EARTH IS BLUE™

Volume 7 October 2021

ALONG FOR THE GLIDE

SAVING ICONIC REEFS

TREASURES OF THE BLUE

CHANGING SANCTUARIES

MAGAZINE OF THE

NATIONAL MARINE SANCTUARIES

Common octopus (*Octopus vulgaris*) make their dens in the hard-bottom rocks and ledges throughout Gray's Reef National Marine Sanctuary.

Photo: Greg McFall/NOAA

Photo: Ian Armor

FROM THE DIRECTOR

The choices we make today to protect the health of our blue planet will reverberate for decades to come. The talented women and men who work for NOAA's Office of National Marine Sanctuaries are dedicated to our mission because we want the American people to enjoy these special underwater places today, tomorrow, and for generations to come. Climate change and other human-caused impacts present an enormous challenge to that dream, giving all of us more reason to do what we can now to help solve these problems.

From the Quileute woman whose family depends on shellfish, to the fourth generation fisherman who watched the black sea bass move north to cooler waters, to the scuba guide who now teaches visitors about coral bleaching—climate change is affecting Indigenous people and the coastal communities and businesses that depend on critical resources that your national marine sanctuaries protect. This impact to the "Blue Economy" ripples throughout our sanctuary communities, and beyond.

Not only are national marine sanctuaries and marine national monuments affected by climate change, but they also have an important role to play in addressing the impacts. Most are real-time laboratories for climate change research, while others offer refugia—places where change is not happening as rapidly or where organisms appear particularly resilient to climate impacts.

The Biden Administration has communicated in Executive Order 14008 and the corresponding "Conserving and Restoring America the Beautiful" report that climate change and protecting our nation's land and water are of utmost importance. Sanctuary researchers are already taking important steps to understand which resources and habitats are most affected by climate change. This information will allow us to develop management plans that reflect these new challenges and prioritize future actions to protect our most vulnerable resources.

National marine sanctuaries are also an important interface between communities and the ocean, and between scientists and the public. These spectacular places in the ocean and Great Lakes, which are open to the public for responsible recreation and tourism, offer opportunities for our experts and educators to reach out to people and communicate the causes and effects of climate change. We are not taking this task on alone, however. Our partners across the National Marine Sanctuary System—fishing and diving captains, whale watch operators, museums and aquariums, tribal partners, etc.—are working with us to raise awareness of the threats facing natural and cultural resources in sanctuary and marine national monument waters.

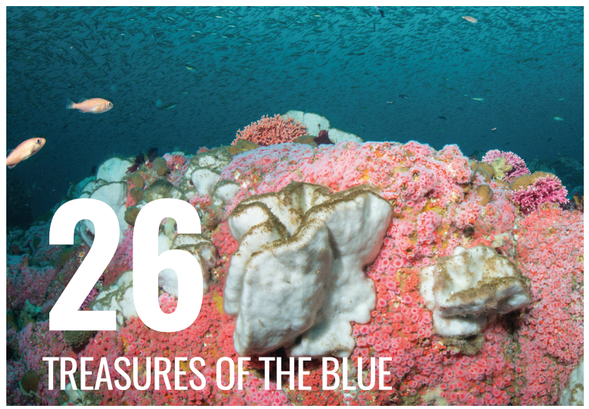
It is my hope that by prioritizing climate change research, scaling up our outreach efforts, and continuing to work collaboratively with other agencies and partners, we can minimize the impacts and begin to turn the tide.

John Armor, Director

NATIONAL MARINE SANCTUARIES

Cover: At "cleaning stations," herbivorous fish eat the algae growing on the carapaces (top shell) of sea turtles in Hawaiian Islands Humpback Whale National Marine Sanctuary. Photo: Matt McIntosh/NOAA

At right: John Armor snorkels in National Marine Sanctuary of American Samoa. Photo: David Ruck/NOAA



EARTH IS BLUE

OUR BLUE HERITAGE

From the ancestral environments and archaeological remains important for living native Hawaiian culture, to the “Ghost Fleet” in Maryland’s backyard, your National Marine Sanctuary System works diligently to protect our nation’s maritime heritage. While it is our job to protect these resources, it’s the people who are connected to them that keep the memories of ***Our Blue Heritage*** alive today.

The steel propeller of *Monohansett* sits upright on the limestone lake bottom of Lake Huron.

Photo: Nick Zachar/NOAA

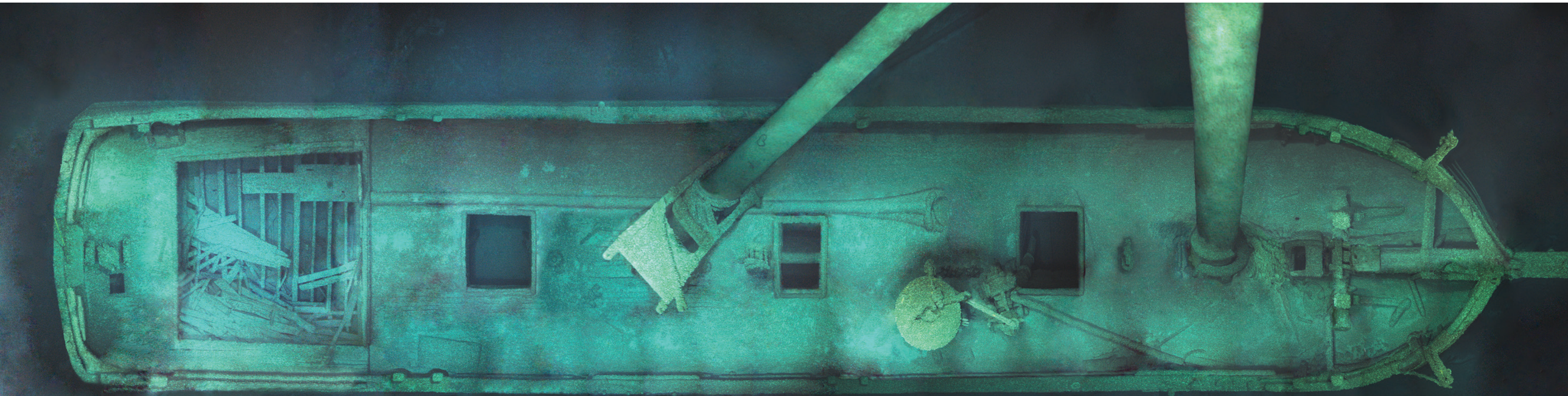
WELCOME A NEW SANCTUARY: WISCONSIN SHIPWRECK COAST

A 962-square mile area of Lake Michigan, named Wisconsin Shipwreck Coast National Marine Sanctuary, was designated by NOAA in August 2021 with support from diverse organizations and individuals at local, state, regional, and national levels. Co-managed with the state of Wisconsin, the sanctuary protects and celebrates the region's maritime cultural heritage while creating unique research, educational, recreational, and tourism opportunities. Spanning the 1800s through the early 20th century, the sanctuary's shipwrecks represent a cross-section of vessels that played an essential role in the growth of the nation.

"The sanctuary designation was driven by communities here in Wisconsin," said Russ Green, Great Lakes regional coordinator for NOAA's Office of National Marine Sanctuaries. "The sanctuary will help to promote heritage tourism and recreation on a national stage, and create impactful partnerships with cultural institutions, local and state tourism bureaus, conservation organizations, educators, and others."

(Right) The sanctuary brings opportunities for educational programming and community engagement. (Below) *Walter B. Allen* is a well-preserved, two-masted schooner within Wisconsin Shipwreck Coast National Marine Sanctuary.

Photo: (right) Matt McIntosh/NOAA; (below) Wisconsin Historical Society and Woods Hole Oceanographic Institute



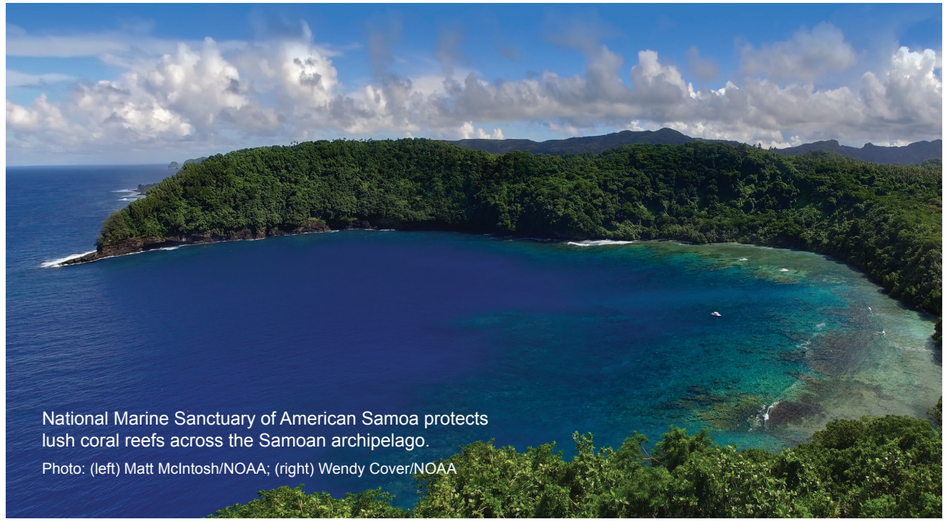
OUR BLUE HERITAGE

CULTURAL CONNECTIONS

In December 2020, Palau National Marine Sanctuary was officially recognized as a sister site to National Marine Sanctuary of American Samoa. This agreement opens the door for international collaboration through joint ocean exploration, marine protected area management, and education and outreach initiatives. Sister site partnerships enable sites with similar cultural or ecological foundations to work together to improve conservation, stewardship, and livelihoods across international boundaries.

Divers may come across cuttlefish during night dives in Palau National Marine Sanctuary.

Photo: Jesse Cancelmo/National Geographic Society



National Marine Sanctuary of American Samoa protects lush coral reefs across the Samoan archipelago.

Photo: (left) Matt McIntosh/NOAA; (right) Wendy Cover/NOAA

FOSTERING OCEAN STEWARDSHIP

Photo: Tara Roberts

STORIES FROM THE BLUE:

Jay V. Haigler

There are two types of people—scuba divers and those who are about to become scuba divers. Jay is the diving safety officer for the National Association of Black Scuba Divers Foundation's Scientific Diving Program, a board member and lead instructor with Diving With a Purpose, and a member of the International Leadership Team for the Slave Wrecks Project. As a D.C.-native, Jay cherishes the waters of the Chesapeake Bay and Potomac River. After years of documenting maritime heritage throughout the National Marine Sanctuary System, Jay advocated for the designation of Mallows Bay-Potomac River National Marine Sanctuary, and is now a member of the Sanctuary Advisory Council. He inspires youth to become stewards of the waterways around them. This is his Story from the Blue.

> "I am passionate about passing on the life-changing experience of scuba diving to the next generation."

(Left) Underwater archaeology allows a rich history to be shared for many generations. (Above) Students can learn about marine life in the sanctuary.

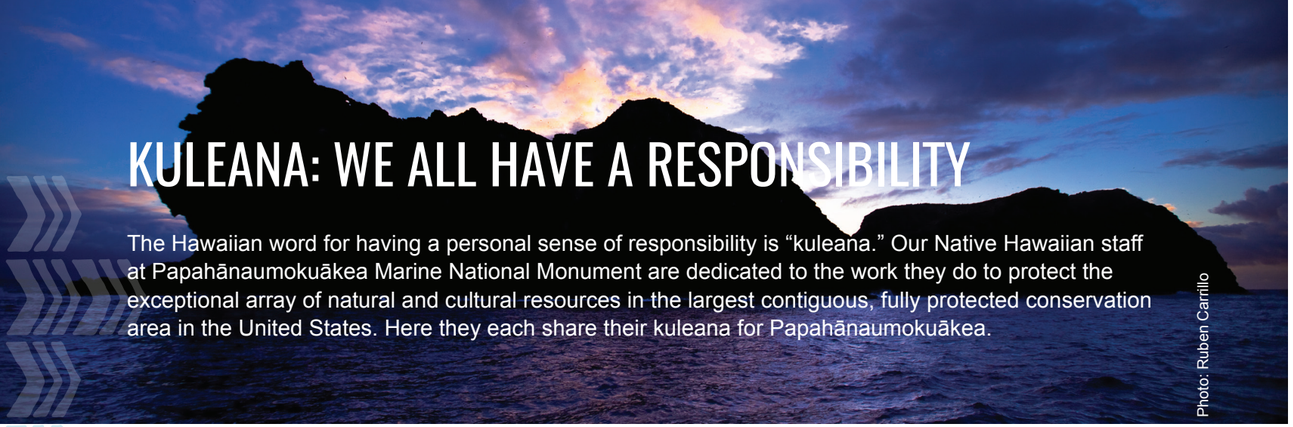
Photos: (left) Matthew Lawrence/NOAA; (above) Matt McIntosh/NOAA

Growing up, I spent a lot of time on the many rivers and tributaries that feed into the Atlantic Ocean in the Washington D.C. metropolitan area—such as the Potomac, Anacostia, and Rock Creek rivers, and Chesapeake Bay. My parents were both educators and would make time for the entire family to spend on these waterways, often turning our visits into a science project for my older brother and I. It wasn't until later in 2004, during my first experience in the Cayman Islands, that I knew I wanted to become a certified scuba diver. My wife and I took a PADI Discover Scuba class. Seeing so much aquatic life underwater, such as a big school of sergeant majors, and experiencing weightlessness for the first time was just amazing.

Now I have completed over a thousand dives as an instructor and diving safety officer with Diving With a Purpose, and I am passionate about passing on the life-changing experience of scuba diving to the next generation. With financial support from the National Marine Sanctuary Foundation, we started an Introduction to Scuba program in Charles County, Maryland with Henry E. Lackey and North Point high schools. The program gave these students an opportunity to take their first breath underwater. Seeing the "light bulb" go off for these students is what gets me up in the morning. It is a defining moment that opens them up to so many new possibilities.

Mallows Bay-Potomac River National Marine Sanctuary provides a tremendous opportunity to participate in and engage youth in the D.C. metro area in the aquatic environment. Diving With a Purpose's motto is "restoring our oceans, preserving our heritage," and while we are not doing any scuba diving with youth at the Mallows Bay sanctuary, we are teaching these young people that all waterways do lead to the ocean, and what they do to the environment here has a ripple effect throughout the aquatic environment elsewhere. We are also connecting them to the blue heritage protected by the sanctuary—the "Ghost Fleet"—as well as the rich cultural history around Mallows Bay.

It was truly an honor to witness the designation of Mallows Bay-Potomac River National Marine Sanctuary in 2019, because there hadn't been a new sanctuary designation in over 20 years. It was like seeing a new beginning in marine conservation happening in America, and I had a chance to be a part of that. I see my position on the Sanctuary Advisory Council as an opportunity to be an ambassador for my community; a BIPOC (Black, Indigenous, Person Of Color) representative; and to help cultivate a deeper connection to the sanctuary and all that it protects.



KULEANA: WE ALL HAVE A RESPONSIBILITY

The Hawaiian word for having a personal sense of responsibility is “kuleana.” Our Native Hawaiian staff at Papahānaumokuākea Marine National Monument are dedicated to the work they do to protect the exceptional array of natural and cultural resources in the largest contiguous, fully protected conservation area in the United States. Here they each share their kuleana for Papahānaumokuākea.

Photo: Ruben Carrillo

Jenny Crawford
Educator

My kuleana to my family, to my place, to my people, and to my culture has always been to learn from them, grow from them, always lend a hand when you can, make them proud, and then when your time pau (finished), make sure that you’ve had a hand in readying the future generation to stand in your place. I've been blessed with the opportunity to live and breathe my kuleana through Papahānaumokuākea.

Malia Kapuaonālani Evans
Educator and Native Hawaiian Outreach Associate

Deeply embedded within the Hawaiian worldview are generational values that uphold the familial relationships we maintain to the land, the ocean, the atmosphere, and the organisms around us. The value of mālama (to care for, protect, preserve) reinforces the kuleana I have to these elder family members that have continued to feed and sustain our lāhui (nation, people). Hawaiian knowledge systems endure, and are valuable, applicable, and guide the rewarding work I do on behalf of Papahānaumokuākea.

Kahi Fuji
Web/Graphic Designer

I knew that it was my kuleana to protect Papahānaumokuākea for future generations. In every facet of my work, I am able to create designs through a cultural lens by incorporating Hawaiian motifs and sensibilities.

Lucy Kaneshiro
Administrative Assistant

Within Papahānaumokuākea, I think of my place with an attitude of kōkua, how can I help someone? I invite new employees to meet with me to learn our oli and mele (chants and songs) that are used at meetings and community events. Helping people learn ‘ōlelo Hawai‘i (Hawaiian language) ensures that our staff are comfortable with annunciation of these Hawaiian words. This gives them confidence and connection to my home, my Hawai‘i.

Keolohilani H. Lopes Jr.
JIMAR/PMNM Field Logistics Technician

When I travel into Papahānaumokuākea, I take along my entire family and all of the people not able to make these journeys. I do my best to observe nature and absorb the power of the place, while walking with a light foot. This job takes me into what is arguably the most sacred place to Native Hawaiians, Papahānaumokuākea.

Moani Pai
Administrative Officer

Connection to place and knowing where you come from will guide you to where you're headed. In 2002, I felt this connection on a physical, spiritual, and cultural level while visiting all 10 islands and atolls of our kūpuna (elder) islands—a truly life changing experience. Since then, it has been 19 years that I have had the privilege of serving our lāhui (Native Hawaiian race) and protecting one of our most sacred wahi pana (legendary place), Papahānaumokuākea. I have the opportunity to work across many in the Native Hawaiian community to bring people to place.

Kalani Quiocho
Cultural Resources Coordinator, Pacific Islands Region

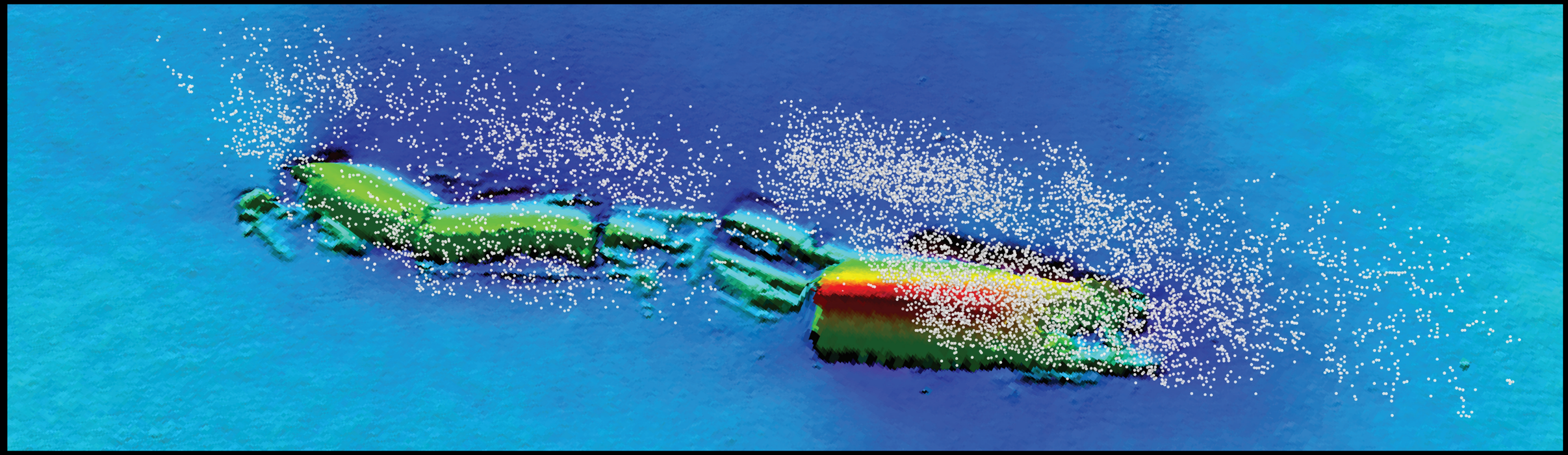
I believe that part of my kuleana is to make sure our management is always seeking to be pono or appropriate, correct, and deemed necessary by traditional standards in the Hawaiian culture for Native Hawaiians and all others. I also believe my kuleana is to make sure we are always looking back to look forward as the navigators did.

LIVING SHIPWRECKS

Through NOAA's new website, Living Shipwrecks 3D, you can explore the rich maritime history and diverse marine life of Monitor National Marine Sanctuary and the surrounding area. In a collaborative research project between the National Centers for Coastal Ocean Science and the sanctuary, scientists collected data from several WWII shipwrecks to better understand the significance of these wrecks as artificial reef habitat, and documented them for further archaeological examination. This accessible research honors the valor of the U.S. Merchant Marine and advances sanctuary goals to protect and explore marine ecosystems.

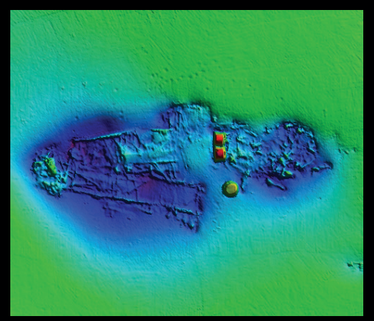
In the early hours of March 19, 1942, *W.E. Hutton* was struck by a torpedo. The wreck site sits off the Cape Lookout area near Beaufort, North Carolina.

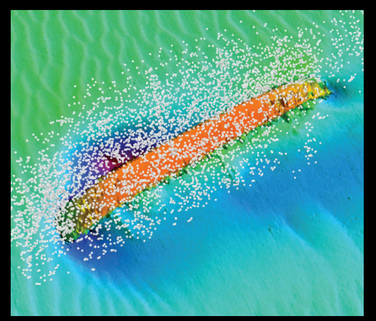
Photo: NOAA

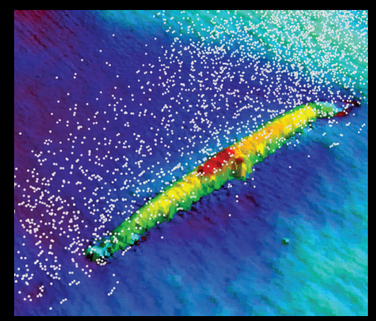


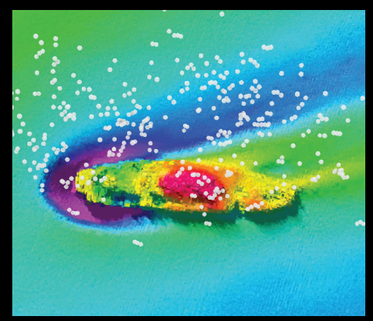
(Above) High resolution image of *W.E. Hutton*, and the fish living on it. Fish school extent is displayed via white dots. (Right) Data collected by visual and acoustic methods gives researchers detailed 3D imaging of the shipwrecks.

Images: NOAA









GET INTO THE BLUE

Water is a thread that connects us all, and your national marine sanctuaries are places for everyone to get outside and enjoy together. We balance the protection of marine ecosystems, maritime history, and cultures, with allowing responsible enjoyment and compatible resource use within sanctuaries. The majority of waters are open for sustainable recreation, including surfing, diving, snorkeling, kayaking, canoeing, sailing, fishing, tidepooling, visiting educational centers, and watching spectacular wildlife. What are you waiting for: ***Get into the Blue***!

Whale watching offers excellent educational opportunities for people of all ages.

Photo: Matt McIntosh/NOAA

RESPECT, PROTECT, ENJOY

National marine sanctuaries are some of the best places in the world to see wildlife. From birdwatching to whale watching, these special places have something for everyone. For the safety of wildlife, as well as your own, please follow the simple guidelines, created in coordination with NOAA Fisheries. Doing so will help set a positive example for others and keep wildlife and the habitats they depend on safe, healthy, and productive! Learn more and show your commitment to wildlife by taking the pledge for #WildSanctuaries at **sanctuaries.noaa.gov/wildlife-viewing.**

When you hang back and enjoy the view, you maximize your chances of seeing natural behaviors.

Photo: California State Parks

HANDS TO YOURSELF
Keep wildlife safe and healthy.

KEEP PETS HOME OR ON A LEASH
Wildlife and pets can harm each other.

REPORT WILDLIFE THAT SEEMS ABANDONED OR SICK
Leave it to the experts.

LEND A HAND WITH TRASH REMOVAL
Keep their home clean.

SNACKS TO YOURSELF
Wildlife can find their own food.

LEAD BY EXAMPLE
Help others become responsible wildlife watchers.

(Clockwise, from top) Follow these wildlife viewing guidelines; give sea turtles space when they lay on the beach; use binoculars to get a closer look; lend a hand with trash removal to protect marine life.

Photos: (clockwise, from top) NOAA; Nick Zachar/NOAA; Nick Zachar/NOAA; Leave No Trace Center for Outdoor Ethics

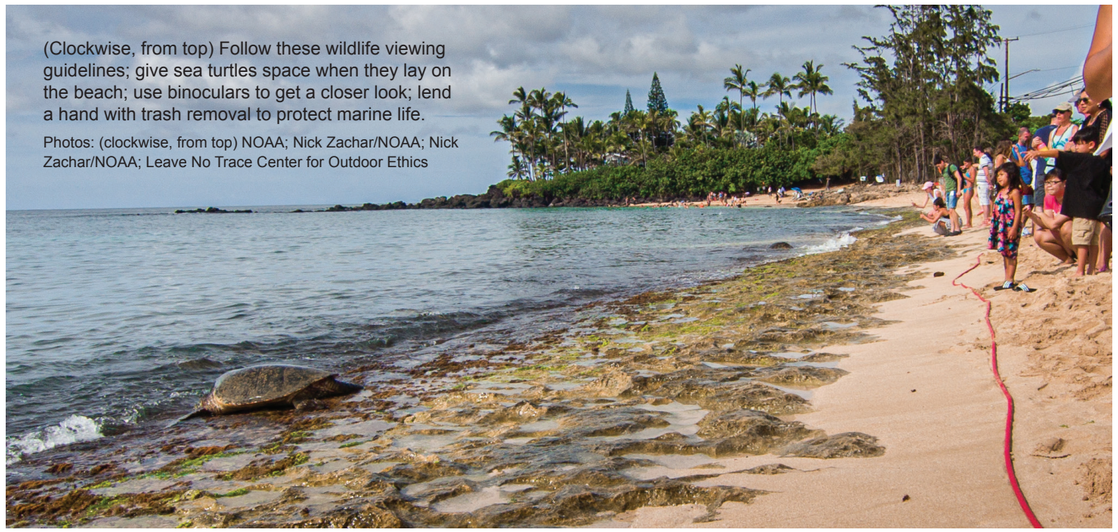


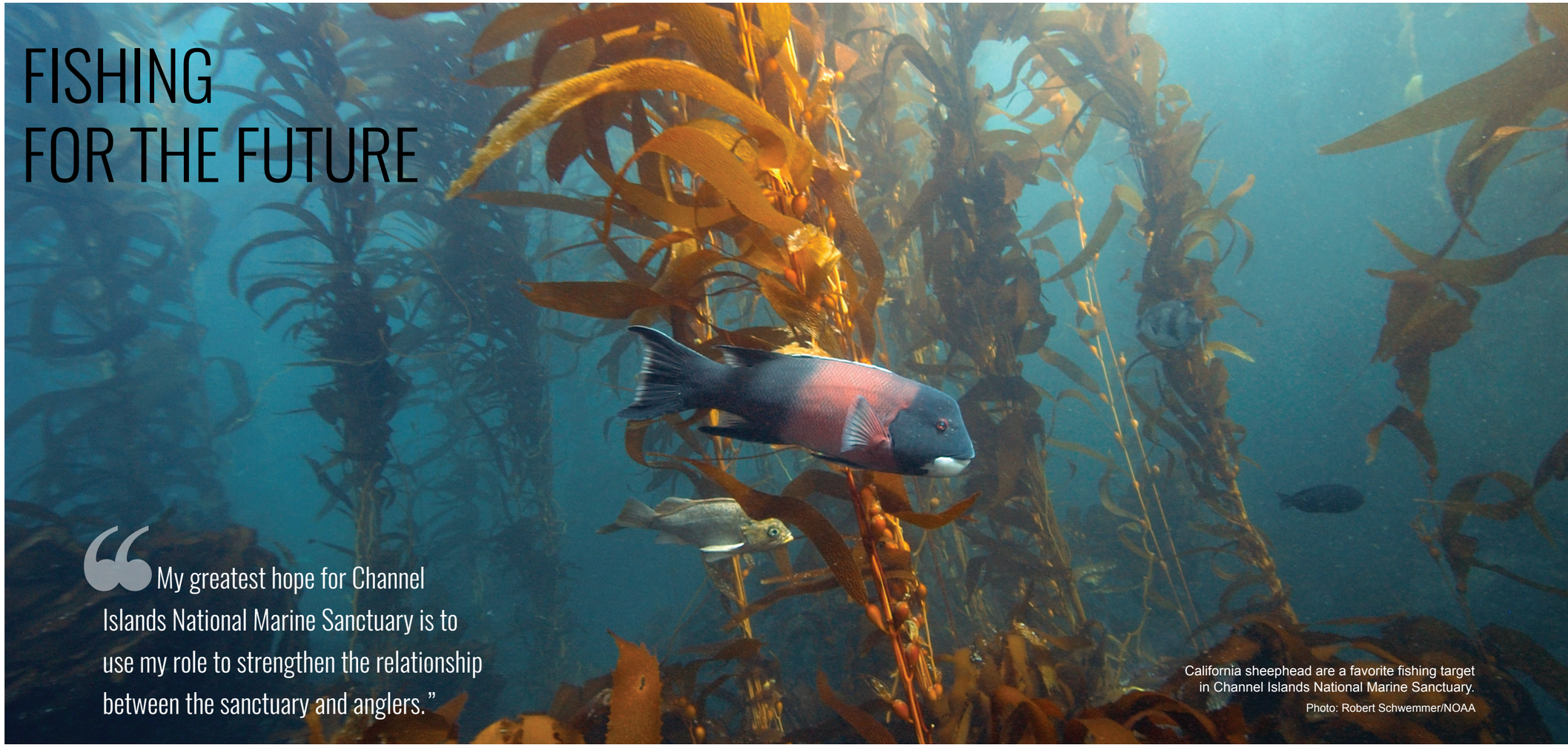
Photo: courtesy of Captain David Bacon

STORIES FROM THE BLUE:

Captain David Bacon

Captain David Bacon is the owner and operator of WaveWalker Charters and his family owns Hook Line and Sinker fishing tackle store. While working in the high tech industry, he came to Santa Barbara, California one day on a fishing trip, and decided to stay. He became a captain and has spent decades running a fishing charter boat in the Santa Barbara Channel and around the Channel Islands. "I was born and bred for fishing—been doing it all my life—fishing and hunting." This is his Story from the Blue.

FISHING FOR THE FUTURE



> "My greatest hope for Channel Islands National Marine Sanctuary is to use my role to strengthen the relationship between the sanctuary and anglers."

California sheephead are a favorite fishing target in Channel Islands National Marine Sanctuary.
Photo: Robert Schwemmer/NOAA

What makes Channel Islands National Marine Sanctuary truly unique for fishing is that we are positioned where the cold California Current comes down the coast from the Gulf of Alaska, and the warm Southern California Countercurrent comes up the coast. The western section of the Santa Barbara Channel, near the Channel Islands, is where it all mixes together. I've seen a lot of changes happen in these waters over the years. Giant sea bass were fairly abundant when I was a kid, and then one day they weren't—they were overfished. Now they are protected and are becoming more and more abundant. An entire generation of fishers had to give up fishing for them in order to make that happen and to do what it takes to help those stocks recover.

My role on the Channel Islands National Marine Sanctuary Advisory Council is to represent recreational anglers. We get the entire spectrum of anglers into our tackle store, which allows me to hear a range of perspectives. My position on the advisory council allows me to inform sanctuary staff about those perspectives. My job is to be a bridge between the sanctuary and the anglers, and much of that requires education both ways. A common misconception anglers have is that you can't go fishing in the sanctuary, but that couldn't be farther from the truth! I let people know that you can absolutely fish within the sanctuary, but you need to avoid fishing within the 11 marine reserves inside of the sanctuary which are marked on sanctuary maps. I also communicate these misconceptions to sanctuary managers so they can do a better job of informing anglers about where they can and cannot fish.

There are so many diverse perspectives around that table—government agencies and local people sitting down to talk and work towards common goals. The anglers want to help the sanctuary achieve its angler-friendly goals because they care about having access to healthy fisheries, and the sanctuary wants the advice of the anglers because they are the ones out there on the water every day.

My hope for the ocean is that we can make it healthier. The ocean is undergoing so many changes, and we need to consider how they might be affecting the fish populations, because ultimately I want healthy fisheries. My greatest hope for Channel Islands National Marine Sanctuary is to use my role to strengthen the relationship between the sanctuary and anglers, because I believe the more we work together, the more we can accomplish.

EMPOWERING BUSINESSES

Businesses located in and near sanctuary communities play important roles in the protection of marine resources by promoting sustainable use and responsible recreation and tourism, and helping to raise public awareness about research and conservation efforts. The Sanctuary System Business Advisory Council is an opportunity for us to engage with and empower businesses in the protection and management of marine resources and support opportunities for equitable access. The expertise and diverse perspectives of the Business Advisory Council will be essential as we continue to work to improve visitor experiences, expand and enhance our public-private partnerships, and generate interest in marine conservation and sustainable use.

MEMBERS OF THE BUSINESS ADVISORY COUNCIL

- Taishya Adams - Outdoor Afro
- Maite Arce - Hispanic Access Foundation
- Dave Bulthuis - Pure Fishing
- Elissa Foster - Patagonia, Inc.
- Marie Fukudome - Hyatt Hotels Corporation
- Taldi Harrison - Recreation Equipment Incorporated (REI)
- Greg Jacoski - Guy Harvey Ocean Foundation
- Greg Klassen - Twenty31 Consulting, Inc.
- Richard Loomis - Executive Strategic Advisor
- Betsy López-Wagner - López-Wagner Strategies
- Joost Ouendag - Viking River Cruises
- Martin Peters - Yamaha Marine Motors
- Sherry L. Rupert - American Indian Alaska Native Tourism Association (AIANTA)
- Jessica (Wahl) Turner - Outdoor Recreation Roundtable (ORR)
- Stephanie Vatalaro - Recreational Boating and Fishing Foundation

"So many of our nation’s coastal regions and marine parks have deep ties to Native American culture and heritage, and I look forward to working with NOAA to help elevate the voices of the native peoples connected to those coastal regions."
Sherry Rupert, CEO of the American Indian Alaska Native Tourism Association

Photo: Nick Zachar/NOAA

"A healthy ocean is vital for the wellbeing of people because it’s a key factor in areas like climate action, food security, livelihoods, biodiversity, recreation, and tourism."
Marie Fukudome, director of environmental affairs at Hyatt Hotels Corporation.

Photo: Matt McIntosh/NOAA

BEYOND ACCESS

— By KARLISA CALLWOOD
OUTDOOR AFRO

The first time I took a solo trip, it was to Channel Islands National Marine Sanctuary. As a single Black woman, travelling alone was never something I prioritized for myself. When I turned 30, I decided I would try a short solo trip. I just had to figure out where to go and what to do. Choosing an excursion to the Channel Islands was an easy decision. Although the outdoors has historically not been a welcoming space for people like me, the ocean has always been my safe space. Growing up in the Virgin Islands, some of my earliest memories include swimming long before I even knew how to walk. And as a marine scientist, I was comfortable being in water and very used to being the only Black person in certain spaces. I was aware of the Channel Islands and had been in awe of the natural history and geology. As an avid kayaker, I was excited at the opportunity to try sea cave kayaking at Santa Cruz Island.

As a volunteer leader with Outdoor Afro in Seattle and now in Miami, one of my personal missions has been to help other Black youth and families reconnect to the ocean and to the legacy of the Black Americans who stewarded it. Founded in 2009, Outdoor Afro is a national organization that celebrates and inspires Black connections and leadership in nature. Many of my events have focused on getting Black people to the water, through low-stake activities like low-tide beach walks and sailing, and more advanced activities like kayaking, standup paddleboarding, and whitewater rafting. For some of these participants, it is often their first time experiencing these activities in what feels like a safe space —surrounded by other Outdoor Afros—where they can build their confidence around and comfort level with the ocean. To encourage and support more Black people in water-based activities, Outdoor Afro created the Swimmership program that provides swim scholarships for Black youth and their caregivers to promote embracing water and swimming as a life-saving skill. More than 200 people have received "swimmerships" (swim scholarships) to begin new relationships with water.

Nature-based education and experiences in outdoor environments are beneficial to children and adults alike.

Photos: Karlisa Callwood

While it has always been difficult for Black people to find safe spaces in the outdoors, particularly near water due to systemic racism and segregation, places like the national marine sanctuaries have the opportunity to help change this narrative by continuing to emphasize the ocean's connection to us all. It's important to amplify the voices in the Black community who have found solace in these places, but it's also just as important to provide activities to reach these audiences while encouraging other users to prioritize access, quality, and belonging.

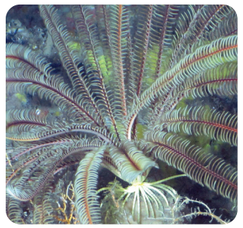
Outdoor Afro has become the nation's leading, cutting edge network that celebrates and inspires Black connections and leadership in nature. We are a national not-for-profit organization with leadership networks around the country. With more than 100 leaders in 33 states and 56 cities around the country, we connect thousands of people to nature-based experiences and are changing the face of who can help protect our waterways and wildlife. So come out in nature with us, or be a partner to help us grow our work so that we can help lead the way for outdoor recreation, nature, and stewardship. Learn more at outdoorafro.com

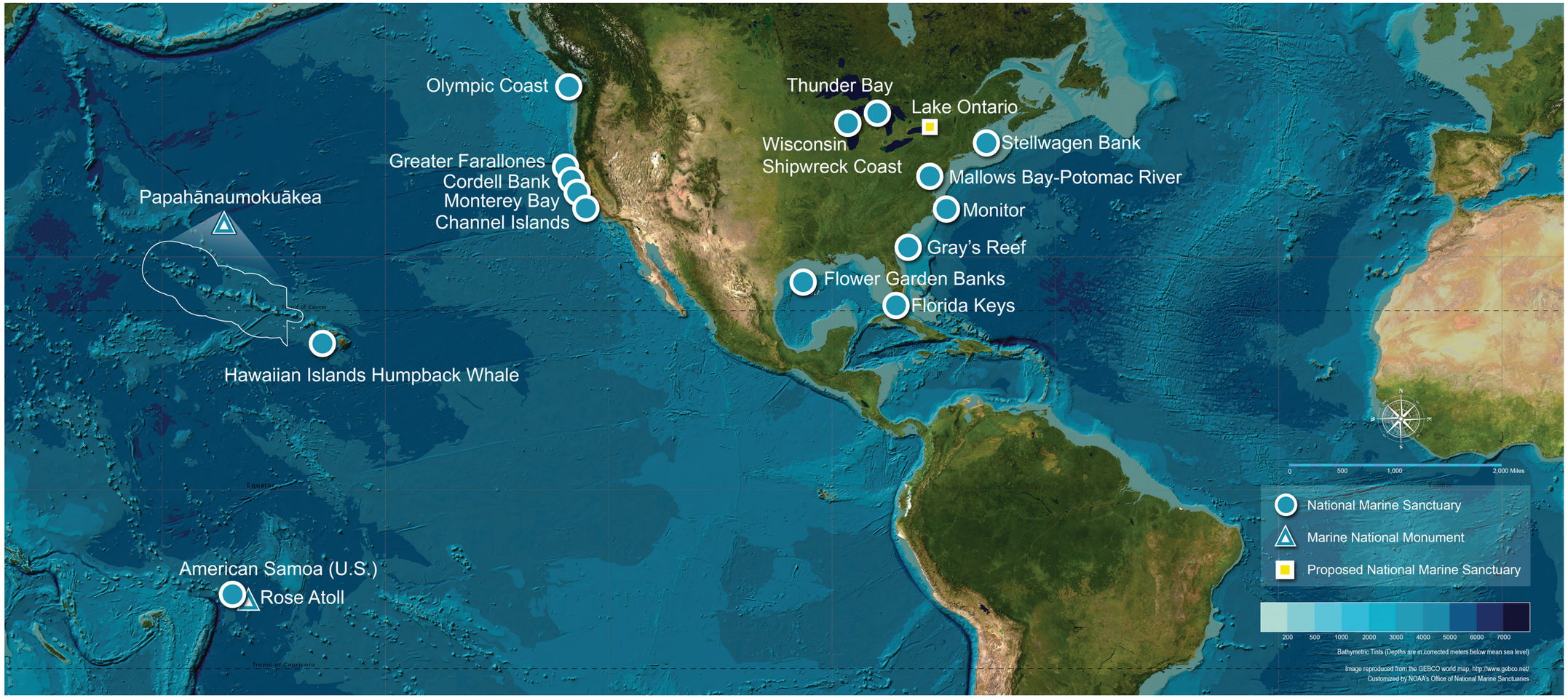
TREASURES OF THE BLUE

Which types of reefs exist throughout the sanctuary system, and what is the difference between a coral atoll and a coral barrier reef? How did a mountain form underwater, and what sort of wildlife can you find there? How do shipwrecks become a living part of the marine environment? Explore the ***Treasures of the Blue*** around the National Marine Sanctuary System to find the answers to these questions and more!







Photos (clockwise from bottom left): Ed Lyman/NOAA Fisheries Permit #782-1719; Marine Robotics & Remote Sensing, Duke University; Global Foundation for Ocean Exploration/NOAA; Jon Anderson; Greg McFall/NOAA; Matthew Lawrence/NOAA; Steven Gnam/NOAA; Robert Lee/Bay Area Underwater Explorers; Jessie Altstatt/NOAA

HABITAT FEATURE

THUNDER BAY

Sinkholes

Sinkholes are like a time capsule, taking us back to how Earth may have appeared billions of years ago. In the cold waters of Lake Huron, the limestone, dolomite, and gypsum rocks remind us that the area was once part of a saltwater sea. Over time, these rocks became underwater caves that eventually collapsed and formed sinkholes. The sinkholes in Thunder Bay National Marine Sanctuary host unique microbial communities, including some that use the sun's energy and some that rely on chemical processes to make their own food. Scientists are still uncovering how Earth went from a planet with very little oxygen to the habitable place we call home. Knowledge of modern-day microbial mats, such as those found in Lake Huron's sinkholes, could provide clues to how ancient microbes may have survived under extreme conditions of the early Earth. These organisms are thought to have evolved to use the sun's energy to make food and give off oxygen—leading to oxygenation of early Earth.

Photo: NOAA

Freshwater Shipwrecks

Preserved for centuries by Lake Michigan's cold freshwater, 36 historically significant shipwrecks are protected within Wisconsin Shipwreck Coast National Marine Sanctuary, co-managed by NOAA and the state of Wisconsin. Rising from the lake-bottom, freshwater shipwrecks can provide structure that attracts fish. Great Lakes fishers often target shipwrecks for this reason. Coho and Chinook salmon and steelhead and brown trout are popular game fish. Wisconsin's mid-Lake Michigan coast is home to a large sport fishing fleet.

Photo: Tamara Thomsen/Wisconsin Historical Society

WISCONSIN

HABITAT FEATURE

HABITAT FEATURE

MALLOWS BAY

Floating Forests

Nearly a century of natural processes have gradually transformed the wooden steamships in Mallows Bay-Potomac River National Marine Sanctuary. The ships were built between 1917-1919 as part of America's engagement in World War I, but the war ended before the ships could be deployed. Many were scuttled to the Potomac River for scrap, but when the shipbreaking efforts ended, over 100 ships still remained, and are now known as the "Ghost Fleet." The aged wood structure has provided a suitable place for vegetation to take root, and the overgrown wrecks now serve as a series of islands, intertidal habitats, and underwater structure for fish, beavers, ospreys, blue herons, and bald eagles.

Photo: Marine Robotics & Remote Sensing, Duke University

MONITOR

Shipwreck Reef

When a ship meets its fate at the bottom of the ocean, sometimes it becomes a benthic habitat. The Civil War ship *Monitor*, found within Monitor National Marine Sanctuary, and several World War I and World War II ships located on the seafloor near the sanctuary are the gravesites of the brave people who once fought and died there, and are also a living part of the marine environment. Shipwrecks cannot grow over time like a natural hard-bottom coral reef, but corals, anemones, sponges, tunicates, and other marine invertebrates colonize the surface of shipwrecks, therefore providing food, shelter, and breeding grounds for fish such as snapper, grouper, and sand tiger sharks.

Photo: NOAA

HABITAT FEATURE

HABITAT FEATURE

Coral Barrier Reef

Paralleling Southeast Florida, a few miles offshore, lies the only living coral barrier reef in the continental United States. Much of the reef tract occurs in a spur and groove formation (ridges and channels), with about 6,000 patch reefs scattered along inshore waters. Approximately 150 miles of Florida's Coral Reef lies within the waters of Florida Keys National Marine Sanctuary, which protects 45 species of hard coral, including seven federally protected species. The hard-bottom structure of the reef provides hiding holes and ledges for hundreds of species of fish and invertebrates, while the corals, sponges, and calcareous and fleshy algae that make up the living veneer of the reef provide both habitat and food. The future of this habitat is being preserved through a 20-year project called *Mission: Iconic Reefs*, one of the largest coral restoration efforts in history.

Photo: Jack Fishman

FLORIDA KEYS

Live-Bottom Reef

Not all reefs are formed through coral growth and the gradual accumulation of limestone layers over time. The term live-bottom reef refers to the myriad of invertebrates, such as sponges, corals, and sea squirts, that form a dense carpet of living creatures on hard-bottom areas such as the rocky outcrops in Gray's Reef National Marine Sanctuary. This reef structure was formed by the cementing and consolidation of marine and terrestrial sediments, which were originally deposited as a blanket of loose grains between six and two million years ago. This vibrant reef habitat is home to many fish and invertebrate species and is a place for loggerhead sea turtles to forage and rest.

Photo: Greg McFall/NOAA

GRAY'S REEF

HABITAT FEATURE

HABITAT FEATURE

OLYMPIC COAST

Kelp Forest

Kelp forests, like the ones found in the cold, nutrient-rich waters of Olympic Coast National Marine Sanctuary, harbor a greater variety and higher diversity of plants and animals than almost any other ocean community. Many organisms use the thick blades as a safe shelter for their young from predators or even rough storms. These underwater towers of kelp provide food, shelter, and protection for all kinds of marine life, including seals, sea lions, sea otters, invertebrates, fish, whales, birds, and more. Kelp forests also provide a variety of ecosystem services to humans and serve as habitat for a number of economically and ecologically important fish species.

Photo: © Florian Graner

CHANNEL ISLANDS

Eelgrass Meadow

Found in the shallow, sandy, coastal waters of temperate regions around the world, eelgrass meadows provide important ecosystem services and provide habitat for a broad array of fish and invertebrate species. Eelgrass is a type of seagrass—a flowering plant that grows underwater. Their roots provide stability and structure in an otherwise loose, sandy seafloor, help reduce coastal erosion, store carbon, and filter contaminants from runoff. Along the Southern California coast within Channel Islands National Marine Sanctuary, eelgrass meadows occur off of Anacapa, Santa Cruz, and Santa Rosa islands.

Photo: Jessie Altstatt/NOAA

HABITAT FEATURE

HABITAT FEATURE

Ocean Bank

An ocean bank, sometimes called a fishing bank, is an elevation of the seafloor on the continental shelf where the water becomes shallow. Cordell Bank National Marine Sanctuary protects Cordell Bank, located offshore just north of the Gulf of Farallones, measuring roughly 4.5 miles wide by 9.5 miles long. The bank was formed nearly 100 million years ago as part of the southern Sierra Nevada mountain range, and now supports a healthy benthic community of sessile invertebrates. Seasonal upwelling caused by the California Current brings in nutrient-rich water that fuels the food web from phytoplankton to fish, marine mammals, and seabirds.

Photo: Robert Lee/Bay Area Underwater Explorers

CORDELL BANK

FLOWER GARDEN BANKS

Mesophotic Reefs

Beginning around the depth limits of recreational scuba diving (130 feet), mesophotic ("twilight zone") habitats experience low light conditions that several light-dependent species have adapted to live in. From here, the mesophotic zone extends into even lower light areas, where we begin to see deeper mesophotic reefs full of black corals, soft corals, sponges, algae, and algal nodules. It is here that many new species discoveries have been made over the past few decades in the northwestern Gulf of Mexico. Researchers at Flower Garden Banks National Marine Sanctuary have also learned that these ecosystems serve as essential fish habitat for economically and ecologically important fish species.

Photo: Global Foundation for Ocean Exploration/NOAA

HABITAT FEATURE

HABITAT FEATURE

Tidal Estuary

Tidal estuaries occur along coastlines, often in areas where one or more bodies of freshwater flow into the ocean. The freshwater mixes with the salty seawater, creating brackish conditions. Estuaries such as Bolinas Lagoon, a 1,100 acre tidal estuary in Marin County, California in Greater Farallones National Marine Sanctuary, contains unique open water, mudflat, and marsh habitats that support a diverse population of terrestrial and aquatic flora and fauna. Invertebrates and juvenile fish seek refuge in the waters, while wading birds, such as herons and egrets, can be found foraging in the shallows and nesting nearby.

Photo: Nick Zachar/NOAA

GREATER FARALLONES

Salt Marsh

Tidal salt marshes, such as Elkhorn Slough in Monterey Bay National Marine Sanctuary and the surrounding Elkhorn Slough National Estuarine Research Reserve, are biologically rich places that provide habitat for resident and migratory birds, plants, marine mammals, and fish. The vegetation here naturally filters impurities from the water before entering the ocean, and also acts as a carbon sink by removing and storing greenhouse gases from the atmosphere. Elkhorn Slough is home to over 340 species of birds, as well as California sea otters and harbor seals. While it was historically a shallow freshwater marsh, this ecosystem has been altered by humans and as a result is invaded by the tidal flow of seawater—functioning more like a tidal salt marsh than a freshwater slough.

Photo: Jon Anderson

MONTEREY BAY

HABITAT FEATURE

HABITAT FEATURE

STELLWAGEN BANK

Underwater Plateau

Sand is not just great for building sand castles—it also serves as habitat for a myriad of benthic infauna (organisms that burrow)! Stellwagen Bank, an underwater plateau at the mouth of Massachusetts Bay, is made up of ancient bedrock covered by sand and gravel. The steep sides of the plateau cause tidal and deep-water currents to upwell (rise up), bringing nutrients and minerals from the bottom and enriching the ecosystem on the bank. Sand lance, a fish whose genus name *Ammodytes* means "sand burrower," are picky about the quality of the sand in which they make their home, preferring the type of sand found on Stellwagen Bank. The presence of sand lance attracts predators such as great shearwaters and humpback whales to the bank.

Photo: Matthew Lawrence/NOAA

HAWAIIAN ISLANDS

Open Ocean

The pelagic zone, also known as the “open ocean,” is the part of the ocean that exists away from coastal areas, and is home to many of the largest ocean animals. Thousands of humpback whales can be found in Hawaiian waters each winter. The largest concentrations may be found in the waters between the islands of Maui, Molokaʻi, Lānaʻi, and Kahoʻolawe, as well as the area known as Penguin Bank—a bank extending approximately 28 miles southwest of west Molokaʻi. Within the open ocean, microscopic plankton make up the base of the food web, the presence of which is influenced by large-scale oceanographic and atmospheric processes.

Photo: Ed Lyman/NOAA Fisheries Permit #782-1719

HABITAT FEATURE

HABITAT FEATURE

AMERICAN SAMOA

Seamount

Seamounts are underwater mountains formed through volcanic processes. Vailulu'u Seamount in National Marine Sanctuary of American Samoa is an active underwater volcano that was first discovered in 1975. Starting at a depth of 16,000 feet at the base and rising to about 2,000 feet beneath the surface, Vailulu'u Seamount is still growing and could eventually reach the surface. Benthic marine invertebrates such as sponges and octocorals attach to the bare volcanic rock, like this pillow lava, and the hydrothermal vents support unique communities of crabs, shrimp, isopods, and eels.

Photo: NOAA

PAPAHĀNAUMOKUĀKEA

Coral Atoll

Coral atolls form when corals grow in a ring around a high volcanic island in tropical and subtropical seas. Over the years, as the volcano erodes and sinks beneath the surface, a lagoon is formed in the middle and the corals continue to grow in a ring around the lagoon. Several coral atolls are found in the Northwestern Hawaiian Islands, including the Pearl and Hermes (Manawai), Midway (Kuaihelani), and Kure (Hōlanikū) atolls in the waters of Papahānaumokuākea Marine National Monument. Hawaiian atolls are a haven for reef fish, a feeding ground for pelagic fish and sharks, and also provide breeding and nesting grounds for monk seals and sea turtles.

Photo: Steven Gnam/NOAA

HABITAT FEATURE

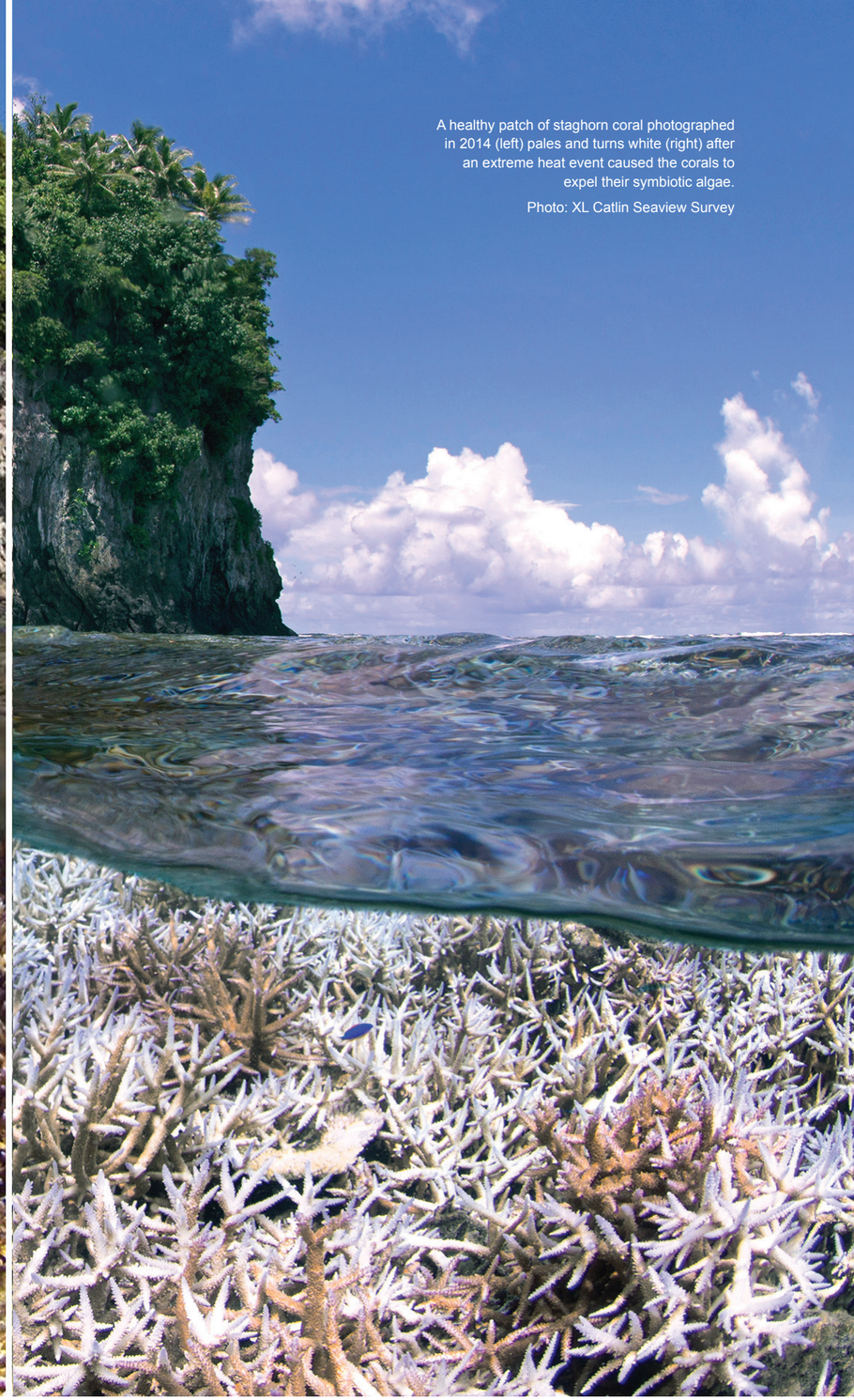
CHANGING SANCTUARIES

— By RACHEL PLUNKETT

All water on Earth is connected—in the ocean, lakes, rivers, streams, and glaciers—and changes to these water resources can have a major impact on people's lives. The ocean dominates Earth's surface. Just as the heart circulates blood and regulates the body's temperature, the ocean controls the circulation of heat and moisture throughout the climate system. When we burn fossil fuels, such as coal, oil, and natural gas, excess carbon dioxide is released into the atmosphere and builds up, acting like a heat-trapping blanket. This puts stress on the ocean, which damages its ability to regulate the climate system and maintain stability. National marine sanctuaries are marine protected areas in U.S. ocean and Great Lakes waters and are affected by the changes in Earth's energy and water cycles.

The impacts from human-caused climate change are happening now, and while we have a good understanding of what the large-scale effects of climate change are likely to be, there are differences in the rate and extent of change from place to place. Your national marine sanctuaries and marine national monuments, which are scattered across the United States, offer excellent opportunities to research and understand these changes and how the effects vary from place to place. As new information and insights are gathered, we will be able to respond adaptively to better manage sanctuary resources. In 2020, we published a new series, National Marine Sanctuary Climate Change Impacts Profiles, highlighting changes that are already occurring within the National Marine Sanctuary System, the threats these changes pose to habitats, wildlife, and cultural resources, and how these changes are projected to continue impacting sanctuaries and the people who depend on them.

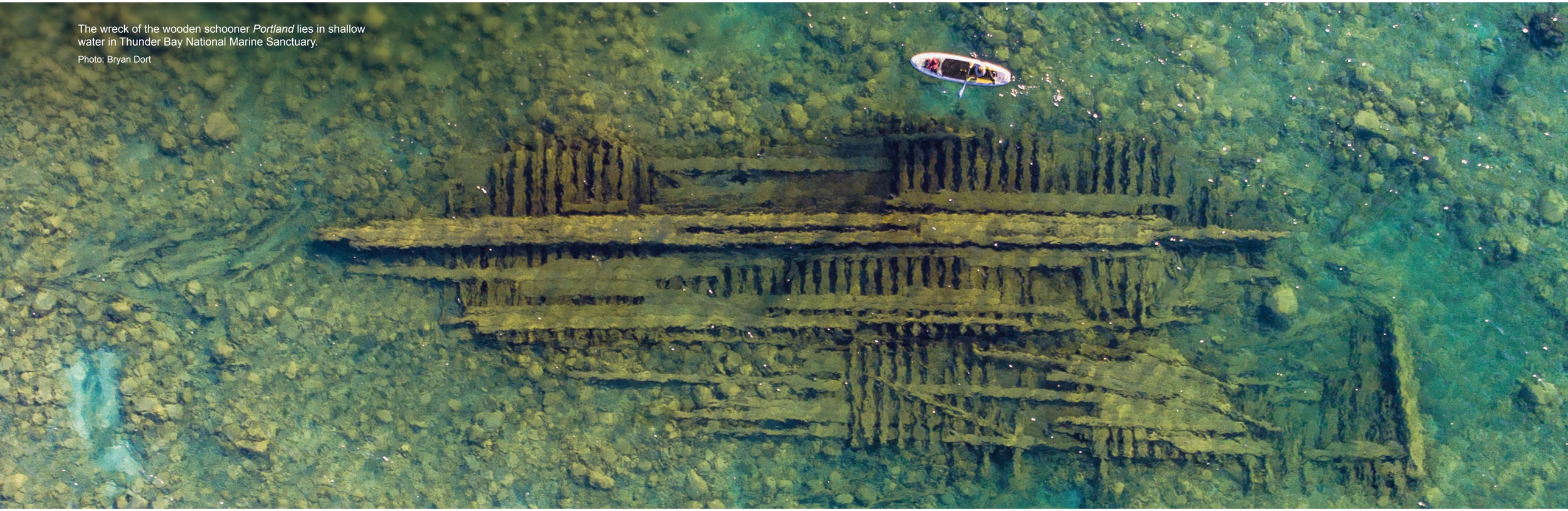
The living and nonliving resources in sanctuary waters are vulnerable to climate change impacts such as ocean acidification, rising water temperatures, and increasing storm intensity. These changes can affect wildlife, food webs, and the integrity of heritage resources. As average ocean temperatures rise worldwide, we are seeing more extreme temperature events in certain areas. Some species are more vulnerable to these changes than others. In Gray's Reef National Marine Sanctuary, researchers believe that continuing trends of increased ocean temperatures could cause red snapper to become more common in the sanctuary, while species like



A healthy patch of staghorn coral photographed in 2014 (left) pales and turns white (right) after an extreme heat event caused the corals to expel their symbiotic algae.

Photo: XL Catlin Seaview Survey

CLIMATE OF THE BLUE



The wreck of the wooden schooner *Portland* lies in shallow water in Thunder Bay National Marine Sanctuary.

Photo: Bryan Dort

black sea bass may become less abundant. But what about flora and fauna that can't swim, such as kelps and corals? These organisms in particular are greatly impacted by more frequent and intense ocean heatwaves. Intense heatwaves lead to reductions in kelp forests, while prolonged periods of extreme heat cause corals to expel the microscopic algae living inside their tissues—an event known as coral bleaching—which can eventually cause corals to starve. In both kelp forests and coral reefs throughout the National Marine Sanctuary System (and beyond), these changes are leading to a loss of biodiversity and ecosystem function.

The ocean absorbs much of the excess carbon dioxide in the atmosphere, changing the chemistry of the water. The change in chemistry increases the acidity of the water and reduces the concentration of carbonate, a compound needed for shellfish, corals, and some sponges to grow and strengthen their skeletal components; similar to how humans need calcium to build and strengthen bones. This is known as ocean acidification. At Cordell Bank National Marine Sanctuary, studies have shown that higher ocean acidity affects the reproductive success of krill, which are important primary consumers in the marine food web there. Increased ocean temperatures also have a negative impact on krill populations and other zooplankton, and these changes are partly responsible for mass mortalities of seabirds and marine mammals that have occurred along the entire West Coast in recent years. Sanctuary researchers are also concerned that sand lance, an important part of the food web in Stellwagen Bank National Marine Sanctuary, may be impacted by climate change. Sand lance are a pencil-sized forage fish and a favorite food of humpback whales, sharks, seals, seabirds, and other ocean predators. Researchers are studying how increasing temperatures and ocean acidification will impact the development and growth of sand lance, which could impact the ecology of sand lance predators.

These effects are not just limited to marine waters—freshwater bodies feel the wrath of climate change as well. In Thunder Bay National Marine Sanctuary, increasing acidity can cause corrosion on metal parts of shipwrecks. Additionally, weather patterns around the world are being altered by climate change. Changes to wind and evaporation impact rainfall, causing more frequent and prolonged droughts in some areas, and in turn more rainfall in other parts of the world. Droughts can lead to lower lake levels, which can cause shipwrecks in shallow water to be overexposed to the elements and degrade faster than normal.

America's national marine sanctuaries and monuments are recognized as "sentinel sites." The routine monitoring and coordinated environmental observations and applied science by government, tribal, academic, and citizen scientists taking place within sanctuary waters allows for investigation of changing ecosystem resources and conditions over time. Each sanctuary faces a unique suite of threats that present challenges to resource management. The work being done within each of these sentinel sites provides early warning capabilities, allowing us to respond more quickly and efficiently than would be possible in other locations.

For example, Olympic Coast National Marine Sanctuary was designated as a sentinel site for ocean acidification in late 2019 in response to growing concern over the potential impacts of ocean acidification to marine ecosystems and local economies. Coordinated monitoring, research, outreach, and public engagement efforts have catalyzed the interest and

involvement of partners to work together to collectively address the increasing threat of ocean acidification in Washington's outer coastal waters.

Elsewhere, Papahānaumokuākea Marine National Monument and Greater Farallones National Marine Sanctuary are participants in NOAA's Sentinel Site Program through Cooperative Management Teams and are focused on sea level rise. There are other special projects to monitor ocean acidification in sanctuaries, such as Cheeca Rocks Reef (data buoy MPACO2) in Florida Keys National Marine Sanctuary and the ocean acidification studies taking place in National Marine Sanctuary of American Samoa.

In addition to conducting research on climate change within sanctuary waters, our staff are also working to educate the public through programs and outreach products across the National Marine Sanctuary System. Communicating about climate change is important to increase the general public's understanding of the many threats and changing conditions within each sanctuary and monument, and throughout the water bodies that connect the sanctuary system. Docents from sanctuary visitor centers and partner institutions use NOAA's innovative Science on a Sphere® to communicate the global and local impacts of climate change in a way that is engaging, informative, and fun.

Individual sanctuary sites have their own unique programs as well. National Marine Sanctuary of American Samoa incorporates climate change messaging into their outreach to local communities through initiatives such as the Sanctuary Summer Science in the Village program and is developing a community-facing web portal with information about the local impacts of climate change. At Stellwagen Bank National Marine Sanctuary, staff work with whale watch naturalists to help them communicate climate change information to the over 500,000 people each year who go on whale watch tours.

(Left) Shearwaters and other seabirds may be affected by the impacts of climate change on their prey. (Right) Gooseneck barnacles and other shellfish are susceptible to ocean acidification.

Photos: (left) Peter Flood; (right) Elizabeth Weinberg/NOAA

We hope that learning a bit more about the work our staff and partners have been doing (and will continue to do) throughout the National Marine Sanctuary System gives you reason for hope. As a team of scientists, policy experts, educators, and communicators who are dedicated to studying, protecting, and promoting the natural and cultural resources within your national marine sanctuaries and marine national monuments, we do what we do because we have hope for the future—and you should too! There's so much you can do to help out with these efforts, from volunteering your time as a citizen scientist, to perfecting your climate change communication skills. After all, caring for our ocean is not any one person's responsibility, it is a community effort.

As coral reef health declines, government agencies and partners are coming together to take bold action to restore coral populations.

Photos: XL Catlin Seaview Survey

CLIMATE OF THE BLUE

LIFE IN THE BLUE

National marine sanctuaries and marine national monuments protect vital habitats that support a variety of wildlife. From mangroves, seagrasses, salt marshes, and kelp forests, to our fragile coral reefs—shallow and deep—the work we do is all about protecting ***Life in the Blue***.

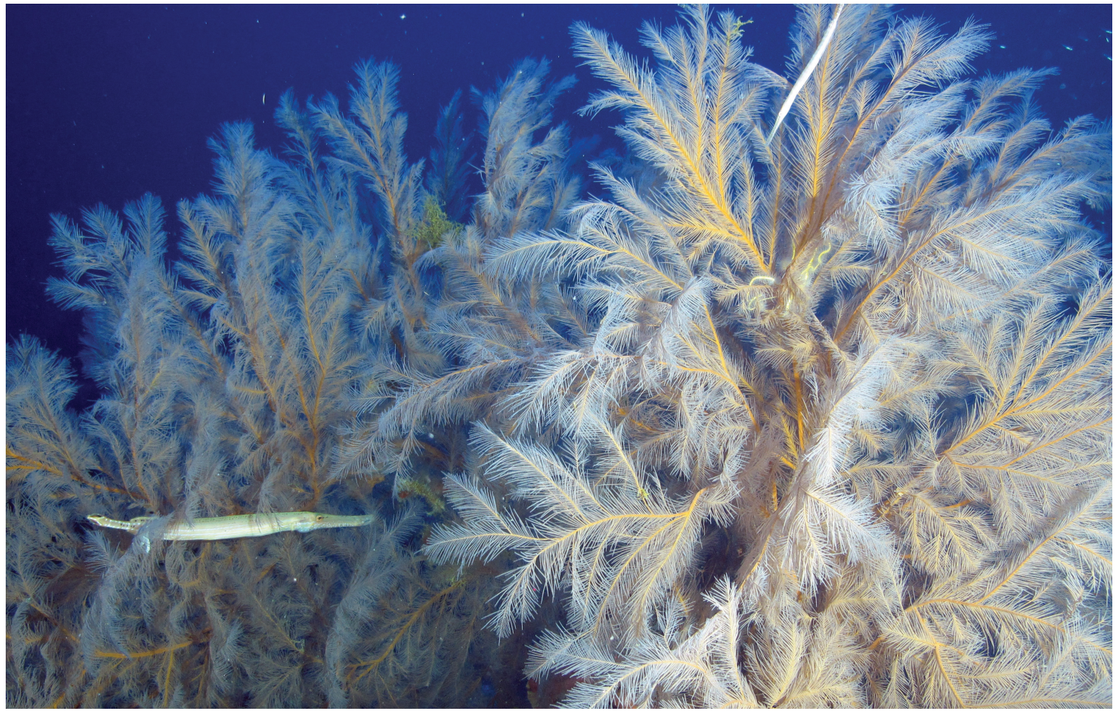
Anemones and other invertebrates can be found on rocky surfaces surrounded by kelp in sanctuaries along the West Coast.

Photo: Paul Chetirkin/NOAA

PROTECTING GULF HABITATS

Expanded by 104 square miles, the new Flower Garden Banks National Marine Sanctuary boundary protects commercially and recreationally important fish and threatened or endangered species while promoting the exploration and preservation of additional reef habitats and species. The newly protected areas are widely recognized as marine biodiversity hotspots that provide critical ecosystem services for the Gulf of Mexico region, but are vulnerable to changing ocean and climatic conditions. The expansion recognizes the interconnectedness of the northwestern Gulf of Mexico's ecosystems and will help support sustainable economies in the region.

Basalt blocks at Alderdice Bank are covered in octocorals, encrusting sponges, and algae.
Photo: Global Foundation for Ocean Exploration/NOAA



(Top) A trumpetfish swims among soft coral at Geyer Bank.
(Bottom) Several reef fish swim among algal nodules at Bouma Bank.
Photos: Global Foundation for Ocean Exploration/NOAA

STORIES FROM THE BLUE:

Sarah Fangman

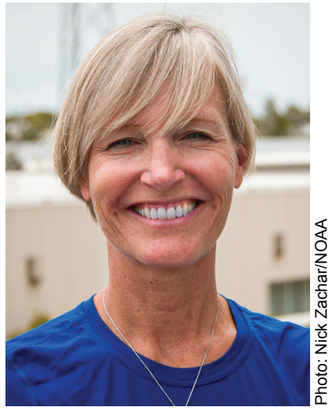


Photo: Nick Zachar/NOAA

As someone who has spent most of her life trying to protect the ocean, Sarah Fangman stepped up as superintendent of Florida Keys National Marine Sanctuary because she saw it as a challenging opportunity to make a difference. Drawing upon her experiences and accomplishments at Channel Islands and Gray's Reef national marine sanctuaries, Sarah works with a range of partners to protect and restore the only barrier coral reef in the continental United States. This is her Story from the Blue.

I remember when I first discovered my love for the ocean. Growing up in Minnesota, my family escaped the winter one year to Grand Cayman where I spent the entire trip with a mask on my face looking at the amazing life underwater. I was captivated.

While in graduate school, I met the superintendent of Channel Islands National Marine Sanctuary and was exposed to how scientific research can be used to inform the management of marine natural resources, so they can be enjoyed and utilized into the future. I served as the research coordinator at the Channel Islands sanctuary for eight years. What I saw during my time in California taught me that when everyone comes together, we can make meaningful progress in marine conservation. I continue to reference the lessons learned from the Channel Islands reserve processes as we consider how to address issues here in the Keys.

I then moved to the East Coast, working collaboratively with Grays Reef, Florida Keys, and Flower Garden Banks national marine sanctuaries for our regional office. Afterwards, I became the superintendent of Gray's Reef National Marine Sanctuary, which protects uniquely pristine habitats off the coast of Georgia. My career then took me down to the Florida Keys, which has many beautiful marine habitats, including coral reefs, seagrass meadows, and mangrove-fringed islands. We are in a critical time, and the choices we make now will make a difference for the future of this sanctuary.

I believe that a key to successful sanctuary management is being a good listener—taking the time to hear the suggestions made by local stakeholders who are intimately familiar with the marine resources we're protecting. Our Sanctuary Advisory Council is composed of community members who work together to provide ideas and suggestions to the sanctuary and identify solutions. Over the past few years, we launched a boater education program, a Blue Star Fishing business recognition program, and *Mission: Iconic Reefs*, all which would not be possible without the help of our community and partners! We were also excited to launch a new Restoration Blueprint for the Florida Keys, after extensive input from community members, partners, and federal and state agencies.

We have a lot of work to do in order to return the ecosystem to a sustainable state. My hope is that our community can come together to ensure a brighter future for our marine environment. I hope that when we look back 20 to 30 years from now, the Florida Keys will be an inspiring example of how to work collaboratively on a local and national level to restore a marine ecosystem.

Pillar coral is a threatened stony coral species that grows in colonies with large spires.

Photo: Nick Zachar/NOAA

STORING BLUE CARBON

Blue carbon habitats, such as mangroves, seagrasses, salt marshes, and kelp forests, are coastal ecosystems that pull carbon out of the atmosphere and store it in vegetation and soil, sometimes for hundreds or thousands of years. These habitats play an important role in the fight against climate change, storing more carbon per area than land-based forests. Blue carbon ecosystems also provide a host of other benefits, serving as vital habitat for wildlife, providing coastal protection against storms and flooding, and helping to filter pollutants and other contaminants before they reach our waterways and ocean.

Many blue carbon habitats have been degraded or destroyed in the past century. Protecting and restoring large and continuous areas of these vital habitats ensures they will be around for decades to come.

Photo: (left) Paul Chetirkin/NOAA; (right) David Ruck/NOAA

LIFE IN THE BLUE

The leatherback sea turtle is the only sea turtle species that lacks a hard shell. Special projections, called “papillae,” in their mouths and esophagus aid in the digestion of sea jellies.

Photos: Douglas Croft

GOING THE DISTANCE

The leatherback sea turtle—the oldest and largest marine turtle on the planet—is an endangered species. There are several distinct leatherback populations throughout the world, and these animals make long migrations, often across ocean basins. Some Pacific leatherback populations have declined by over 90% since the 1980s. This unique species is often found in the coastal California waters of Monterey Bay National Marine Sanctuary, but some individuals also pass through Hawaiian Islands Humpback Whale National Marine Sanctuary as they endure a lengthy migration of about 7,000 miles to the Indonesian coast to mate and lay eggs. The United States engages in several international partnerships and agreements to enhance leatherback sea turtle conservation. Additionally NOAA Fisheries and the U.S. Fish and Wildlife Service listed the Pacific leatherback under the “Species in the Spotlight” initiative, emphasizing five priority actions to aid in population recovery for 2021–2025. You can do your part to help leatherbacks and other sea turtles by reducing your use of single-use plastics and supporting sustainable seafood and aquaculture practices.

EXPLORE THE BLUE

There's still so much to learn about the wildlife and ecosystem processes in the ocean and Great Lakes. Exploring sunlit waters, the twilight zone, and deep-sea habitats has led to several new species discoveries, and eavesdropping on whales has revealed new insights that could help us take steps to reduce threats to marine mammals, like ship strikes and entanglement. Discover how technology and partnerships help us ***Explore the Blue***!

Applied California Current Ecosystem Studies (ACCESS) research cruises help scientists understand how ocean conditions influence the dynamic ocean food chain.

Photo: Shelley Gordon

FOSTERING THE NEXT MARINE RESEARCHERS

Created in honor of the late Dr. Nancy Foster, former director of NOAA's National Ocean Service, the Dr. Nancy Foster Scholarship provides an opportunity for graduate students, especially women and minorities, to complete marine-related degrees that support research in NOAA's national marine sanctuaries. NOAA and the National Marine Sanctuary System facilitate field experience and skill building for scholars, helping them pave the way for their future careers. By supporting a diverse array of students, the Dr. Nancy Foster Scholarship helps students overcome barriers to higher education and creates long-lasting ambassadors of science and NOAA. Over the last 20 years, the 79 students who have been awarded this prestigious scholarship have had the opportunity to collaborate and connect with NOAA staff as they develop their careers.

Scholars had a chance to participate in planting staghorn coral onto a damaged reef in Florida Keys National Marine Sanctuary during orientation.

Photo: Nick Zachar/NOAA

Right (from top to bottom): Carina Fish observes a specimen; scholars pose for a photo during the orientation at Thunder Bay National Marine Sanctuary; Lindsay Marks investigates *Sargassum horneri* in Channel Islands National Marine Sanctuary.

Photos: (right, from top to bottom) Nick Zachar/NOAA; Dayna McLaughlin/NOAA; © Tom Boyd

Emily Aiken helped conduct water quality monitoring at the Keawanui Fishpond on Moloka'i in Hawai'i.

Photo: David Ruck/NOAA

OUTSIDE OF THE COMFORT ZONE

> “I truly believe my experiences in Dr. Brugler’s lab and out at sea in Flower Garden Banks National Marine Sanctuary provided me with a robust education and confidence...”

(Above) The newly discovered black coral, *Distichopathes hickersonae*, was found at 172 meters depth. (Left) After collecting the specimen with the ROV *Mohawk*, Nadia Alomari and Dr. Mercer Brugler displayed the sample.

Photos: (above) NOAA/UNCW-UVP; (left) G.P. Schmahl/NOAA

EXPLORE THE BLUE

STORIES FROM THE BLUE:

Nadia Alomari

Photo: Rachel Sellers

Nadia Alomari grew up in Brooklyn, New York with her mother, father, and six siblings. With little prior experience in the water, she never really expected to explore the ocean. It wasn’t until one fateful day as a biomedical informatics student at the NYC College of Technology that the alluring world of oceanographic research was introduced to her. Alomari seized an opportunity as a research assistant in Dr. Mercer Brugler’s Black Coral Lab and participated in an expedition aboard the Research Vessel (R/V) Manta *in Flower Garden Banks National Marine Sanctuary in 2017. It was an experience filled with adventure and discovery that will live with her forever, having taught her to appreciate the incredible biodiversity within the ocean. This is her Story from the Blue.*

When I boarded the plane, I was so excited knowing that I was just hours away from an experience many only dream of. When I first walked aboard the R/V *Manta*, my heart sank and I felt a rush of emotions. I was excited to learn from some of the top scientists in the field, however, I wondered, “what would happen if the boat sank?” I worried about my son and how inaccessible I would be if he did need me. It was the first time in 12 years that I was going to be away from him. Fortunately, I did not stay nervous for long, because on a research vessel there is always work to be done.

Every day I performed a different task—from deploying the ROV *Mohawk*, to capturing high resolution imagery of the marine life we encountered, and even operating the ROV and collecting samples. One of my favorite memories was having a chance to see dolphins in their natural habitat! It was an incredible moment that reminded me of my childhood when my father used to take me to the Bronx Zoo every other weekend to see the dolphin and seal shows. And then there was the big discovery—the moment that defined the expedition for me—the moment we realized that the sample we just collected was actually a new species of black coral!

This year I began a new journey in the master’s physician’s assistant (PA) program at SUNY Downstate. I never knew I had a passion for research before, and I truly believe my experiences in Dr. Brugler’s lab and out at sea in Flower Garden Banks National Marine Sanctuary provided me with a robust education and confidence that led to my acceptance into the PA program.

I was thrilled to hear the news that the sanctuary has been expanded, and that some of the incredible habitats and wildlife I had a chance to see during that expedition are now being protected. I no longer view the ocean as this scary and dark place—my experience at Flower Garden Banks has taught me otherwise. So much of what exists in the ocean has yet to be uncovered, and research being conducted by sanctuary staff and partners is bridging the gap between the known and the unknown.

PARTNERING FOR HEALTHY MARINE ECOSYSTEMS

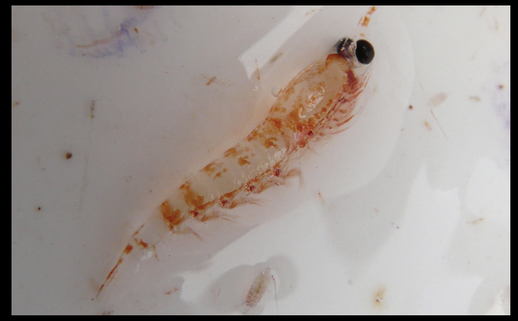
The Applied California Current Ecosystem Studies (ACCESS) project is a long-term research and monitoring collaboration between Cordell Bank National Marine Sanctuary, Greater Farallones National Marine Sanctuary, and Point Blue Conservation Science. Scientists measure the physical and chemical conditions in the ocean, the availability of prey such as krill and other zooplankton, and the abundance and distribution of predators, such as seabirds and whales. Information from this project enables sanctuaries to examine coastal and open-sea ecosystem health, contributing to a better understanding of ecosystem patterns and changes. NOAA and other agencies use the project data to protect resources in the sanctuaries, by addressing whale entanglement, ship strikes, climate change impacts, and more.

(Top) Researchers deploy water sampling devices to measure water conductivity and temperature change with depth; (bottom, left) tiny krill make up an important part of the food chain in Greater Farallones and Cordell Bank national marine sanctuaries; (bottom, right) the size and abundance of krill can tell researchers a lot about the health of an ecosystem.

Photos: (top) Jenny Woodman; (bottom, left) Dru Devlin; (bottom, right) Dru Devlin

ACCESS research cruises are conducted aboard the R/V *Fulmar* and other NOAA ships.

Photo: Jenny Hartigan

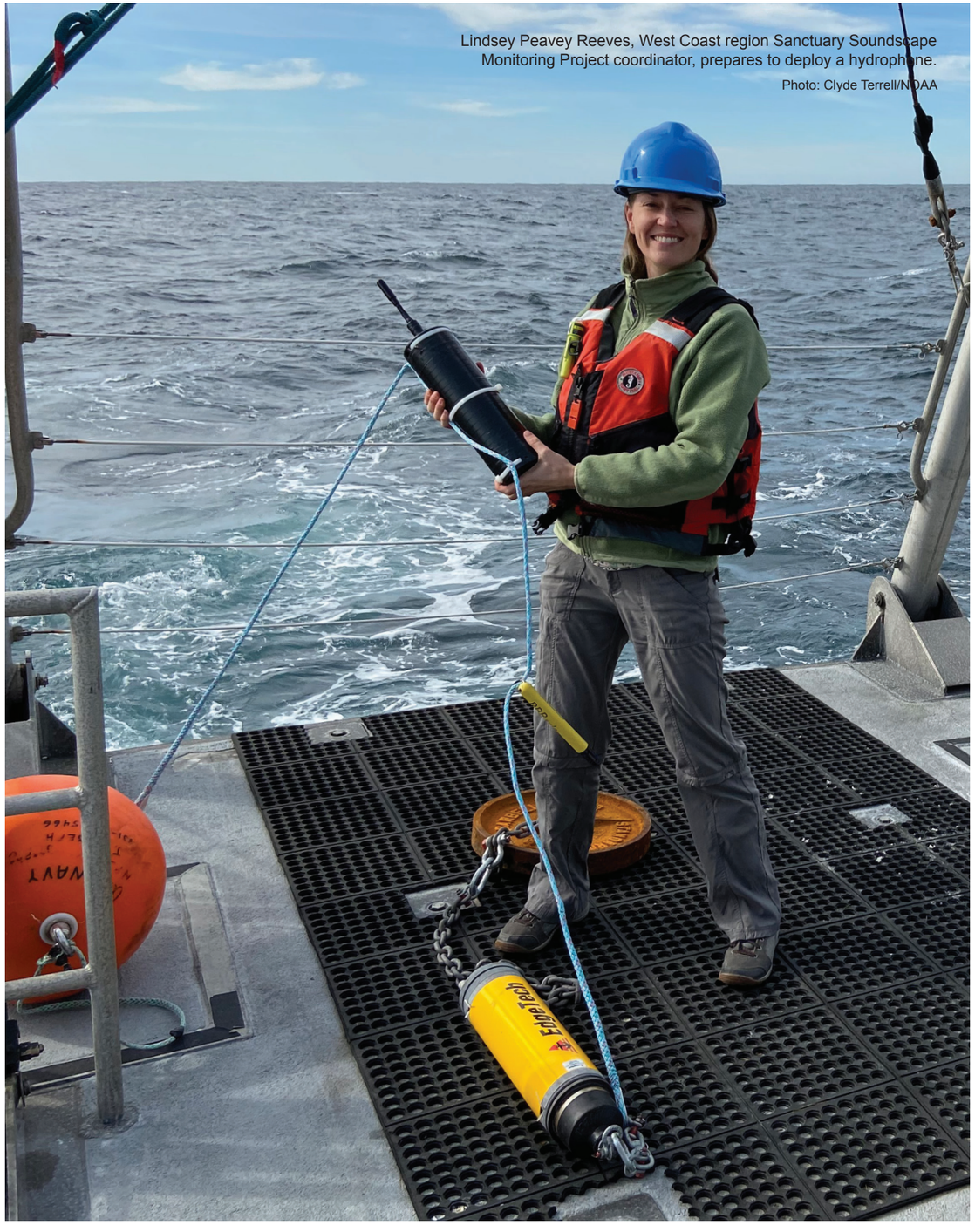


LISTENING FOR CLUES

The underwater world is full of sound. Many marine animals—shrimp, lobsters, fish, whales—use sound to communicate with one another, to find food, to detect predators, to attract mates, and more. NOAA and the U.S. Navy are managing a four-year project, working with numerous scientific partners, to study and better understand underwater sound within seven national marine sanctuaries and one marine national monument, including waters off Hawai'i and the East and West coasts. Sound data from the Sanctuary Soundscape Monitoring Project (SanctSound) are being integrated with other types of monitoring information. This includes animal tracking and environmental conditions to describe vital marine animal behavior, like where and when whales feed and fish spawn. Sounds made by people are also being monitored to better inform sanctuaries in designing ways to ensure that human uses are compatible with the long-term protection of resources.

(Clockwise, from top left) hydrophones on AUVs record sound along a predetermined path; Timothy Rowell attaches a hydrophone to a stationary monitoring site; equipment is deployed from the sanctuary system's fleet of vessels.

Photo: (top, left) NOAA ; (top, right) Justin Miyano/NOAA; (bottom) Marc Lammers/NOAA



Lindsey Peavey Reeves, West Coast region Sanctuary Soundscape Monitoring Project coordinator, prepares to deploy a hydrophone.

Photo: Clyde Terrell/NOAA

ALONG FOR THE GLIDE

From January through March 2020, Jupiter Research Foundation conducted a passive acoustic survey of the waters of Papahānaumokuākea Marine National Monument using the autonomous wave glider “Europa.” Along its journey, the wave glider listened to the monument’s humpback whales. It traveled a whopping 2,627 nautical miles over the course of 67 days—that’s equivalent to the roundtrip distance from Washington, D.C. to Denver, Colorado! The results suggest that whales use the waters of the monument extensively as a breeding habitat during the winter and spring months.

The waters of Hawai‘i provide critical winter breeding grounds for humpback whales.

Photo: Jason Moore/NOAA, under NOAA Permit #15240

EXPLORE THE BLUE

Jupiter Research Foundation’s Wave Glider, Europa, can listen to life underwater in a minimally invasive way.

Photo: Marc Lammers/NOAA

THE BLUE AND YOU

Who's the key to protecting the ocean and Great Lakes? You are! Volunteers, visitors, and partners make the National Marine Sanctuary System a success. You help us foster environmental stewardship of these special places, even during a time when in-person events and programs have gone virtual to keep us all safe. Despite the challenges over the past year, you stuck by our side—all thanks to ***The Blue and You***!

The Ocean Guardian School program provides opportunities for students to work on conservation projects, like this beach cleanup in Santa Barbara, California.

Photo: Nick Zachar/NOAA

VOLUNTEERING FOR SANCTUARIES

Volunteers are an integral part of many sanctuary programs, contributing invaluable time and energy across the National Marine Sanctuary System. The Team Ocean Conservation Education Action Network (OCEAN) volunteer program consists of passionate individuals who are dedicated to informing the visiting public in national marine sanctuaries about responsible use of sanctuary resources, and also help out with work that supports sanctuary research and monitoring.

Team OCEAN divers are trained to conduct habitat assessments and reef fish and marine debris monitoring in Gray's Reef National Marine Sanctuary.

Photo: Greg McFall/NOAA

Team OCEAN Hawai'i volunteers serve as on-the-water naturalists in kayaks, providing ocean users with information about whales and promoting responsible wildlife viewing in Hawaiian Islands Humpback Whale National Marine Sanctuary.

Photo: Ed Lyman/NOAA

During peak recreational boating season and holiday weekends, Team OCEAN volunteers in Florida Keys National Marine Sanctuary help educate boaters at high-use reef sites.

Photo: NOAA

Team OCEAN and Bay Net volunteers foster wise environmental stewards through actions on-the-water and on-the-trail.

Photo: Amity Wood/NOAA

Photo: Ocean Exploration Turst

STORIES FROM THE BLUE:

Jennifer Stock

Cordell Bank National Marine Sanctuary is located entirely offshore. Within its 1,269 square miles, the sanctuary protects soft seafloor habitat, a rocky bank, deep-sea canyons, and communities of wildlife. Jennifer Stock, education and outreach coordinator at the sanctuary, uses her scientific knowledge and interpretation skills to bring this remote, remarkable place to people of all ages through educational programming. This is her Story from the Blue.

The ocean supports our lives—the air that we breathe, the comfortable temperatures on this planet, the water we need in our daily lives, and the sense of peace and calm that is provided by the water around us. The ocean feels like home to me. As an education and outreach coordinator at NOAA's Cordell Bank National Marine Sanctuary, I love helping people learn something new about this place that I value and treasure. There are an infinite amount of stories to share about the ocean that inspire me to keep wanting to do more to help people learn and care about it.

I grew up on Long Island and spent a lot of time on the Long Island Sound and Atlantic Ocean. My mom loved being near the water and my dad was a science teacher and environmental educator, so we did a lot of fun adventures and I learned about nature and ecology through him. Over time I realized the ocean was the place I was most interested in. I studied biology in college and then started working for the National Park Service as an interpreter. I soon realized my passion was for sharing my love of nature and the ocean with other people, so I started developing my career around education and interpretation. Having the opportunity to work for NOAA's Office of National Marine Sanctuaries was like a dream come true—I have been working for the sanctuary system for about 20 years now!

CONNECTING TO DIVERSE AUDIENCES

Jenny Stock is dedicated to teaching children and adults about the wonders of Cordell Bank National Marine Sanctuary.

Photos: (background) Robert Lee/ Bay Area Underwater Explorers; (above, left) Jazzy Dingler/ Stewards of Coast and Redwoods; (above, right) Nick Zachar/NOAA

> "I love helping people learn something new about this place that I value and treasure."

Since the sanctuary is located offshore, people don't really get to experience it up close and in person. Cordell Bank National Marine Sanctuary provides support and educational resources to several partners in the region, and works with a lot of partners, such as the U.C. Davis Bodega Marine Laboratory and Reserve, to conduct studies on topics like oceanography, deep-sea corals, and ocean acidification. To communicate this work to the public, we focus on bringing the sanctuary to people.

We incorporate the findings from our science into permanent exhibits in highly visible locations for diverse audiences, create curriculum and conduct trainings for teachers, do community presentations, social media, and even have a monthly radio program called "Ocean Currents" on the community radio station KWMR to bring ocean science topics to our listeners, which is also a podcast. I hope that the support for the sanctuary continues so we can build out our programs and reach even more people.

When I came to work for Cordell Bank National Marine Sanctuary, I knew that it was a special place but over time started to realize what an amazing place it was for ocean life. The sanctuary is an incredible source of biodiversity that is hard to match in other parts of the world. This place is just so wild and beautiful, and it's my job to help people see its splendor!

LEARNING FROM A DISTANCE

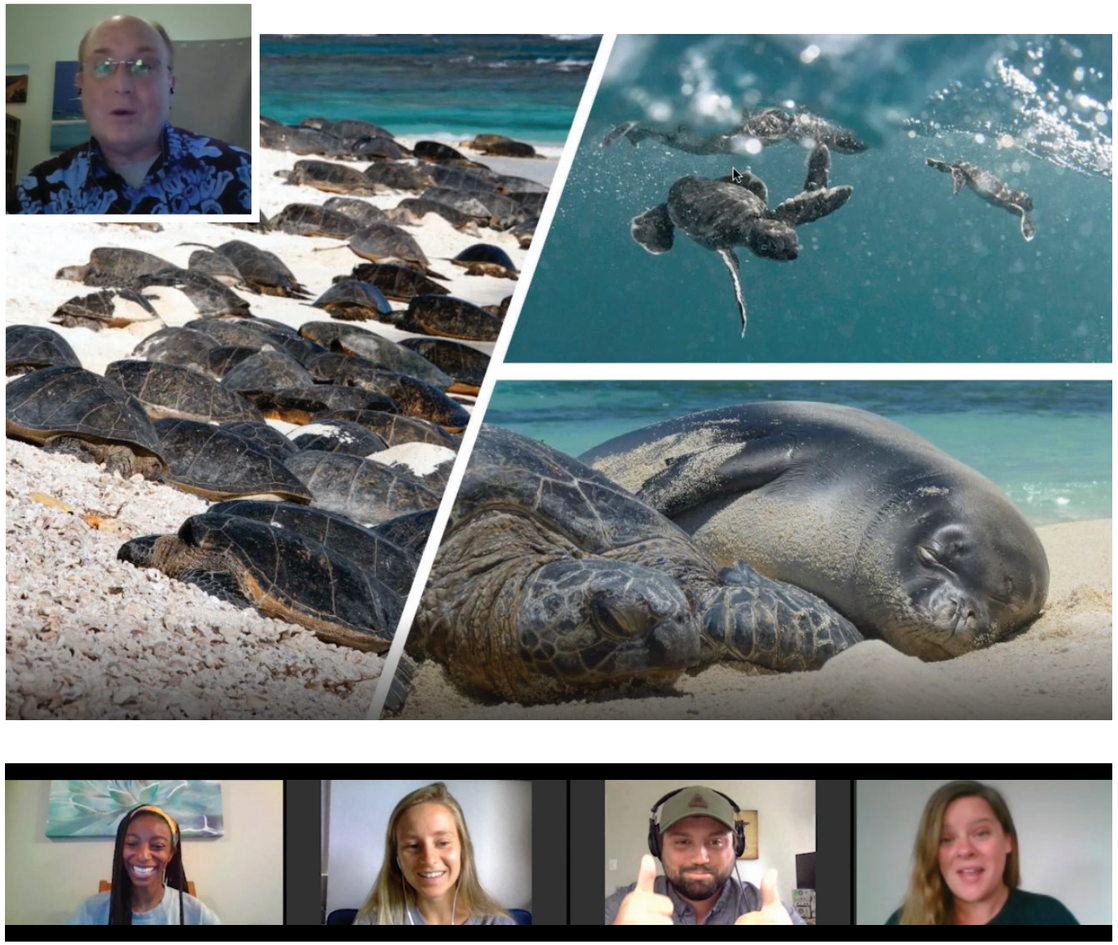
Now more than ever, access to virtual learning experiences for formal and informal educators, students, and other interested people has been in high demand. Interest in distance learning programs through the National Marine Sanctuaries Webinar Series increased by 610% since 2019. In 2020, NOAA's Office of National Marine Sanctuaries hosted 90 live programs that reached 47,196 people, on topics ranging from studying whales and dolphins in the Hawaiian Archipelago, to gardening corals for coral reef restoration.

The public was invited to explore Channel Islands National Marine Sanctuary virtually during an E/V *Nautilus* expedition.

Photo: Michael Murray/NOAA

The National Marine Sanctuaries Webinar Series provides educators, students, and the interested public with programming that supports ocean and climate literacy.

Photos: (top) Isabel Gaoteote/NOAA; (middle) Andy Collins/NOAA; (bottom) NOAA



NATIONAL MARINE SANCTUARIES

360

DIVE INTO SANCTUARIES

The Sanctuary 360° Series allows viewers of all ages and abilities to explore a vast variety of marine life, ecosystems, and maritime history throughout the National Marine Sanctuary System. In its first year, the virtual dive gallery attracted more than 340,000 visitors, making it the most visited section on the sanctuaries.noaa.gov website! By working with Ocean First Education to provide lessons that complement each virtual reality video, teachers and parents are able to further engage students in ways that also align to best practices in science education. The lesson plans teach middle school students about ocean literacy and national marine sanctuaries and are aligned to the Next Generation Science Standards.

VR allows users to experience the thrill of encountering wildlife, such as sea lions in Channel Islands National Marine Sanctuary!

Photo: (background) Robert Schwemmer/NOAA; (inset) Claire Fackler/NOAA

Winner's Circle

Winner of the “Sanctuary Views” category: Jon Anderson (background). Sunbeams penetrate the canopy of a kelp forest in Monterey Bay National Marine Sanctuary as blue rockfish (*Sebastes mystinus*) congregate beneath.

Winner of the “Sanctuary Life” category: Jon Anderson (right, top). A yellowfin fringehead (*Neoclinus stephensae*) peeks out from behind a red-rust bryozoan (*Watersipora subtorquata*) in Monterey Bay National Marine Sanctuary.

Winner of the “Sanctuary Recreation” category: Bruce Sudweeks (right, middle): Bruce Sudweeks’ granddaughter catches a wave in Hawaiian Islands Humpback Whale National Marine Sanctuary.

Winner of the “Sanctuary at Home” category: Jill Brown (right, bottom): Sea turtles and tropical fish inspired by Florida Keys National Marine Sanctuary make a big splash as delightful works of sidewalk art.

earth is blue®

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VOLUME 7

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Douglas Croft
Bryan Dort
Bruce Sudweeks

Each year, in honor of the annual Get Into Your Sanctuary celebration, NOAA’s Office of National Marine Sanctuaries holds a photo contest. Please join us in congratulating the winners of the 2020 contest, pictured here! Through photography, these sanctuary visitors show the world our special ocean and Great Lakes treasures through their eyes.

Enter the Get Into Your Sanctuary photo contest for a chance to see your photos in next year’s Earth Is Blue Magazine. Visit sanctuaries.noaa.gov/mag/submissions to learn how you can submit your photos.

Can’t get enough of Earth Is Blue? Follow NOAA’s Office of National Marine Sanctuaries on Facebook, Twitter, Instagram, Tumblr, and Flickr for more incredible images of your National Marine Sanctuary System.

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YOUR #EARTHISBLUE

CELEBRATE 50 YEARS

Fifty years ago, the U.S. ushered in a new era of ocean conservation by creating a system of national marine sanctuaries. As part of the 50th anniversary in 2022, a new commemorative poster will be released each month to capture the beauty and diversity of your National Marine Sanctuary System—starting with Monitor National Marine Sanctuary in October 2021. Learn more about our 50th celebration and collect your posters at: **sanctuaries.noaa.gov/50**