EARTH IS BLUE™

Volume 2, June 2017

NATIONAL MARINE SANCTUARIES

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MALICIOUS BUT DELICIOUS

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COMMUNITIES OF THE BLUE

NATIONAL MARINE SANCTUARY FOUNDATION

NOAA

MAGAZINE OF THE

NATIONAL MARINE SANCTUARIES

DATA & TECHNOLOGY

The New Conservation Tools

Philanthropist and Vulcan Inc. founder Paul G. Allen uses data to inform conservation efforts and supports innovative approaches that can save endangered species, address climate change and improve ocean health.

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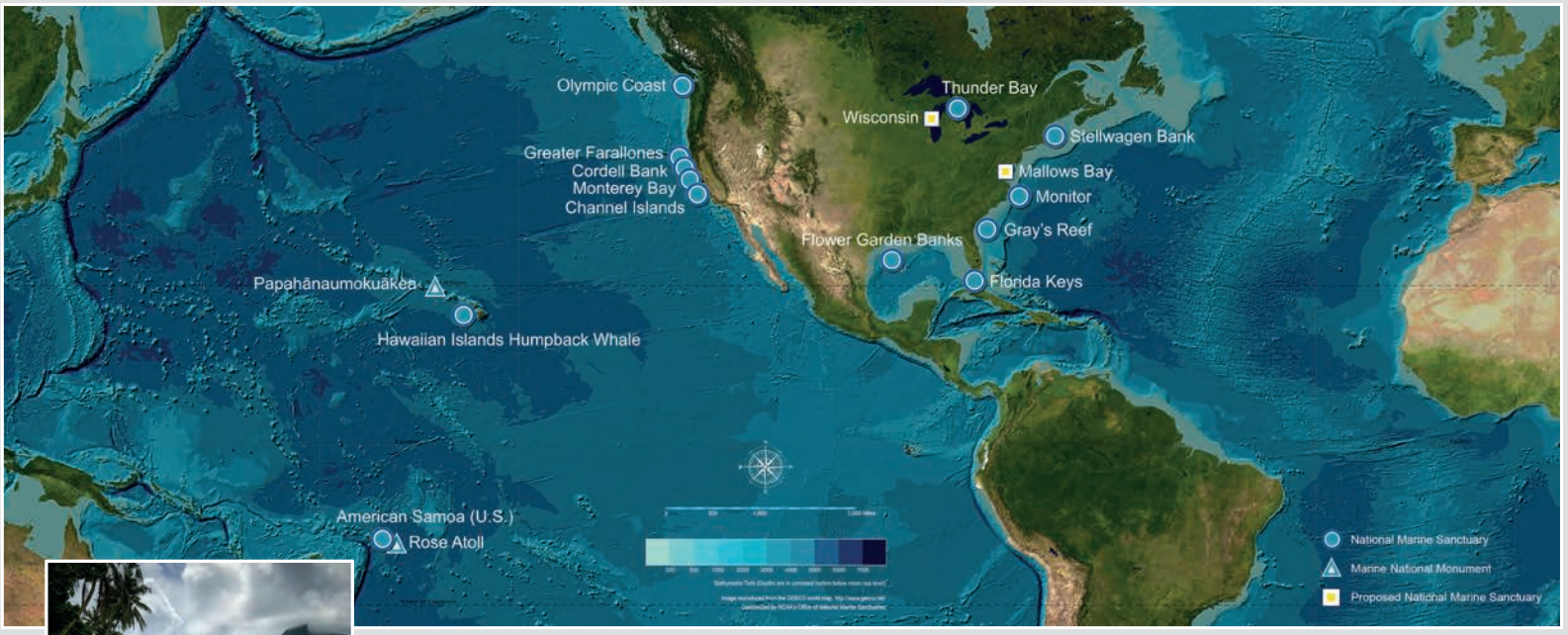

Photo: Matt McIntosh/NOAA

FROM THE DIRECTOR

What does "sanctuary" mean to you? Is it a place of serene quiet, or one of safety? An iconic view? A place for rejuvenation? A community of people?

National marine sanctuaries are all of these. They are our nation's iconic underwater parks. They inspire wonder, spark our sense of adventure, feed our communities, fuel our imaginations, and prod us to protect them for future generations.

I grew up in Rhode Island—the Ocean State. I spent my summers working on my grandfather's dairy farm and swimming in Narragansett Bay. Going back and forth between the two, I could see just how connected they were, and how our choices upstream at the farm affected the ocean downstream. When I got my scuba certification as a teenager and got a better, closer view, it became clear to me that these fragile and phenomenal marine places need our protection and appreciation.

Like my family depended on the Narragansett Bay watershed, many communities depend on sanctuaries: the people who live on their shores and rely on them for their livelihoods; the researchers and managers who have dedicated their lives to protecting them; and the marine organisms for which they are home. All these exist and thrive because of shared bonds, a shared sense of place and of the importance of these ocean and Great Lakes areas. And in turn, these ties encourage us to protect, explore, and enjoy these iconic places. National marine sanctuaries work to foster and strengthen these connections.

Marine protected areas bring people together on and off the water. In sanctuary waters, you might find a parent teaching her child to snorkel for the very first time or a group of scientists working with fishermen to study fish populations. In our Sanctuary Advisory Councils, you'll find people from all walks of life coming together to figure out how to make sanctuaries work for everyone. You'll find government agencies, educators, small business owners, scientists, divers, fishermen, boaters, and more collaborating to figure out how they can support their industries and the broader community.

Photo courtesy John Armor

National marine sanctuaries also serve as centers for communities to strengthen the connections between the environment and their economies, and to perfect new ways for everyone to benefit from healthy and intact marine resources. Through our new community-driven nomination process, sanctuaries serve as focal points for communities to come together to determine how they want to protect those places for future generations.

These healthy sanctuary ecosystems support healthy blue economies with a big return. Each year, $8 billion is generated by ocean recreation, tourism, education, science, and commercial fishing across the National Marine Sanctuary System. Recreation in sanctuaries brings in $2.15 billion in income, supporting 63,000 jobs, while volunteers contribute nearly 150,000 hours each year—the equivalent time of 74 full-time employees. Sanctuary visitor centers serve as hubs for community engagement, and research vessels provide cutting-edge platforms for the scientific community to get out on the water.

This planet is a blue planet. The ocean and Great Lakes sustain us and soothe us; they bring us joy and food and a place to play. In this year's Earth Is Blue Magazine, we celebrate and tell the stories of the communities that make the special ocean and Great Lakes places of national marine sanctuaries possible. No matter who you are or where you're from, sanctuaries are here for you—and I'm so glad you've joined us.

John Armor, Director

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From shipwreck to safe haven: from tragic loss comes new life and a thriving city beneath the waves.

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NOAA

COVER PHOTO: Surfers walk along the beach in Olympic Coast National Marine Sanctuary. Photo: Matt McIntosh/NOAA

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OUR BLUE HE

For millennia, humans have depended on the sea for their livelihoods, for food, and as a highway from one land to another. The ocean and coastline have long been—and continue to be—places around which our communities are organized.

In "Our Blue Heritage," learn how maritime heritage resources like shipwrecks can serve as living museums. Shipwrecks like *Conestoga* and those in the Graveyard of the Atlantic can teach us about our past as a maritime nation even as we celebrate the future. By searching for, protecting, and studying shipwrecks, we can provide closure to lost sailors' loved ones and better understand key events in our nation's history.

The National Marine Sanctuary System also protects areas that indigenous tribes have depended upon for generations and generations. In this section, learn about the annual razor clam digs of the Quinault Indian Nation of the Olympic Coast, and how the sanctuary helps sustain the healthy razor clam population that tribal members depend upon for food and income.

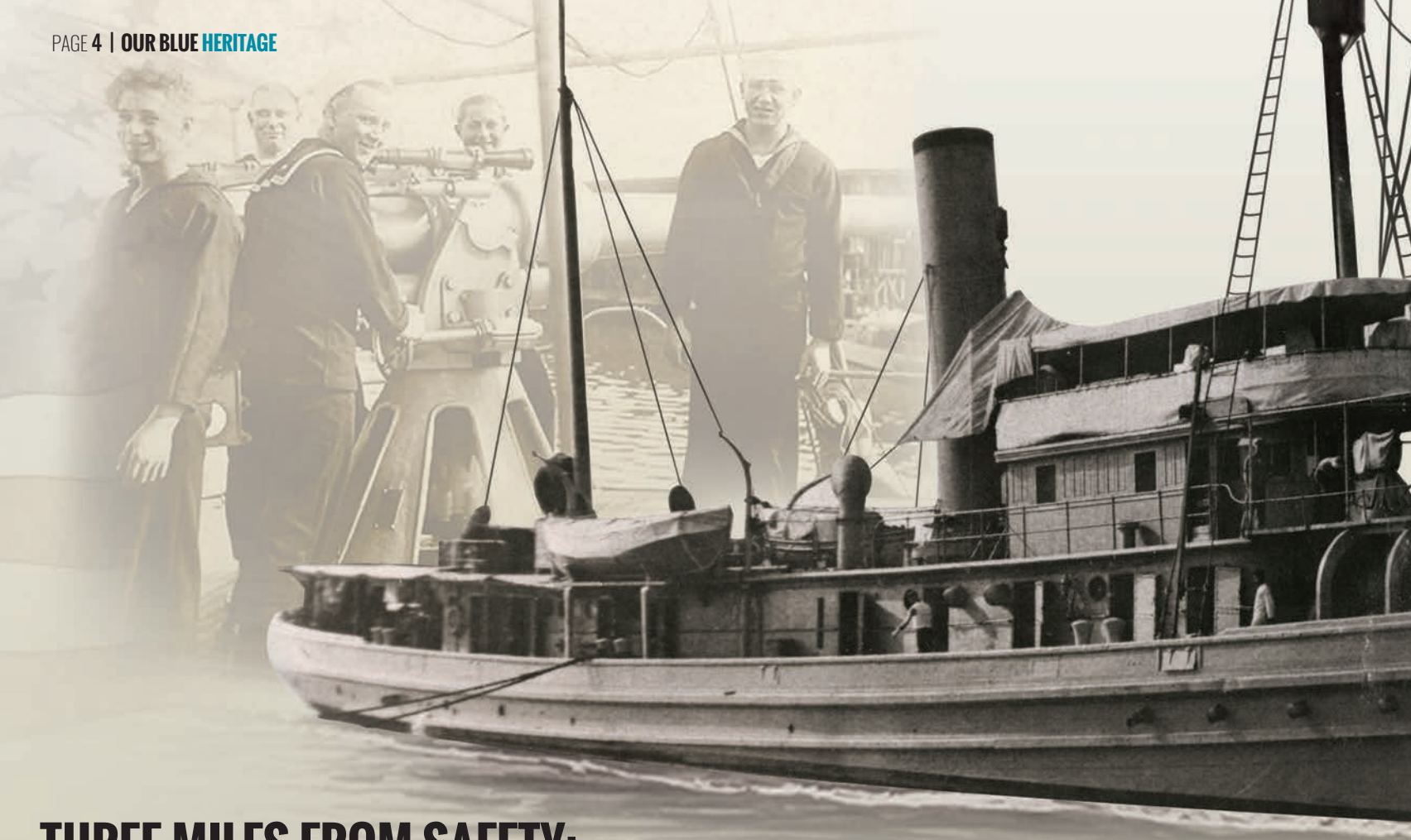
In this section, you'll also learn how these sites serve as places to play and honor our heritage. Each year, for example, Thunder Bay National Marine Sanctuary hosts the Thunder Bay Maritime Festival to encourage visitors to dive deeper into the maritime world and learn about Great Lakes history.

Together, the United States is a maritime nation. By celebrating and protecting maritime heritage resources and artifacts, we ensure this history can endure for future generations.

RITAGE

Monitor National Marine Sanctuary archaeologist Joe Hoyt photographs U-*576* from inside a submersible.

Photo: Robert Carmichael/Project Baseline



THREE MILES FROM SAFETY:

USS *CONESTOGA*

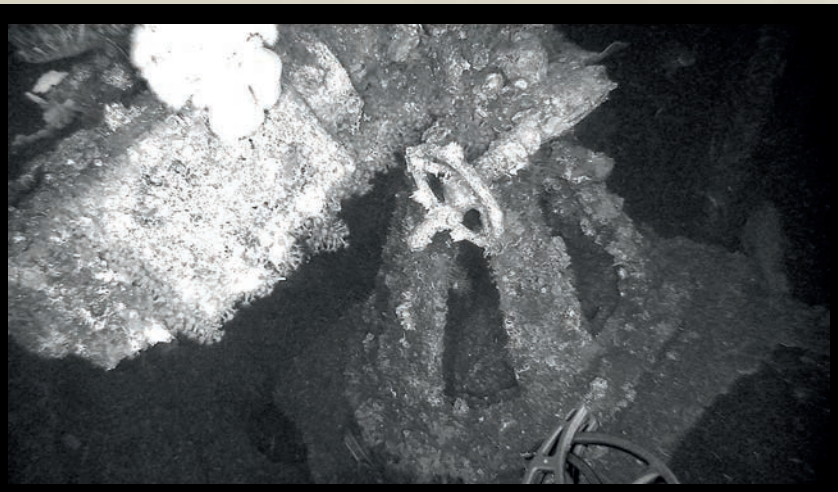
Diane Gollnitz, granddaughter of *Conestoga* commanding officer Ernest Larkin Jones, holds a photo of her grandfather.

Credit: David J. Ruck/NOAA

On March 25, 1921, the U.S. Navy tug USS *Conestoga* and its 56-man crew left San Francisco Bay bound for American Samoa. Before they could reach their stopover point in Hawai'i, *Conestoga* and its crew vanished without a trace. Despite a detailed search by the U.S. Navy, *Conestoga*'s location, and the fate of its crew, remained a mystery for nearly a century.

In 2014, the NOAA Office of National Marine Sanctuaries Maritime Heritage Program investigated a target in Greater Farallones National Marine Sanctuary that was thought to be a shipwreck. Using a remotely operated vehicle (ROV), maritime archaeologists conducted survey dives to characterize the target. The ship appeared to be an unknown vessel of late 19th or early 20th century vintage—but its characteristics matched none of the ships known to have been lost in the sanctuary. After careful assessment of historical accounts, the wreck was finally identified as the USS *Conestoga*.

Members of *Conestoga*'s Gunnery Department were among those lost when the vessel sank.



Using footage obtained with an ROV, maritime archaeologists were able to identify the wreck of the USS *Conestoga*.

Left to right: Courtesy of U.S. Naval History and Heritage Command; NOAA/Teledyne SeaBotix

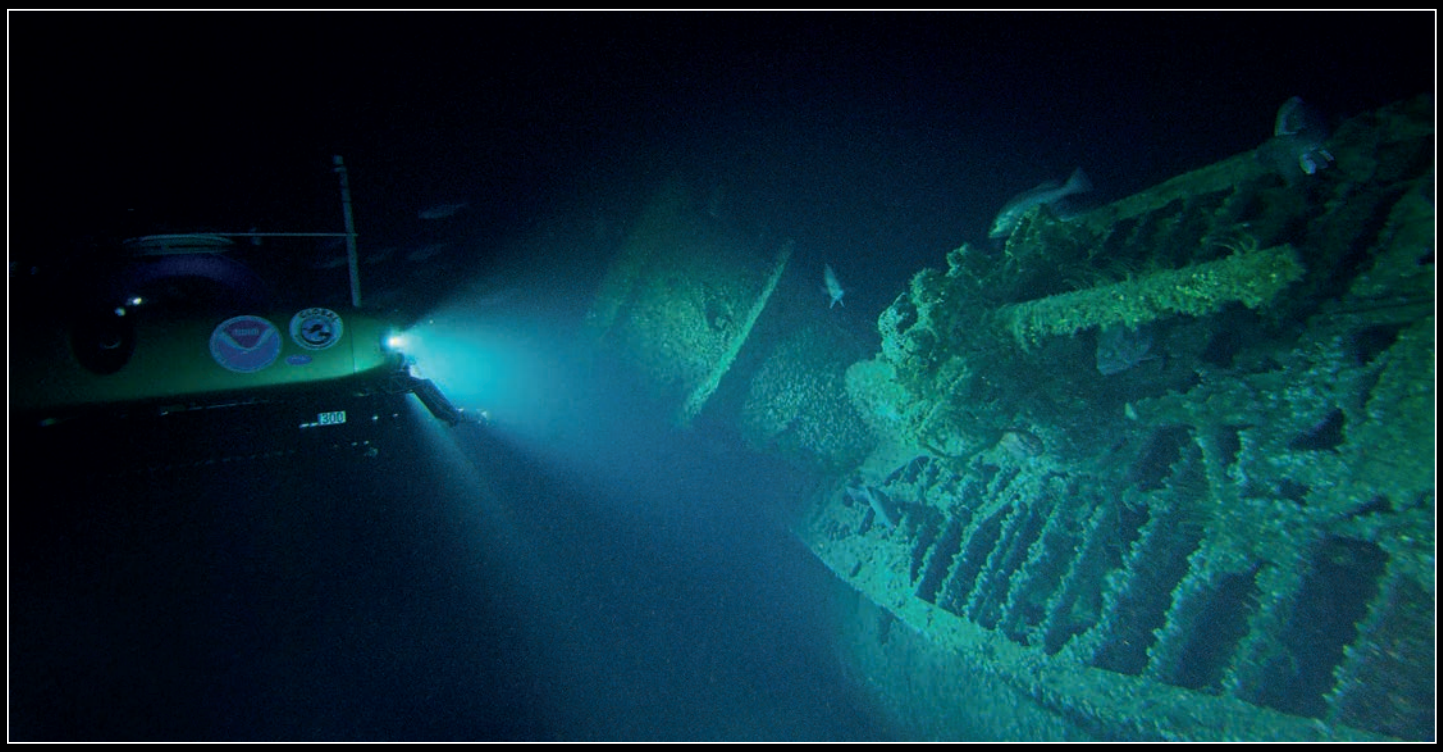
Conestoga had been presumed lost off the coast of Baja California or close to Hawai'i. Instead, archaeologists believe *Conestoga* most likely ran into trouble soon after leaving the Golden Gate and steaming into gale conditions. Perhaps leaking from the strain of laboring in heavy swell and overwhelmed by water washing over the decks, *Conestoga* headed to the sanctuary of the Farallon Islands, which had a lighthouse and a U.S. Naval Radio Station.

They nearly made it: today, the USS *Conestoga* rests on the seafloor just three miles off Southeast Farallon Island, the largest of the Farallones and the site of the islands' lighthouse. The vessel is now a military grave for its 56 crew, the remains of whom may still be entombed inside the hull, and is protected by the National Marine Sanctuary Act and the Sunken Military Craft Act.

The wreck is also a habitat within the sanctuary: from this tragic loss comes new life. This discovery has provided closure for the families of *Conestoga*'s crew, who keep the story alive for future generations.

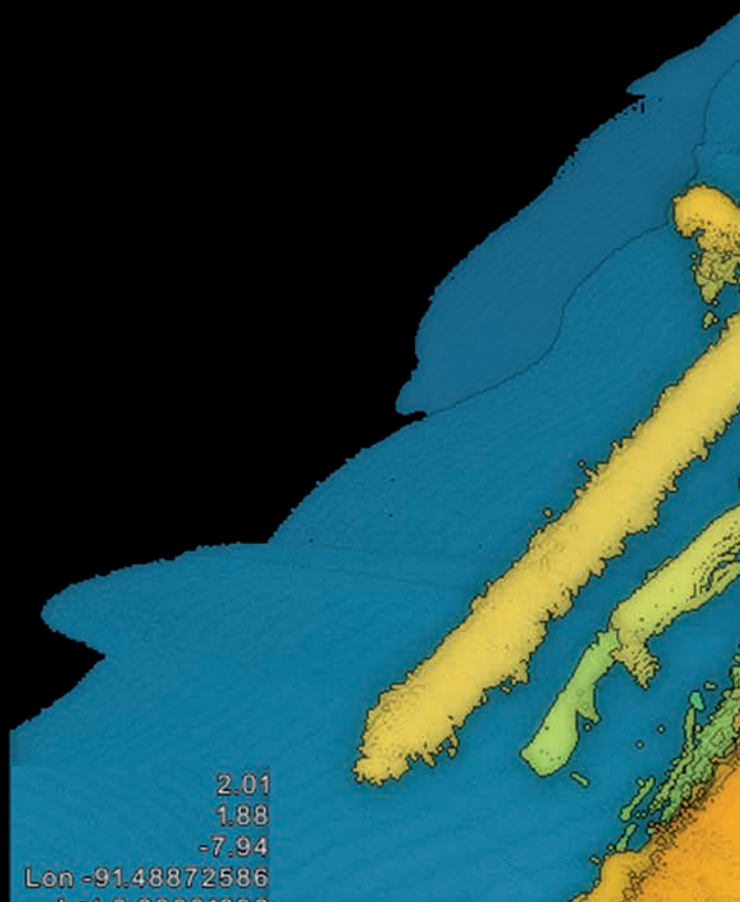
EXPLORING A LOST BATTLEFIELD OF WWII

To maritime archaeologists, the seafloor can be the key to the past. In August and September 2016, a team of archaeologists from Monitor National Marine Sanctuary and their partners surveyed two shipwrecks, an Allied freighter and German U-boat, from a World War II battlefield off the coast of Cape Hatteras, North Carolina. *Bluefields* and U-*576* are two vessels that could be protected by an expanded Monitor National Marine Sanctuary.



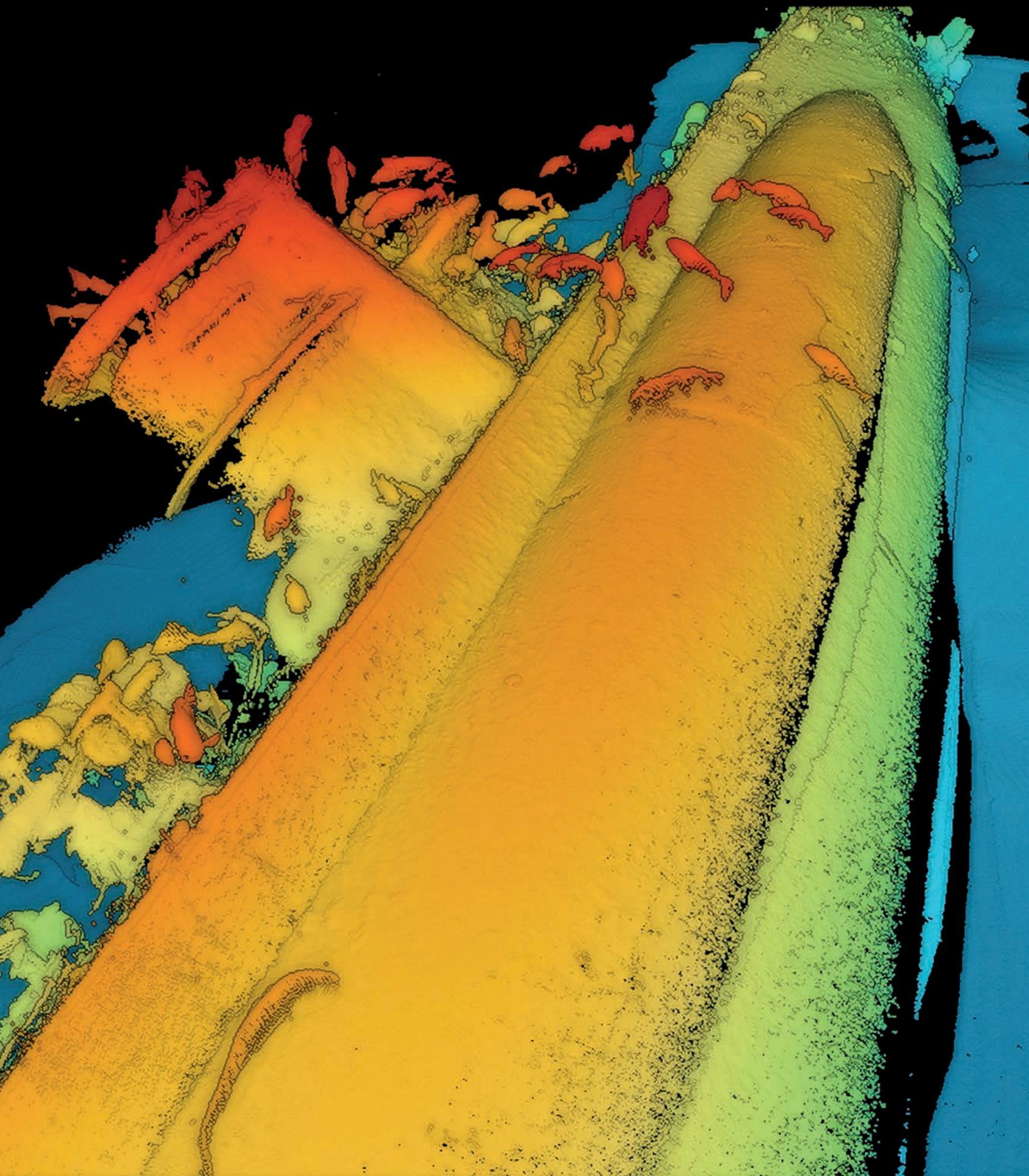
Courtesy of John McCord, UNC Coastal Studies Institute - Battle of the Atlantic Expedition.

Project Baseline's *Nemo* submersible shines light on U-*576*.



A point cloud model generated from laser data collected in August 2016 depicts U-*576*. The 88mm deck gun and conning tower are shown on the left; the smaller red shapes surrounding the conning tower are grouper.

Image: NOAA/2GRobotics



Members of the Quinault Indian Nation dig for razor clams, which serve as an important source of income and protein.

Photo: David J. Ruck/NOAA

PROTECTING A WAY OF LIFE:
The Quinault Indian Nation's Razor Clam Dig

— *By* ELIZABETH WEINBERG

South from Point Grenville on Washington's Olympic Peninsula, the state's rocky shores give way to broad expanses of sand. Buried within these sandy beaches are hundreds of thousands of razor clams—one of the most sought-after shellfish in the state of Washington.

Resource managers work together to ensure that the ocean is healthy and razor clams can be safely gathered for tribal and recreational harvests. Non-tribal recreational harvest, typically scheduled from October through May, occurs on public beaches, while harvest is limited during the summer to allow razor clams to spawn and grow. During the fall and winter when low tides occur during dark hours, thousands of clam diggers brave the elements to dig by lantern or flashlight.

For the indigenous tribes of the Olympic Peninsula, clams have been important for millennia. Quinault Department of Fisheries marine resources scientist Joe Schumacker explains that for the Quinault Indian Nation, razor clams are a way of life. "Historically, they've been a major source of protein and trade items for the tribe," he says. Razor clam harvest is "so important to Quinault, it's part of their culture, it's part of their being."

The Quinault Department of Fisheries directly manages its clam harvest season on Quinault reservation beaches—which are closed to the non-tribal public—with openings throughout the fall, winter, and spring. Like the non-tribal recreational season, razor clam harvest is not allowed during the summer, except for two digs at the end of August. Those commercial harvests are timed to help Quinault families get the income they need for new school supplies and clothes. The clams are either bought on the beach or taken to the Quinault fish processing plant in Taholah, Washington, where they are sold for cash. In addition to commercial harvest, the Quinault Indian Nation holds many subsistence digs throughout the season to feed tribal members and to keep their pantries and freezers full.

The Quinault Indian Nation manages or co-manages approximately 55 miles of beach area and has treaty rights to 2,000 square miles of ocean. Point Grenville Beach, located on the Quinault Reservation, has not always been a clam haven. "During the mid-to-late 2000's, this beach really did not have a good long-term crop of razor clams," says Schumacker. At the time, he explains, dead fish were found on the beach throughout the summer, having likely been killed by hypoxia, or low oxygen conditions, in waters upwelled from the deep. In recent years, though, the hypoxic events have subsided and, Schumacker says, "things have turned around, at least temporarily."

The clam population isn't fully in the clear, though. Carbon dioxide released by the burning of fossil fuels traps heat in the atmosphere, and the ocean is warming as it absorbs some of this heat. A warmer ocean may affect razor clam populations. The increased carbon dioxide is also absorbed by the ocean and changes the ocean's chemistry, making it harder for organisms like clams to form skeletal

Photos: David J. Ruck/NOAA

Clockwise (from top): Razor clam size and quantity can help indicate the health of a beach; Quinault members bring the razor clams to Quinault Pride Seafood to be weighed and sold; razor clams are dug from the sand at low tide. Logo (below): Quinault Pride Seafood is an enterprise of the Quinault Indian Nation.

structures in their larvae or shells as they change into adults. While this ocean acidification has already affected Pacific Northwest oyster hatcheries, the good news is that direct impacts to razor clams have not been shown. Still, Schumacker emphasizes that "we need to monitor for [the impacts of ocean acidification] in the future. We see this as a real threat on the horizon."

Olympic Coast National Marine Sanctuary helps the Quinault Indian Nation and other resource managers protect the waters of the Olympic Coast, which in turn can help support a healthy razor clam population. "Sanctuaries like Olympic Coast can serve as sentinel sites that allow for early detection of changing ocean conditions because of natural events and human threats," explains Olympic Coast National Marine Sanctuary superintendent Carol Bernthal. "Working with partners like the Quinault Indian Nation, we can take action to better understand how the ocean is changing and take steps to protect these valued resources."

Razor clams have sustained the Quinault Indian Nation for generations. Because their treaty rights extend only to a legally defined area, Schumacker explains, "The tribe has to be very very careful and conservation-minded about their resources and how they manage them. The treaty right doesn't exist anywhere else. Should they (Quinault) lose these razor clams in the treaty area, they can't just move and still have rights to them elsewhere. This goes for all of their treaty resources including salmon, crab, and many other species."

Place-based peoples have long known that they must respect the world around them and harvest resources sustainably. Quinault and other tribes in Washington state are leaders in natural resource management and are at the forefront of efforts to maintain, improve, and rebuild the habitats that support their treaty resources. On the remote Washington coast, Olympic Coast National Marine Sanctuary shares the waters with four treaty tribes and works together to maintain one of the great coastal areas of the United States. Working together with tribes and researchers, the sanctuary serves as a sentinel site to maintain the precious resources that have supported people throughout history.

As Schumacker says, "The Quinault Indian Nation and all of the tribes know full well that they have to support not just this generation, but all of those generations to come."

CELEBRATING OUR GREAT LAKES HISTORY

Throughout the history of the United States, we have depended on the Great Lakes for transportation and resources. A microcosm of this history exists in Thunder Bay National Marine Sanctuary, where fire, ice, collision, and storms have claimed more than 200 vessels over the centuries. Every year, the sanctuary hosts the Maritime Festival in Alpena, Michigan, to commemorate this history. Thousands of visitors walk along the Thunder Bay River's Great Lakes Maritime Heritage Trail, see local and visiting ships, and watch the annual Cardboard Boat Regatta. The Maritime Festival has been an annual community event since 2001.

Visitors celebrate maritime heritage at the annual Maritime Festival.

Photo: NOAA

Left to right: Visitors relax outside the Great Lakes Maritime Heritage Center; visitors experience shipwrecks on a glass-bottom boat; children participate in the annual Cardboard Boat Regatta.

Photos: NOAA

GET INTO THE

Sanctuaries are our nation's underwater parks. They're protected for good reason: here, you'll find some of the best views and the most amazing wildlife in the country. These treasures make national marine sanctuaries some of the best places to have the adventure of a lifetime. Within their boundaries, you can surf, kayak, fish, dive, whale watch, and more.

In this section, experience the spectacular views that await you when you come play in your national marine sanctuaries. Learn how activities like recreational fishing and boating can help support stewardship of diverse marine communities, and how recreation supports thriving local economies.

If you can't make it to the water, never fear! Through partnerships with aquariums and other institutions, national marine sanctuaries come to you. In this section you'll find information about these exhibits so that you can get up close and personal with national marine sanctuaries without getting your feet wet.

Did you know you can also support sanctuaries from your kitchen? Local sustainable seafood from sanctuary communities is celebrated by chefs and diners alike. By focusing your seafood choices on invasive species like Indo-Pacific lionfish, you can bring the fish-to-table movement to your own kitchen while also supporting ocean health. Turn to page 20 for a delicious recipe to learn more.

BLUE

Olympic Coast National Marine Sanctuary makes for an epic surf spot.

Photo: Matt McIntosh/NOAA

GET INTO YOUR SANCTUARY

From sunset paddleboarding to tidepool exploration, adventures await for everyone in your national marine sanctuaries. In these communities, you'll find some of the best spots in the country for sustainable recreation!

Thunder Bay National Marine Sanctuary's superintendent, Jeff Gray, enjoys a Lake Huron sunrise while paddleboarding.

Photo: Jeff Gray/NOAA

ENJOYING YOUR SANCTUARIES

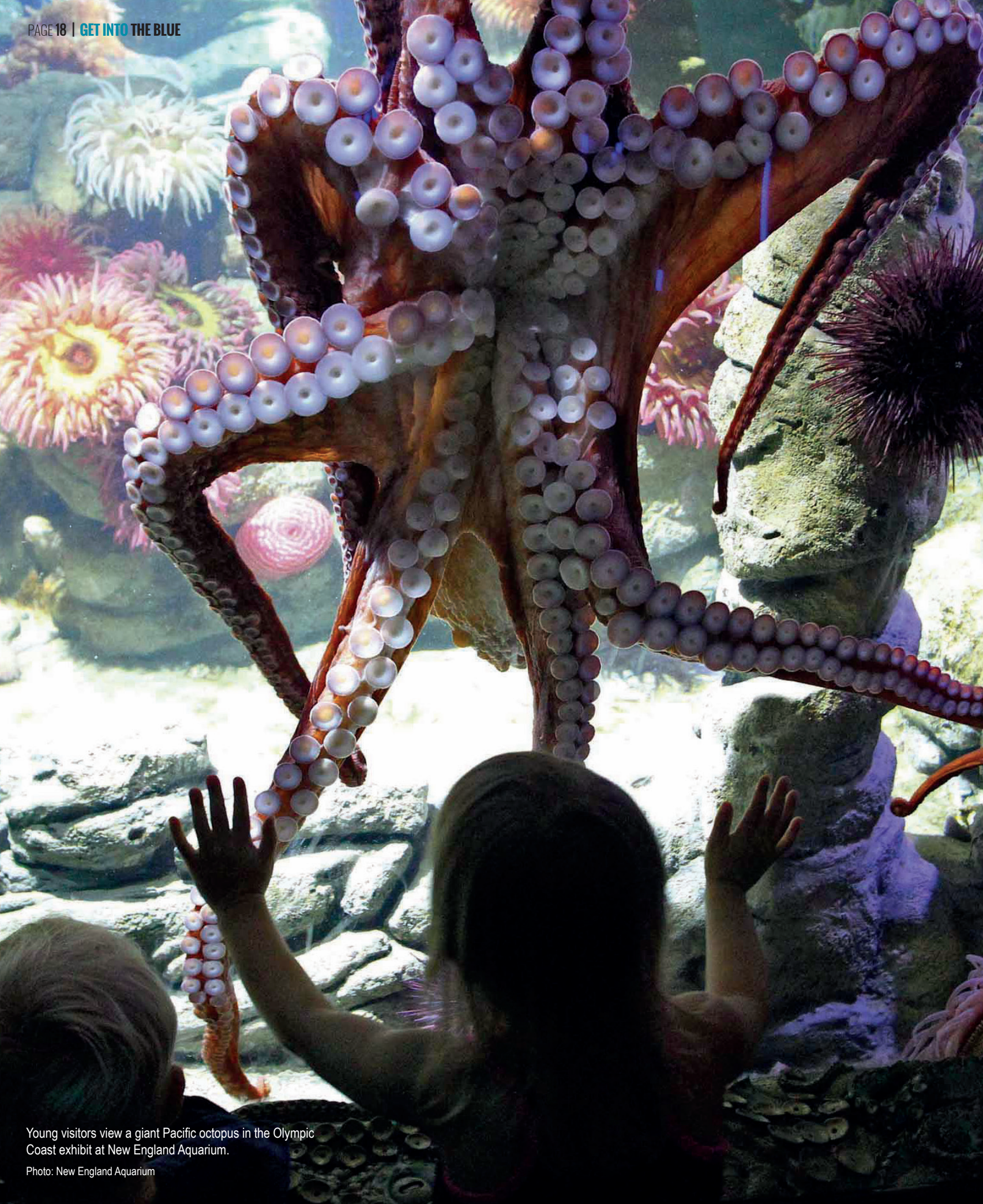
Recreational fishing and boating are among the most popular activities in the United States. More than just favorite pastimes, these activities are a source of economic vitality to coastal communities. In conserving the places cherished by recreational saltwater anglers and Great Lakes sport fishermen, national marine sanctuaries celebrate the boating lifestyle and sportfishing culture. Sanctuaries welcome visitors to have their own sustainable on-the-water experiences and be fellow stewards of our marine resources.

An angler fly-fishes for tarpon in Florida Keys National Marine Sanctuary.

Photo: Matt McIntosh/NOAA

Clockwise (from top): Recreational fisherman, NMS of American Samoa; Native Samoan basket fishing, NMS of American Samoa; recreational boating, Florida Keys NMS

Photos: Kate Thompson/NOAA; Matt McIntosh/NOAA; David J. Ruck/NOAA



Young visitors view a giant Pacific octopus in the Olympic Coast exhibit at New England Aquarium.

Photo: New England Aquarium

WINDOWS TO SANCTUARIES:
The Partners Who Tell Our Stories

— *By* ELIZABETH WEINBERG

You don't have to be an experienced diver or an avid kayaker to get to know your National Marine Sanctuary System. National marine sanctuaries partner with aquariums, science museums, parks, and more to bring even the most remote of marine protected areas right to your fingertips. Here are some exhibits you can't miss!

THE MARINERS' MUSEUM AND PARK

The Mariners' Museum and Park is home to the USS *Monitor* Center. At this incredible museum, you can see more than 200 tons of artifacts recovered from Monitor National Marine Sanctuary, watch restoration in action, and learn about the historic USS *Monitor*.

MONTEREY BAY AQUARIUM

Located on the shores of Monterey Bay National Marine Sanctuary, the Monterey Bay Aquarium provides visitors with a seafloor-to-surface experience of the neighboring sanctuary. Visit the aquarium's kelp forest exhibit to get a fish's-eye view of life in the sanctuary, or check out the 90-foot-long exhibit highlighting five different Monterey Bay habitats. Don't forget to visit the decks for a chance to spot sanctuary wildlife!

OAKLAND MUSEUM OF CALIFORNIA

Cordell Bank National Marine Sanctuary is located off the shores of Northern California, and the swift currents around its deep, rocky reef make it difficult to dive in the sanctuary. Fortunately, the Oakland Museum of California's Natural Science Gallery has an entire wing—including interactive stations and an immersive video room—focused on the rich and unique Cordell Bank ecosystem.

CALIFORNIA ACADEMY OF SCIENCES

Need more time in your California national marine sanctuaries? Visit the California Academy of Sciences to encounter stunning views of California's underwater ecosystems. The Northern California Coast exhibit boasts a 100,000-gallon tank replicating the habitats of Greater Farallones National Marine Sanctuary, and the Discovery Tidepool can help young visitors get a hands-on understanding of the sanctuaries' natural worlds.

WAIKĪKĪ AQUARIUM

Designated to protect an exceptional array of natural and cultural resources within the Northwestern Hawaiian Islands, Papahānaumokuākea Marine National Monument is remote, and closed to visitors without research or special use permits. But visitors to Honolulu can get to know the monument's amazing ocean ecosystems at the Waikīkī Aquarium. The oldest public aquarium in the United States, the Waikīkī Aquarium hosts an exhibit featuring the special and rare marine life of the Northwestern Hawaiian Islands.

TENNESSEE AQUARIUM

Flower Garden Banks National Marine Sanctuary is situated 70 to 115 miles off the coasts of Texas and Louisiana, but you can stay dry and visit it at the Tennessee Aquarium. The aquarium's 618,000-gallon saltwater exhibit, the Secret Reef, gives visitors an up-close and personal view of the huge boulder coral formations that form the reef structure at East and West Flower Garden Banks.

TEXAS STATE AQUARIUM

Can't get enough of Flower Garden Banks National Marine Sanctuary? The Texas State Aquarium in Corpus Christi has had a Flower Garden Banks exhibit since 1990—before the sanctuary was even designated! This 40,000-gallon exhibit showcases the sanctuary's coral reef ecosystems, and includes daily Diver in the Water presentations.

TYBEE ISLAND MARINE SCIENCE CENTER

Take a virtual visit to Georgia's Gray's Reef National Marine Sanctuary at the Tybee Island Marine Science Center. Year-round programs for island visitors and groups provide information about local conservation efforts and the importance of coastal Georgia's natural resources.

NEW ENGLAND AQUARIUM

Stellwagen Bank National Marine Sanctuary is renowned as one of the world's premiere whale watching destinations. Whales aren't the only ocean creatures that call the sanctuary home, though, and you can discover the sanctuary's marine life at Boston's New England Aquarium. Six Gulf of Maine exhibits cover more than half of the aquarium's third floor, giving visitors an exceptional opportunity to view the ecosystems in and around Stellwagen Bank.

Learn more about the gateways to your National Marine Sanctuary System at http://sanctuaries.noaa.gov/visit/visitor-centers.html.

LIONFISH ZACATECAS

In recent years, Indo-Pacific lionfish have invaded reefs in and around Gray's Reef, Florida Keys, Flower Garden Banks, and Monitor national marine sanctuaries. Lionfish eat whatever they can find, reproduce rapidly, and have no known predators in their new habitats. As a result, they seriously threaten the health and biodiversity of reef communities. But you can help by focusing your seafood choices on invasive species like lionfish, which is increasingly available at grocery stores around the country.

Lionfish is a white, flaky fish with a firm, buttery texture. From ceviche to fish tacos, there are an abundance of ways to enjoy this delicious invader! This recipe, brought to us by the Reef Environmental Education Foundation (REEF), is a sanctuary favorite.

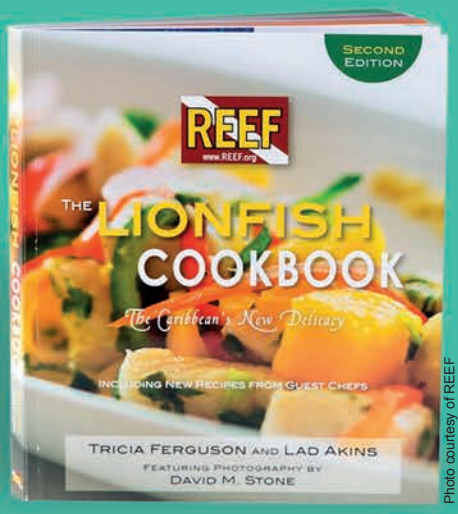


Photo courtesy of REEF

MALICIOUS but

Ingredients

for the FISH

2 lbs
lionfish fillets

2 eggs,
whisked

2 cups
bread crumbs

1 cup
flour

½ cup
melted butter

salt & pepper
to taste

for the BUTTER

1 cup
butter

2 tbsp
peanut butter

2 tbsp
Adobo sauce

2 tbsp
brown sugar

2 tbsp
chipotle pepper

Step 1 Mix all compound butter ingredients together and form into a log. Wrap with wax paper and refrigerate for a minimum of one hour.

Step 2 Preheat the oven to 350 degrees and grease a large sheet pan. Season the lionfish fillets with salt and pepper. Coat the fish in flour, shaking off excess. Dip fillets in egg, then dredge in breadcrumbs to encrust. Place the breaded fillets on the sheet pan and drizzle with melted butter. Bake the fish for seven minutes.

Step 3 While the fish is baking, remove the compound butter from the refrigerator and slice into ¼-inch slices. Remove fish from the oven and place one slice of compound butter in the center of each fillet.

Step 4 Return fish to the oven for an additional two minutes. Remove the fish from the oven and enjoy!

Photo: iStock/GlobalP

DELICIOUS

STORIES FROM THE BLUE

Uncle Sol explains that slowing erosion and sedimentation on the island of Lānaʻi will help protect the ocean and the sanctuary.

As a *kupuna*, or elder, Solomon is often referred to as "Uncle Sol" by the sanctuary community as a sign of respect.

Photo: David J. Ruck/NOAA

From *Mauka* to *Makai*: Solomon Pili Kahoʻohalahala

Solomon Pili Kahoʻohalahala is the chair of the Hawaiian Islands Humpback Whale National Marine Sanctuary Advisory Council. For him, Lānaʻi, with all its shifts and changes, is home. This is his Story from the Blue.

I'm seventh generation on the island of Lānaʻi, which is the only island here that is encompassed by sanctuary waters. Within the sanctuary are many, many storied places that are tied to the culture of the people that are living here. The stories must be cared for, the resources must be cared for, and now we have the responsibility as a sanctuary to look at these waters.

Historically, the island was divided into land districts called *ahupuaʻa*. These divided the island into pie shapes so that you have a district that runs from the highest part of the island, the mountain, all the way down toward the sea. That connection from mountain to sea, or *mauka* to *makai*—or as it is often described today, ridge to reef—makes it possible for you to live in any ahupuaʻa and have access to everything you need.

When I was younger, we spent our time hiking and horseback riding over the entirety of this island. We spent our day gathering fruits and having a lot of fun outdoors. When you only had one kind of employer

'Ohiki, or ghost crabs, are considered the caretaker of the shore environment in Native Hawaiian culture.

Above: Uncle Sol performs a chant describing the island landscape in years past.

Above photos: David J. Ruck/NOAA

Lāna'i is the only Hawaiian island entirely encompassed by sanctuary waters.

Photo: Kate Thompson/NOAA

> "The manner in which we care for our land is going to be the manner in which the ocean is going to reflect that."

and one economy, just one job, then it was important for you to take care of your family through subsistence gathering. So we hunted on this island for the sheep, the goat, and the deer, along with game birds, and we gathered seaweed and edible seashells. And that became part of our Hawaiian cultural lifestyle to be subsisting from this mauka makai.

In the sanctuary we want to understand the relationship of the humpback whale to its environment, and that environment includes the land and the sea. When heavy rain events come, the valley of Maunalei sends out erosion and sedimentation and the entire shoreline area where the reef fringes is covered in mud. So the manner in which we care for our land is going to be the manner in which the ocean is going to reflect that. If we're good about taking care and making sure that the island is intact, and we're not allowing sedimentation and erosion to continue, then our ocean waters within the sanctuary should be pristine and clean.

But if we fail to do that, then we can be assured that the result will be that this sedimentation will enter into the sanctuary waters and then our reef areas and our nearshore areas will be inundated. We'll be losing those environments that are important to us culturally as part of our sustenance and our way of life.

We can help the sanctuary to become the kind of ecosystem that's pristine and one that's going to be sustaining itself, regenerative. As a result, it will be the kind of place that will help the people of Lāna'i to continue to sustain themselves.

COMMUNITIES F

From ecosystems beneath the waves to towns along their shores, the sites within the National Marine Sanctuary System are all about communities. By protecting habitats and key species within their boundaries, we ensure that ecosystems can thrive. And from the economic benefits of coastal tourism to the knowledge that their treasured places are safeguarded, national marine sanctuaries help maintain strong coastal communities.

In "Communities of the Blue," learn how the National Marine Sanctuary Foundation works with community partners to support a strong National Marine Sanctuary System. Then, travel all the way to National Marine Sanctuary of American Samoa to learn how the sanctuary community worked together to remove a grounded vessel that threatened a way of life in Aunu'u.

Discover how communities are key to restoration in California's Bolinas Lagoon, located within Greater Farallones National Marine Sanctuary. Here, grassroots restoration efforts have revitalized this rich habitat, sustaining it for future generations.

And learn how communities are propelling our nation toward new marine protected areas. NOAA's new community-driven process ensures that nominations for new national marine sanctuaries come directly from the people who depend on them. The growth of the National Marine Sanctuary System reflects a nation that is increasingly aware of and concerned with the health of our ocean and Great Lakes resources, and is coming together to care for these key areas.

ROM THE BLUE

Dancers and singers practice for the 2017 Flag Day Fautasi Race in American Samoa.

Photo: Matt McIntosh/NOAA

A MESSAGE FROM THE

NATIONAL MARINE SANCTUARY FOUNDATION

Legendary producer Ken Burns called the national parks "America's Best Idea" because they are the story of people, Americans from all walks of life devoted to protecting lands they love. The same is true for our national marine sanctuaries, which are a uniquely American idea. They are the story of people and communities dedicated to conserving special places in our ocean and Great Lakes for both current and future generations. Sanctuaries capture the spirit of communities through participatory conservation. Thousands of volunteers enthusiastically donate their time to aid in conservation, scientists study these living laboratories to unlock mysteries, and local citizens serve on advisory councils that inform the management of our public waters for all Americans.

Six months ago, I got a dream job: president and CEO of the National Marine Sanctuary Foundation. I am following in the wake of giants who had the vision to establish the Foundation 17 years ago. For me, honoring their vision means being part of the community dedicated to strengthening the system of national marine sanctuaries, the goal of which is to conserve our rich natural, cultural, and historic resources for future generations.

Photo: David J. Ruck/NOAA

WE ARE EXPLORERS. Americans are explorers and the ocean is the last frontier on Earth. From research to recreational diving, there is always something new to learn or awe-inspiring to discover in our ocean and Great Lakes. Sanctuaries are our living laboratories to better understand the world we live in and satisfy our appetite for adventure.

WE ARE STEWARDS. Sanctuaries are homes to millions of species, and play a critical role in the recovery of many endangered and threatened species. They generate approximately $8 billion annually to support coastal- and ocean-dependent economies. We are all stewards of our ocean and Great Lakes for both the species that depend on them and future generations of Americans. Sanctuaries give us all the opportunity to work collectively to conserve these resources for all Americans to enjoy.

WE ARE CONNECTED. The health of our ocean and Great Lakes, the quality of life of our communities, and human health go hand in hand. As we go about our busy lives, it is easy to forget that life on Earth is made possible by the water. Sanctuaries help us realize our connection to the water by connecting communities to our marine and freshwater environments.

Connecting Americans to their national marine sanctuaries, igniting curiosity through science and exploration of these living laboratories, building partnerships with local communities to conserve these unique places, and engaging a more diverse population in these efforts are my vision for the National Marine Sanctuary Foundation.

For the first time in 16 years, we are on the verge of designating two new sanctuaries to preserve important pieces of our nation's maritime heritage. And, many other communities across the country are urging us forward to conserve areas of national significance along their coasts. With communities involved in conservation, I believe there is optimism for our ocean and Great Lakes.

Kris

Kris Sarri, President & CEO
National Marine Sanctuary Foundation

NATIONAL MARINE SANCTUARY FOUNDATION

WRECKED ON A REEF

A Community's Effort to Save Their Livelihood

— *By* ELIZABETH WEINBERG

Late on a Thursday night in April 2016, the fishing vessel *No. 1 Ji Hyun* lost its main engines and grounded on the reef just off the west side of Aunu'u Island in National Marine Sanctuary of American Samoa. While the crew evacuated safely, the grounding occurred on a remote island in an even more remote archipelago. It would be months before the 62-foot vessel could be safely removed from the reef—and it would take an entire community to do it.

Fa'a Samoa, or the Samoan way, is central to everyday life in American Samoa. The foundation of Samoan culture, it places importance on the dignity and achievements of the group rather than the individual. With that in mind, National Marine Sanctuary of American Samoa places a high value on partnerships with sanctuary communities and maintains great respect for fa'a Samoa. The vessel grounding highlighted just how important this community collaboration is for maintaining a strong sanctuary and protecting the marine ecosystems of American Samoa.

The stakes were high. The grounding affected the people of Aunu'u every day the vessel remained on the reef: *No. 1 Ji Hyun* rested on one of the community's best fishing grounds. "This is an intact community that survives on what the reef provides," explains Gene Brighouse of National Marine Sanctuary of American Samoa. The vessel not only was destroying the reef, but fuel and two tons of loose sand onboard continued to pose a significant threat as well.

When the vessel first grounded, the Coast Guard and sanctuary staff worked together to respond to the event. But they faced some major challenges. The vessel could only be towed during daylight hours at high tide of at least three feet. During low tide it perched precariously, crushing the reef. Only two of the three tugs in Pago Pago harbor had the necessary towing capacity to remove the fishing boat, and they were in heavy demand: any large vessel, like a cruise ship or a cargo ship, that enters Pago Pago must be escorted by one of these tugs. And what's more, these tugs were built in the 1960's and are not set up for towing or salvage. The Coast Guard made several removal attempts, but ultimately, once any residual oil was removed from *No. 1 Ji Hyun*, jurisdiction was turned over to NOAA.

With the salvage now resting on sanctuary staff to get the job done, the sanctuary recognized the need for the village of Aunu'u's help. The village was key: it was up to Aunu'u residents to allow salvage contractors onto the island whenever weather and sea conditions cooperated for removal attempts, and it was up to them to keep community members from getting too close to the vessel. "You

The fishing vessel *No. 1 Ji Hyun* grounded on the coral reef just off the west side of Aunu'u Island in National Marine Sanctuary of American Samoa.

Photo: Joseph Paulin/NOAA

can never go wrong with having community engagement and getting their support," says Atuatasi Lelei Peau, deputy superintendent of National Marine Sanctuary of American Samoa and one of the sanctuary's leads for the vessel removal.

After several unsuccessful removal attempts, some in the village of Aunu'u were doubtful that NOAA would be able to remove the vessel. But Atuatasi, a high talking chief in his community in American Samoa, worked closely with Fonoti Simanu, a high chief from Aunu'u, to communicate the removal process. Fonoti is a member of the Sanctuary Advisory Council, and with his dual positions he served as an ideal go-between: as high chief, he serves as a voice of the village, while as Sanctuary Advisory Council member, he is familiar with the sanctuary and sanctuary staff. Fonoti was at the table for nearly every meeting about the removal process, while Atuatasi, too, attended village council meetings to keep the council up to speed.

Finally, on a calm, clear August day with light winds and just the right amount of surf, the sanctuary, along with the help of multiple partners, successfully removed the vessel. Set-up for the removal began before sunrise, as the crew lined up two tugs for a tandem tow and dealt with breaking lines. But once the vessel began to move, it came off in about a minute. "It went straight out, and it was almost like you couldn't believe what you were looking at, after hundreds of hours over the previous three months," says Joe Paulin, the sanctuary's conservation ecology and policy specialist. Two hours later, the team dropped the vessel off in the shipyard at Pago Pago harbor.

Now, the sanctuary is working to assess the damage the vessel did to the reef. While the vessel's hull stayed intact the entire time, it moved along the reef, turning coral to rubble. As part of the overall assessment, sanctuary staff are also determining lessons learned: the grounding has highlighted the need for greater response capabilities and supplies, and to create clearer processes for accountability from vessel owners who ground within sanctuary waters.

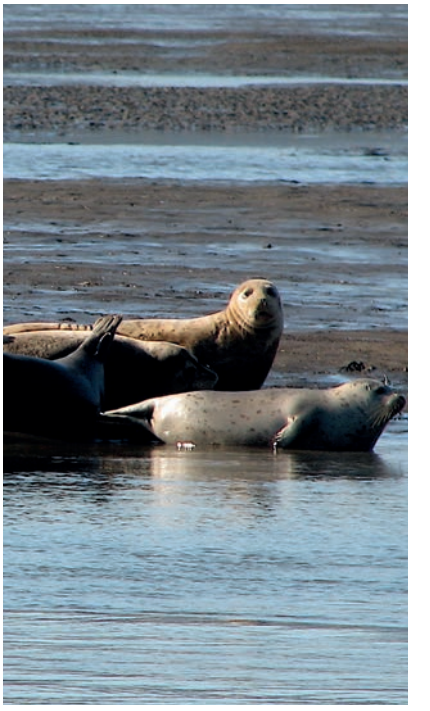
More than anything, the grounding has made it clear just how important it is to work with the local community. "The process should start with the village and it should end with the village," says Brighouse. While some in Aunu'u were originally reluctant to allow the sanctuary to expand into their waters back in 2012, the grounding was an opportunity to show how the sanctuary can help support their culture and their way of life. The sanctuary's work now, says Brighouse, "is to seize opportunities to really galvanize the community and their understanding."

BOLINAS LAGOON: A RESTORATION STORY

Bolinas Lagoon, a United Nations designated Wetland of International Importance located within Greater Farallones National Marine Sanctuary, provides rich habitat for shorebirds, waterfowl, fish, marine mammals, and invertebrates. Commercial fishermen, local residents, and visiting tourists are drawn to its beauty and wildlife. Unfortunately, historical land uses altered the shoreline and watershed, threatening the health of the lagoon and the businesses, people, and organisms that depend on it. Decades of grassroots efforts to protect Bolinas Lagoon gained national attention and led to current restoration efforts. Today, through sound science, community support, and collaborative planning, sanctuary managers and partners are actively implementing projects that protect the lagoon while helping it adapt to changes.

Bolinas Lagoon is home to many shorebirds, waterfowl, fish, marine mammals, and invertebrates.

Photo: Matt McIntosh/NOAA



Right (clockwise from top): University of San Francisco students volunteer for the Kent Island restoration project; harbor seals; staff from Greater Farallones NMS and their partners participate in an annual staff day to remove non-native species from Kent Island; marbled godwit; aerial shot of Bolinas Lagoon; sanderling

Photos: Kate Bimrose/Greater Farallones Association; May Chen; Kate Bimrose/Greater Farallones Association; Len Blumin; LightHawk and Bob Wilson; Len Blumin

BY THE PEOPLE, FOR THE PEOPLE

In 2014, the sanctuary nomination process opened for the first time in two decades. Now, the process empowers the people to whom sanctuaries matter most: new national marine sanctuaries are nominated by communities, rather than suggested to them. Here are just a few of the treasured places that the American people have nominated as potential new national marine sanctuaries.

A boat sails off of Dobbin's Landing in Erie, Pennsylvania, part of the proposed Lake Erie Quadrangle National Marine Sanctuary.

Photo courtesy of Erie County Planning Department

The proposed St. George Unangan Heritage National Marine Sanctuary encompasses part of the Pribilof Islands and a biologically rich area in the heart of the Bering Sea.

Photo: Joe Connelly

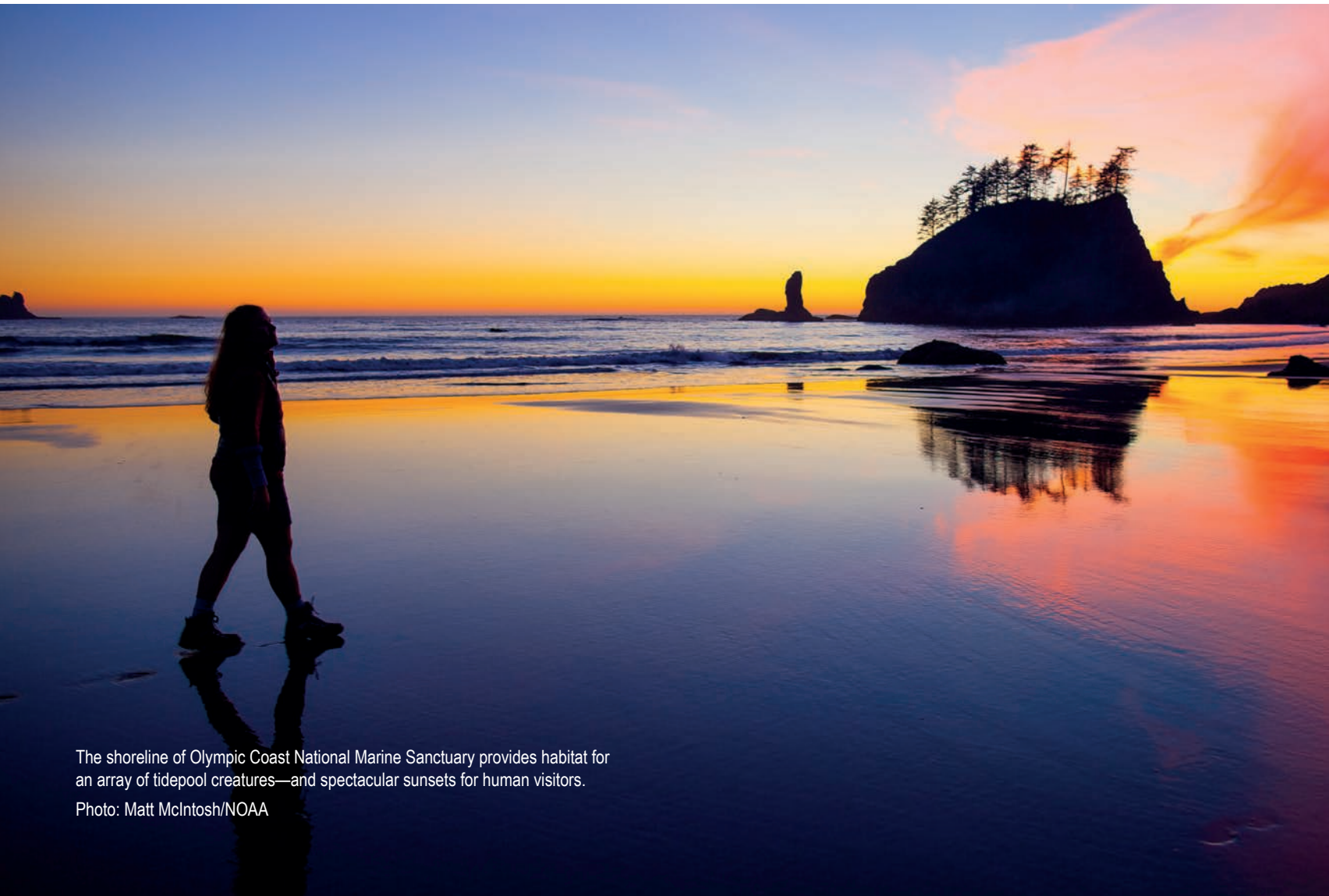
Through the sanctuary nomination process and public meetings, communities have the opportunity to guide the creation of new national marine sanctuaries.

Photo: Kate Thompson/NOAA

COMMUNITIES OF THE BLUE:

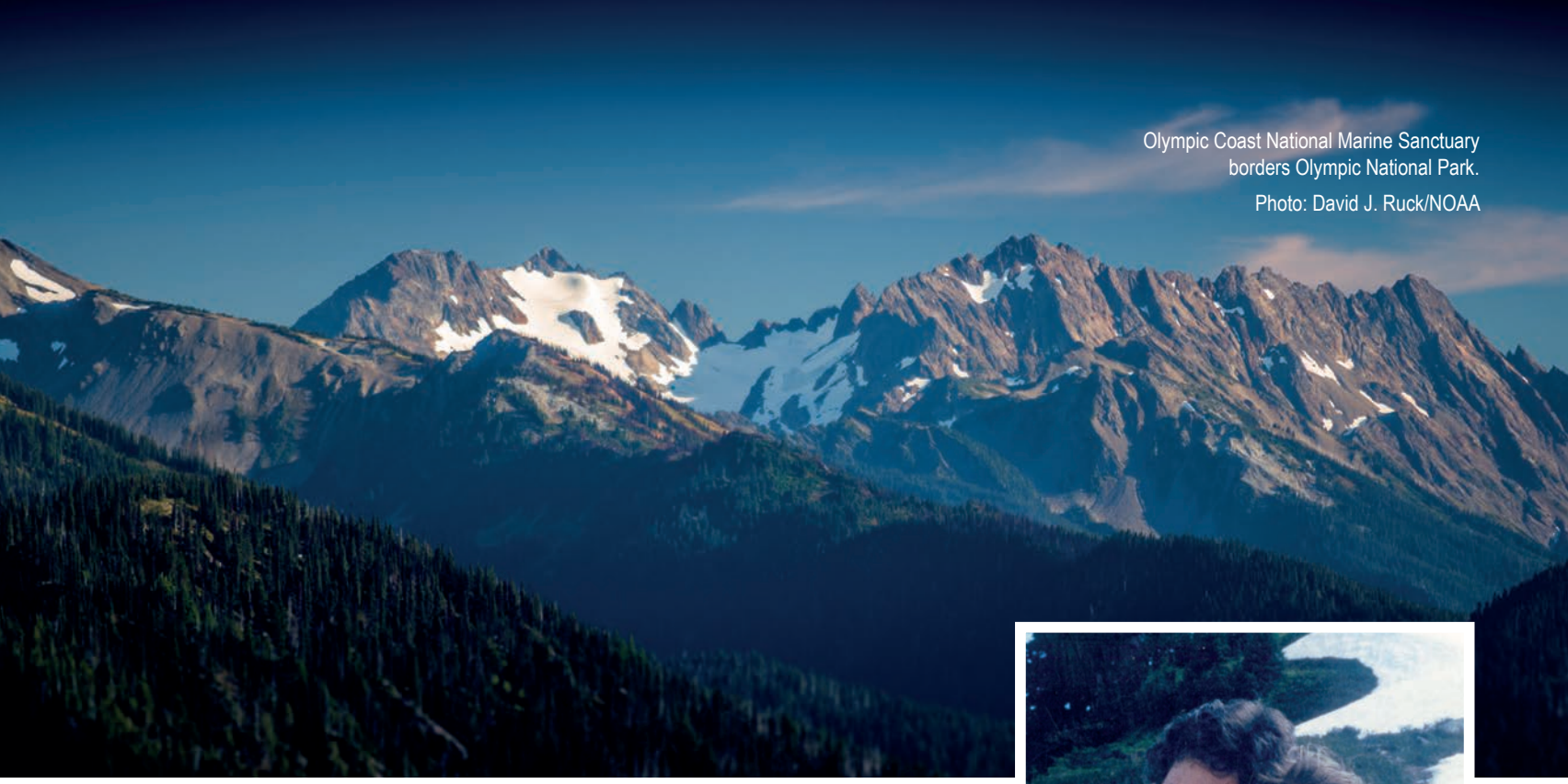
GATEWAYS TO OUR SANCTUARIES

— *By* ELIZABETH WEINBERG



The shoreline of Olympic Coast National Marine Sanctuary provides habitat for an array of tidepool creatures—and spectacular sunsets for human visitors.

Photo: Matt McIntosh/NOAA

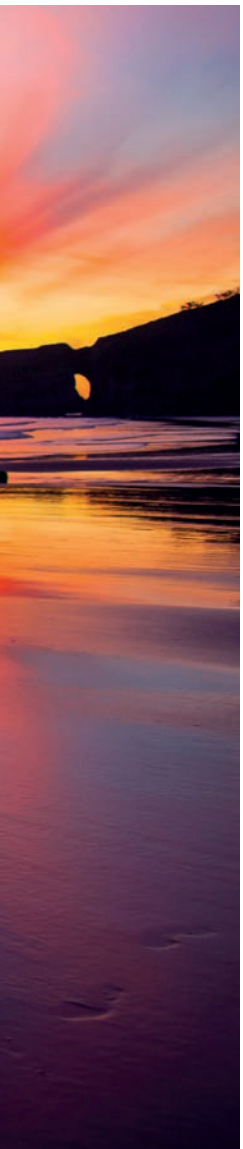


Olympic Coast National Marine Sanctuary borders Olympic National Park.

Photo: David J. Ruck/NOAA

Right photos: Olympic Coast National Marine Sanctuary superintendent Carol Bernthal first visited the Olympic Peninsula as a teenager.

Photos courtesy of Carol Bernthal



IT STARTS WITH COMMUNITIES

It wasn't until she was a teenager that Carol Bernthal first visited the ocean. A Wisconsin native, she traveled to Washington's Olympic Peninsula to visit her older brothers. Little did she know that that trip would change her life.

"After visiting the mountains we went out to La Push," she describes, "and we went out for a hike on the beach. And I just remember walking out onto this point and looking out at the ocean and just being kind of overwhelmed by the power and the history of this place."

That experience, she explains, set her down the course of working to protect the environment. Today, Bernthal serves as the superintendent of Olympic Coast National Marine Sanctuary, dedicating herself to protecting the marine communities off the coast of the Olympic Peninsula and supporting the human communities that depend on these ecosystems. With Bernthal at the helm, the sanctuary protects more than 3,000 square miles of ocean that serve as a home to marine mammals, seabirds, fishes, and other sea life.

Bernthal's experience is similar to that of so many people who have come to work in national marine sanctuaries, who volunteer to support them, who visit to watch wildlife or surf sanctuary waves. Visit a sanctuary like Olympic Coast and you can feel it: these places aren't just a glossy ocean view—they contain something far more profound.

Waves crash on the shoreline of Monterey Bay National Marine Sanctuary.

Photo: Chad King/NOAA

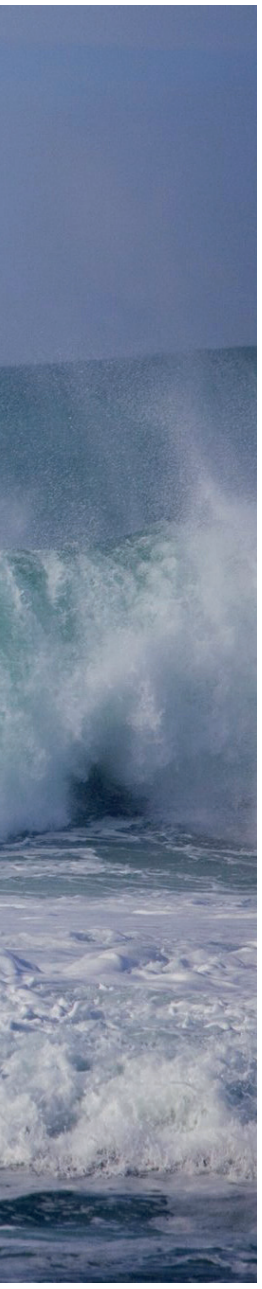
These iconic underwater places are the beating heart of the ocean and Great Lakes. From Stellwagen Bank off the coast of Massachusetts to National Marine Sanctuary of American Samoa all the way in the Southern Hemisphere, the sites of the National Marine Sanctuary System support rich ecosystems. In the system's more than 600,000 square miles, you can find communities of humpback whales feeding, mating, and raising their calves; lush coral reefs that support thousands of species of fish, invertebrates, and other organisms; kelp forests that shelter sea otters, crabs, sea urchins, sea stars, and sea lions—and so much more.

In addition to supporting rich biological communities, the ocean and Great Lakes serve a multitude of purposes for human communities. They provide our food. They help regulate our climate and weather and provide our fresh water and oxygen. They are key to our cultural heritage and history. They provide places for us to relax and serve as sources of rejuvenation. And so, sanctuaries are different things to different people: they are homelands, fishing grounds, or playgrounds; scientific laboratories or places to better ourselves. But no matter who you are, where you're from, and how you see your national marine sanctuaries, one thing is always true: when we help these ecosystems thrive, our communities thrive as well.

SUSTAINING CULTURES

Though national marine sanctuaries have been around for a little less than 50 years, these special marine places have been sustaining life for far longer. Many national marine sanctuaries, including American Samoa, Olympic Coast, and Channel Islands, have close partnerships with indigenous cultures who have inhabited these places for millennia and still call them home today. By working together, NOAA and these indigenous cultures help preserve whole maritime cultural landscapes, from key species to cultural resources.

Indigenous peoples depend on the resources within and around national marine sanctuaries for their survival. Gene Brighouse, of National Marine Sanctuary of American Samoa, explains, "The ocean is an important connection to the people of American Samoa in that we rely on resources that sustain our families and livelihoods." In places like the community of Aunu'u, one of the sanctuary's six protected areas, residents depend on reef fish and other organisms for food. Protecting sanctuary waters enables those in American Samoa to help protect key sources of nourishment.



Fa'a Samoa, or the Samoan way of life, is an integral part of National Marine Sanctuary of American Samoa.

Photo: Matt McIntosh/NOAA

Each year, the Chumash community crosses from California's Channel Islands Harbor to Limuw (Santa Cruz Island) in Channel Islands National Marine Sanctuary, using traditional plank canoes.

Photo: Robert Schwemmer/NOAA

Resources and culture are inextricably linked: by working together to protect sanctuary resources, members of indigenous cultures and sanctuary managers can help sustain important cultural practices. Brighouse explains that the land and ocean interface is an integral part of Samoan folklore and cultural identity, so by protecting the sea, the people of American Samoa protect their culture. Similarly, within Hawaiian Islands Humpback Whale National Marine Sanctuary "are many, many storied places that are tied to the culture of the people that are living here," explains Solomon Pili Kaho'ohalahala, chair of the sanctuary's advisory council. "We must care for this place and the stories must be cared for, the resources must be cared for, and now we have a responsibility as a sanctuary to look at these waters."

"That's the future—it's a collective," says Hanohano Nae'hu, Hui o Kuapā project director and land manager. Native Hawaiians, scientists, and the government have to "be on the same team, the same page. We're in this together. We want the same thing—we want to save our planet. We want to take care of our resources." Working together makes the most sense, he explains: "Science can make us smarter, but we believe native intelligence can make science smarter also."

Hanohano Nae'hu works to maintain a traditional Hawaiian fishpond and to preserve Native Hawaiian culture.

Photo: David J. Ruck/NOAA

SANCTUARIES FOR THE PEOPLE

"People protect what they love," Jacques Cousteau famously said. The National Marine Sanctuary System protects unique spots throughout our ocean and Great Lakes. But our ocean and our watersheds are all connected; sanctuaries and monuments can't protect our world's waters by themselves. To help the positive effects of marine protected areas reverberate beyond their borders, it takes a community of dedicated people.

That begins with science. To protect these ocean and Great Lakes treasures for future generations, we have to understand them—and research partnerships are crucial for that. "Collaborations that happen in sanctuaries solve problems that simply couldn't be overcome working in isolation," explains Dr. Steve Gittings, chief scientist for NOAA's Office of National Marine Sanctuaries. Scientific collaboration has helped sanctuaries like Stellwagen Bank National Marine Sanctuary reduce the threat of ship strikes to North Atlantic right whales. It can also help researchers track changing ocean conditions, like the effects of ocean acidification in sanctuaries like Olympic Coast.

But ocean conservation can't stop there: volunteer and stewardship opportunities in sanctuaries provide a huge variety of chances for people to give back to, and care for, the ocean and Great Lakes that they love so much. Sanctuary volunteers serve as citizen scientists, visitor center docents, divers, and more; they help clean up beaches, identify whales, and monitor water quality. With volunteers contributing more than 130,000 hours of their time annually, it's easy to see just how integral they are to protecting national marine sanctuaries for future generations.

Also with this in mind, each national marine sanctuary has its own advisory council to provide recommendations. These advisory councils represent a broad cross-section of the communities adjacent to national marine sanctuaries, ensuring that everyone gets a seat at the table. "Advisory councils are one way—a great way—for communities to be involved and increase their investment in these places and often their livelihoods," says Becky Holyoke, national advisory council coordinator of NOAA's Office of National Marine Sanctuaries. "Advisory council members serve as two-way streets. They bring their experiences to the table and help us ensure sanctuaries meet communities' needs, while in turn sharing information with their communities. All this helps us make the most informed decisions possible to protect these places and continue to support the communities that depend on them."

Clockwise (from right): Beach cleanup in Olympic Coast National Marine Sanctuary; Dr. Steve Gittings (at right), then superintendent of Flower Garden Banks National Marine Sanctuary; anglers in Florida Keys National Marine Sanctuary; volunteer divers in what would later become Flower Garden Banks National Marine Sanctuary, c. 1960.

Photos: Karlyn Langjahr/NOAA; courtesy of Steve Gittings; courtesy of Florida Memory Project; NOAA

GETTING TO KNOW YOUR SANCTUARIES

"Sanctuaries exist because they were appreciated as special places to begin with—something within them was worth protecting," explains Chiara Zuccarino-Crowe, the tourism and recreation coordinator at NOAA's Office of National Marine Sanctuaries. While some national marine sanctuaries are designated to protect key species or habitats, others protect historic maritime artifacts that offer a window into the past. All of these resources offer an opportunity for visitors to learn and play. "Adventurers and explorers don't seek out the mundane. They want to have an experience that is singular, that evokes wonder. Sanctuaries deliver that."

And that same sustainable tourism and recreation helps support strong economies. From 2010 to 2012, $156 million was spent annually on recreational fishing in the four California national marine sanctuaries. In 2014, $101.3 million was spent on recreation in the remote Olympic Coast National Marine Sanctuary alone. When these sites are protected, they gain recognition across the country and around the world, bringing important economic support to the communities that depend on them.

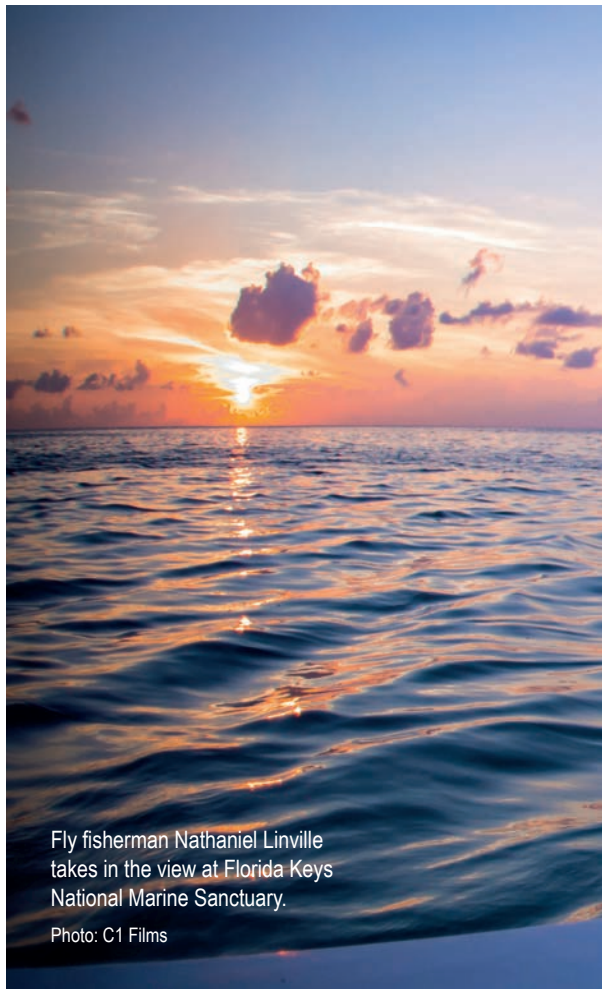
Protecting these special ocean and Great Lakes places also ensures that future generations of adventurers can have equally amazing experiences. Nathaniel Linville, fly fisherman and owner of The Angling Company, says, "I think that we have a really great thing with" Florida Keys National Marine Sanctuary. "You don't have tours or airboat rides running around the backcountry, but there is still a lot of commercial activity out there. If it wasn't for the regulation and thus the preservation provided by the sanctuary, this place would be finished."

ENSURING OUR OCEAN'S FUTURE

"Sanctuaries are the epicenters of communities that depend on and thrive from the greatness within and beauty of their waters," says Becky Holyoke. "The more communities engage with national marine sanctuaries, the more they understand their value and want to protect them."

We are all connected to the ocean. It brings us together; it provides us food and sustenance, relaxation and adventure. It covers 70 percent of our planet, and it's easy to think of it as so vast that nothing we do can possibly affect it. But the more we study it, the more we realize that just as we need the ocean, it needs us, and it will take all of us to protect it for generations to come.

The future of our communities—their economic resilience and their environmental integrity—depends on how we treat the ocean and Great Lakes today. By maintaining the iconic places of the National Marine Sanctuary System, we ensure that the ocean can remain a place of beauty and bounty for us all.



Fly fisherman Nathaniel Linville takes in the view at Florida Keys National Marine Sanctuary.

Photo: C1 Films

National Marine Sanctuary of American Samoa protects beautiful reefs and coves, such as this one in the island of Ofu.

Photo: Kate Thompson/NOAA

LIFE IN THE B

Life in the ocean is all about communities. Whether you're a triggerfish swimming in the coral reefs of Papahānaumokuākea Marine National Monument, or a loggerhead sea turtle exploring Gray's Reef National Marine Sanctuary, your survival depends on the health of your community's ecosystem.

In "Life in the Blue," take a trip to the West Coast, where kelp forests provide shelter and food for giant sea bass, sea lions, sea stars, sea urchins, and more. Holding the kelp forest ecosystem together is the sea otter, which keeps sea urchin populations—the major consumer of kelp—in check.

Then head to the live bottom reef of Gray's Reef National Marine Sanctuary to take in a technicolor view of an ocean floor teeming with life. Here, rocky sedimentary ledges provide a home for a diverse assemblage of invertebrates.

In warmer waters, visit the coral reefs of sites like Flower Garden Banks, American Samoa, and Florida Keys national marine sanctuaries, as well as Papahānaumokuākea Marine National Monument. Coral reefs are some of the most biodiverse ecosystems in the world, and support thousands of species.

What determines where these ecosystems occur? On page 50, learn how seafloor features like rocky banks and salt domes shape ocean habitats and serve as driving forces in ocean communities.

LUE

A diver and sea lion appraise one another in Olympic Coast National Marine Sanctuary.

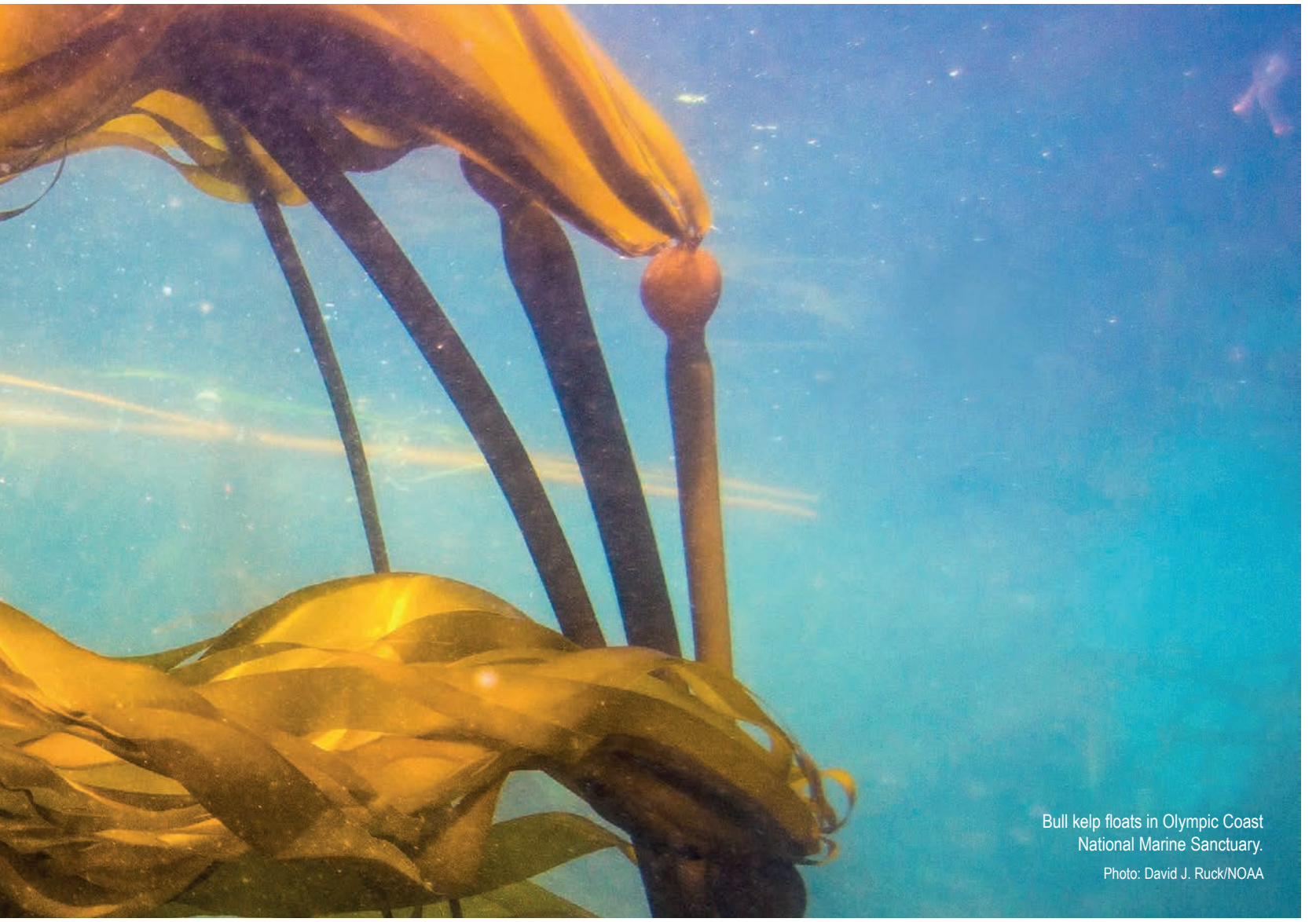
Photo: David J. Ruck/NOAA

KELP FORESTS

Dive into your West Coast national marine sanctuaries to discover magnificent kelp forests. Tiered like a terrestrial rainforest with a canopy and several layers below, kelp forests shelter an amazing array of life, from tiny invertebrates to the charismatic sea otter.

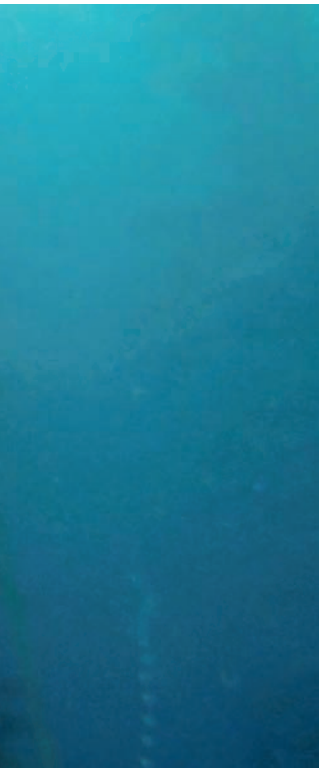
A tiny sea butterfly, or pteropod, floats in the kelp forest of Channel Islands National Marine Sanctuary.

Photo: Evan Barba



Bull kelp floats in Olympic Coast National Marine Sanctuary.

Photo: David J. Ruck/NOAA



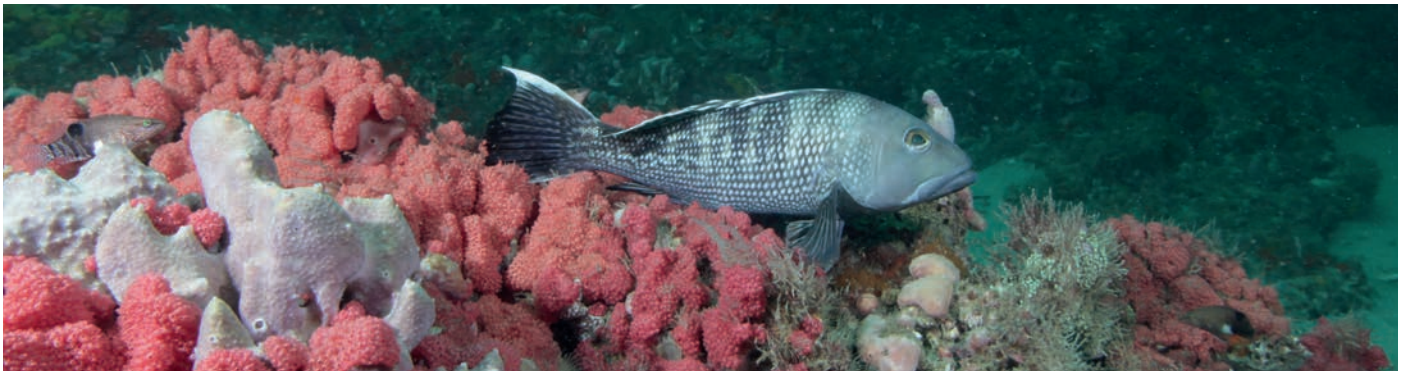
Kelp forests are home to striped seaperch, sea urchins, sea stars, and more in Channel Islands National Marine Sanctuary.

Photo: Kelly Teich

LIVE BOTTOM REEFS

Encounter a special kind of reef in Gray's Reef National Marine Sanctuary. Here, many colorful invertebrates—sea sponges, corals, sea squirts, and more—attach to the sea floor's rocky ledges, leading to its designation as a "live bottom" reef. This vibrant reef is home to many fish species and is a place for loggerhead sea turtles to forage and rest.

Moray eels hide in the crevices of the reef.
Photo: Greg McFall/NOAA



Clockwise (from top): Black seabass; *Callinectes* crabs; seaweed blenny; sea star; Christmas tree worms; soft corals

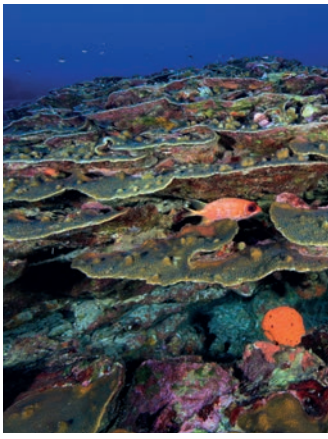
Photos: Greg McFall/NOAA

CORAL REEFS

Coral reef ecosystems are some of the most diverse ecosystems: thousands of species rely on them for survival. They are also crucial to human communities, protecting coastal populations from storm damage, supporting commercial fisheries, attracting tourists, and more.

Photos (below, left to right): NMS of American Samoa; Florida Keys NMS; Flower Garden Banks NMS; Papahānaumokuākea MNM; Flower Garden Banks NMS

Photos: Mark Manuel/NOAA; David J. Ruck/NOAA; Greg McFall/NOAA; James Watt/NOAA; G.P. Schmahl/NOAA



Located in the Ta'u unit of National Marine Sanctuary of American Samoa, "Big Momma" is one of the largest *Porites* coral heads in the world.

Photo: XL Catlin Seaview Survey

Salt domes form the foundation of the lush ecosystems of Flower Garden Banks National Marine Sanctuary.

Photo: Emma Hickerson/NOAA

UNDERSEA ARCHITECTURE

— *By* ELIZABETH WEINBERG

Say you're a coral gamete drifting through the water or a Dall's porpoise looking for fish to eat. How do you decide where to spend your time?

Location, location, location.

Throughout the world's ocean, relatively barren plains give way to mountainous features called banks and seamounts. These transitions in ocean topography can make a big difference: many seamounts and banks teem with life, and for that reason, several of them are protected within the National Marine Sanctuary System.

In California, Cordell Bank National Marine Sanctuary protects a large bank that rises from the soft sediments of the continental shelf at depths of 300 to 400 feet and reaches to within 115 feet of the ocean's surface. Each spring and summer, strong northwest winds and the south-flowing California Current drive surface waters away from shore, making way for deep, nutrient-rich offshore water to upwell in its place. As it moves over Cordell Bank, this upwelled water fuels an explosion of life, powering the production of phytoplankton and zooplankton that feed the fish, seabirds, invertebrates, and marine mammals found around the bank and throughout the sanctuary. Thanks to its ideal location, Cordell Bank hosts life in technicolor, with strawberry anemones, hydrocorals, sponges, and more all competing for space and nutrition.

The seafloor landscape of Flower Garden Banks National Marine Sanctuary supports a different, but equally lush, ecosystem. Unlike the granite reef of Cordell Bank, the Flower Garden Banks are actually formed by salt domes that push the sea floor upward. These domes formed about 190 million years ago when the Gulf of Mexico was a shallow sea and hot temperatures caused evaporation, depositing a thick layer of salt on the seafloor. This salt layer was later covered by mud, sand, and silt deposits, and over time, these dense layers put pressure on the salt deposits. The more buoyant salt deposits forced themselves through areas of weakness in the overlying sediments, forming domes that rise from more than 400 feet deep to within 60 feet of the sea surface.

Roughly 10,000 to 15,000 years ago, coral reefs began developing on top of the salt domes beneath the East and West Flower Garden Banks. The hard surface of the seabed pushed up by the salt domes served as the perfect place for coral gametes to attach, and the clear, warm, sunlit water above the domes and the area's steady food supply allowed the reefs to flourish. Today, the sanctuary protects some of the world's healthiest coral reefs.

Seafloor features are significant in the deep ocean, too. The recently expanded Papahānaumokuākea Marine National Monument protects a number of deep-sea volcanic seamounts, some of which are nearly 16,000 feet high—over half the height of Mt. Everest. While much of the surrounding seafloor is soft mud, the exposed rock ledges found on seamounts serve as the perfect place for deep-sea corals to attach. Plus, by sticking up above the seafloor, seamounts often intercept and cause acceleration of water flow, bringing more food into the waiting mouths of deep-sea organisms. With these unique habitat features, seamounts can serve as oases of diverse, and often record-breaking, life—in 2015, scientists discovered the largest sponge in the world on a seamount in Papahānaumokuākea!

The sites of the National Marine Sanctuary System harbor unique and exceptional ecosystems, each distinct from the others. And many have one thing in common: their extraordinary seafloor features make essential habitat, food, and shelter available to hard bottom marine organisms and the rich communities of wildlife they attract.

Upwelling water flows over the large bank of Cordell Bank National Marine Sanctuary, fueling an explosion of life.

Photo: Robert Lee/BAUE

EXPLORE THE

Much of what happens in the National Marine Sanctuary System occurs out of sight, beneath the waves. Through science and research, we can better understand how marine communities function—and once we understand them, we can better protect them.

In "Explore the Blue," learn how monitoring ocean noise in sanctuaries is enabling researchers to better understand the effects of anthropogenic noise on marine life. Discover how long-term monitoring capability and local partnerships make it possible for sanctuaries to respond to shifting ocean conditions and ecosystem emergencies.

It's hard to truly understand and track ecosystems and maritime heritage artifacts from a distance. Throughout the decades, diving operations have made it possible for scientists all across the National Marine Sanctuary System to study conditions and key species. On pages 56-57, check out some of the recent research projects NOAA divers have been working on.

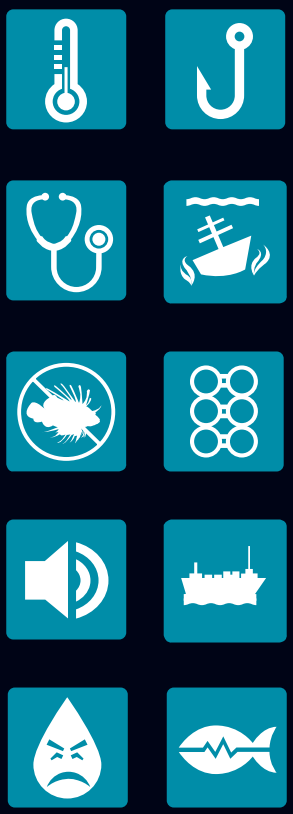
Plus, new technology is making it possible for scientists—and the public—to study parts of the ocean that divers can't reach. Research vessels like the NOAA Ship *Okeanos Explorer* and the Ocean Exploration Trust's E/V *Nautilus* are equipped with remotely operated vehicles and telepresence capabilities. Using robotics, researchers on these vessels can venture deeper into the ocean than ever before, and can bring high-definition video and photos back to shore in real time. In this section, learn about recent expeditions that have brought sanctuary resources to the public in real time using telepresence.

BLUE

A research diver documents the vibrant habitat of California's Cordell Bank National Marine Sanctuary.

Photo: Joe Hoyt/NOAA

SENTINEL SITES



Located across the country, the sites of the National Marine Sanctuary System offer the opportunity to monitor, observe, and investigate the ocean and Great Lakes on a local, regional, and national scale. These "sentinel sites" can provide early warning capabilities for detecting changes to ecosystem processes and conditions. The above icons identify the issues and threats common to multiple sites: climate change and ocean acidification, fishing impacts, human health, integrity of heritage resources, invasive species, marine debris, noise, vessel impacts, water quality, and wildlife health. For more information, visit sanctuaries.noaa.gov/mag/sentinel-sites.

LISTENING IN

— *By* ELIZABETH WEINBERG

What do a 100-ton blue whale and a three-centimeter snapping shrimp have in common? SOUND.

Beneath the surface, the signals we take for granted above the water, like light and smell, are obscured by waves, darkness, and turbidity. But sound travels farther underwater than it does on land—even the smallest of sounds can travel for miles. From tiny snapping shrimp that can create a sound louder than a jet engine to enormous blue whales that vocalize in highly-structured rumbles, many marine animals rely on sound to gather and understand information about their marine environment.

But over the last century, the soundscape beneath the waves has changed considerably. As humans increasingly use the ocean for shipping, recreational boating, energy exploration, military defense operations, and more, the ocean has become a noisier place. Think of how hard it can be to concentrate or hear your friends in a bustling coffee shop or with the drone of an airplane engine nearby. For many marine creatures, that noisy coffee shop is an everyday reality that they cannot escape.

A humpback whale mother and calf swim in the waters of Hawaiian Islands Humpback Whale National Marine Sanctuary.

Photo: NOAA, under NOAA permit #14682-38295

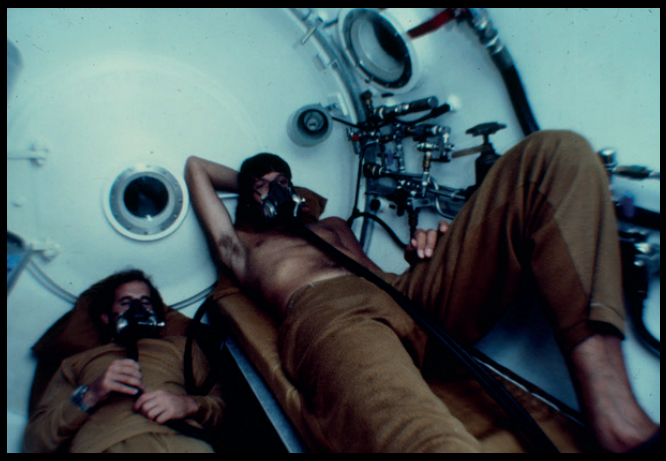
Scientific research has shown that anthropogenic, or human-sourced, noise is making it harder for animals to hear the sounds they depend on for navigation, locating food, finding mates, and avoiding predators—which in turn makes it harder for them to survive. Anthropogenic noise can also make it harder for groups of marine animals, like a pod of dolphins or a family of orcas, to communicate and build strong communities. And at its worst, noise from acute sound sources like airgun blasts can cause physical injury like hearing loss or tissue damage.

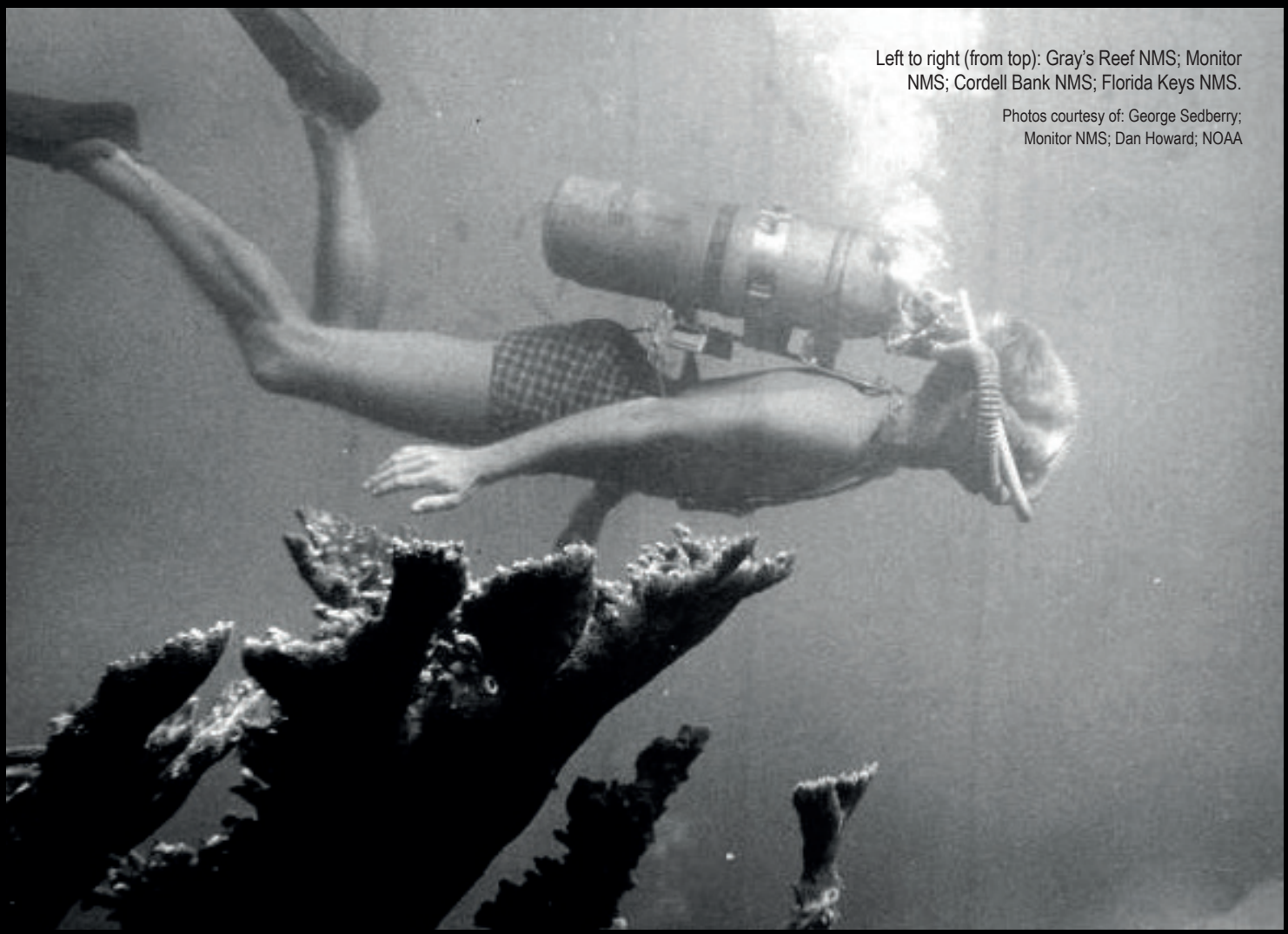
The good news is that the problem with ocean noise can stop if we simply turn down the volume. With that in mind, scientists in the National Marine Sanctuary System are working to understand how noise affects organisms that live within these protected areas so that noise can be better managed within their boundaries.

Recently, sanctuary scientists deployed deep and shallow water hydrophones at several national marine sanctuaries to compare soundscapes over time and at different sanctuary sites. Because each marine species makes specific, identifiable sounds, passive acoustic hydrophones can help scientists understand what species live in sanctuaries and how they use sound to communicate. Dr. Leila Hatch, a marine ecologist at Stellwagen Bank National Marine Sanctuary and co-lead of the NOAA Ocean Noise Strategy initiative, explains that "these comparisons are highlighting peak time periods for animal vocalization behavior, like lunar patterns in fish sound production and the seasonal presence of vocalizing baleen whales. They also highlight year-round calling within areas that support feeding by deep-diving toothed whales or resident fish and invertebrates."

In addition to sound generated by marine life, the hydrophones also record man-made noise. Hatch says that the "recorders are documenting contributions to sanctuary soundscapes by human activities, including both close and distant noise from large commercial ships, research vessels, geological and geophysical surveying, and other sources." Tracking noise sources will help sanctuary managers characterize the impacts of different human activities on sanctuary organisms. This in turn allows them to select the most useful tools, ranging from voluntary guidelines to new regulations, to prevent or minimize wildlife impacts.

"Noise doesn't just affect individual marine animals, it affects the functioning of entire communities, and ultimately, ecosystems," explains Hatch. "Sanctuaries can serve as sentinel sites for the development of new scientific and policy tools that serve the need for place-based protection from ocean noise impacts. And those tools then can be applied throughout the world in places facing similar challenges."



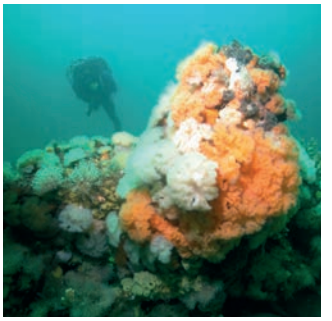


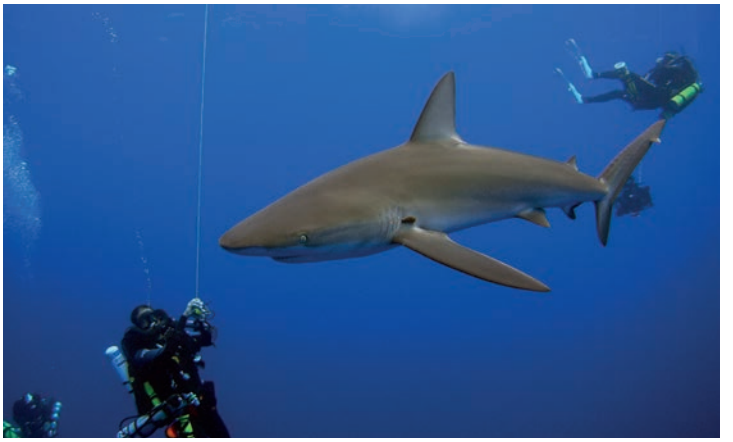
Left to right (from top): Gray's Reef NMS; Monitor NMS; Cordell Bank NMS; Florida Keys NMS.

Photos courtesy of: George Sedberry; Monitor NMS; Dan Howard; NOAA

DIVING AS A TOOL FOR SCIENCE AND RESEARCH

The development of scuba equipment opened up the marine world to scientists and adventurers alike. Many of the incredible ecosystems and maritime heritage sites protected by the National Marine Sanctuary System were first explored by divers, who strove to protect these beautiful places. Today, volunteers and NOAA staff rely on scuba equipment to dive deeper and perform critical scientific research to better understand our national marine sanctuaries and marine national monuments.



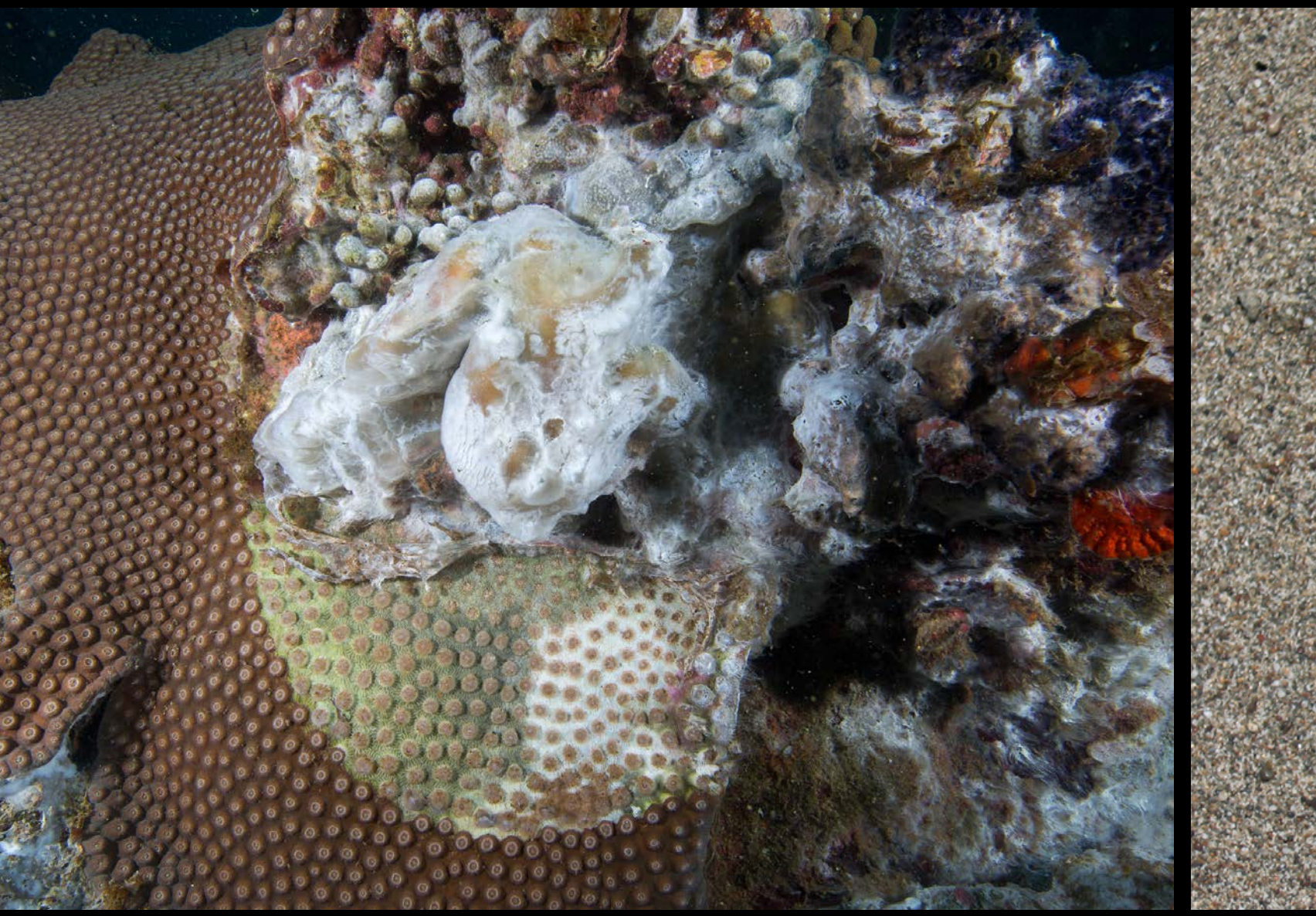


Left to right (from top): Cordell Bank NMS; Stellwagen Bank NMS; Monitor NMS; Gray's Reef NMS; Stellwagen Bank NMS; Flower Garden Banks NMS; Florida Keys NMS; Monitor NMS; Papahānaumokuākea MNM

Photos: Clinton Bauder/BAUE; Matthew Lawrence/NOAA; NOAA; Greg McFall/NOAA; NOAA; G.P. Schmahl/NOAA; Greg McFall/NOAA; NOAA; NOAA and Richard Pyle/Bishop Museum

SANCTUARIES AS RESPONDERS

With monitoring programs in place, national marine sanctuaries are ideally positioned to respond to unusual events and emergencies.



In 2016, sport divers in Flower Garden Banks National Marine Sanctuary reported hazy water, decomposing corals and sponges, and dead animals at their dive site. They alerted sanctuary scientists who were working nearby, unaware of the very localized event. The group quickly documented the die-off and alerted the global scientific community, receiving many suggestions and offers of help. To date, no definitive cause has been found. Based on conditions at the time, it may be tied to a combination of stressors, including high temperatures, heavy coastal rains that reduced salinity, and low oxygen—or something not yet considered. The initial mortality was extremely localized, affecting just one percent of the sanctuary's coral reef. It was sudden, and ended quickly, but the scientists have not given up on figuring out what happened.

Photo: G.P. Schmahl/NOAA

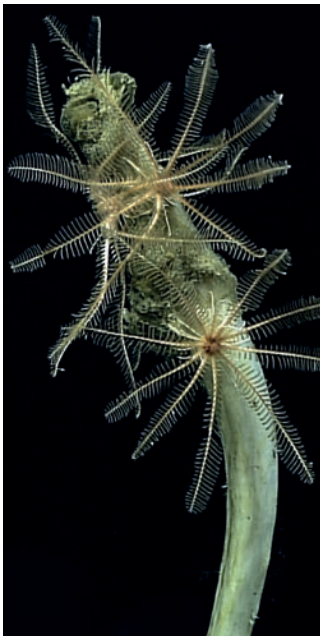
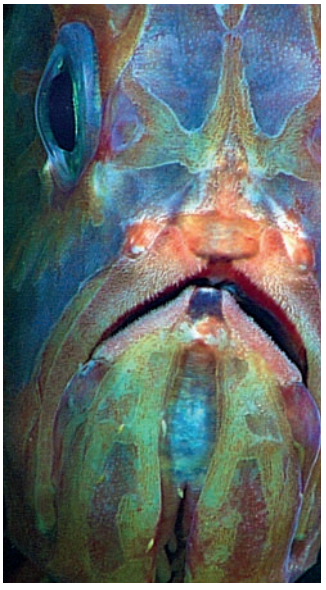
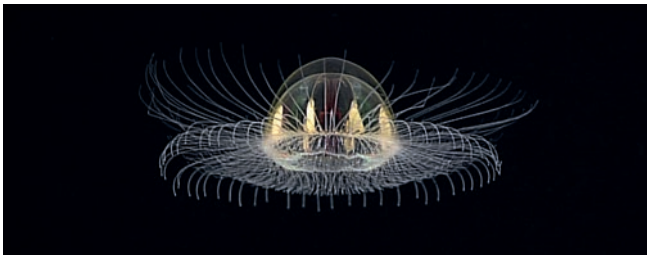
When hundreds of Cassin's auklets showed up dead on the shores of Greater Farallones National Marine Sanctuary in 2014 and 2015, Beach Watch volunteers were on the scene. Through this citizen science program, the sanctuary trains volunteers to monitor stretches of shoreline on a monthly basis. This long-term data set is crucial to establishing baseline conditions that can in turn help researchers understand and respond to changes and crises. Beach Watch citizen scientists recorded data for what turned out to be the largest Cassin's auklet die-off that has ever been documented on the West Coast. Today, their data are helping scientists understand what happened: they believe it was highly correlated with sudden shifts in food availability due to the presence of unusually warm water.

Photo: NOAA








BRINGING THE BLUE TO YOU

You don't have to go to sea to experience the wonders of the ocean. Ship-to-shore telepresence expeditions throughout the National Marine Sanctuary System bring these incredible ecosystems to people around the world. The NOAA Office of National Marine Sanctuaries partners with NOAA's Office of Ocean Exploration and Research and the Ocean Exploration Trust to unlock the secrets of the blue.

Above (from top): Students and facilitators watch the *Okeanos* live feed in the classroom; remotely operated vehicles aboard *Okeanos*; NOAA Ship *Okeanos Explorer.* Opposite page (left to right, from top): Siphonophore, Papahānaumokuākea MNM; Venus fly trap anemone, NMS of American Samoa; scorpionfish, NMS of American Samoa; octopus, Channel Islands NMS; wolf eel, Channel Islands NMS; stubby squid, near Channel Islands NMS; crinoids on dead sponge stalk, Papahānaumokuākea MNM; *Hoplostethus crassispinus*, Papahānaumokuākea MNM; jelly, near NMS of American Samoa; sea star, Channel Islands NMS

Photos (above): Marine Science Institute, University of California, Santa Barbara; NOAA; NOAA. Photos (opposite page): NOAA, NOAA, NOAA, OET/NOAA, OET/NOAA, OET/NOAA, NOAA, NOAA, NOAA, OET/NOAA

THE BLUE AN

The National Marine Sanctuary System protects more than 600,000 square miles of ocean and Great Lakes waters—but we can't do it without you.

In this section, hear from Xploration Nature Knows Best host and Big Blue & You cofounder Danni Washington about the importance of fostering connections to the ocean in young people and creating a more inclusive ocean conservation movement. "By exposing youthful minds to our sanctuaries," Washington explains, "we are inspiring the next generation to fall in love with these aquatic treasures."

Then, take flight with Stellwagen Bank National Marine Sanctuary's Stellwagen Sanctuary Seabird Stewards program. These intrepid volunteer citizen scientists collect data on the sanctuary's seabirds, which in turn help sanctuary scientists and managers understand seabird populations over time.

Through K-12 education, sanctuaries help energize and teach the next generation of ocean stewards. Learn how across the country, Ocean Guardian schools are making commitments to the protection of local watersheds and the ocean through school- and community-based projects. And check out the Winged Ambassadors program, a partnership between Cordell Bank National Marine Sanctuary, Papahānaumokuākea Marine National Monument, and Oikonos Ecosystem Knowledge. This innovative program uses the charismatic albatross to teach ocean literacy to students grades six through 12.

D YOU

Visitors enjoy tidepooling in Olympic Coast National Marine Sanctuary and Olympic Coast National Park.

Photo: David J. Ruck/NOAA

Photo: Diana Larrea

Left: Danni Washington enjoys The Big Blue & You's annual ArtSea Festival in Miami, Florida. Right: Washington (back row, right) joins a local school group at the ArtSea Festival as they hold up blue marbles provided by Blue Mind's Dr. Wallace J. Nichols.

Photo: Laura Johnson

DO YOU SEA LOVE?

— *By* DANNI WASHINGTON

An ocean advocate, the TV host of *Xploration Nature Knows Best*, and co-founder of the Big Blue & You

Water has no boundaries. It is the physical element that reminds us of our interconnectedness with one another and all life on Earth. The ocean represents the vast expanse of knowledge that we have yet to understand. It wouldn't be surprising if a majority of those reading this believe they possess a well-established and positive affinity for the sea. With that thought in mind, consider one question: Do you believe most of the human population genuinely LOVES the ocean?

With more intensity each day, we are being pummeled with bad news about the future of our seas, water resources, and overall health of our planet. The public should be sufficiently alarmed about the danger of an unhealthy ocean and encroaching sea level rise. But honestly, how can someone be alarmed if they don't have a personal connection or feel the impacts on an individual level?

In order to embrace the place that covers three-fourths of our planet, each of us must explore the blue frontier for ourselves. With over 600,000 square miles of underwater parks, the National Marine Sanctuary System provides the perfect opportunity for anyone who desires to connect with the ocean. But even with open access, it is important to acknowledge that certain groups may have disadvantages and vulnerabilities that can limit their exposure to the sea. Inclusivity and creativity are required in order to inspire people of every gender, race, age, and economic status to experience the wonder of the ocean.

As more data reveal the repercussions of human activity negatively impacting Earth's natu-

ral balance, we are faced with a choice. As simple as it sounds, we can either choose to wallow in pessimism believing that life itself is doomed forever or we can decide to create possibilities of a more sustainable future. In order to achieve the latter, we need every passionate, skilled, and talented ocean enthusiast to put in mindful work to help solve the biggest challenges threatening the Big Blue.

This work must begin with young people who are unyielding creators of hope and optimism. By exposing youthful minds to our sanctuaries, we are inspiring the next generation to fall in love with these aquatic treasures. The good news is that, in spite of the anthropogenic pressure, the ocean is intrinsically resilient. We know that marine ecosystems will continue to change, adapt, and evolve. Young leaders are the strongest catalysts to forge new ideas about how our global community can truly appreciate and protect what we love.

We need every individual who cares to assist in providing inclusive opportunities to awaken a new collective consciousness that emboldens everyone to feel a heartfelt connection to the sea. Every action counts. Let's work together to affirm the right for all people to have access to clean and healthy oceans. We must act expeditiously to encourage respectful coexistence with our blue planet simply because our survival depends on it.

Learn more about educational opportunities in sanctuaries at sanctuaries.noaa.gov/education, and about Washington's work to bring the ocean to everyone at danniwashington.com, seayouthriseup.org, and bigblueandyou.org.

Clockwise (from top right): Volunteers and staff at the annual Christmas Bird Count; northern gannet; yellow-bellied flycatcher rests on the head of a volunteer; two Stewards with binoculars; humpback whales and great shearwaters feeding on sand lance

Photos: NOAA; Rob MacDonald; Andy Martinez; Evelyn Ganson; Jeremy Winn, under NOAA Fisheries Permit #605-1904

STELLWAGEN SANCTUARY SEABIRD STEWARDS

Since 2011, a devoted community of birders has helped pioneer a year-round, systematic seabird survey in the wildlife-rich waters of Stellwagen Bank National Marine Sanctuary. Their efforts have helped reveal previously unknown details about these avian world-travelers and how they can serve as barometers of change in the marine environment. The Stellwagen Sanctuary Seabird Stewards have spent more than 6,000 hours (and counting!) collecting and analyzing data and reaching out to local New England communities to share their passion for seabirds and to communicate the importance of the sanctuary to birds and humans alike.

Great shearwaters travel 12,000 miles a year to feed in Stellwagen Bank National Marine Sanctuary. Seabirds like these help researchers understand ecosystem health.

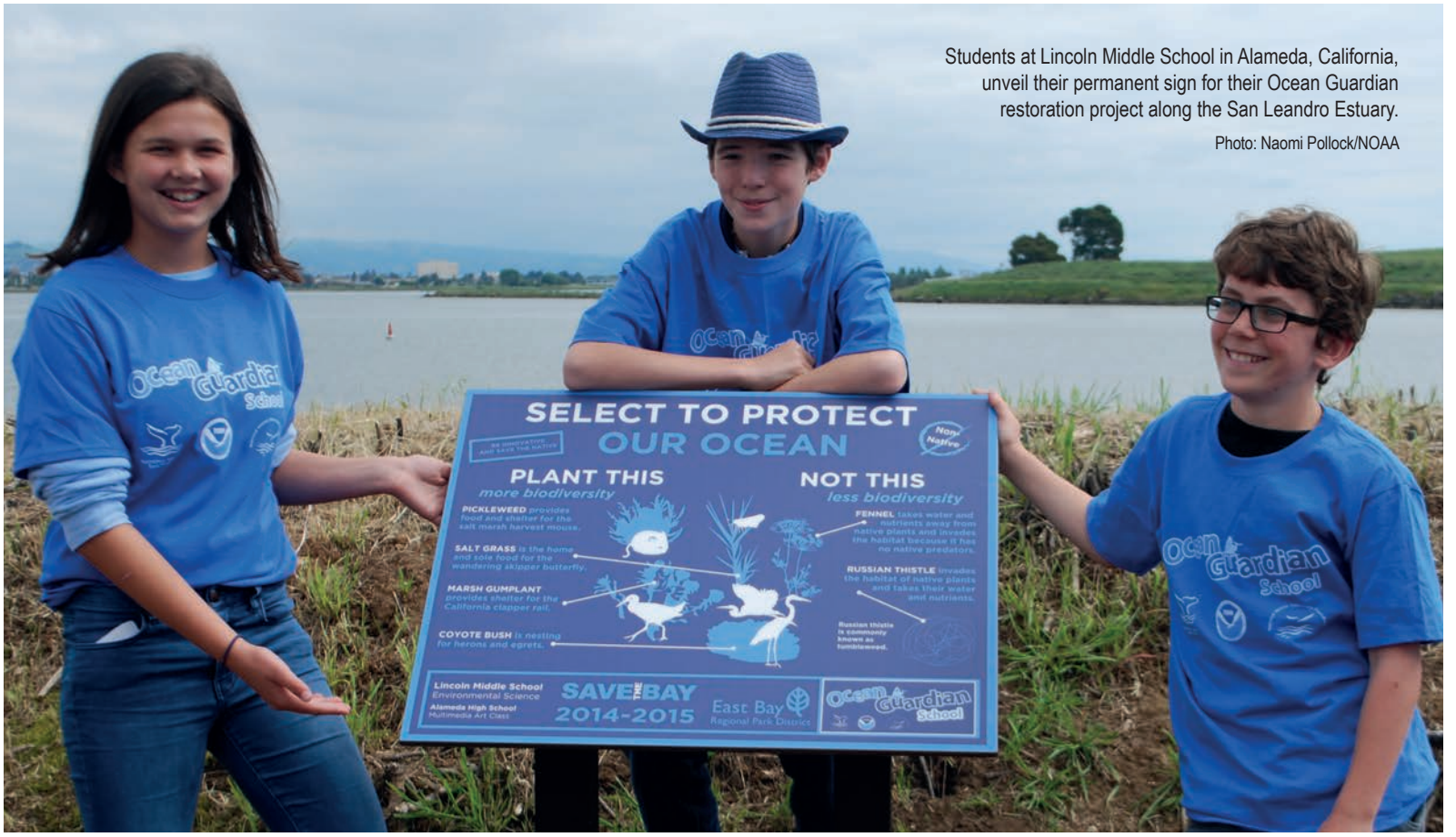
Photo: Elliot Hazen, under NOAA Fisheries Permit #14245

Gault Elementary School students restore a coastal area by removing non-native invasive plants and planting native species.

Photo: Naomi Pollock/NOAA

THE NEXT GENERATION OF GUARDIANS FOR OUR OCEAN

The National Marine Sanctuary System's Ocean Guardian program encourages students to explore their natural surroundings to form a personal connection to the ocean or watersheds where they live. Ocean Guardian Schools work within their communities to protect and conserve local watersheds, the ocean, and special ocean areas like national marine sanctuaries.



Students at Lincoln Middle School in Alameda, California, unveil their permanent sign for their Ocean Guardian restoration project along the San Leandro Estuary.

Photo: Naomi Pollock/NOAA

Students from J.C. Parks Elementary School in Indian Head, Maryland, found a crustacean while exploring their local watershed.

Photo: Naomi Pollock/NOAA

Clockwise (from top right): A mass of indigestible material, known as a bolus, from an albatross chick; students and sanctuary staff dissecting bolus; NOAA Marine Debris team cleaning a beach in Papahānaumokuākea MNM; items that can be found in a bolus.

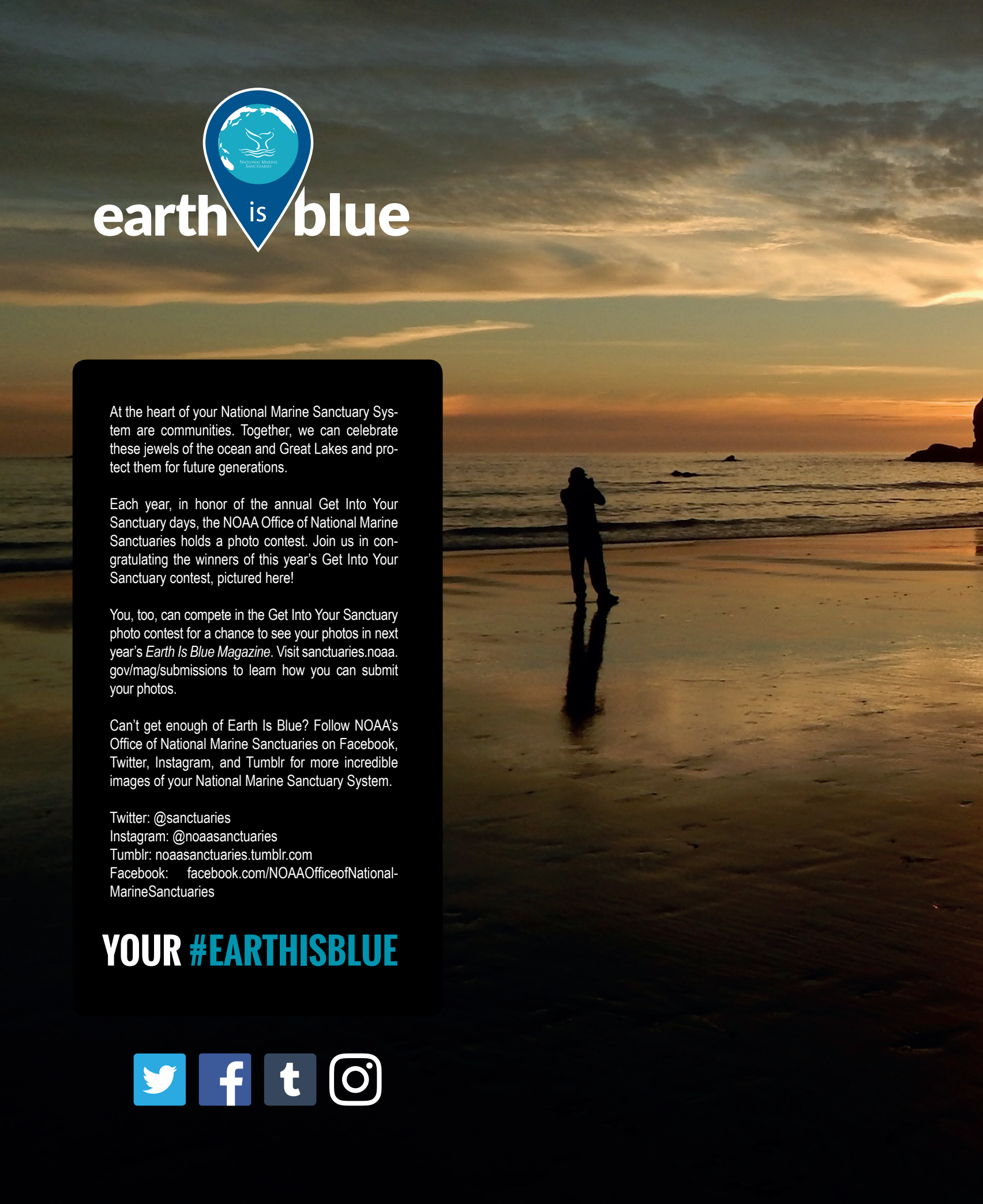
Photos: David Liittschwager; Gina Schilling; Ryan Tabata/NOAA; David Liittschwager

WINGED AMBASSADORS

What connects California and Hawai'i? Seabirds! Some species of albatross travel between the food rich-waters of Cordell Bank National Marine Sanctuary and the perfect breeding climate of Papahānaumokuākea Marine National Monument. As they traverse vast oceanic regions searching for floating food, many albatrosses ingest plastic trash, which can harm or even kill them. The *Winged Ambassadors: Ocean Literacy through the Eyes of Albatross* curriculum teaches students to use real data to track albatross travels and to identify human-caused threats such as ocean plastic pollution, and how to reduce these threats. This curriculum was created in partnership with Cordell Bank National Marine Sanctuary, Papahānaumokuākea Marine National Monument, and Oikonos Ecosystem Knowledge.

The Laysan albatross (top) and the black-footed albatross (bottom) breed in Hawai'i, but return to the rich waters of California to feed.

Photos: Daniel Dietrich



earth is blue

At the heart of your National Marine Sanctuary System are communities. Together, we can celebrate these jewels of the ocean and Great Lakes and protect them for future generations.

Each year, in honor of the annual Get Into Your Sanctuary days, the NOAA Office of National Marine Sanctuaries holds a photo contest. Join us in congratulating the winners of this year's Get Into Your Sanctuary contest, pictured here!

You, too, can compete in 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, and Tumblr for more incredible images of your National Marine Sanctuary System.

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Facebook: facebook.com/NOAAOfficeofNationalMarineSanctuaries

YOUR #EARTHISBLUE

Winner of the "Sanctuary Portraits" category: A photographer captures the sunset at Second Beach in La Push, at Olympic Coast National Marine Sanctuary.

Photo: Selah Preskey Martin

Winner of the "Sanctuary Views" category: The sun sets on a *foaga* site on Tutuila Island, National Marine Sanctuary of American Samoa. The basins in this volcanic rock were worn by people making stone tools.

Photo: Jason Jaskowiak

Winner of the "Sanctuary Life" category: This young Brandt's cormorant was photographed preening on the rocks on the Coast Guard Pier in Breakwater Cove Marina, in Monterey Bay National Marine Sanctuary.

Photo: Christina Parsons

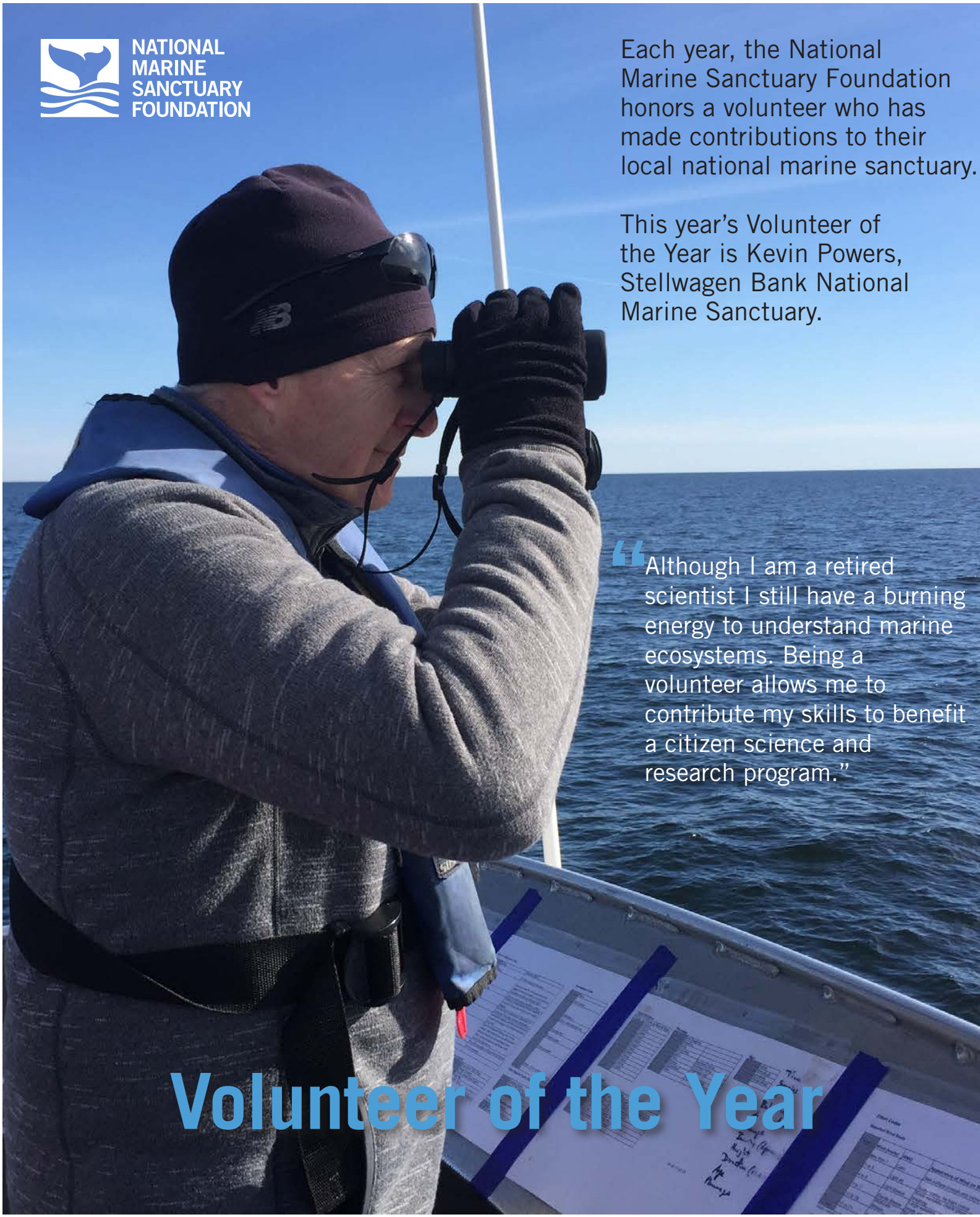
"The ocean is everything I want to be. Beautiful, mysterious, wild and free."

Liz Love Scholarship Fund

National marine sanctuaries protect our ocean for everyone, and for many young people, experiencing these ocean treasures can change their life. For Liz Love, that was especially true. Working at the Catalina Island Marine Institute as a marine biology instructor in California's Channel Islands as a young woman set her on a career path toward ocean conservation and education. For 23 years, she served as the education and outreach coordinator at Monterey Bay National Marine Sanctuary.

In memory of Liz's passion for marine education and mentoring the next generation of scientists, the Liz Love Scholarship Fund helps cultivate scientific curiosity and support educational experiences for young women. The fund supports young women who would not otherwise be able to afford attendance at Catalina Sea Camp, which is located near Channel Islands National Marine Sanctuary.

To learn more about the scholarship or to donate, email seaforwardfund@gmail.com.



NATIONAL MARINE SANCTUARY FOUNDATION

Each year, the National Marine Sanctuary Foundation honors a volunteer who has made contributions to their local national marine sanctuary.

This year's Volunteer of the Year is Kevin Powers, Stellwagen Bank National Marine Sanctuary.

"Although I am a retired scientist I still have a burning energy to understand marine ecosystems. Being a volunteer allows me to contribute my skills to benefit a citizen science and research program."

Volunteer of the Year

earth is blue™

Magazine of the National Marine Sanctuaries

VOLUME 2

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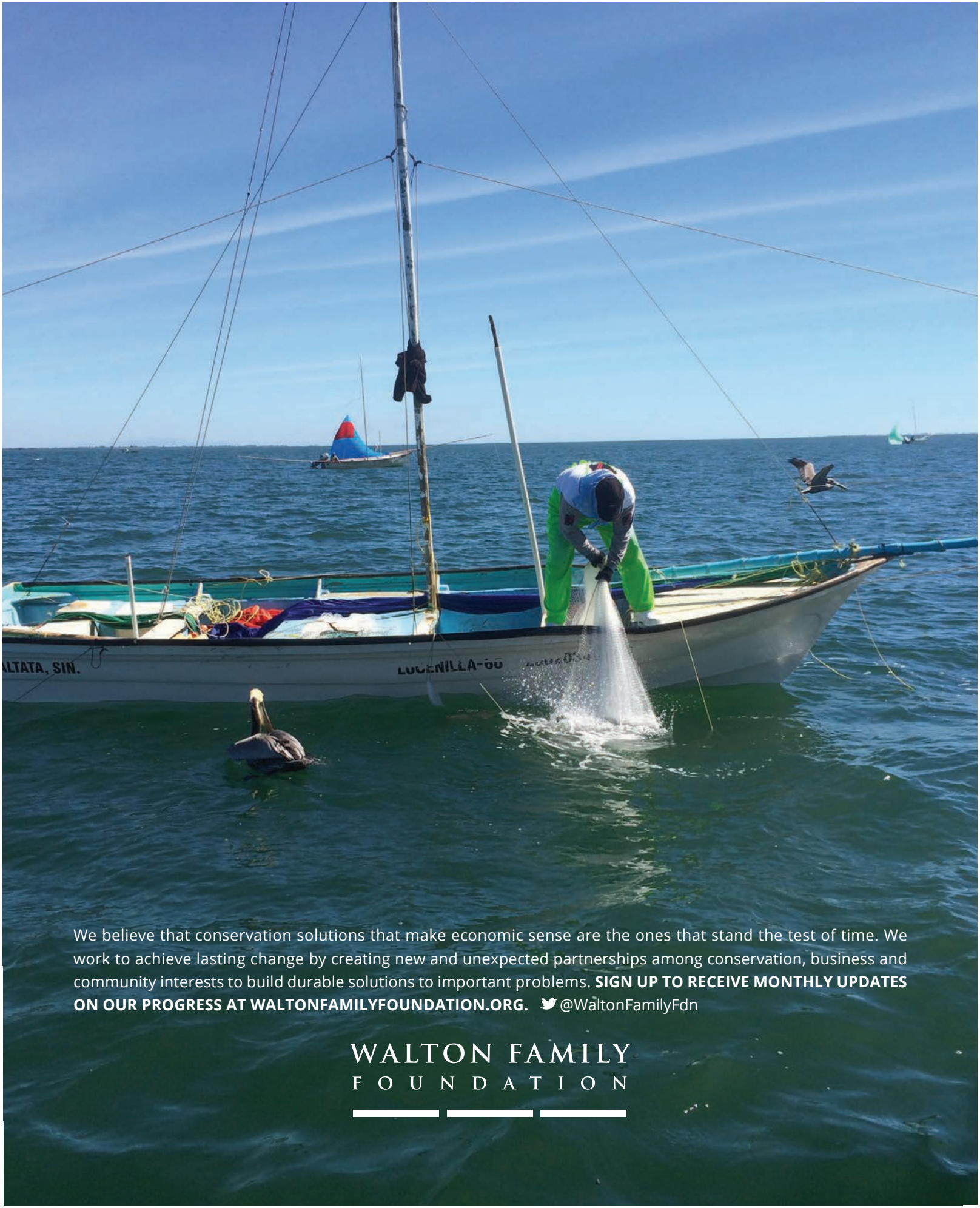
Photo: Ed Lyman/NOAA permit #14682



We believe that conservation solutions that make economic sense are the ones that stand the test of time. We work to achieve lasting change by creating new and unexpected partnerships among conservation, business and community interests to build durable solutions to important problems. **SIGN UP TO RECEIVE MONTHLY UPDATES ON OUR PROGRESS AT WALTONFAMILYFOUNDATION.ORG.** @WaltonFamilyFdn

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EXPLORE. DISCOVER. ENGAGE.

From Capitol Hill to local communities, the National Marine Sanctuary Foundation advocates for marine and Great Lakes sanctuaries and a healthy ocean. Explore our nation's sanctuaries, discover their natural and cultural riches above and below the surface, and engage with us to protect these sites for current and future generations.

LEARN MORE. JOIN US.

NATIONAL MARINE SANCTUARY FOUNDATION

marinesanctuary.org

Photo: Matt McIntosh/NOAA