over environmentally-taxing imports and mitigated shelf life in products. When presented with the question of “does aquaponics work” the most candid answer anybody can give is “definitely maybe.” A new old-practice in an ever-changing environment makes it hard to work with absolutes.

There is certainly a lot of potential, but even at the optimal output entrepreneurs are at the mercy of consumers and good business practices. What we can definitively attribute to aquaponics is the success as a model for dual propagation and a point of interest that needs to be considered when looking at alternative production methodologies. Hobbyists and commercial producers alike have a responsibility to evangelize the potential of this practice in order to give it an active presence in the market. In a post-COVID world business as usual no longer exists. Finding new means to adapting in a safe and environmentally conscience manner is not a matter of passive thought. Aquaponics will not save the world alone, but it can certainly help as a key player to achieve those goals.

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CHRISTOPHER WILLIAMS is a current freelance environmental consultant and project coordinator living in Columbus, Ohio. He carries his MS in Environment and Natural Resources from the University of Iceland, where he performed viability assessments on aquaponics systems. His expertise in aquaponics has covered trend analyses, forecasting, market assessments, strategic sales, lab studies and design optimization, among many other fascinating topics. Chris is currently doing research in sentiment analyses and keyword analytics to find ways to maximize outreach in the industry.

CIVILIAN CONSERVATION CORPS: A JOBS PROGRAM IN THE WAKE OF COVID-19 COULD MAKE NATURE AS RESILIENT AS POSSIBLE

PAUL J. BAICICH

The lessons of the original Civilian Conservation Corps could help frame the dialogue on the suitability of a retooled jobs program to enhance our coasts and oceans, complementing what needs to be done on land and in our cities.

Modern day policy makers have wondered whether similar programs could lift us out of more recent economic set-backs as well. For instance, former Secretary of Labor, Robert Reich, suggested that the U.S. could pursue a comprehensive jobs program that matched the audacity of Roosevelt's, including a new WPA and CCC. However, once the Obama Administration got the Recovery Act and its infrastructure stimulus passed in 2009, the call for any revived CCC-like effort dissipated. Such a dalliance into any new CCC, however, would have to avoid at the outset three obvious CCC drawbacks that would be intolerable today-the CCC's male-only participation, its segregated units, and its near-military makeup.

That being said, we can fast forward to January 2015, when Senator Bernie Sanders (I-VT) proposed a trillion-dollar jobs bill over five years. It was bursting with bold infrastructure proposals for roads, bridges, transit systems, wastewater treatment plants, airports, seaports, dams, levees, and other "bricks-and-mortar" projects. Once again, the hint of a CCC-approach appeared within the Sanders proposal, with a call for $15 billion over five years in boosting our National Park System. This was bigger than what anyone in the Obama Administration had ever dared to propose, but still short of a sweeping CCC-type jobs and environment program, however the bill failed to see the light of day. Since then, repeated proposals for a Green New Deal have arisen in the U.S. A pair of Congressional resolutions-House Resolution 109 and S. Res. 59-sponsored by Rep. Alexandria Ocasio-Cortez (D-NY) and Sen. Ed Markey (D-MA), respectively, aka The Green New Deal Resolution, drew the most attention. Those two proposals revived discussion about combating climate change and economic inequality simultaneously with something akin to a CCC.

The current Covid-19 health and economic crisis has only strengthened the discussion of what a jobs bill might look like once we crawl out of this abyss. We now can see that the nation, and the world, can respond quickly and in a coordinated way to pressing problems. Proposals for how to recover from the pandemic and economic downturn abound. Once again, Senators like Markey and Sanders and House members aplenty are making regular references to the CCC as America considers options for the future.

We are today 80 years wiser ecologically than we were in 1933. At the time, wildlife management and ecology were in their infancy, but now these fields have matured and the experiments of the CCC have paid rich dividends in expanding our practical knowledge in how to manage and restore ecosystems.

Improving on the old CCC, one might imagine three modern branches to best suit our post-Covid-19, climate-threatened world. One could be rural-oriented to lift neglected rural communities out of poverty and despair, another urban-concentrated to help improve environmental quality and thus human well being in cities, and a third coastal, to protect the country's most valuable ecosystems and allow them to deliver precious ecosystem services to the nation and the world.

A Coastal CCC could be front-and-center in helping the country cope with sea level rise and hurricane threats. Along the East and Gulf Coasts in particular, there are dire needs to protect barrier islands, stabilize and re-vegetate associated sand dunes, and restore coastal and bay grasses (submerged aquatic vegetation), oyster beds, salt marshes, and mangroves. This will aid in climate change and hurricane preparedness, but it will also make coastal industries more profitable, and lessen the costs that municipalities and coastal counties have to bear in fighting sea level rise and erosion.

Scientists with the Forest Service Research Station in the Pacific Southwest completed a long-term study that found restored mangroves stored as much as carbon as intact ones. Credit: U.S. Forest ServiceA Coastal CCC could also enhance 'blue carbon habitats' that sequester carbon and thus mitigate against our ever-continuing carbon emissions. Such blue carbon habitats, including marshes, mangroves, and sea grasses also

help protect communities from floods and storms, improve water quality, and support recreational and commercial fisheries. Thus, coastal wetland restoration is a win-win for both mitigating greenhouse gas emissions and protecting coastal economies, and a CCC-led coastal restoration program could employ thousands of people.

Specifically, the Coastal CCC could target the recovery of submerged

of oystermen (and the broader communities in which they live) require it.

Another obvious mission for a new Coastal CCC is cleaning up plastic pollution and other marine debris. With increasing and threatening plastic production, poor levels of recycling, and insufficient waste management, between four and 12 million metric tons of plastic enter the ocean each year, reportedly

the Coastal CCC with other conservation initiatives, as well as the other CCC branches operating in rural and urban areas (including deep inland and far upstream) to confront the plastic problem where it starts.

To become a reality, the new Coastal CCC could work alongside the National Oceanic and Atmospheric Administration in a mutually beneficial arrangement.

aquatic vegetation, improving water quality and expanding the habitat needed by vulnerable young fish and shellfish. Similarly, the CCC could target the restoration of oyster beds-a task that was part of the historic WPA and CCC function in multiple places. Both the balance of marine life and the maintenance of a unique industry

enough to cover every foot of coastline on the planet. Beach clean-up could employ unskilled workers as well as youth, turning environmental enhancement into an educational opportunity. But even more important is to stop plastics at their source, before the debris ever reaches the ocean. Such a workplan would connect

The Coastal CCC could also work with the U.S. Army Corps of Engineers, which has many billions of dollars of backlogged coastal project that it might reassign or share with a new CCC involving beach, estuary, and barrier island restoration. But how to get from an ambitious idea to a national program in practice?

TRANSITIONING TO A NEW CCC

In his previously held position as Governor of New York, Roosevelt launched an outdoor resources program in 1931 called the Temporary Emergency Relief Administration (TERA), almost immediately creating 10,000 conservation-related jobs. These jobs were mostly in forestry, for out of work New Yorkers. By the end of 1932, right after the national election and before Roosevelt was inaugurated, the TERA program was already aiding 25,000 enrollees.

Clearly, Roosevelt considered TERA a prototype for the CCC, and TERA was effectively a dry run for the much more ambitious project. Once in office, the new President immediately proposed putting about 250,000 young men to work by the first summer of his administration to "conserve our precious natural resources."

For many decades now, smaller state-based and NGO-associated models have existed. In the late 1950s the Student Conservation Association (SCA) launched projects for college students in National Parks and National Forests. The Youth Conservation Corps-a joint effort of the Department of the Interior and the USFA Forest Service-hired youth for summer work outdoors. At its height during the mid-1970s, the YCC enrolled some 32,000 young people across the country. From 1977 to 1982, a larger federal program, the Young Adult Conservation Corps (YACC), provided some young people with year-round conservation-related employment.

By 1981–1982, both the YCC and the YACC were virtually eliminated due to federal budget cuts. Still, the concept of a natural resources Corps had been proven, and many states began to initiate these programs directly. By mid-1980s, state-operated Corps for youth could be found in Iowa, Maryland, Minnesota, New Jersey, Ohio, Pennsylvania, Vermont, Washington and Wisconsin, with California launching the first Urban Conservation Corps in 1983. Across the 1980s-and into the 1990s-despite the absence of federal funding, new state and local Corps continued to spring up, here and there, across the nation.

There was at least one ambitious federal plan in the 1980s for a modified revival of the CCC, an effort that deserves revisiting. It was the American Conservation Corps Act, passed in the House of Representatives in early 1983 and then by the House in the fall of 1984 with amendments. The final bill called for spending $225 million over three years ($579 million in today's dollars or the equivalent of $193 million per year for three years) to establish an American Conservation Corps under the direction of the Secretary of the Interior.

Modeled after the CCC, it was intended to "implement conservation, rehabilitation, and improvement projects on public lands and Indian lands." Supporters estimated that it would provide work for 18,500 youth in the first year. But President Ronald Reagan pocket vetoed the bill, claiming that the American Conservation Corps would have created "temporary make-work" jobs, which he declared were part of a "discredited approach to youth unemployment." That is the closest we have seen to a revived-although limited-CCC, a proposal that actually reached the President's desk.

Far more modest efforts have occasionally arisen: in response to the April 2010, Deepwater Horizon oil-rig disaster in the Gulf of Mexico, the RESTORE Act provided for $7 million to implement a Gulf Corps program for ecological restoration across the Gulf states. A private/public partnership led by NOAA, the Corps provided for short-term employment for local citizens, as well as skills training and experience in restoration-based jobs in the areas of exotic vegetation removal, seaside native planting, species monitoring, management of invasive species, and more.

In 2014, President Obama's Secretary of the Interior, Sally Jewell, invoked the legacy of the CCC in recommending a "21st Century Conservation Service Corps" that could give tens of thousands of young people and veterans the opportunity to serve

the country and enhance their lives through work in the outdoors. Her goals were to raise $20 million in private funds by 2017 to recruit young Americans for a 21st Century Conservation Service Corps (21 CSC).

Sometimes known as the Public Land Corps, 21 CSC has existed, along with the older and more experienced organization, The Corps Network, as an ambitious attempt to connect similar nonprofits or are operated by units of state or local government. Since 1985, The Corps Network has continued to assemble a loose association of about 130 corps-organizations across the country providing young adults and veterans work through projects on public lands and in rural and urban communities.

These more localized programs have built an essential base of action and valuable experience which can benefit a broader and more comprehensive effort. By and large, many of these state-reliant ventures have worked well– transient and modest as they are. Imagine a situation where the collective knowledge from these varied transitional projects could actually flourish, could be "shovel-ready". The circumstances today are ripe for this sort of approach-a true Solution within Reach.

ADVANCING THE DISCUSSION

Taking a page from the Green New Deal proposals, a larger infrastructure discussion is sure to include aspects of spending for creative "green" components. The recurring calls for wind-and-solar jobs are to be expected on the green side, as well they should. But a new CCC is not simply an add-on to the wind-and-solar renewables argument; it should be integral to an ambitious proposal. Indeed, it cannot be viewed as "the other green infrastructure jobs program," but rather a way to restore the land, and restore the people.

From its very start, the CCC was confronting a country that abused and over-exploited its natural resources. The looming Dust Bowl-which was to reach it apogee in three successive waves (1934, 1936, and 1939–1940)-was proof enough of a real crisis on the land. Drained wetlands, over-cut forests, and exhausted farm soil only exacerbated the pervasive industrial crisis of the Great Depression in America.

Today we have equally devastating environmental crises, with parched forests ready to burst into flames and threatening a wildlands-urban interface; spreading invasive plants; the elimination of vital pollinator habitat; the ongoing destruction of 10,000-year-old virgin grasslands; the destruction of remote parks and wildlands by encroaching suburban development; neglected city parks; and along our threatened coasts, the erosion of barrier beaches, the loss of vital coastal wetlands, the pollution caused by run-off of toxins and waste; and so much more. A jobs program in the wake of Covid-19 could not only restore economic well-being and dignity to workers, but also help make nature as resilient as possible. And healthy nature makes for a healthy planet-and populations of humans better able to confront the next pandemic or economic shock to come along.

The lessons of the original Civilian Conservation Corps could help frame the dialogue on the suitability of a retooled jobs program to enhance our coasts and oceans, complementing what needs to be done on land and in our cities.

CONCLUSIONS

There may be opportunities to reinvent a new kind of green movement in the context of a changing and transitional post-Covid-19 economy. What we have already witnessed over the last 80 years has been a shift from traditional conservation, morphing into environmentalism and then into climate change activism. At each of these important changes, a new set of goals, methods, and vocabularies have been adopted, each building on their predecessor movement. We are on the cusp of solidifying just such a change, but only if we consciously make the best use of our experiences and opportunities.

Neil Maher, in his insightful Nature's New Deal, clarified that the development of the CCC transformed the very perception of what conservation was. A new CCC, in conjunction with accompanying serious green transition, could likewise re-calibrate what comes next. We could witness , and be part of, a real culture shift. While building a new CCC and a climate-ready economy (relying heavily on wind and solar), real connections could be created between forces in traditional conservation, environmentalism, climate change activism, and environmental justice that have, more often than not, developed apart.

Whether a move toward these possibilities actually happens depends on how prepared concerned parties (professional environmental advocates and educators, academic economists, labor leaders, federal and state conservation agency administrators, and human rights champions) are ready for change. Such change rests on a combination of essential and visionary alternatives. The lessons of the original CCC could help frame the dialogue on the suitability of a retooled jobs program to enhance our coasts and oceans, complementing what needs to be done on land and in our cities. Whether we are able to make this solution a reality depends on how all stakeholders in recovery can connect with each other, and especially with those young people looking for creative work today, the people already waiting for the change, and the very people that will inherit the future we make.

MORE TO CONSIDER

For those readers looking into sources and details on the relevancy of New Deal projects today, and on the existing network of smaller CCC-like projects and institutions that continue to exist:

THE LIVING NEW DEAL is a project dedicated to the historical work of uncovering the immense riches of New Deal public works. Insofar as there is no national register that exists of what the New Deal built, this effort attempts to fill that niche. The Living New Deal's team is creating a national database of information, documents, photographs, and personal stories about the public works made possible by the New Deal. It's all about research, presentation, and education. Visit livingnewdeal.org.

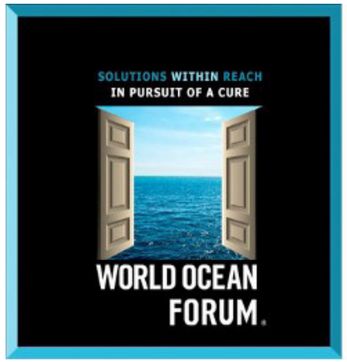
THE CORPS NETWORK is a meeting place for locally-based organizations that engage young adults (generally ages 16 – 25) and veterans (up to age 35) in service projects that address outdoor, conservation, and community needs. Established in 1985, The Corps Network is the National Association of Service and Conservation Corps. It was preceded by the Student Conservation Association– launched in the late 1950s–which has been regularly placing at least a few thousand young people in conservation internships and summer crews in service to the environment. The Corps Network could easily function as the bridge to a new and far more sweeping CCC if one were to arise out of the discussions for a Green New Deal.

You can find information on the Corps and its member projects at corpsnetwork.org.

PAUL J. BAICICH is a bird conservationist and co-author of three books on North American birdlife. He was formerly an activist and officer in the Machinists' union (IAMAW). He is currently Chair of Our Revolution in Howard County, Maryland.

A BLUE RENAISSANCE: THE VALUE OF ECOSYSTEM ANALYSIS IN A POST-COVID WORLD

PETER NEILL



A contribution to the *Solutions Within Reach: in Pursuit of a Cure* blog series on worldoceanforum.org

In April 2020, Friends of Ocean Action, a coalition of committed and influential ocean activists, convened by the World Economic Forum and the World Resources Institute, published a most welcome report-The Ocean Finance Handbook-with the intent to provide a current overview of the investment landscape in the blue economy, by providing a common baseline of understanding of sustainable finance for all stakeholders. The Handbook aims "to serve as a reference for decision makers within governments, NGOs, the private sector, and ocean-based communities who want to understand where and how blue finance can be raised, how it can best be managed, and the types of activities that it can enable."

The Introduction continues, "The Report will also seek to serve a similar purpose for financial professionals, offering insight into opportunities and considerations for sustainable investment in the ocean," to include an overview of the current landscape of ocean finance, available financing options, investable opportunities, and case studies.

There are many possibilities and existing tools that are available and have been used successfully for some projects in some places by some investors with a willingness to explore new avenues for finance, new value propositions, and new calculations of return.

I urge that we expand the notion of ecosystem service to include the active application of analysis, an idea sometimes mentioned in the international meeting hallways and policy web-posts, but which never seems to get traction beyond concept and a few disparate exceptional examples. The subject is included in the Report as a discussion of carbon sequestration and natural infrastructure, specifically mangrove restoration.

But as I understand it, ecosystem service analysis is a much more specific application of the value of Nature as researched, calculated, and entered into financial estimates and projections, as part of the accounting and planning for any transaction or endeavor from carbon offsets to species protection. It is a numerical tool, a measure of what Nature provides as an asset or as part of a system that produces a monetized return. The problem is that historically that value has been ignored, certainly not included in budgets and estimates of profit and loss prospectively or retrospectively. It is a value that lies at the core of exchange, financial and social, but it is never entered into the actuality of transaction.

This omission represents a substantial gap in what passes as comprehensive accounting posted to the balance sheet and cited by executives in management objectives and reports to shareholders and the investment community. To take an obvious example, the asset value of oil is typically calculated as a function of the cost of its discovery, research and development, extraction, distribution, and sale. If one accepts the idea that oil underground is the property of the citizens of the place where it is found, then its transferred value to an energy company is purely the expense of its production against its revenue stream. This is, of course, further complicated by incentives, subsidies, and grants to those companies, additional revenues if you will, that further skew the calculation and constitute an extraordinary transfer of wealth from public to private benefit.

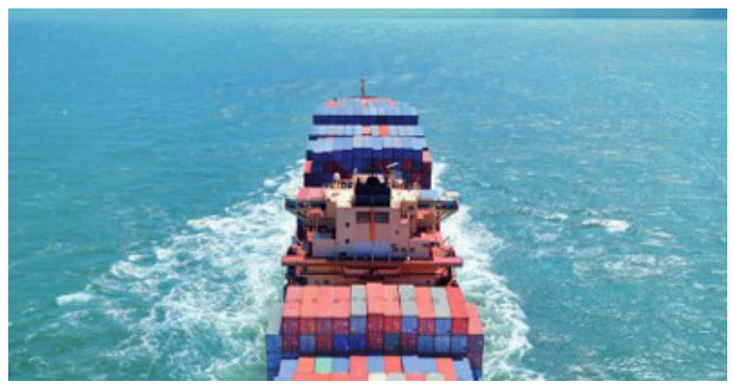
Further still, as the oil is a non-renewable resource, the value of its depletion as loss and the cost-benefit of alternative renewable energy technologies are also subverted or ignored. Further still, if there is an accident along the way, such as Deep-Water Horizon, with massive environmental and social damage, the financial consequence is off-set by insurance and costs born again by the tax-payer in the form of the fines to be written off, government bail-out to be sought, and a glib rationalization for any dip in the share price to be promoted the public relations department. It is, by intent, an incomplete presentation of the financial reality into which markets have invested for decades without question.

Why? Primarily, in my view, because it undermines that balance sheet by introducing not only new financial value calculations, but also by upending a conventional practice that leaves out the deficit side of the consequences. We just don't put any real value on Nature and natural services beyond commodity value for consumption. It is a false accounting. And until that changes, the old ways, however gussied up, will endure as normal. We don't appropriately value original value; we don't give full measure to what is gained/lost in production; we don't include the depletion value, irreplaceable, when the original value is exhausted. And, finally, we don't calculate the profits of alternative utility in our measures of choice.

Why not? The two most obvious explanations relate to vested interest and fear of change. If the system has proven enormously profitable, it is assumed not to be broken and not in need of fixing. A new system is an unknown, one best left unexplored, or discussed but never implemented. Until now, when a pandemic event brings economic destruction to an interconnected global financial system.

I suggest that this tragic situation seek redress-a courageous, opportunistic, transformational switch to alternative energy sources; to recovery through the implementation of new technologies; the reconstruction of infrastructure; to any and all other activities designed to mitigate the impacts of climate change and pandemics; and to the application and invention of what, how, and who we want to be on the other side of today.

The risk in doing nothing is astronomical-for the present, the near future, and for future generations. The risk in embracing such change is negligible, as we have all the tools required today if only we transform our pessimism into positive political will. Ecosystems service analysis applied in the consideration of all this change would assure the additional proactive protection that such actions would contribute to a new paradigm of controlled growth based on principles of conservation, sustainability, and protection of natural resources as the essential foundation for a viable future. As the sea connects all things, from food to cultural traditions, the ocean will contribute its part. To fail in this endeavor is an act of self-destruction in the face of a blue renaissance to come.



WORLD OCEAN FORUM

THE BLUE ECONOMY: WILL ITS SIREN CALL LURE US TO OUR DEMISE?

DR. TUNDI AGARDY

The Blue Economy is getting much attention as countries undertake systematic ecosystem services assessments to identify the potential value of marine and coastal areas, and thereby recognize that their marine resources are sometimes under-utilized. However, for ocean development to be truly characterized as targeting a Blue Economy, decisions on resource use and space allocation must be made in such a way that long term environmental, social, and economic sustainability is maintained.

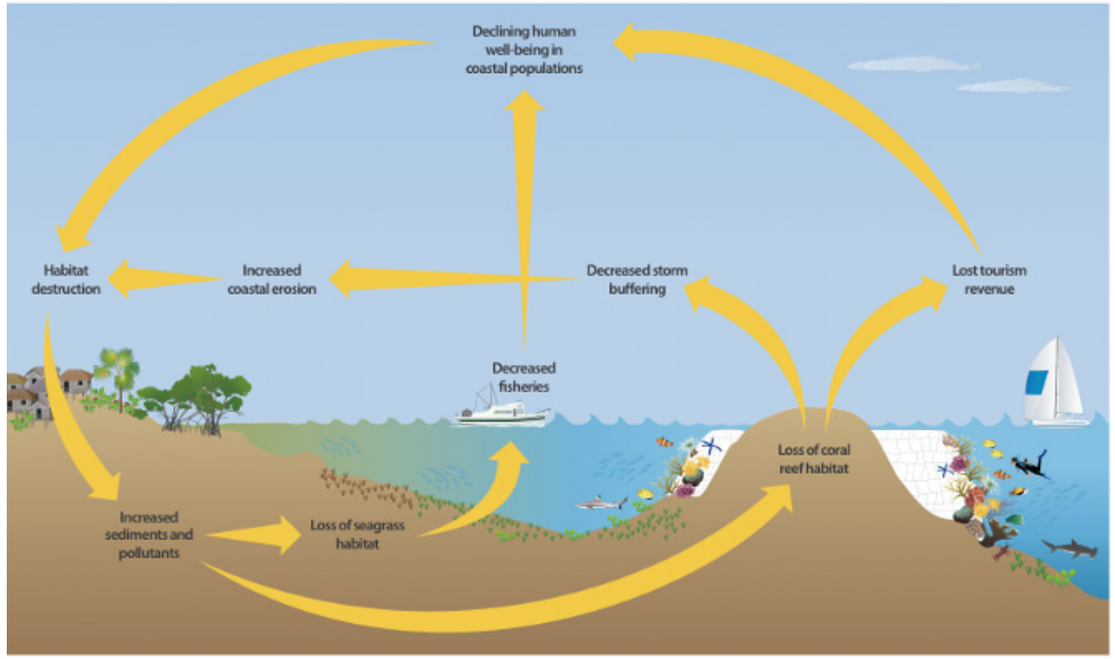
The world is increasingly looking to the sea for drinking water, energy, food, and strategic minerals, alongside important non-extractive uses such as shipping and transport, recreation, and tourism. How this bodes for the future of humanity and the planet is open to question, as the global population is expected to reach about 9 billion by 2050, and attendant demands for food and energy will be nearly double what they are today. Under-developed parts of the world are on trajectories to intensify their economic development, while developed countries continue to consume at per capita levels more than 10 times those of poorest countries. Intense conflicts over scarce surface water and aquifer water resources have already started, and the spectacular growth of energy-demanding desalination in response to water scarcity threatens access to and availability of seafood resources, already in decline from poor or absent fisheries management. At the same time, offshore energy development displaces fishers from those fishing grounds that are still productive, and catastrophic oil and chemical spills harm or even shut down fisheries.

To date, siloed thinking about how to plan economic development that allows for effective protection of the resource base, including management of marine resources and ecosystems delivering vital services, has resulted in uncoordinated fisheries, energy, mining, and marine use policies that do not allow the consideration of trade-offs and do not capitalize on the synergies that taking a nexus approach would provide. At the same time, the allure of the 'Blue Economy' may be pushing development of oceans even more quickly toward short term gain and long term un-sustainability. A paper by Voyer et al (2018) describes two competing discourses about oceans: one as areas of opportunity, growth, and development, and the other, of threatened and vulnerable spaces in need of protection.

The Blue Economy is getting much attention as countries undertake systematic ecosystem services assessments to identify the potential value of marine and coastal areas, and thereby recognize that their marine resources are sometimes under-utilized. However, for ocean development to be truly characterized as targeting a Blue Economy, decisions on resource use and space allocation must be made in such a way that long term environmental, social, and economic sustainability is maintained. Unfortunately, many governments are viewing any sort of marine development-including possibly unsustainable expansion of existing commercial fisheries, minerals extraction, and mass tourism, as well as the development of new industries whose sustainability has not been tested-as part of the new Blue Economy. This is essentially green-washing, that is, allowing unsustainable development to proceed as long as planning processes are labelled as participatory (Howard, 2018). But who participates and who benefits is widely variable from country to country, and many ocean planning initiatives do not promote sustainable and/or equitable uses of the marine and coastal environments.

Given the worldwide economic downturn that curtailed the rampant growth of the late 20th century, many coastal countries are now looking to unlock the blue growth potential in their maritime areas. Ocean industries are seen as having the potential to grow gross domestic product (GDP) and attract foreign investors into under-developed countries and areas. Though lip service is paid to the Blue Economy and its roots in sustainability, the rush to promote blue growth has occasionally eclipsed discussions of wider human well-being and the equitable sharing of benefits from commons areas. In some regions, government-sanctioned blue growth is seen as an excuse for ocean grabbing (the marine equivalent of land-grabbing, where ocean use is guaranteed to powerful business interests that have political influence, while local communities and artisanal users are denied access). As a result, many countries end up trying to pack as many profitable uses as possible into any given ocean space.

In this sort of distorted blue growth, conservation can end up being forced into a back seat as planning and policy initiatives are decided. Planning, and in particular marine or maritime spatial planning (MSP), is taken on as a regulatory necessity, not for problem-solving. The marine plans that result can be a codification of existing use patterns, or a synthesis of all the available datasets on marine ecosystems and their uses. MSP in these cases does not consider the full array of ecosystem services and values,



nor considers seriously the trade-offs that must occur when development impairs ecosystem functioning. The consequence of marginalizing conservation instead of making conservation the cornerstone of sustainable use that maintains ecosystem functioning and productivity, could well be a lack of economic as well as social sustainability, and a loss of traditional values.

It seems odd that concerns about how development affects the long term health and viability of the ocean-and with it its ability to sustain humans-have only recently come to the fore. The siren song of the Blue Economy and the allure of being able to unlock the 'blue growth potential' may have blinded us to the risks of wholesale marine development. We continue to ignore the danger of messing with planetary balances and clinging to the notion that perhaps the ocean's resources will be able to satisfy our insatiable appetites.

Coastal areas the world over have been the focus of much development, and the sustainability of such development has only recently been called into question. The damage we cause is hard to see, and our uneven knowledge about ocean ecology and how we undermine it creates opportunities for us to look away. We need the coastal infrastructure-even if it causes losses of important coastal habitat or impairs the functioning of coastal systems. Protected areas cannot mitigate the large scale transformations we are causing by coastal development and maritime industrial use.

At the same time, consumption drives an even more insidious loss of biodiversity, since the favorable attributes of coastal land draw in the affluent. People in high income demographics expend significantly more energy, rely on expensive imported products, and often deny others access to coastal shores and resources. As the cost of living goes up, the less well-off are pushed to marginalized areas, and can get caught in a poverty cycle that drives them to over-exploit the resources they do have access to, causing further ecological impairment.

Marine planning that is grounded in principles of environmental, social, and economic sustainability could counter these trends. However, many countries are missing opportunities to use marine planning generally, and MSP more specifically, to their full potential to promote sustainable use of ocean space and resources while at the same time meeting social and conservation objectives. Effective MSP has the potential to steer us away from danger if it occurs in sync with coastal planning and allows the creation of truly effective ecosystem-based management. This can prevent degradation of important ecosystems by focusing management on drivers of degradation-even if those drivers do not trace back to ocean use but rather have their base in land and freshwater use. This sort of holistic planning also creates opportunities for trans-boundary collaboration to effectively manage shared resources. Marine planning processes can also ensure that the needs of local communities, and the safeguarding of values that extend beyond those captured by large maritime industries, are considered in decisions on how to allocate space and resources in an equitable way, while promoting economic growth. And well-executed MSP can anticipate climate change and other large-scale changes, and proactively plan for maximum resilience into the future. Finally, MSP and related ocean zoning can ensure that ecologically important areas are fully represented in a mosaic of use and protection. Such systematic conservation planning embedded into MSP will maximize the prospect that expanded use of marine space and accelerated development of maritime industries does not undermine ecosystem health and function.

Whether marine planning is used to promote equitable and balanced access or instead is used in a potentially dangerous way to promote rampant exploitation, corporate hegemony, and inequitable blue growth is up to us. We can heed the siren's song and still steer clear of danger, but only if we pay attention and prepare, just as Odysseus did back when the ocean was still bountiful, the coasts were still natural, and the planetary balances (if not the Gods) seemed to be in harmony.

WORLD OCEAN FORUM
Dedicated to proposals for change in ocean policy and action worldwide, linking unexpected people with unexpected ideas and offering a knowledgeable outlet for research, opinion and storytelling.

To inquire about becoming a contributing writer, or to contribute to the Solutions Within Reach series, please contact us at director@thew2o.net.

Online at medium.com/world-ocean-forum

TUNDI AGARDY works at the interface between science and policy in marine systems around the world. She founded Sound Seas to do this independent work, and also holds positions with Forest Trends, as MARES Director, and at Baird & Associates, where she is Caribbean Environment Lead. Her major research interests and publications focus on coastal and marine planning, ocean zoning, marine protected areas, ecosystem services, and marine ecosystem based management.

OCEAN SEABED MINING

NISHAN DEGNARAIN

The covid-19 crisis has been a wake-up call for global governance.

Will mining delay the discovery of new vaccines?

Last week saw the most unprecedented reaction to a global health crisis in modern times. The World Health Organization declared COVID-19 a global pandemic, the US President announced a National Emergency that released $50 billion in federal funding, Italy introduced a national quarantine, over 145 countries (and rising) now have recorded cases, travel restrictions are in place in every country around the world, and the New York Federal Reserve announced a $1.5 trillion intervention to stabilize markets.

Most countries are either in the containment phase of the disease (i.e., test, identify and isolate cases) or the mitigation phase (i.e., delaying the spread and ensuring business continuity measures).

At the same time, the race is now on to develop a COVID-19 vaccine, ahead of any second wave of infections later this year. The speed with which a vaccine is developed depends on many factors (e.g., the success of pre-clinical trials, animal testing phases, human clinical trials, and production scale up). Advances in biological technology (such as gene-editing CRISPR and cell free protein synthesis) is accelerating the time to vaccines and treatment development. However one critical element is still needed. That is the initial step to find the biological clues which lead to the high potential chemical compounds that could reduce the potency of COVID-19.

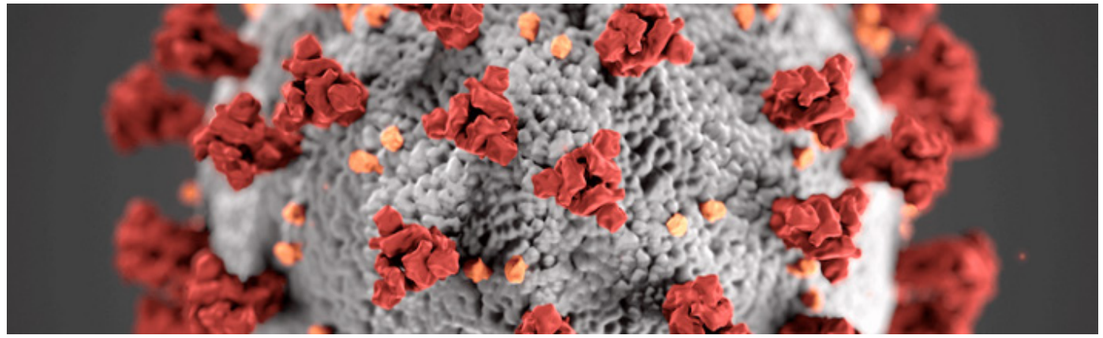
Many of these high potential chemical compounds come from natural sources, so modern medicine will need to return to the wild to find them.

SOLUTIONS FROM THE DEEP OCEAN?

Last week among the COVID-19 headlines, David Attenborough made a plea calling for Deep Ocean Seabed Mining to be banned. One of the reasons he cited was the importance of deep water corals and microscopic microbes at the bottom of the ocean.

It turns out, these are extremely valuable for modern medicine, including addressing coronaviruses. A protein from an ocean seabed algae found among coral reefs was revealed to show activity against another coronavirus known as Middle East Respiratory Syndrome or MERS. MERS is a close relative of the coronavirus responsible for COVID-19, and was responsible for an outbreak in the Middle East in 2012 that infected almost 2500 people, leading to over 850 deaths in 27 countries (34% fatality). This marine compound griffithsin was extracted from the red algae Griffithsia that is native to coral reefs around the Canary Islands and identified in 2016 to be a potential inhibitor to the MERS coronavirus.

This is just one of over forty marine compounds that have anti viral properties and are undergoing pre-clinical and clinical trials around the world (such as another coronavirus inhibitor from the ocean sponge axinella corrugata found in the Caribbean). These are all at the early stage of vaccine



discovery, but help researchers identify areas of high potential. Having such a library of high potential chemical compounds from nature against coronaviruses, could have greatly accelerated progress for vaccine development ahead of time among the several major companies working on these solutions.

Yet, less than 0.05% of the deep ocean has been visited, photographed or sampled. We are just learning the true potential and value of life in the deep ocean.

Being able to sample marine wildlife is critical to identify more potential targets to address threats such as the coronavirus in the future. Not all will come from the ocean, but natural products will be a crucial part, given that COVID-19 jumped the species barrier to impact humans. Indeed, the WHO has called the Climate Crisis a Health Crisis, and as the ocean warms, the risks to humans rise with more novel diseases and less biology with which to help combat them.

It is important that we are able to catalogue these environments before these ecosystems and their complex biology are lost forever.

Valuable medicines from the deep Selective pressures-the unique conditions under which lifeforms evolve-are no more extreme than at the bottom of the deep ocean. Life here has evolved to live at extraordinary pressures, temperatures, and chemical environments. This means that deep sea creatures have evolved distinct genes, which encode proteins, which in turn catalyze unusual chemistry or possess other useful properties. These unique marine genetic resources are the product of evolution over timescales and in conditions which humans cannot replicate.

Marine genetic resources are therefore irreplaceable products of nature that play a critical role in modern medicine and industrial processes today. Take a look at any major disease and often the highest potential treatments have their origin in a marine natural product.

For example:
A treatment for advanced breast cancer developed by the Japanese Pharmaceutical company Eisai, was derived from the marine sponge natural product called eribulin. The drug-called Halaven-has prolonged numerous lives, generated over $500 million in annual sales since 2015, and is now approved in over 65 countries. Eribulin is found in the marine 'breadcrumb sponge' called halichondria, that is prevalent in the North Atlantic, Mediterranen and around New Zealand at a depth of 500m.

The first effective HIV treatment was azidothymidine (better known as AZT). This is a variant of a chemical compound made from a marine sponge in the Caribbean called tectitethya crypta. It generated $4 billion in sales alone and in combination with other anti-HIV drugs, since being approved by the FDA in 1987.

Infectious diseases are increasingly drug-resistant, and medical science is constantly battling to stay ahead. Organisms that cause malaria

and tuberculosis can be killed by marine-derived compounds such as cyclomarin. Cyclomarin comes from an ocean bacteria called salinispora arenicola first identified around islands in the Bahamas in 1991.

In addition to medicine, the biology from the deep ocean is valuable for industrial purposes, especially cleaning up pollution and environmental remediation, which will be critical to restore our planet to a healthy ecosystem.

A recently discovered deep sea microbe in 2014 from 2km depth in the Indian Ocean, nesiotobacter exalbescens, efficiently degrades hydrocarbons (benzene and toluene which are common soil and water pollutants), and is therefore a potential tool for environmental cleanup, especially oil spills in the ocean.

A bacteria discovered in the deep sea can clean contaminated soil and water from the toxic mercury pollution caused by coal power plants. The alcanivorax bacteria was discovered at 2km depth on the East Pacific Rise in the Pacific Ocean, close to where Seabed Mining is due to begin in the Clipperton Zone. This bacteria converts mercury salt into a less harmful form of the metal, and along with the metal reducing bacteria living on and in metal polymetallic nodules, may enable the remediation of the millions of square kilometers of mercury-contaminated soil and water that surround coal-power stations across the USA and China that make agriculture grown there not fit for human consumption.

An enzyme which copies pieces of DNA, was discovered in a microbe living on a deep-sea hydrothermal vent off the coast of Italy. It has been turned into a product by New England BioLabs and sold commercially. The enzyme's evolution under extremely hot and high-pressure conditions makes it more stable, and a more effective approach to copy DNA than its relatives in other species, rendering it a valuable tool for molecular biologists.

These are just a handful of medical and industrial examples of a world that humans have only just begun to explore and understand, as new technologies open new biological frontiers in the sustainable blue industrial revolution.

A HABITAT AT RISK

2020 was supposed to be the biggest year for the environment, with major UN negotiations to protect our oceans, biodiversity and the climate.

Some of these talks around the importance of life in the oceans (the Biodiversity Beyond National Jurisdiction Treaty or BBNJ), has now been postponed to later in the year. The BBNJ treaty was supposed to create a framework to ensure such life in the deep ocean is protected and valued, rather than be put at risk by extractive industrial activities.

At the same time as countries are recognizing the value of deep ocean species, seabed mining companies are lobbying countries to allow them to mine the deep ocean seabed for mineral resources.

A Jamaica-based UN Agency called the International Seabed Authority was due to vote on a legal framework in July 2020 to authorize such commercial mining. It was against particular countries voting at this agency that David Attenborough voiced his opinion.

SCIENTIFIC OUTRAGE

The prospect of starting commercial scale Seabed Mining in 2020 has been to the outrage of leading ocean scientists, civil society and major environmental NGOs, who fear an unprecedented loss of biodiversity and weak regulatory oversight. They are calling for a ban or at the very least, a ten year moratorium on any such commercial operation, until science has sufficiently advanced to understand deep ocean environments.

There are many environmental uncertainties with seabed mining, which would devastate deep ocean habitats and the valuable life that inhabits them.

Life around hydrothermal vents were only discovered 43 years ago in 1977, which completely overturned theories of how life evolved on Earth. Yet, mining will be allowed around such communities in the Indian and Atlantic Oceans.

Following a trial of experimental Seabed Mining off the coast of Peru in 1989, a quarter of a century later, almost 80% of life had not returned, revealing the extent of permanent damage seabed mining would do to life in our oceans. This includes loss of the valuable microbial colonies that are powerful for new medicines and sustainable industrial processes.

In addition, there is great uncertainty around the toxic clouds of sediment around mining operations, called plumes, that will rise up around any deep ocean machinery as excess sediment is discarded away from the mined metals. Seabed nodules grow 10mm every 10 million years in very delicate ocean environments. Hence Seabed Mining companies' plans to remove 4cm of seabed sediment implies destroying 40 million years of evolutionary history. This is in addition to any noise and other permanent damage being done by dredging up the seabed as is planned for the Pacific Ocean.

Hence, it is critical that the world has time to study, identify and categorize the unique life on the deep ocean floor before they are lost forever.

VALUING OCEAN LIFE OVER MINERALS AND PROFITS

Given that the consequences of COVID-19 are estimated to cost the global economy as much as $3 trillion in 2020 (over $8 billion a day, or over $5.5 million a minute), every moment counts in developing effective treatments. There is no seabed mineral more valuable and unavailable on land that justifies such a planetary risk.

The current coronavirus crisis shows just how important it is to have a library of deep ocean natural resources, including deep ocean microbial communities. It is critical to ensure we have a large enough repository of natural product targets to be prepared for the next health pandemic crisis. This could save precious months to identify high potential compounds and develop effective vaccines, saving the global economy hundreds of billions of dollars.

Advances in deep ocean exploration, machine learning and biotechnology to better understand natural products, are all significantly accelerating our understanding of nature and potential medical and industrial applications.

The activities we permit to occur in our oceans are yet another area where the world needs to turn its attention to, but this time with much more consideration.

Nishan Degnarain is a development economist focused on innovation, sustainability and ethical economic growth. He currently works with leading Silicon Valley technology companies on sustainable growth opportunities, particularly targeted at lower income nations.

SDG14: Life Below Water focuses on the conservation and sustainable use of the world's oceans, seas and marine resources for sustainable development. There are ten targets within SDG14 that can be used to create action to conserve and sustainable use the oceans.
Learn more at sdgs.un.org/goals/goal14

SOLUTIONS WITHIN REACH

World Ocean Forum offers a platform for great ocean minds to share ideas, innovations, and the possibility of solutions yet to discover.

WORLD OCEAN FORUM is a place for key ocean voices to contribute to an active forum of opinion, ideas, and proposals for change in ocean policy and action worldwide. We invite opinion, research, storytelling and journalism as vehicles for communicating the ocean message.

The Forum links unexpected people with unexpected ideas. Since 2019 we've heard from scientists, artists, explorers, biologists, climateologists, and more. Some contributors include **E.O. Wilson**, The Half-Earth Project; **Meera Subramarian**, nature writer; **Charles Norchi**, Maine School of Law; **Mia Bennett**, Cryopolitics; **Amos Nachoum**, nature photographer; **Mark Spalding**, The Ocean Foundation; **Thor Sigfússon**, the Iceland Ocean Cluster; **Andrew Kornblatt**, the Online Ocean Symposium; **Doug Struck**, Pew Charitable Trust; **Krisanne Baker**, Eco Artist and Educator; and many others.

World Ocean Forum offers a powerful tool for ocean communications. It is an aggregate of information, opinion and educational resources, and serves to amplify the ocean message and encourage engagement with a global audience. It is the goal of the World Ocean Observatory to provide responsible science-based information to institutions, experts, students, educators and curious citizens around the world. The Forum offers a platform for great ocean minds to share ideas, innovations, and the possibility of solutions yet to discover.

4 ADDRESSING OCEAN POLLUTION

STEPS TO ACHIEVE SDG TARGET 14: THE CONSERVATION AND SUSTAINABLE USE OF THE OCEANS, SEAS AND MARINE RESOURCES FOR SUSTAINABLE DEVELOPMENT

Photo by Naja Bertolt Jensen on Unsplash

AQUAMMODATE
Water purification and desalination

NOVOLOOP
Performance materials from post-consumer plastic

EUREKA RECYCLING
Zero waste non-profit social enterprise

EVOY ELECTRIC BOAT
The world's most powerful electric outboard

FORTUNA COOLS
Could coconut coolers replace plastic foam insulation?

THE GREAT BUBBLE BARRIER
A smart solution to plastic pollution in our waterways

ICHTHION
Disruptive technologies to extract plastics and synthetic waste from waterways and ocean

MANGO MATERIALS
Biodegradeable replacements to plastic

ROZALIA PROJECT FOR A CLEAN OCEAN
Protecting the ocean through cleanup, education, and solutions-based research

ADDRESSING OCEAN POLLUTION

STEPS TO ACHIEVE SDG TARGET 14
FOR MARINE PLASTIC LITTER & MICROPLASTICS

According to Ocean Action Hub (oceanactionhub.org), eight to twelve million tons of plastics end up in the ocean every year. One of the targets of Sustainable Development Goal 14 (SDG14: Life Below Water) calls upon states to prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris, by 2025. Following China's ban of all imports of non-industrial plastic wastes in 2018, exports of plastic wastes by high-income countries such as the US have shifted to South East Asian countries putting unbearable stress on their waste management systems. Despite worldwide attention devoted to the ocean plastics crisis, these practices are likely to aggravate the problem. It shows that current efforts are not sufficient to achieve the SDG target 14 for marine plastic litter and microplastics.

AQUAMMODATE

Pure Water at Minimum Energy Cost

Aquammodate was founded in 2019 with the aim to bring the technology for energy-efficient and high purity grade water purification to people and industries in need.

Nature's finest water purification boasts up to 100x productivity at 100% selectivity for the same energy input as today's desalination. Aquammodate leverages ocean-based stabilization of natural components to put existing membranes on par with natural performance, envisioning affordable, sustainable production of safe drinking water from the ocean.

As membranes are also used in water treatment, Aquammodate's component has the potential to cost-effectively prevent small pollutants, such as pharmaceutical residues, metals, and microplastics, from being released into rivers, lakes, and oceans through wastewater streams. This will benefit marine ecosystems and cut costs for various industries.

Aquaporin proteins are water channels that selectively facilitate water transport across the cell membrane of all living cells in an energy-efficient way. The key stabilization components are lipids and silicon dioxide (silica). The lipids are dual purpose since they both mimic the natural environment of the aquaporins and act as the impermeable component in the filter. Silica provides the biological components with mechanical and chemical robustness while preserving their structure. For details, see their PhD thesis at:

aquammodate.com/wp-content/uploads/2019/09/Aquammodate-PhD-thesis.pdf

14 LIFE BELOW WATER

NOVOLOOP

Upgraded Performance Materials from Post-Consumer Plastic

A California company says it's developed the world's first thermoplastic polyurethane made from post-consumer polyethylene waste. It has mechanical performance properties comparable to commercial, virgin-grade thermoplastic polyurethane (TPUs). The company, Novoloop, is taking grocery bags, food packaging, bubble wrap, shampoo containers and milk jugs and turning them into a new product called XIRC.
XIRC is good news because it comes with a lower carbon footprint than virgin TPUs, an alternative to synthetic rubber and silicone found in products like shoe soles, cell phone cases, and automotive floor mats and interiors. According to the company's news release, XIRC "remains flexible at low temperatures, exhibiting high elasticity, outstanding abrasion resistance, and superior dry and wet grip, making the product an ideal choice for footwear, sporting goods and automotive applications," the company says in a news release.

"The age of oil is over," said Miranda Wang, CEO and co-founder of Novoloop. *"Plastic waste is the new resource. And that could change the world."*

Novoloop was founded with the vision to be the most transformational materials company by showing the world what can be done with plastic waste. This is a technology with great potential impact for a sustainable ocean.

novoloop.com

EUREKA RECYCLING

Zero-Waste Non-Profit Social Enterprise

Eureka Recycling is a nonprofit zero waste organization and social enterprise recycler based in Minneapolis, Minnesota. They are one of only a handful of nonprofit recyclers in the United States and have provided recycling services and zero-waste education to the Twin Cities metro since 2001.

Eureka works to bridge the gap between a zero-waste future and the realities of today with tangible, real-world solutions. The company models the idea that by systematically addressing the way we manage our resources, we can create solutions to the most pressing issues of our time, including climate change, building strong local economies, and supporting healthy equitable communities.

Eureka Recycling believe that communities deserve access to the most accurate information about waste reduction. Whether it's studies on the benefits of composting or textiles recycling, or advocating for local and national policy changes, Eureka pursus new horizons, challenges assumptions, and provides forward-thinking solutions for the benefit of the environment.

eurekarecycling.org

EVOY ELECTRIC BOAT
Accelerating the Transition to Sustainable Boating

In recent years, electric propulsion for boats has been growing in demand and popularity, motivated by a desire to reduce pollution and noise. Traditional pleasure boats consume massive amounts of fuel each year and emit loads of pollution into the atmosphere. Evoy's vision is to eliminate boating emissions: imagine our water bodies with no sound and no fumes! Evoy was founded in 2018 and is headquartered in Florø, Norway. Their electric voyaging technology offers inboard and outboard turn-key systems for any pleasure craft. They are among a handful of companies paving the way toward eco-friendly solutions to a growing problem worldwide.

evoy.no

FORTUNA COOLS
Coconut Coolers to Replace Plastic Foam Insulation

Fortuna is a new technology in early development, focused on affordable cold chain solutions. Fortuna Cools is producing a cheaper and biodegradable alternative to traditional iceboxes using coconut husks--the leftover waste product of an enormous coconut meat and water industry.

Fortuna was founded as a collaborative social enterprise: graduate students from Stanford University, a fishing village in the western Philippines, and the conservation NGO Rare. Their idea is to replace plastic foam insulation once and for all, using the nine billion coconut husks that are burned as garbage every year in the Philippines alone. Fortuna's coconut fiber insulation avoids CO2 emissions from incineration and provides extra income for impoverished coconut farmers. Currently, Fortuna partners with rural communities in the Philippines to build coolers that will last for years with minimal impact on the marine enviornment.

fortunacools.com

THE GREAT BUBBLE BARRIER
A Smart Solution to Plastic Pollution in Our Waterways

The Great Bubble Barrier is a young and fast-growing start up located in Amsterdam, Netherlands. The technology comprises three main components: a bubble curtain, a compressor, and a catchment system. The three components are designed to work in tandem to create an optimal plastic pollution collection solution wherever one is installed. The bubble curtain is created by a perforated tube on the bottom of the waterway where air is pumped through. This generates a screen of bubbles that blocks plastics and directs suspended plastics to the surface. The diagonal placement of the bubble curtain in the waterway guides plastic waste to the side and into the catchment system. There are many benefits to a system such as this: they operate 24/7; they are open to ship traffic without obstruction; they increase oxygen in the water; they are safe for fish passage; the affect the entire depth and breadth of the waterway where installed. There are currently Bubble Barriers in Amsterdam and other parts of the Netherlands and the team hopes to soon bring their technology to Asia--home to three of the world's most polluted waterways.

thegreatbubblebarrier.com

ICHTHION
Disruptive Tech to Extract Waste from Waterways and Ocean

In 2018, increased efforts of global organizations created greater awareness of the plastic pollution problem, resulting in greater levels of action. However, outcomes typically focus far from the source of the problem: polluted rivers of developing economies that do not have waste management systems in place. Studies show it is 30 times more effective to collect plastic before it has reached deep-water environments. Plastic pollution is set to triple by 2030 without significant interventions, making the future of the world ocean--and the humanity that depends on it--bleak at best. Ichthion Limited in the UK has developed three types of technology streams that operate in different marine environments to prevent micro and macro plastics from entering into phytoplankton growth areas in coastal zones--and for reclamation of plastics in the deep ocean. Their technology also has the capacity to provide data on the plastic extracted--helpful information for governments as they develop strategies of circular economy that can effectively reduce the plastics entering waterways.

ichthion.com/technology

MANGO MATERIALS
The Future is Biodegradeable

Mango Materials is a renewable bioproducts company located in the San Francisco Bay Area that strives to be the global leader in the bio-manufacturing revolution. Their team of have invented a proprietary platform that delivers optimally-formulated, biodegradable polyhydroxyalkanoate (PHA) pellets that incorporate into any supply chain.

mangomaterials.com

We believe biopolymers are critical to preserving our natural environments, especially our beloved oceans. Biopolymers are no longer just a "nice to have", they are a "need to have" – now. PHA offers a solution that is completely harmonious with nature. ~ Mango Materials

ROZALIA PROJECT
Working Toward a Clean Ocean

Rozalia Project for a Clean Ocean protects the ocean through cleanup, education, solutions-based research and by embracing innovation and technology. As a member of the Trash Free Seas Alliance®, Rozalia Project provides expertise related to their experience in all kinds of waters – from surface to seafloor, urban to coastal. Working across all of these geographies has helped improve the understanding of how marine mammals and humans are affected by the increase in marine debris. Rozalia Project encourages citizens to come up with solutions relevant to marine debris-related problems in their own communities and on their shores.

rozaliaproject.org

5 TACKLING CLIMATE CHANGE

INNOVATIVE SOLUTIONS TO MATCH THE URGENCY OF THE CLIMATE CRISIS THAT MAXIMIZE NATURE'S ABILITY TO FIGHT CLIMATE CHANGE WHILE BOLSTERING RESILIENCE FOR PRECIOUS ECOSYSTEMS AND VULNERABLE COMMUNITIES

The ocean holds a vast portfolio of options to help combat climate change. From converting CO2 in the atmosphere and ocean to a vast source of energy alternatives, from strengthening our resilience at the coastline to providing us with the resources necessary to sustain life. In this chapter we provide a number of examples, including some compiled by 1000 Ocean Startups. Online at 1000oceanstartups.org/startups

GIVEPOWER
Clean water through clean energy

PROJECT DRAWDOWN
Ocean-based climate solutions research

BLUE PLANET
Converting CO2 into carbon negative building materials

DESOLENATOR
Sun-powered water purification

IMPACT-FREE WATER
Wave-powered desalination

NOON ENERGY
Renewable energy batteries

SOLAR DUCK
Offshore floating solar

SYMBROSIA
Achieving methane reduction naturally using seaweed

Photo by Patrick Perkins

TACKLING CLIMATE CHANGE

INNOVATIVE SOLUTIONS TO MATCH THE URGENCY OF THE CLIMATE CRISIS

If we have problems, where do we look for solutions? As we confront the challenges of the early 21st century – climate change and its causes, food insecurity and its causes, political turmoil and its causes – we discover that the ocean provides all the resources and opportunity we need. If we have exhausted the land, there is nowhere else to turn, and, to our great fortune, the sea still remains a place of optimistic resort. But all is not well there. Despite our best efforts, the old paradigm of unlimited growth, consumption, and fossil fuel economy resists and remains, and we are faced with evermore evident deterioration of our ocean world. Where is the urgency? What will it take? We are best when we imagine and apply solutions to inexorable problems. In convention and despair lies operative pessimism. In innovation and enterprise lies operative optimism. The ocean is our hope for the future.

GIVEPOWER

Clean Water Through Clean Energy

GivePower Solar Water Farms are sustainably creating access to clean water in scarce regions around the world. By employing solar-powered desalination technology they are providing a water purification system that can be rapidly deployed in regions around the world that are suffering from shortages of clean water. GivePower produces two models of solar water farm: the Max and the Mobi. Both are capable of transforming as much as 70,000 liters of saltwater into clean drinking water every day--enough for up to 35,000 people per day.

givepower.org

PROJECT DRAWDOWN

A Leading Resource for Climate Solutions

Founded in 2014, Project Drawdown is a nonprofit organization that seeks to help the world reach Drawdown—the future point in time when levels of greenhouse gases in the atmosphere stop climbing and start to steadily decline.

Since the 2017 publication of Paul Hawken's *New York Times* bestseller, *Drawdown*, the organization has emerged as a leading resource for information and insight about climate solutions.

Drawdown refers to the moment in time when global greenhouse gasses will stop and reverse their current upward trajectory and will begin to decline year over year. If deployed over the next 30 years, the solutions presented in Project Drawdown could realize drawdown by the year 2050.

After discovering that no other plan existed in the world to actually reverse global warming trends, Paul Hawken and his team chose Project Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming to remind us of the critical importance of bringing people and ideas together on a global scale. The uniqueness of Project Drawdown is fact that they come at the problem from three unique angles:

EDUCATING GIRLS / ELIMINATING FOOD WASTE / LOW FLOW HYDRO / SHARING ECONOMY / SOLAR MICROGRIDS / FUEL CELLS / GREENROOFS / LIVING BUILDINGS / DYNAMIC SKINS / AIR HEAT PUMPS / KITE SAILS / ROTATIONAL GRAZING / SMART GRID/SMART METERS / SOLAR FARMS / TIDAL ENERGY / WIND TURBINES / CONGESTION PRICING / GREYWATER SYSTEMS / HIGH SPEED RAIL / VERTICAL FARMING / AFFORESTATION / AVOIDED DEFORESTATION / BIOCHAR / BIOLOGICAL AGRICULTURE / CARBON FARMING / NO-TILL FARMING / PASTURE CROPPING / BIKING / REFORESTATION / DEMAND RESPONSE / LOW-FLOW FIXTURES / SOLAR HOT WATER / SOLAR PV / CHILD HEALTHCARE / FAMILY PLANNING / PYROLYSIS / ENERGY STORAGE / WHITEROOFS / ALGAE BIOFUELS / CAR EFFICIENCY / AGRO FORESTRY / CENTRATED SOLAR / RECYCLING TRUCK BUILDING / INTEGRATED SOLAR / REFORESTATION / BIOMASS HEAT

DRAWDOWN

1. It evaluated hundreds of currently available solutions across eight sectors for their viability, then used data and modeling to project their potential impacts over the next 30 years. The result is a list of 80 solutions that already exist and are proving their value; 2. It is ongoing.

The coalition of researchers and writers who produced the plan will continue to update, expand and share their findings to remain current with solutions as they develop and become more viable over time; and 3. It empowers change at all levels of society. It reminds us that decisions and actions by individuals, corporations and communities in every corner of the globe can positively impact the future of our planet.

The Project Drawdown solutions are divided into eight sectors: Materials, Electricity, Food, Women and Children, Land Use, Buildings and Cities, Transport and Coming Attractions. According to the Project Drawdown website, each solution is measured and modeled to determine its carbon impact through the year 2050, the net cost to society, and the total lifetime savings.

drawdown.org

BLUE PLANET
Economically Sustainable Carbon Capture

The cement industry is one of the top producers of carbon dioxide and is considered one of the most destructive materials on Earth. Based in San Jose, California, Blue Planet Systems Ltd. is a startup that manufactures and develops carbonate aggregates and carbon capture tech designed to reduce carbon intensity of industrial operations.

Distinct from some other industrial carbon capture and utilization technologies, Blue Planet's process does not require CO_2 purification and enrichment prior to use which can reduce cost and unit energy consumed during capture. Blue Planet's technology potentially enables permanent capture of CO_2 in building materials at scale, converting CO_2 to a lower-carbon product for sale in the growing global market of aggregates. Blue Planet's solution involves converting CO_2 into limestone to be used in concrete, and replace the rock mined in open-pit quarries, which is one of the greatest contributors to CO_2 in the atmosphere. Blue Planet Ltd uses Direct Air Capture (DAC) technology to concentrate and remove carbon dioxide from the air. The company then creates a chemical reaction that converts CO_2 into limestone–the building block of concrete.

blueplanet-ltd.com

DESOLENATOR
Sun-Powered Water Purification

Based in London and founded in 2014, Desolenator Ltd. has patented a method of water purification that operates entirely on the power of the sun. It purifies water from any source (including seawater, heavy metal contaminants and brackish) without chemicals, filters or moving parts. The result is among the most economical and environmentally-friendly method of desalination. Their tech can produce more than 250,000 liters of water per day. It is modular, easy to install, has no filters, and eliminates the cost of fuel and other consumables.

desolenator.com

IMPACT-FREE WATER
Wave-Powered Desalination

Impact-Free Water Ltd. has developed a wave energy reverse osmosis pump (WEROP) that uses wave energy to pressurize and pump seawater for desalination, electrical power production and high volume/low pressure seawater supply, the latter for use in sea farming. The wave energy pump sits on the sea bed anywhere between 500m and 1km out to sea. Using wave power, the pump pushes water through an undersea pipe to the shore where it is configured to: 1) run through a reverse osmosis unit to produce fresh water; 2) run through a turbine to produce electricity; or 3) be pumped at high volume for land-based mariculture.

Impact-Free Water tech can be configured to produce water for irrigation, or high quality consumable tap water, or even ultra-high quality drinking water for bottling.

impactfreewater.com

NOON ENERGY
Renewable Energy Batteries

Today's widely used batteries store energy in expensive and destructive-to-extract metals such as lithium, cobalt, and vanadium--many of which are "harvested" by deep sea mining from the sea floor. With the rise of electric vehicles and the lithium-powered batteries required to run them, we must look beyond the battery if we are to reach sustainability through a renewable energy grid. Enter Noon Energy. A US-based startup with a battery technology that stores energy in carbon and oxygen: media that cost well below $1 per kWh. Noon Energy is turning solar and wind electricity into on-demand power. Noon is part of an exciting new trend in electricity generation that is utilizing more renewable sources entering the grid, which would help decrease the ecological footprint of batteries. In March 2021 Noon Energy landed a $3M seed stage investment.

noon.energy

SOLAR DUCK
A Profitable Solution to Carbon Emissions

SolarDuck powers the world with clean solar energy. They are generating offshore solar energy using state of the art technology that is fully scaleable, offering a sustainable alternative to meet the world's rising demand for energy. In April of 2021 SolarDuck launched their first floating solar energy project. Called the *Demonstrator*, the project consists of four triangular platforms covered with solar panels which rest on floaters and delivers energy to the grid. The main driving forces of this market are a global ambition to get to net zero and a lack of space to place solar panels on land.

solarduck.tech

SYMBROSIA
Fighting Methane Production With Seaweed

Alexia Akbay, founder and CEO of seaweed farming start-up Symbrosia, wants to make cows less gassy. It was long-thought that cow flatulence was the cause for methane release into the atmosphere, but it is actually burps that release most of the gas. Research has shown that some additives, when mixed into a usual ruminant diet, can inhibit the production of methane in a cow's stomach. The solution? Seaweed. Symbrosia, based in Hawaii, is developing a system that grows a methane-reducing algae: Asparagopsis taxiformis, a red seaweed that grows in temperate waters in parts of Asia, Australia, Southern California, the Florida Keys, and Hawaii. Symbrosia and its founder Akbay are looking at ways of scaling up Asparagopsis taxiformis production so that it can be sustainably and profitably sold to farmers. While the seaweed doesn't need much beyond seawater and sunlight to grow, it is potentially an invasive species that can't be casually introduced into a new environment. Harvesting from an ecosystem where it already grows is also a problem. California's coast is already grappling with the growth of the edible seaweed industry. Despite the complexities, Akbay still thinks this is an idea worth pursuing. "I'd really like to encourage people to start working on harder solutions," she said. "The world needs more people, more hands on deck, more doers."

symbrosia.co

The SolarDuck project *Demonstrator* floats at IJzendoorn in the Netherlands and delivers energy to the grid.

6 USING OCEAN RESOURCES SUSTAINABLY

CAREFUL MANAGEMENT OF OCEAN RESOURCES IS KEY TO A SUSTAINABLE FUTURE

ATLANTIC SEA FARMS
Commercially viable seaweed farming on the coast of Maine

AUSTRALIAN SEAWEED INSTITUTE
Toward a sustainable and climate-positive seaweed industry

BIOFISHENCY
Aquaculture solutions to increase grower productivity and sustainability through its innovative technology

FUTURE PLANET
A revolutionary boat that draws its power from wave energy

ALGAEPRO
Sustainable microalgae froma circular bio-economy

HOOKED
100% plant-based seafood

IMPACT-9 OFFSHORE AQUACULTURE
Innovative open ocean aquaculture solutions

KELP-BLUE
Reviving the kelp forests around the world

OCEAN RAINFOREST
Sustainable Nordic seaweed

SU-SE-WI
Sunlight, seawater and wind: unlocking the power of microalgae

Image by Caleb Kastein

USING OCEAN RESOURCES SUSTAINABLY

CAREFUL MANAGEMENT OF OCEAN RESOURCES IS KEY TO A SUSTAINABLE FUTURE

The ocean provides an astonishing variety of things to eat—protein that sustains approximately 40% of the world population. And yet we are determined to exhaust the supply by our insatiable demand. As with resources on land, we seem to be on a path to consume ocean resources to extinction. Over-fishing, illegal fishing, coastal pollution, ocean acidification, habitat destruction, indiscriminate alongshore development, deep sea mining, and climate change factors – all this and more combine to threaten the sustainability of this food necessity. The addition of aquaculture production is inevitable, along with new marine food sources such as seaweed and algae. And we will need to increase policy and regulation, surveillance and enforcement, species and regional quotas, traceability of fisheries products, and public education to sustain this rich resource for human health and community.

Image by Atlantic Sea Farms

ATLANTIC SEA FARMS
Commercially-Viable Seaweed Farming

Over 98% of the edible seaweed currently on the market is grown in Asia. Some is grown in compromised water with little or no environmental oversight or batch testing for quality and safety. Atlantic Sea Farms is growing 100% natural kelp in the clean, cold waters of Maine. Kelp is delicious and good for you. It is a great source of iodine for thyroid health; it is loaded with vitamins and minerals; it has been found to have anti-inflammatory properties and antioxidants; and so much more. And kelp is good for the ocean: it sequesters more carbon than trees, and there are no inputs required for rope-grown kelp — no arable land, no fresh water, and never any pesticides or herbicides. Besides tourism, Maine's coastal economy is largely dependent on lobster. Atlantic Sea Farms is working with fishermen in their community to help diversify coastal incomes, reduce ocean acidification, and bring mineral-rich sea greens to market. They identify and partner with Maine fishermen to help them start their own kelp farms. They provide technical assistance to help these farmers get farm leases, set up gear, learn how to seed and harvest, and support their business planning. And they provide free seeds to all of their farmers. They're also working to increase the market for kelp in Maine and beyond.

atlanticseafarms.com

AUSTRALIAN SEAWEED INSTITUTE
A Blueprint for Growth

The Australian Seaweed Institute is the driving force behind the sustainable and climate-positive seaweed industry in Australia. The Institute is committed to thriving oceans and communities with the aim to establish a world class seaweed industry for Australia. In September of 2020, in collaboration with the Australian Seaweed Institute, they developed a new seaweed blueprint: a plan to develop a $100 million industry within the next five years, to reduce emissions, to improve ocean health and to create jobs regionally. The Blueprint offers a foundation to mobilize industry development and realize opportunity.

Australia currently has no commercial-scale seaweed farms but change is on the way—including plans to grow and harvest Asparagopsis seaweed to feed cattle as laid out in the last chapter.

australianseaweedinstitute.com.au

BIOFISHENCY AQUACULTURE
Better Water. Better Fish.

Based in Israel, BioFishency is working to improve aquaculture productivity and sustainability by developing, producing and disseminating high-quality technologies that increase aquaculture output while reducing costs and saving resources.

BioFishency was established in 2013 as a portfolio company of The Trendlines Group. Today, BioFishency is an aquaculture solutions leader, focusing on best practice, increasing growers' productivity and sustainability through its innovative technologies and extensive knowhow. BioFishency develops and produces cost-effective, easy-to-use water treatment systems for use in land-based aquaculture.

biofishency.com

USING OCEAN RESOURCES SUSTAINABLY

CAREFUL MANAGEMENT OF OCEAN RESOURCES IS KEY TO A SUSTAINABLE FUTURE

FUTURE PLANET
Boat Technology from Wave Energy

Could wave-powered propulsion become a reality? A new design of ship in the Philippines is hoping to provide a low carbon alternative to the country's traditional *bangka*–a monohull fitted with two outriggers, in order to give the vessel improved stability and to keep it stable in choppy seas.

Jonathan Salvador, a marine engineer who owns a shipbuilding company in the Philippines, is the initiator of this latest wave power project which he is developing in collaboration with the Aklan State University. Originally he was inspired by what he saw, in how the outriggers on the Bangka constantly react to the upward and downward movement of the waves. He said, "what if we can convert this reaction into electrical energy?"

The innovative technology uses the kinetic energy of the motion of the outriggers–essentially the motions of the waves–to produce electrical energy. The trimaran has a wave energy convert integrated into the outriggers that harvest the momentum of the waves, converting their kinetic energy into electrical energy that's fed into a generator that that supplies the ship. The more waves the trimaran encounters the more power it can produce.

Construction of the hybrid trimaran began in 2018 and is expected to carry 100 passengers and a number of vehicles. This wave-powered boat could be the first in a series of increasingly ambitious designs moving away from fossil fuels.

ALGAEPRO
Sustainable Microalgae from Circular Bioeconomy

Fish is a vital source of animal protein for the global population, which is expected to exceed 9 billion by 2050. Aquaculture will play a critical role in ensuring that enough fish is produced.

Fish farmers have traditionally relied on fishmeal and oils as the main ingredients in feed, as these provide well-balanced, high-quality protein and Omega-3 fatty acids. However, the need for these ingredients outweighs the availability, and many of the fish stocks they are sourced from are being depleted due to overfishing.

Microalgae have great potential as an alternative and sustainable source of marine protein and oils. The feed market is vast and growing, but it demands high production at low prices. The technology for cultivation of microalgae on a large scale has not yet been optimized. This is particularly true for Nordic climates.

AlgaePro, a Norwegian startup, is developing technology for cultivating microalgae through circular bioeconomy. Their aim is to recycle biowaste, CO2 and waste heat to fuel microalgae cultivation. The microalgae is then used as a protein and Omega-3 rich feed supplement for use in aquaculture.

In 2018, Algaepro was chosen to participate in the first ever cohort of the Hatch Aquaculture Accelerator. From the Accelerator Algaepro grew as an industry innovator in the microalgae field.

algaepro.no

HOOKED
100% Plant-Based Seafood

The consumption of seafood has increased rapidly in the past century and is estimated to increase another +30% within the next ten years. The supply of seafood is limited and the ocean ecosystem is fragile--both from wild harvest and from fish farms/aquaculture. So what does the future of seafood look like? Hooked, a startup based in Stockholm, Sweden, is developing a plant-based shredded salmon alternative and will soon launched Hooked Toona.

Hooked was a part of Proveg Incubator program in early 2020 and is raising its first seed funds in order to launch in Nordic countries. They have signed Katapult Ocean, an accelerator that works with startups focusing on sustainable solutions for the ocean. In October 2020 Hooked received its first investment of €150,000 to launch in Scandinavia with plans for later expansion into Europe.

CEO Jonas Skattum Svegaarden of Katapult Ocean said, "Plant-based seafood is an upcoming megatrend. When interviewing startups this investment round, we have seen several exciting startups in this space. The Hooked team combines massive drive, passion and strategic focus. They are here to make a change and we are proud to support their journey!"

hookedfoods.com

IMPACT-9
Innovative Open Ocean Aquaculture Solutions

Global salmon production is a $15.4 billion market, focused on sheltered water bodies in Norway, Chile and Scotland. Impact-9, a startup company in Dublin, Ireland, is developing technology to make aquaculture possible in harsh open ocean environments. The technology targets a €5 billion growth market opportunity for sustainable aquaculture in waters around the United Kingdom and Ireland, with further opportunities globally.
John Fitzgerald, founder of Impact-9, is developing a new fish cage that will help producers to move their salmon offshore. He explains that this approach could help farmers to reduce sea lice outbreaks, as well as prevent diseases from spreading.

Impact-9 is also developing a robust mussel-production tech.

impact-9.com

USING OCEAN RESOURCES SUSTAINABLY

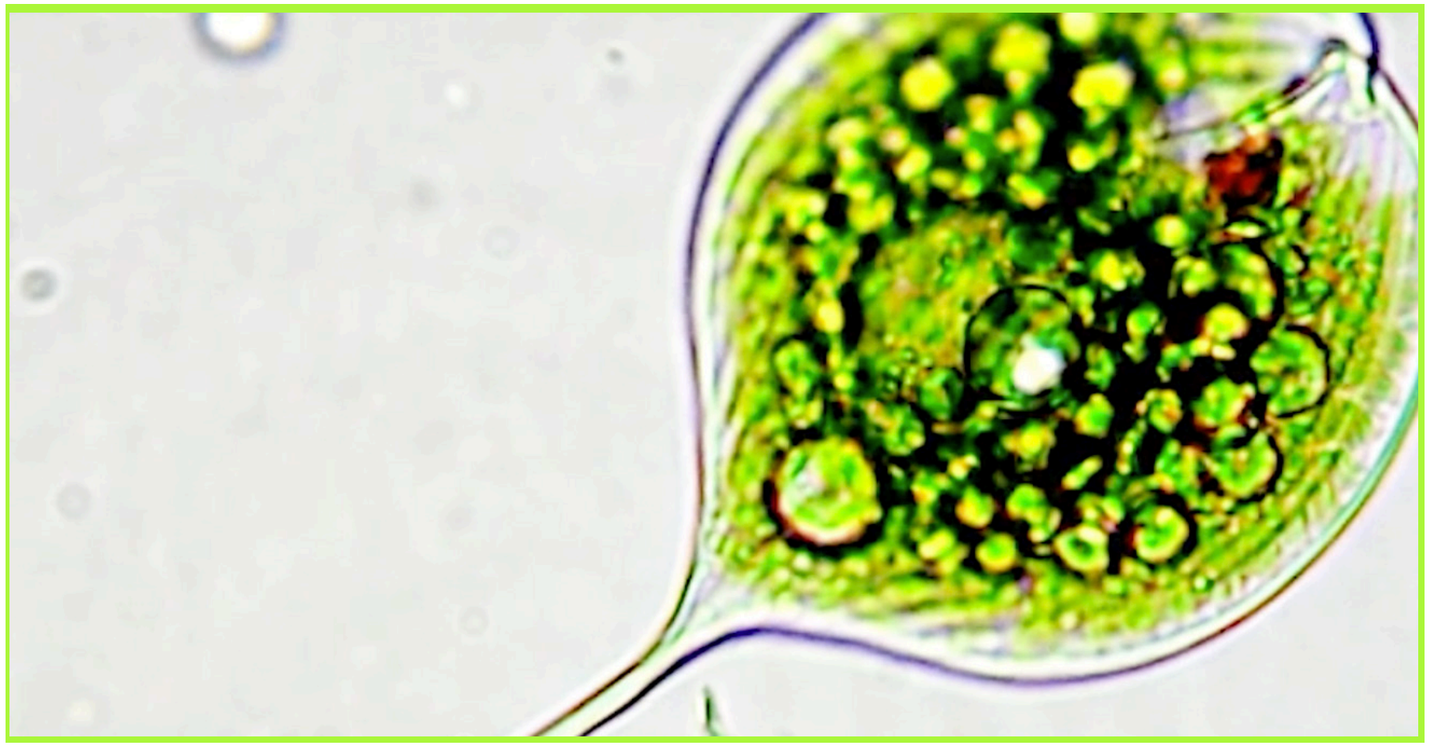
CAREFUL MANAGEMENT OF OCEAN RESOURCES IS KEY TO A SUSTAINABLE FUTURE

KELP BLUE
Re-Wilding the Ocean

Kelp is a fast-growing seaweed that is highly effective at sequestering CO2. It generates positive ecological benefits to surrounding ecosystems in the form of water filtration, nitrogen removal and habitat provision, which in turn boosts marine biodiversity and improves fish stocks. Kelp also plays a role in counteracting the acidification and de-oxygenation of the ocean.

Kelp Blue, a startup based in Namibia, is planting kelp forests around the globe to boost the health of the ocean and to help lock away CO2. They also harvest the kelp canopy for sustainable agri-foods, fertilizer, pharmaceuticals, and textiles. They are a restorative large-scale offshore kelp cultivation enterprise that produces sustainable agri-foods and bio-stimulants which displace environmentally damaging alternatives.

Kelp Blue's operations contribute to the attainment of the UNDP's Sustainable Development Goal (SDG) 14: Life Below Water.



Kelp Blue is financed through a partnership between Climate Investor Two (CI2), managed by Climate Fund Managers, Kelp Blue and the Namibia Infrastructure Development and Investment Fund (NIDIF), managed by Eos Capital, for the development and commercialisation of the world's first large-scale kelp farm.

In January of 2021 Kelp Blue was recognized by the World Economic Forum Uplink Initiative as one of 11 new innovations protecting life below water--and above it.

kelp.blue

OCEAN RAINFOREST
Sustainable Nordic Seaweed

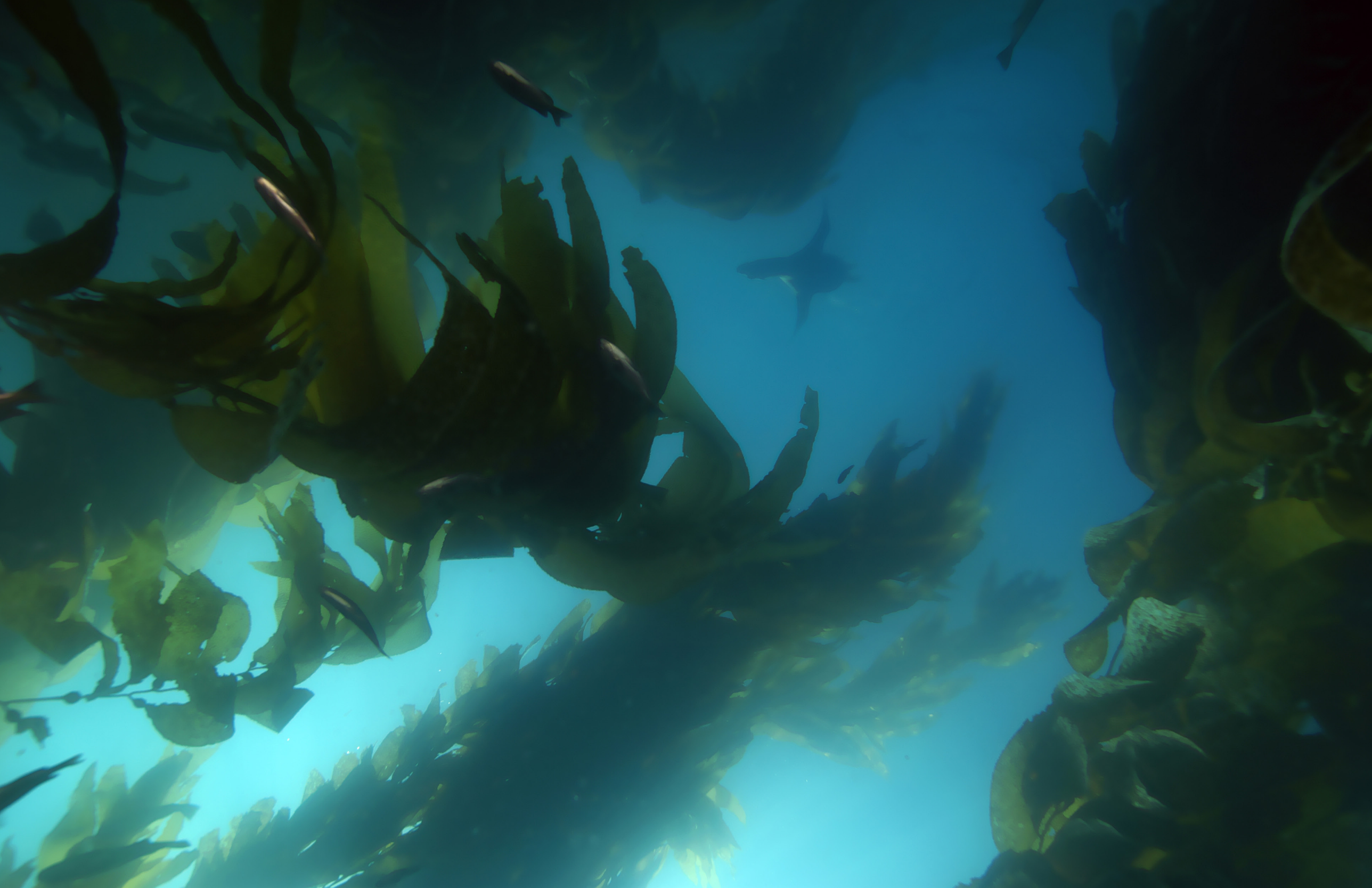
Farming macroalgae (seaweed) requires no freshwater, no arable land, no fertilizers, no pesticides, and can have a positive impact on biodiversity and fish farming. From a carbon sequestration perspective, seaweed is extremely efficient at absorbing CO2 from the ocean and reducing acidification. Its final products are in high demand in the world of cosmetics, fashion, plastic replacements, pharmaceuticals, alternative proteins, biofuels, fertilizers, and animal feed. Ocean Rainforest is an LLC company located in the Faroe Islands producing seaweed in open ocean cultivation installations.

oceanrainforest.com

SU-SE-WI
Unlocking the Power of Microalgae

SuSeWi is a Morocco-based company aiming to make its mark in aquafeed industry with algal meal. Microalgae are the fastest growing, highest yielding, most nutritious aquatic plant, and SuSeWi is aiming to become the world's largest producer of algal biomass. Microalgae can convert sunlight into food twenty times more efficiently than cultivable crops and are able to absorb and store carbon more efficiently than any other living organism. SuSeWi has developed, patented and tested the tech that recreates the natural growing conditions of algae, operating in open ponds with a minimal environmental footprint. The only elements they use are sunlight, seawater and wind. They aim to work toward an algal system that can naturally produce hundreds of thousands of metric tons of alternative protein in desert climates. Founding chief executive Keith Coleman says, "We have shown that the process is successful in all climates and across all the seasons, from the rain and cold of a South African winter, to the 50-degree heat of a desert summer. This brilliant innovation doesn't compete with nature; it allows nature to do what nature does. The governments of Chile, Peru, Namibia and Australia are interested in the system because it uses natural resources and provides food security and employment."

susewi.life



7 OCEAN FINANCE

Financing a sustainable ocean economy

INVESTABLE OCEANS
Simplifying and accelerating market-based sustainable ocean investing

KATAPULT OCEAN ACCELERATOR
Investing in and supporting startups that have a positive impace on the ocean

HOW TO IMPLEMENT THE BLUE ECONOMY
Concepts for increasing the impact of national investments in marine and maritime research and innovation

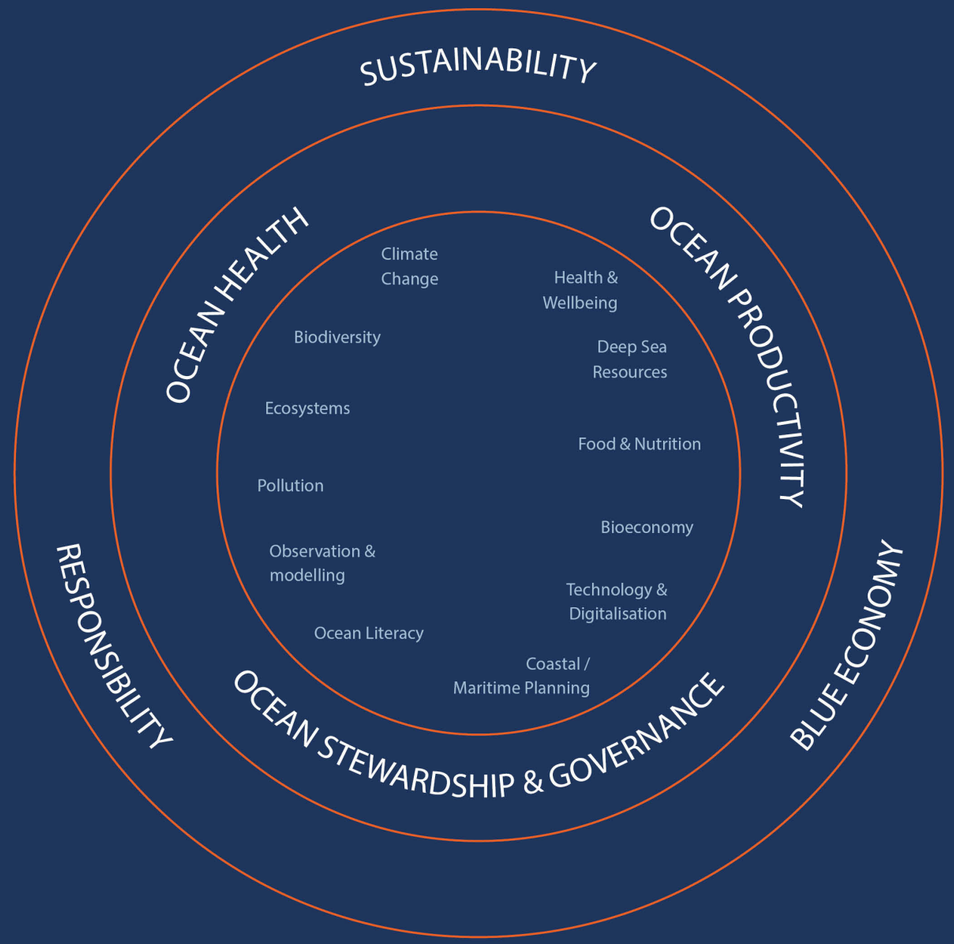
BLUE BONDS
JPI Oceans launches a Strategy Framework 2021-2025 for efficient and impactful research and innovation

ECOSYSTEM ACCOUNTING: HOW IT WORKS
The System of Environmental Economic Accounting (SEEA) offers financial analysis of the Blue Economy

WHAT IS THE BLUE ECONOMY?
An infographic from The World Bank describing the sustainable use of ocean r esources for economic growth and improved livelihoods

OCEAN RESILIENCE AND THE BLUE ECONOMY
The tools for ecological resistance to confront the challenges of stressed ocean systems and define a new, sustainable way forward

REPORTING ON THE BLUE ECONOMY
Important associated reports that inform the global discussion of the blue economy



The Blue Economy is providing new investment in ocean resources. How might individual investors do blue economy investing the right way, and which investments meet the criteria for true blue investing? This illustration represents a new strategic initiatives portfolio conceived by JPI Oceans in Europe that strives to increase the impact of national investments in marine and maritime research and innovation, outlining the values, goals and objectives that propose a structure around which specific investments could be made to achieve social and monetary return while achieving a commitment to sustainability and the ocean. Credit: JPI Oceans.

jpi-oceans.eu/draft-strategy-framework-beyond-2020

OCEAN FINANCE

INVESTING IN THE BLUE ECONOMY

In order to assure these changes, we will also need to re-assign financial assets, change our focus to ecosystem services and accounting, develop new investment instruments, create sustainability-driven funds and partnerships, and demonstrate the economic, social, and political return resulting from new values, structures, and behaviors. This perspective – the advance of a new Blue Economy – must not be diluted by false promises and half-hearted engagement by government, industry, and the investment community tempted to prolong the status quo out of fear of change and risk. The rewards of this economic investment must accrue as social value as well as monetary profit, must be inclusive and just, and must support a critical shift in how we manage the natural resources of the ocean for public profit and benefit for all mankind.

INVESTABLE OCEANS

The world ocean faces serious challenges but also anchor a growing, multi-trillion dollar economy. To reach full potential and achieve the goals of UN SDG 14, broader capital market engagement is needed to complement the vital roles of philanthropies, concessionary investors, and multilateral institutions.

Investable Oceans is an investment hub that brings market-based capital to the oceans. While they recognize the importance of philanthropy to make an impact for ocean sustainability, they also believe that market-based investing has the power to unlock additional capital for a successful Blue Economy.

Investable Oceans simplifies and accelerates market-based sustainable ocean investing across all asset classes (including public equities, fixed income, private equity and venture capital) and all sectors of the Blue Economy (including energy, fisheries, aquaculture, plastic and other ocean pollution, shipping, transportation and ports, and tourism) by centralizing research, commentary, inspiration, and access to blue enterprise in one place.

The Investable Oceans platform allows users to invest with access to a broad array of investment opportunities across all asset classes and all sustainable sectors; to learn and grow through research; to browse ocean books, films and art related to innovation; and to find events sourced from the ocean community.

This platform seeks to support and enhance the important work and growing success of fund managers, incubators and accelerators. Access to the platform is subject to various screens, which include referrals, capital raised, credentials, affiliations, awards and other validating criteria and data points.

investableoceans.com

KATAPULT OCEAN

Katapult Ocean invests in startups that build profitable businesses with a positive impact on the ocean. Through their investment vehicles (Accelerators and Fund), Katapult Future Fest and Katapult Foundation they catalyze capital, talent, companies and startups to accurate the "blue shift" in ocean industry. They steward ocean tech startups to achieve the UN Sustainable Development Goals with a main focus on SDG 14: *Life Below Water.*

Katapult's mission is to solve the world's most pressing problems through the use of exponential technologies, creating a movement that other investors are following. Katapult Ocean's award-winning accelerator program invests in startups within transportation, ocean health, energy and new sustainable innovations. They help startups with complex issues, creating structure, and helping to rise up to the next level.

Are you a for-profit startup with a positive impact on the ocean? Katapult would like to know more about you. They have closed applications for their fourth wave but you can join their watchlist.

katapult.vc/career/between-the-waves

OCEAN FINANCE

How to implement the Blue Economy

by Peter Neill

The Blue Economy is providing new investment in ocean resources. How might individual investors do Blue Economy investing the right way, and which investments meet the criteria for true blue investing? What are the strategic initiatives striving to increase the impact of national investments in marine and maritime research and innovation? Are there specific investments that could be made to achieve social and monetary return while achieving a commitment to sustainability and the ocean?

In the ocean world *The Blue Economy* is a much used phrase to describe some amalgam of perspective and strategy that provides a context for new investment in ocean resources, ostensibly as sustainable enterprise that will demonstrate best practice and best return from ocean investment. Like many such concept labels, this one is threatened by overuse and misunderstanding. What actually does it mean? And what exactly might I do as an individual investor to do it right? What kind of portfolio would I construct? What areas would fit best? Which investments would meet the criteria? Which would be just blue-wash and avoided? What would guide my choices?

Recently I came across a program for strategic initiatives conceived by JPI Oceans, an intergovernmental platform, based in Europe, that strives to increase the impact of national investments in marine and maritime research and innovation and to address aspects related to the influence of freshwater, transitional water, terrestrial environments and land-based activities on the blue economy." In the midst of the dense, EEU and bureaucratic language, I found a diagram, a set of concentric circles that visualized values, goals, and objectives that seemed to me to propose a structure around specific investments could be made to achieve social and monetary return affirming my personal commitment to sustainability and the ocean.

The outer circle suggested three primary values as foundation principles: Blue Economy, Sustainability, and Responsibility. All good. The next circle suggested three specific goals: Ocean Productivity, Ocean Health, and Ocean Stewardship and Governance. Again, all good, as general areas of interest to focus investment. And the innermost circle suggested twelve specific objectives, categories in which research could be tasked to identify the best equities and fixed income assets for particular investment: Climate Change, Biodiversity, Ecosystems, Pollution, Observation and Modelling, Ocean Literacy, Coastal and Maritime Planning, Technology and Digitalization, Bio-economy, Food and Nutrition, Deep Sea Resources, and Health and Wellbeing. As I reflected on these areas, I immediately saw the categories in which to discover the best companies or other investment interests to build a Blue Economy portfolio to capitalize certain ventures with progressive and profitable impact from responsible, sustainable ocean action. Wisely, I will list none of what came to mind lest my recommendation squander your precious assets, even as I might risk mine.

But I will say is that I cannot advocate for the Blue Economy if I am not fully engaged at every level of my personal commitment, as a communicator, advocate, or *Citizen of the Ocean* unless I evaluate and align all my investment–be it my IRA, my energy, or my time–all measures of individual, political, and social capital–in an aggregated commitment to the ocean as key to human survival. I owe this to my grandchildren, and yours.

And so, for each case, I began to make list of projects I knew from almost two decades of following ocean technology and innovation, parsing through the various ESG funds that have become so popular with investors, some of which when you examine the actual holders include companies with marginal sustainability intent. What is interesting is the amount of chatter there is about these things, newsletters and messages on *Bloomberg News* and other financial informational outlets, very enthusiastic, worthy of a closer look at the actuals over the aspirationals, innovators mixed with exaggerators, resembling something very similar to an indexed mutual fund dressed in green or blue.

But real companies with real goods and services that are at the vanguard of transformational endeavor do exist and are available if you look for them and not allow the conventional brokers to discourage such investment on grounds of risk and growth. Think about it this way: we are on the cusp of serious change in how we work, consume, and otherwise act in a world evolving before our very eyes. The old premises must be abandoned; the new ideas are upon us; and the true Blue Economy believer will invest in that inevitable future. Launch yourself into the markets.

It's an oceanic world.

BLUEprint
HOW THE OCEAN WILL SAVE CIVILIZATION

The *World Ocean Radio* "BLUEprint Series: How the Ocean Will Save Civilization" outlines a new and sustainable path forward, with the ocean leading the way.

OCEAN FINANCE

IMPACT THROUGH INVESTMENT

"Our ocean challenges are too big and too important for any one country to face. JPI Oceans has already demonstrated how it can efficiently bring countries together, align strategies and pool resources to fund cutting edge research and innovation. In our new strategy framework, we have a blueprint to deliver the knowledge and tools we need to safeguard and sustainably use our ocean and its rich resources."

Dr. Niall McDonough,
Chair,
JPI Oceans

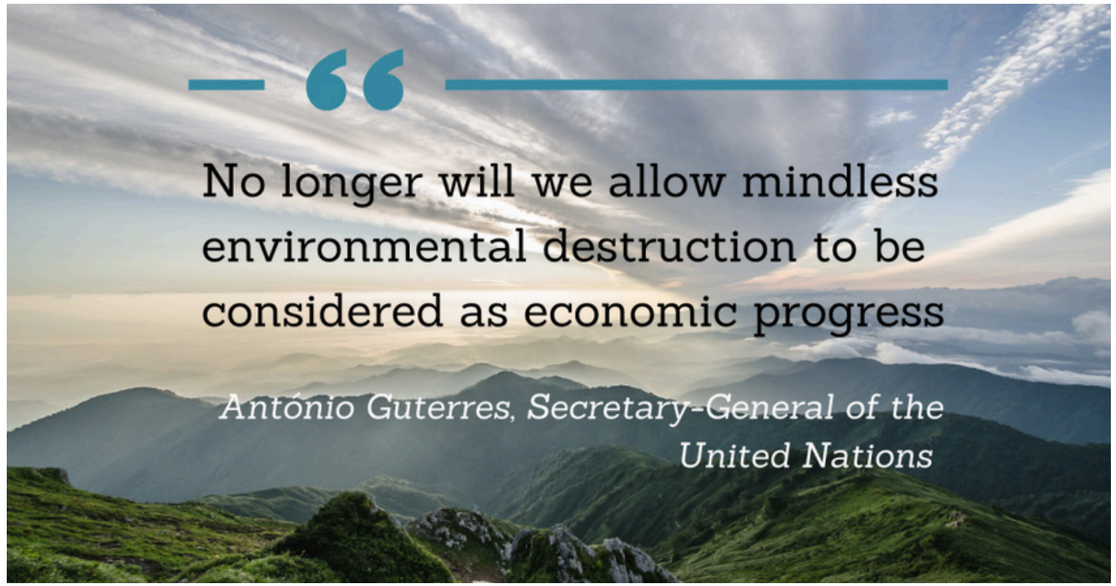
BLUE BONDS
JPI OCEANS

In March of 2021 JPI Oceans launched its Strategy Framework 2021-25 and discussed its contributions to Horizon Europe, the UN Ocean Decade and other initiatives. Developed with JPI Oceans members and co-created with stakeholders, the Strategy Framework provides a coherent setting for the coming years for efficient and impactful pan-European research and innovation, in support of healthy and productive seas and ocean.

One ambition of the strategy framework is to further strengthen the collaboration of JPI Oceans with EU initiatives, sea basin initiatives, overseas countries, sister JPIs and other partners.
The JPI Oceans Strategy Framework 2021-2025 provides the strategic basis and the transition to a stand-alone, legal entity (AISBL) ensures the formal status. Accordingly, Dr Joachim Harms, Vice Chair of the JPI Oceans Management Board, concluded that JPI Oceans looks forward to contributing to the United Nation's Agenda 2030, the Marine Strategy Framework Directive (MSFD) and Horizon Europe initiatives like the Sustainable Blue Economy partnership and the Mission on Ocean Seas and waters.

jpi-oceans.eu

JPI Oceans is an intergovernmental platform that strives to increase the impact of national investments in marine and maritime research and innovation.



In March of 2021 the 52nd United Nations Statistical Commission adopted the System of Environmental-Economic Accounting–Ecosystem Accounting (SEEA EA). This new statistical framework will enable countries to measure their natural capital and understand the immense contributions of nature to our prosperity and the importance of protecting it.

ECOSYSTEM ACCOUNTING
HOW IT WORKS

The System of Environmental-Economic Accounting-Ecosystem Accounting (SEEA EA) is an integrated and comprehensive statistical framework for organizing data about habitats and landscapes, measuring ecosystem services, tracking changes in ecosystem assets, and linking information to economic and other human activity.

The SEEA EA is built on five core accounts. These accounts are compiled using spatially explicit data and information about the functions of ecosystem assets and the ecosystem services they produce. The five ecosystem accounts are: 1) Ecosystem Extent, 2)Ecosystem Condition, 3-4) Ecosystem Services, and 5) Monetary Ecosystem Asset

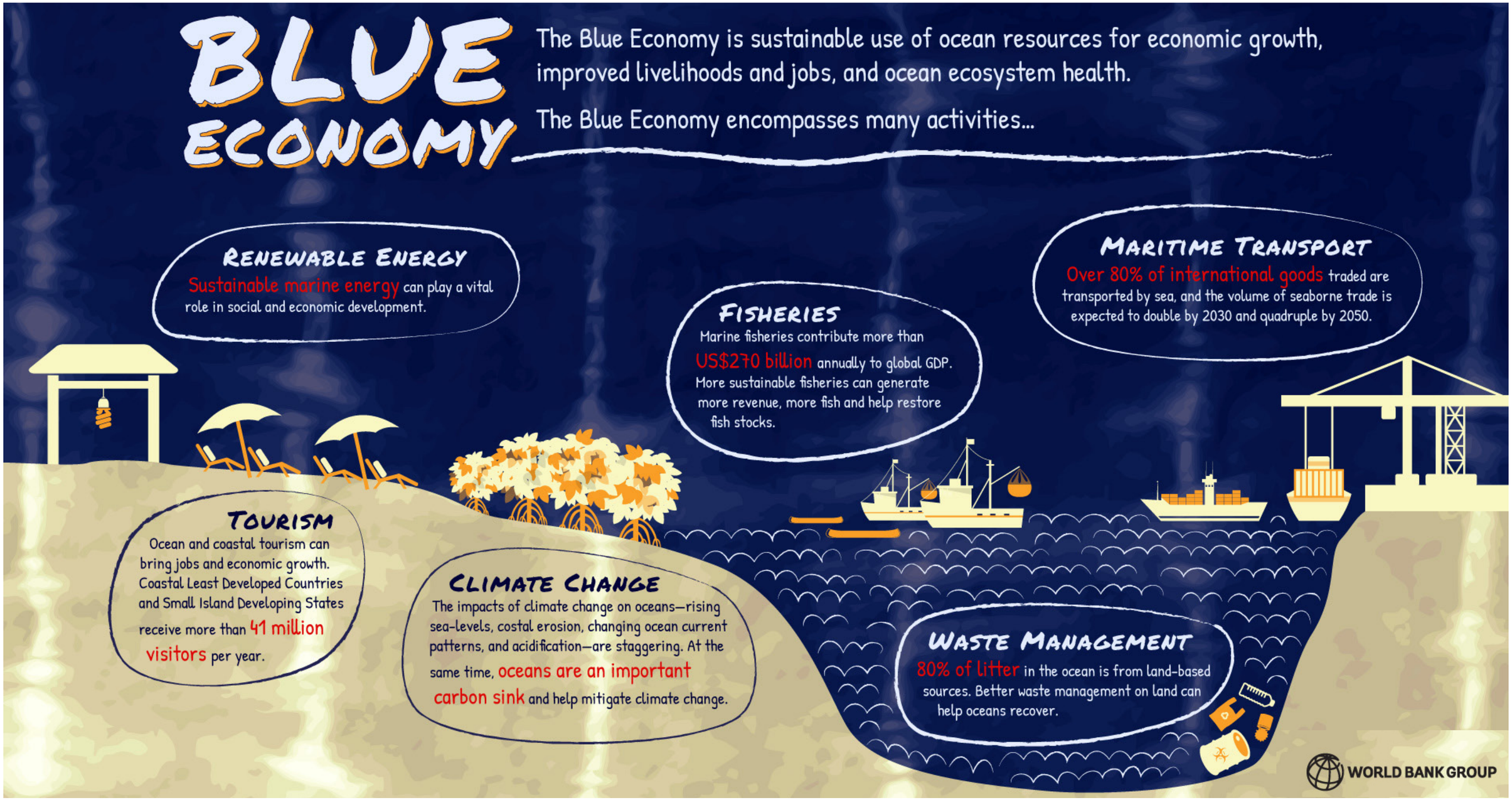
The SEEA EA also supports 'thematic accounting', which organizes data around specific policy-relevant environmental themes, such as biodiversity, climate change, oceans and urban areas. Other important thematic accounts would include accounting for protected areas, wetlands and forests.

A key aspect of ecosystem accounting is that it allows the contributions of ecosystems to society to be expressed in monetary terms so those contributions to society's well-being can be more easily compared to other goods and services we are more familiar with. Monetary estimates can provide information for decision-makers, for example, for economic policy planning, cost-benefit analysis, and for raising awareness of the relative importance of nature to society. Ecosystem service values are derived by using a range of economic valuation techniques.

seea.un.org/ecosystem-accounting

WHAT IS THE BLUE ECONOMY?

The World Bank's Blue Economy Program and PROBLUE are supporting integrated and sustainable economic development in healthy oceans. PROBLUE is an Umbrella Multi-Donor Trust Fund housed at the World Bank that supports healthy and productive oceans and the implementation of SDG14. Learn more at worldbank.org/en/programs/problue.



OCEAN FINANCE

OCEAN RESILIENCE AND THE BLUE ECONOMY

Coastal zone management, pollution reduction, marine spatial planning, and other active restoration programs may serve to diminish the negative decline and define a new, sustainable way forward.

by Peter Neill

When we talk about ocean resilience, we are talking essentially about capacity to heal and sustain ocean systems over time when interrupted by natural events such as extreme weather, flooding, and earthquakes that have throughout history damaged coastal areas and habitats, but have been able to recover through natural processes of restoration and sustainability. The challenge, as we have discussed so often is the intrusion of human activities such as nearshore development, agricultural run-off, industrial pollution, filling and dredging and port construction – all of which disturb the natural order of things and make significant, detrimental changes to the environment not easily renewed or repaired. Some observers estimate that over 40 percent of marine ecosystems – coral reefs, mangrove forests, rocky shorelines, and seagrass beds – have been severely impacted due to such land-based activities aggravated by relentless, illegal fishing.

How then can ecological resilience be sustained? And given the documented consequence on social resilience, how really can we expect to redress and progress out of a global situation that may now be beyond repair? An article by Dr. Anjani Ganase, an ecologist at the Institute of Marine Affairs in Tobago, suggests various tools with which to confront the challenge: coastal zone management, upstream pollution reduction and controls, marine spatial planning, and other active restoration programs, fisheries policies, re-purposing of fishers to aquaculture, and other good ideas that can help, even only to diminish the negative decline and deterioration and define a way forward that heals both the natural wounds as well as the community wounds that people in typically poor and undeveloped places have endured. Tourism has helped, at least in terms of employment and tax revenue, but impacts of beach-front construction, over-consumption of limited resources, crime, and health issues suggest a false economy.

Further, the financial forces may now be even more destructive and enduring than we fully understand. In June of 2021 the U.S. Bureau of Economic Analysis released its first official Marine Economy Account, a satellite analysis of U.S. Gross Domestic Product (GDP) which is the baseline data against which the American economy is measured, understood, and adjusted as necessary. The report indicates that the Blue Economy represents 1.9% or $397 billion, of current-dollar GDP in 2019, and grew at an annual rate of 4.2%, seriously increased over the 2014-2018 analyses. For the first time, the report looks at the marine economy by industry categories: offshore minerals, real estate, rental, and leasing; transportation, sight-seeing and ferries, ship-building, and warehousing; tourism, recreation, accommodation and food services, and national defense and public administration. The geographic scope includes the Atlantic, Pacific, and Arctic Oceans within the US Exclusive Economic Zone (up to 200 miles offshore), as well as marginal seas and other discrete ocean bodies within the U.S.

It is the scale of this enterprise that matters. The marine economy GDP is small in the context of the overall US economy, but it is enormous compared to that of a Caribbean island state. External economic factors create small variances, even to include the devastation of a major coastal hurricane, consequence that does not set the complete economy off-kilter with serious, but limited social effect, typically addressed by large federal funds and other resources to mediate and compensate for the damage. Such an event in Tobago, or Puerto Rico, results in a very different scenario: widespread physical destruction, destroyed services, disrupted employment, and little to no funds available to address social needs or the cost of restoration.

Resilience, then, is a personal matter, not a statistical report, but a set of circumstances measured by loss, the possibility of renewal, and the outcomes experienced on the ground and alongshore. That is no longer a hypothetical event, but a recurring one worldwide, where what we have done and to what we have done it, can no longer protect us from not just natural events, but man-made ones too.

Scale is also a measure of time. How much time do we have to take steps to plan and protect from the mistakes of our own making? How much time do we have with no significant national ocean policy in the United States to mitigate and change the structures and behaviors that have created the problem? How would it be if that 1.9% of Gross Domestic Product was lost? What would happen if all that value was lost to us in a global economy where ocean environments and financial connections, the maritime goods and services that are essential to our health and welfare every day, were no longer available? How resilient, then, would we be? How resilient, then, could we be?

BLUEprint
HOW THE OCEAN WILL SAVE CIVILIZATION

The *World Ocean Radio* "BLUEprint Series: How the Ocean Will Save Civilization" outlines a new and sustainable path forward, with the ocean leading the way.

Photo by Connor Olson

OCEAN FINANCE

ECONOMIC STRATEGIES AND REPORTING

REPORTING ON THE BLUE ECONOMY

Important associated reports that inform the global discussion of the Blue Economy

BLUE ECONOMIC STRATEGY PLAN
NOAA finalizes a strategy to enhance growth in the American Blue Economy

In January 2021 NOAA released its Blue Economy Strategic Plan for 2021-2025, laying out a roadmap for new ways to advance America's Blue Economy and enhance a global ocean economy offsite link expected to double in value to $3 trillion over the next decade.

NOAA's data, tools, and services that support coastal economies and their contribution to the national economy touch all aspects of American life. Approximately 127 million people, or 40% of the U.S. population, live in coastal counties. In 2018, the American Blue Economy supported 2.3 million jobs, and contributed approximately $373 billion to the nation's Gross Domestic Product through activities such as tourism and recreation, shipping and transportation, commercial and recreational fishing, power generation, research, and related goods and services.

The Strategic Plan focuses on five sectors that NOAA will advance through agency-wide initiatives: 1. marine transportation, 2. ocean exploration, 3. seafood competitiveness, 4. tourism and recreation, and 5. coastal resilience.

NOAA plans to further enhance these sectors by leveraging public-private partnerships, harnessing emerging technologies, and developing innovative STEM education and outreach efforts to train the next generation of Blue Economy leaders.

The 2021-2025 NOAA Blue Economy Strategic Plan aligns with several key agency initiatives, including implementing the National Ocean Policy of 2018, the 2018 National Strategic Plan for STEM Education, the 2019 Presidential Memorandum on Mapping the U.S. EEZ and Shoreline & Nearshore of Alaska, the 2020 National Strategy for Mapping, Exploring, & Characterizing the U.S. Exclusive Economic Zone, the 2020 Executive Order on Promoting Seafood Competitiveness and Economic Growth, the 2020 Federal Strategy for Addressing the Global Challenge of Marine Litter, and several NOAA conservation, science and technology, and mapping strategies.

noaa.gov/stories

IUCN: BLUE NATURAL CAPITAL FIANANCING FACILITY
Toward sustainable blue infrastructure finance: the need, opportunity and means to integrate Nature-based solutions into coastal resilience planning and investments

Infrastructure is key to economic and social development, yet often has negative environmental impacts. Coastal and marine life, in particular, is at risk to be damaged. Additionally, the global ocean economy is critically exposed to climate change. Nature-based solutions (NbS), anchored in and serving habitats such as mangroves, seagrasses and coral reefs, can help to make infrastructure investments better, more resilient and financially more attractive. In comparison, coastal infrastructure without NbS largely ignores benefits and services from nature and thus misses other economic opportunities and increases risk.

Redesigning infrastructure to achieve net-zero emissions and no-net biodiversity loss, and even increasing biodiversity (biodiversity net gain), is a critical challenge that requires new approaches, including in terms of finance.

Financial mechanisms are needed to support a paradigm shift away from infrastructure investments in sectors with unclear or negative impacts on nature ("grey finance") towards infrastructure investments that provide transport, clean water and energy as well as flood and erosion control, and protect and enhance natural habitats in coastal and marine areas ("blue finance"). New blended finance solutions integrating Blue Natural Capital can play a critical role for this transition. Such solutions can help de-risk blue infrastructure investments, while specifically attracting a suite of private actors, including impact investors. If successful, it will have broad ecological benefits and cascading effects on the coastal and marine systems on all levels.

Blue infrastructure finance can therefore help to generate positive impacts on coastal and marine ecosystems, alongside significant economic benefits.

Cost-Benefit-Analysis of resilient infrastructure is evolving, but research shows that the economic benefits of resilient infrastructure investments from reducing climate risks provide long-term returns far exceeding the cost of investment; as a recent World Bank study suggests, at a ratio of 5:1. When accounting for the multiple non-economic benefits of resilience approaches, as for instance the Global Ocean Accounts Partnership aims to do, returns will be even higher.

Full report at 4climate.com.

REVALUING ECOSYSTEMS: WORLD RESOURCES INSTITUTE
Pathways for scaling up the inclusion of ecosystem value in decision-making

Ecosystems provide essential services to society, from pollination and filtering of pollution to climate and water regulation. These services are often treated as though they have no value, with ecosystems too frequently managed for short-term gain at the expense of broader, longer-term societal benefits. Efforts to incorporate ecosystem values in decision making are growing – through partnerships, in government and in the private sector – but uptake is not happening quickly enough to stem current rates of ecosystem degradation and loss of these valuable benefits.

This issue brief explores six complementary pathways to scale up the inclusion of ecosystem values in public and private decision making, which grew out of a workshop on "The Future of Revaluing Ecosystems" hosted by The Rockefeller Foundation in Bellagio, Italy in November, 2013. The ideas explored include mainstreaming ecosystem values in national economic accounts; building capacity for more pragmatic ecosystem assessments; highlighting the benefits of investing in natural infrastructure; investing in ecosystems to reduce risk in the food and beverage sector; using bonds as financial tools to restore ecosystems in agricultural landscapes; and using knowledge and communication tools to promote more resilient communities, particularly after disasters. For each pathway, the World Resources Institute brief highlights the barriers, opportunities and what needs to happen to achieve a vision on this pathway by 2025, with the intention of promoting thought, discussion and action. Nature's assets are, after all, what all life depends on.

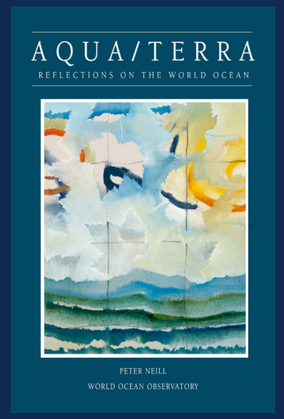
The goal of this "revaluing" effort is to promote longer-term thinking and create incentives to protect and restore ecosystems and ensure their sustainable use.

wri.org/research/revaluing-ecosystems

The W2O is pleased to be an Association Partner for the upcoming The Economist Group's World Ocean Summit Asia-Pacific. The summit will provide the platform for nuanced conversation and tailored discussion to catalyze the blue economy in the Asia-Pacific. We will support the December summit throughout this year by sharing event details, research, reports, and news.
Register free today at events.economist.com/world-ocean-summit-asia-pacific

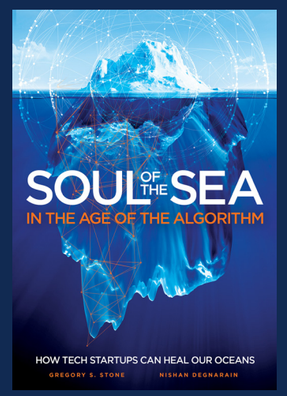
WORLD OCEAN PUBLICATIONS

World Ocean Observatory is proud to partner on a series of provocative publications about the ocean in association with Leete's Island Books. Four titles have been published to date with a fifth slated for spring 2022. Learn more at leetesislandbooks.com.

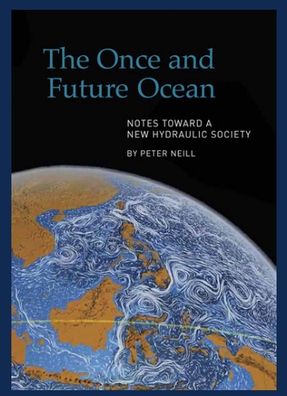


Aqua / Terra
Reflections on the World Ocean
by Peter Neill
180 pages. April, 2021
ISBN 978-0-918172-84-6

The New Fish Wave
How to Ignite the Seafood Industry
by Dr. Thor Sigfússon
144 pages. April 2020
ISBN 978-0-918172-78-5

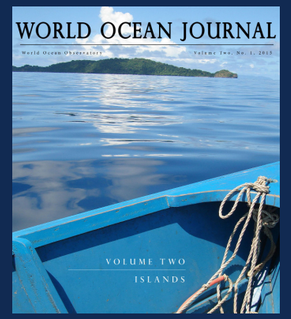


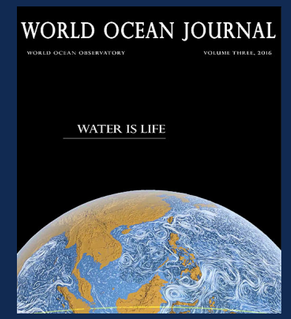
Soul of the Sea in the Age of the Algorithm
How Tech Startups Can Heal Our Oceans
by Gregory Stone and Nishan Degnarain
192 pages. June 2017
ISBN 978-0-918172-62-4

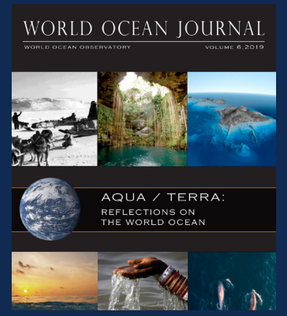


The Once and Future Ocean:
Notes Toward A New Hydraulic Society
by Peter Neill
398 Pages. April 2016
ISBN 9780918172563

ABOUT THE WORLD OCEAN JOURNAL







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WORLD OCEAN OBSERVATORY

Advocating for the ocean through education and science-based communications

World Ocean Radio

Five-minute audio essays on a wide range of ocean issues from science and education to advocacy and exemplary projects. Hosted by Peter Neill, World Ocean Radio is available for podcast, RSS feed, and syndicated use at no cost to college and community radio stations worlwide. *In mid-2021 we celebrated our 600th episode.*

World Ocean Forum

Fresh ideas, new solutions, provocative and imaginative conversations about the future of the ocean. WorldOceanForum.org offers an active platform dedicated to proposals for change in ocean policy and action worldwide, linking unexpected people with unexpected ideas, and offering a knowledgeable outlet for research, opinion and storytelling.

World Ocean Explorer

World Ocean Explorer is an educational gaming experience that will be free for use in the classroom and at home by ocean enthusiasts ages 10 and up. Inspired by the Next Gen Science Standards and the Ocean Literacy Curriculum, World Ocean Explorer is an immersive gaming experience designed to excite students about scientific ocean exploration and to promote ocean literacy worldwide.

Global Ocean Awareness Campaign

Building a global community of ocean advocates through programs and educational outreach, networks, special projects, a comprehensive Ocean Curriculum Catalog and educational website, and relentless social media. We're engaging, educating, and communicating important ocean issues and we're reaching ocean stewards, environmentalists, conservationists, scientists, engineers, and thoughtful citizens of the ocean around the globe. The sea connects all things.

Celebrating 18 Years in 2021

WORLD OCEAN Observatory™

The World Ocean Observatory (W2O) offers an innovative model for ocean communications, aggregating comprehensive ocean information, consolidating educational resources, promoting other organizations' programs and successes, amplifying the ocean message, and multiplying ocean engagement with an audience above and beyond that of any individual endeavor. We are a collective voice for many ocean voices, a central place of exchange of content and accomplishment, and the promoter of best practices, innovation, and effective connection to the global ocean community. Today we perform this task with energy, imagination, economy, and efficiency, reaching a significant audience worldwide through the free distribution of a full catalogue of ocean information. We do so at modest cost, with a conservative annual budget, and all programs funded by prescient donors and private foundations who understand our concept, see our results, and are committed to the future of the W2O.

The World Ocean Observatory is dedicated to advocating for the health and sustainability of the ocean through an accessible worldwide network of communication. Using various programs, creative collaborations and special projects, W2O is building an expansive global community of *Citizens of the Ocean*. Through education, partnership, information exchange, public connection and relentless communications, we promote ocean awareness to conserve marine resources for the future of all mankind.

www.worldoceanobservatory.org

CONTACT

Post Office Box 1

Sedgwick, Maine 04676 USA

director@thew2o.net | worldoceanobservatory.org

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