

EARTH IS
BLUE

Volume 4, June 2019

SHARKS OF YOUR
SANCTUARIES

DARK WATER
JOURNEY

PAWS UP FOR
SCIENCE

BLUE STAR
FOR THE
OCEAN

MAGAZINE OF THE

NATIONAL MARINE SANCTUARIES



NATIONAL MARINE
SANCTUARIES





Cover: A humpback whale swims in the warm waters of Hawaiian Islands Humpback Whale National Marine Sanctuary. Photo: J. Moore/NOAA, under NOAA permit #14682

Below: Corals put on a colorful display in Florida Keys National Marine Sanctuary. Photo: Beata Lerman

At right: John Armor and National Marine Sanctuary of American Samoa acting superintendent Atuatasi Lelei Peau dive in sanctuary waters. Photo: Matt McIntosh/NOAA

The articles within this magazine are the views of the authors within and do not necessarily reflect the views of NOAA's Office of National Marine Sanctuaries.

Printed on recycled paper with environmentally-friendly ink. 





Photo: Ian Armor

FROM THE DIRECTOR

The world's ocean covers more than 70 percent of our Earth, and has always been a link between our planet's human and animal populations. This vast body of water stretches from pole to pole, continent to continent, connecting all of us no matter

where we are. The sites within the National Marine Sanctuary System serve as hubs for people and animals alike.

National marine sanctuaries and other marine protected areas create a network of responders all over the nation and all over the world. After Hurricane Irma and a new coral disease hit Florida Keys National Marine Sanctuary in 2017, partners from around the globe as well as other sites within the National Marine Sanctuary System did not hesitate to send supplies, fuel, and support. When responders need assistance, sanctuaries step in: for example, staff from Stellwagen Bank in Massachusetts have traveled thousands of miles to help disentangle whales in Hawaiian Islands Humpback Whale National Marine Sanctuary. And we've forged relationships with other organizations, like the Coast Guard, which helps us enforce regulations and manage vessel traffic, as well as the dozens of universities, nonprofits, and government agencies working to uncover the cause of the coral disease afflicting the Florida Keys. Connections like these help us do our jobs better.

As we look forward, I'm most excited about the new connections we will make. Our National Marine Sanctuary System is at a turning point: in 2014, we reopened the sanctuary nomination process, and several sites are in the queue to join this rich community. The more we work together, the stronger we will be.

The year ahead will truly be some of our most productive in many years. We hope to finally designate at least one new sanctuary. We plan to move forward with the expansion of both Flower Garden Banks and Monitor national marine sanctuaries, fulfilling our commitments to our sanctuary communities. Likewise, we plan to initiate what we call the "Restoration Blueprint" in the Florida Keys, to focus on working to protect and rebuild that important resource.

I'm also excited about our efforts to expand our understanding of your sanctuaries by partnering with institutions to share seafloor mapping and expeditions with advanced robotic technologies. The goals of the work are to meet sanctuary priorities to conduct high-resolution mapping of sanctuaries and marine national monuments, conduct baseline studies to identify resources and characterize habitats, and to communicate the importance of sanctuaries and the ocean to the public via outreach activities. Across all national marine sanctuaries, about \$8 billion annually is generated in local economies from activities like commercial fishing, tourism, and recreation, and we seek to protect this economic resource.

The United States boasts some of the most important natural, cultural, and historical resources in the world—not just on land but under the water as well. NOAA plays a critical role in protecting and promoting access to these special coastal and marine places. The network of marine protected areas you can get to know in this magazine encompasses more than 600,000 square miles of coastal, marine, and Great Lakes waters. Please join me in helping to protect this blue planet.



OUR BLUE HERITAGE

08

Stories from the Blue: Eva Pagaling

10

Creature Feature: Shipwrecked Sponges

12

Documenting the Graveyard of the Atlantic

14

Honoring the Tuskegee Airmen

GET INTO THE BLUE

18

Stories from the Blue: Captain Will Benson

20

Creature Feature: Black Sea Bass

22

Hidden Gem: The Samoan Dive Experience

24

Diving into History

26

Don't Be That Guy

TREASURES OF THE BLUE

30

Olympic Coast

31

Thunder Bay

32

Greater Farallones

33

Stellwagen Bank

34

Cordell Bank

35

Monitor

36

Monterey Bay

37

Gray's Reef

38

Channel Islands

39

Florida Keys

40

American Samoa

41

Flower Garden Banks

A Laysan albatross shows off its impressive wingspan off the coast of California.

Photo: NOAA

52 64 76

LIFE IN THE BLUE

42

Hawaiian Islands
Humpback Whale

43

Papahānaumokuākea

44

There's Some-Fin Special
About Sanctuaries

Poster

Special Fold-Out Section:
Sharks in Your National Marine
Sanctuary System

54

Stories from the Blue: Keith Ellenbogen

56

Creature Feature: Hawaiian Monk Seal

58

Octopus's Garden

60

Oasis in the Deep

62

Spawntaneous Generation

EXPLORE THE BLUE

66

Stories from the Blue: Jessie Hale

68

Creature Feature: Sea Otter

70

Return of the King

72

Navigating an Ocean of Change

74

Tracking Sanctuary Trends

THE BLUE AND YOU

79

Stories from the Blue:
Susan Dahlgren, Gault School

80

Creature Feature: Laysan Albatross

82

Goal: Clean Seas

84

Partners That Count:
Reef Environmental Education Foundation

86

Your #EarthIsBlue

OUR BLUE HERITAGE

In 1975, the first national marine sanctuary in the United States was designated to protect the iconic wreck of the Civil War-era USS *Monitor*. Since then, your National Marine Sanctuary System has been caring for symbols of our nation's maritime heritage and diverse cultures. National marine sanctuaries and marine national monuments protect and document historic shipwrecks and aircraft. We work with indigenous people to preserve and maintain their cultures. And we help safeguard the marine creatures that live in our marine protected areas so that future generations will get to know them as well. It's all part of *Our Blue Heritage*.

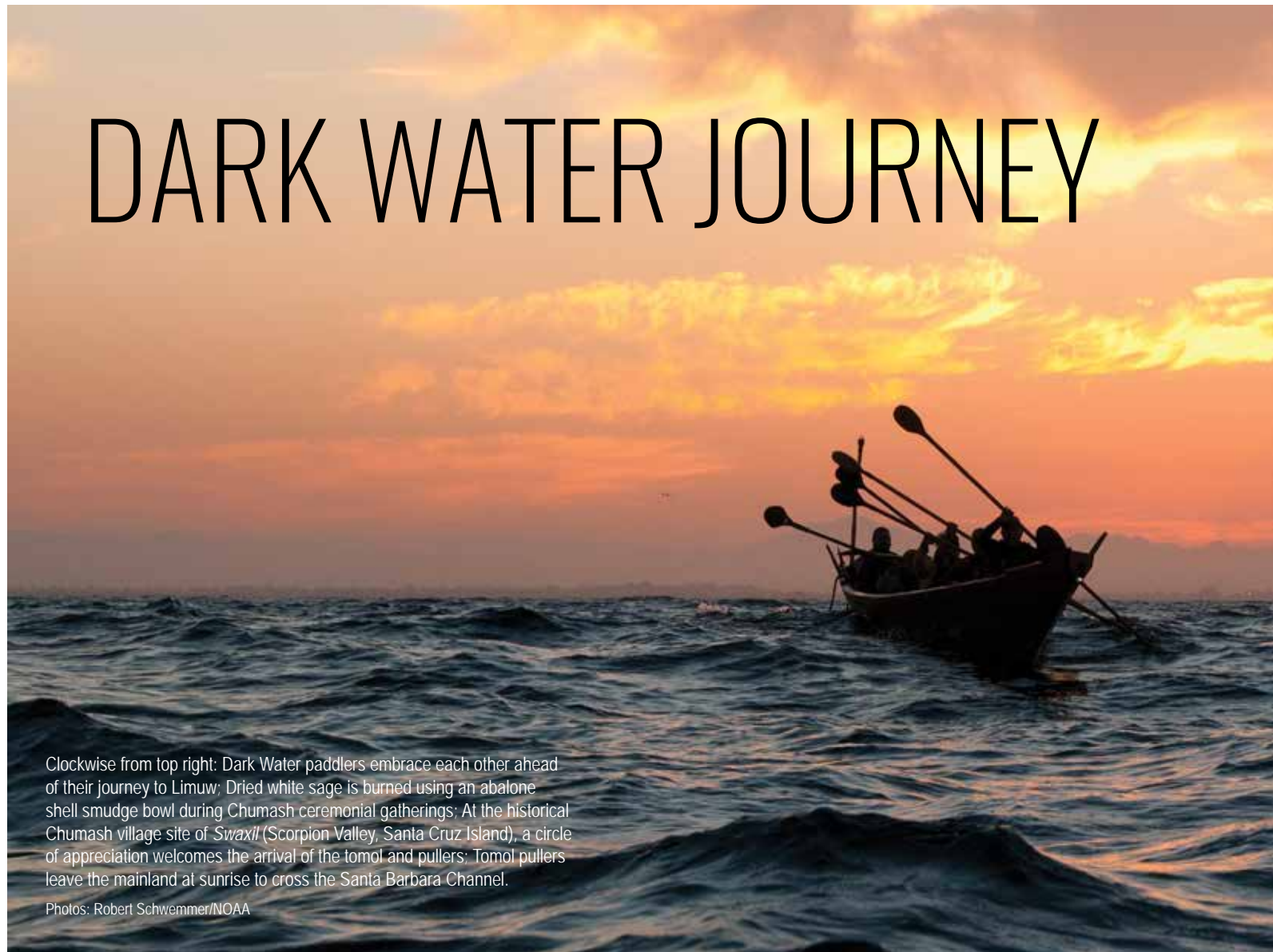




Members of the Chumash community paddle a plank canoe, or *tomol*, on their annual journey to their traditional homeland on California's Channel Islands.

Photo: Robert Schwemmer/NOAA

DARK WATER JOURNEY



Clockwise from top right: Dark Water paddlers embrace each other ahead of their journey to Limuw; Dried white sage is burned using an abalone shell smudge bowl during Chumash ceremonial gatherings; At the historical Chumash village site of *Swaxil* (Scorpion Valley, Santa Cruz Island), a circle of appreciation welcomes the arrival of the tomol and pullers; Tomol pullers leave the mainland at sunrise to cross the Santa Barbara Channel.

Photos: Robert Schwemmer/NOAA



Photo: Robert Schwemmer/NOAA

STORIES FROM THE BLUE: Eva Pagaling

Eva Pagaling is a member of the Santa Ynez Band of Samala Chumash Indians. Each year, she participates in the Chumash community tomol crossing, a traditional journey from the California mainland to Limuw, or Santa Cruz Island. This is her Story from the Blue.

Paddling in Dark Water during the annual Chumash community tomol crossing this year was like paddling into the abyss as we pulled water without the benefit of moonlight. The night sky made the waves between Channel Islands Har-

bor and Limuw appear a shade darker than midnight, and the thick layers of fog floating between us obscured what was left of our vision. I couldn't see more than a few feet in front of me. This forced us to measure the magnitude of the currents as the waves crashed against our tomol and paddles. The sound of those waves is the ocean's breath, and to keep cadence, we must sync our breath with hers.

Our tomol comes to life in the dark of night and she helps connect her paddlers to one another.

“ Without my tomol family coming together for the crossings, I would have lost touch with our ways of the ocean and the islands we come from.”



She does this by reminding us of our ability to sense each other's energy, even in pitch-black waters. As "seat-one" paddler, in order to determine our pace, I must listen to the breathing patterns of my crew. In understanding this, it's taught me that the power behind each stroke is dependent upon our ability to tune in with each other.

As a next-generation female paddler, one of the highest honors I've received was being asked to paddle Dark Water. I've been involved with paddling since I was 10 years old during the first and historic crossing of the tomol *'Elye'wun* (*Swordfish*) in 2001 and have been part of this tomol family ever since. My tomol family consists of paddlers and the tight-knit community that greets us on Limuw after our voyages. Without my tomol

family coming together for the crossings, I would have lost touch with our ways of the ocean and the islands we come from. I am eternally grateful for the tomol community-at-large who loved and reared me from a young age to become a paddler.

I am also especially grateful for my father, Reggie Pagaling. For many years, I watched my father pour everything he had into the crossings while I was on the support boats. I watched his evolution as a paddler, and as he helped lay the foundation for all future paddlers. I saw him go from a puller, to a navigator, and soon after, a captain. And when his days as a paddler came to an end, he chose to take it a step further and build his own elegant redwood plank canoe, the tomol *Muptami* (*Deep Memories*). *Muptami's* name holds

a great deal of space in my heart because I've come to understand what deep memories mean to me after paddling in her this year.

During the crossing, a deep memory that's shared among paddlers is that each pull of the oar is a prayer. This year, I prayed for my loved ones, as well as everyone else in this world. I prayed for strength and healing for all people, wherever they may be on their path in life. We are water people and our medicine for the world can be found in the sacred and life-sustaining power of water.

Next year, I will begin my journey in becoming a navigator, in hopes of bringing new medicine to our people. And once again, I will start a new chapter in our stories.

Shipwrecked Sponges

CREATURE FEATURE



A WHOLE NEW WORLD

Shipwrecks can serve as safe harbor to marine species, providing invertebrates with hard surfaces to attach to and fish with places to hide. In 2016, two sponges unknown to science were spotted on the sunken USS *Independence* at a depth of 2,600 feet. The wreck is located in Monterey Bay National Marine Sanctuary, adjacent to Greater Farallones National Marine Sanctuary. After careful documentation by Dr. Henry Reiswig of University of Victoria, the sponges have been identified as new species and named *Staurocalyptus pamelaturnerae* and *Hyalascus farallonensis*.



Fun Facts

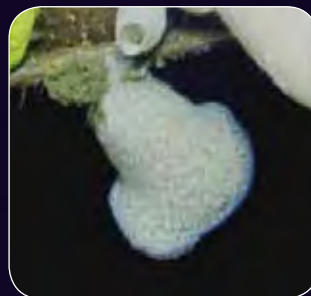
SCIENTIFIC NAME:

Staurocalyptus pamelaturnerae

LOCATION: Midship gun turret

DEPTH: 2,641 feet

COLOR: Bright yellow



SCIENTIFIC NAME:

Hyalascus farallonensis

LOCATION: Midship gun turret

DEPTH: 2,633 feet

COLOR: Light tan



Both of these sponges were collected on a research expedition with the E/V *Nautilus*. Only a small percentage of the deep sea has been explored, so additional new species undoubtedly await discovery.

Photos: OET/NOAA

An underwater photograph showing several fish swimming in clear blue water. In the lower right, a large, dark, and heavily encrusted shipwreck is visible, partially obscured by the water's depth and the presence of marine life. The scene is dimly lit, with light filtering down from above.

DOCUMENTING THE GRAVEYARD OF THE ATLANTIC

The ocean off the coast of North Carolina's Outer Banks is often referred to as the Graveyard of the Atlantic. These waters have entombed thousands of vessels and countless mariners who lost a desperate struggle against the forces of war, piracy, and nature. In recent years, researchers from Monitor National Marine Sanctuary, the National Centers for Coastal Ocean Science, and their partners have been documenting vessels that sank in this area during World War II's Battle of the Atlantic. Their work has been raising awareness that this area is the best representation of a World War II naval battlefield off the United States East Coast. Many of these wrecks, like the submarine USS *Tarpon*, are popular dive sites. Each wreck site holds an important piece of our maritime past, and through documentation, NOAA's maritime archaeologists are discovering their stories.



HONORING THE TUSKEGEE AIRMEN

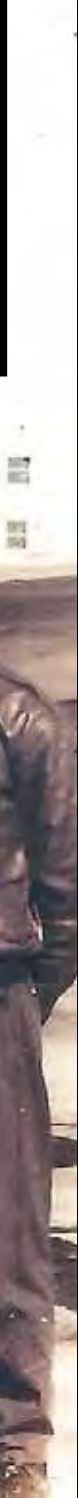
During World War II, some of the Tuskegee Airmen—the first African-American fighter pilots for the U.S. Army Air Corps—trained over the Great Lakes. Six Tuskegee Airmen and their aircraft were lost in the lakes. Recently, archaeologists have been working to find these aircraft so their pilots can be honored and the sites can be protected for future generations. One of the lost Tuskegee Airmen, Lt. Frank Moody, was killed when his Bell P-39Q Airacobra crashed in Lake Huron in 1944. The aircraft was discovered in 30 feet of water in Lake Huron and documented by state maritime archaeologist Wayne Lusardi and partners from Thunder Bay National Marine Sanctuary and the NOAA Office of Ocean Exploration and Research.






Clockwise from top right: Lt. Frank Moody; Tuskegee class 44-B-SE poses for a picture in February 1944, with Lt. Moody standing fourth from right; A Schweizer Aircraft Company tow target like this one was discovered in Lake Huron during a NOAA project to locate additional Tuskegee aircraft; Wayne Lusardi documents the port-side wingtip of Lt. Moody's wrecked aircraft.

Photos: Air Force Historical Research Agency; Air Force Historical Research Agency; Paul Schweizer; Eric Denson



GET INTO THE BLUE

A full-page background image showing a scuba diver in a pink wetsuit swimming horizontally over a vast, colorful coral reef. The water is clear and blue, and the reef below is densely packed with various types of coral in shades of brown, orange, and green. The diver is positioned in the upper right quadrant of the frame, moving towards the left.

Where's the best place to find aquatic adventure? Your National Marine Sanctuary System! From whale watching in Stellwagen Bank National Marine Sanctuary to diving among enormous corals in National Marine Sanctuary of American Samoa, there's never a dull moment in your sanctuaries. By working closely with communities, national marine sanctuaries help protect these ocean and Great Lakes playgrounds for today *and* tomorrow, and you can help too when you *Get into the Blue*.



A snorkeler explores the coral reef surrounding Rose Atoll in National Marine Sanctuary of American Samoa.
Photo: Ian Shive/U.S. Fish and Wildlife Service

BLUE STAR FOR THE OCEAN



Benson has been a fishing guide in Florida Keys National Marine Sanctuary since he was 19 years old.

Photo: Will Benson

STORIES FROM THE BLUE: Captain Will Benson



Photo: Nick Zachar/NOAA

best component of fly fishing is being out on the water and spending time with people out there, choosing to do something you all love. You get to develop these kinds of friendships and relationships with folks that I don't think you can develop outside the realm of a sport or something else difficult that you're pursuing together.

My house is literally in the middle of a national marine sanctuary, and I've always felt a sense of pride about that fact. The sanctuary helps guarantee that the ecosystem's value for our community remains steadfast into the future.

As a parent, I have to be optimistic, and at my core I think I am optimistic for the future. But I'm also being a realist when I say there are significant issues in the Keys and we need the help.

I worked with the sanctuary to create the Blue Star Fishing Guides program. It's essentially a volunteer continuing education ambassadorship program for fishing guides. We decided to craft a program that capitalized on the passion and love that fishing guides have for the area and channel it toward a sustainable future. Just for a moment think about it: some hundred fishing guides who are all individual spirits in their own right, not wanting to be told what to do, coming together voluntarily and partnering with a government agency to create a sustainable future. That's a big deal, and I feel really proud to have helped that along.

Everybody in Florida is ready to call it quits at work and jump out on the boat when the weather is good. Our lives, our economy, our culture, everything about us is tied to the ocean. In the Keys—fishing, diving, living here—you are absolutely connected to the ocean at every moment. It's a culture of ours here to care about the environment.

Captain Will Benson has been a fishing guide in Florida Keys National Marine Sanctuary since he was 19 years old. The sanctuary is his home, and each day he works to protect it. A member of the sanctuary's advisory council, Benson was instrumental to the creation of the Blue Star Fishing Guides program, which recognizes fishing charter operations that promote responsible and sustainable practices. This is his Story from the Blue.

There's this great sequence in tarpon fishing. You stalk a fish, he's quiet, you do this nice, gentle presentation. He comes over and you twist the fly, and he responds, and it keeps going until you convince the fish to eat the fly and you've tricked him, you've bested him. He gets mad and shakes his head and jumps in the air and peels out 200 feet of line and does a magical somersault five feet in the air. And right on cue, the fly ejects out of his mouth.

You fooled the fish, but then that fish's strength beats you. The best part about tarpon fishing for me is witnessing the fish win.

I've been a fishing guide in Florida Keys National Marine Sanctuary for 20 years, and hopefully I'll be a guide for another 20. Fly fishing has offered a challenge for me my entire life: the challenge of learning the fishery, the challenge of fooling the fish, but most importantly the challenge of getting to know your friends and your customers. The

“It's a culture of ours here to care about the environment.”

Black Sea Bass

CREATURE FEATURE



ALL ABOUT THAT BASS

Dive or fish in Gray's Reef National Marine Sanctuary, and you're likely to come across many black sea bass. These fish are a popular and sustainable choice for many recreational fishers. In Gray's Reef, black sea bass play an important role as predators, keeping populations of crabs, shrimp, and small fish in check. Black sea bass will switch sexes as they mature, generally starting out as female and changing to male.



Fun Facts

SCIENTIFIC NAME:
Centropristis striata

DIET: Crabs, shrimp, small fish

AVERAGE SIZE: 11-12 inches

AVERAGE WEIGHT: 1.5 pounds

LIFE SPAN: 8-12 years

EGGS PER SPAWNING SEASON:
30,000 to 500,000

PREDATORS: Skates, spiny dogfish, summer flounder, humans

LOCATION: Western Atlantic Ocean, from Massachusetts to the Gulf of Mexico



Researchers in Gray's Reef National Marine Sanctuary are using audio recorders to better understand activities of fish species like black sea bass.

Photos: Greg McFall/NOAA

HIDDEN GEM: THE SAMOAN DIVE EXPERIENCE



The reefs of National Marine Sanctuary of American Samoa are remote, and worth the trip. Some of the oldest and most massive coral heads in the world are found in the waters surrounding the tiny island of Ta'u. Fale Bommie, or Big Momma, is possibly the largest coral colony in the world: this *Porites* coral towers at over 20 feet tall with a circumference exceeding 130 feet.

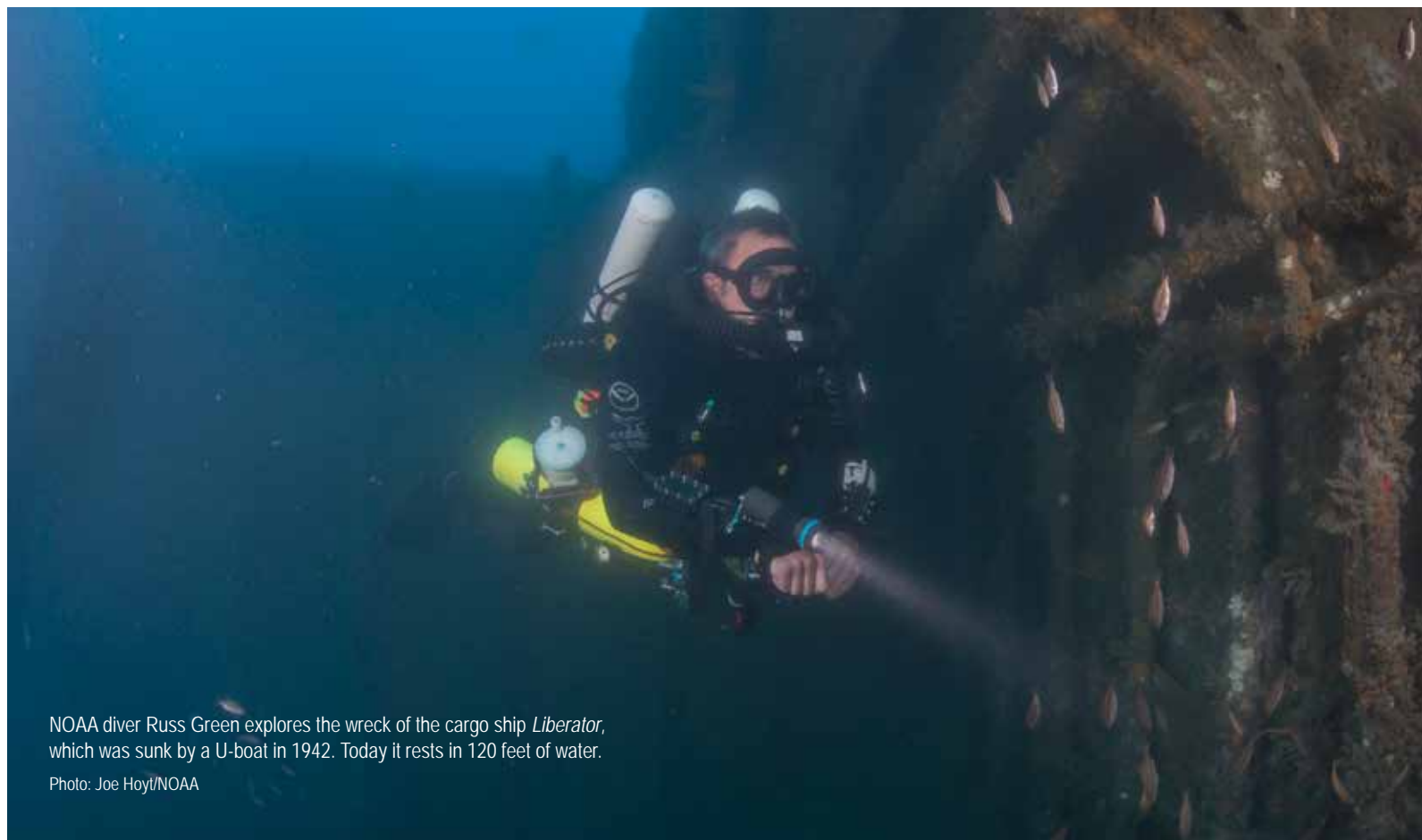


With water temperatures around 82°F year round, National Marine Sanctuary of American Samoa provides idyllic diving. Divers to areas like Fagatele Bay can view tropical reefs and rich marine life, including turtles, whales, sharks, giant clams, anemones, clownfish, and manta rays. It's best to bring your own gear, rent air tanks on island, and charter a vessel to get out to the dive sites.

Photos: David J. Ruck/NOAA

DIVING INTO HISTORY

The Outer Banks of North Carolina are a world-renowned vacation destination. But what many visitors don't know is that the beautiful blue waves also hide historic shipwrecks. Thousands of vessels rest in the Graveyard of the Atlantic, including 17th-century shipwrecks, a World War I-era lightship, and German U-boats that plied U.S. waters during World War II. Some of these wrecks can be viewed by divers, and may be protected by an expanded Monitor National Marine Sanctuary.



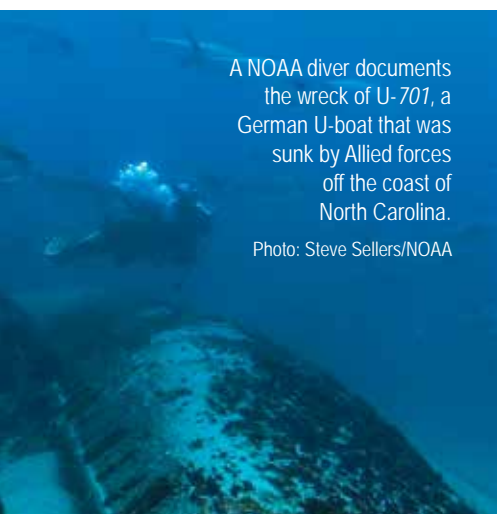
NOAA diver Russ Green explores the wreck of the cargo ship *Liberator*, which was sunk by a U-boat in 1942. Today it rests in 120 feet of water.

Photo: Joe Hoyt/NOAA



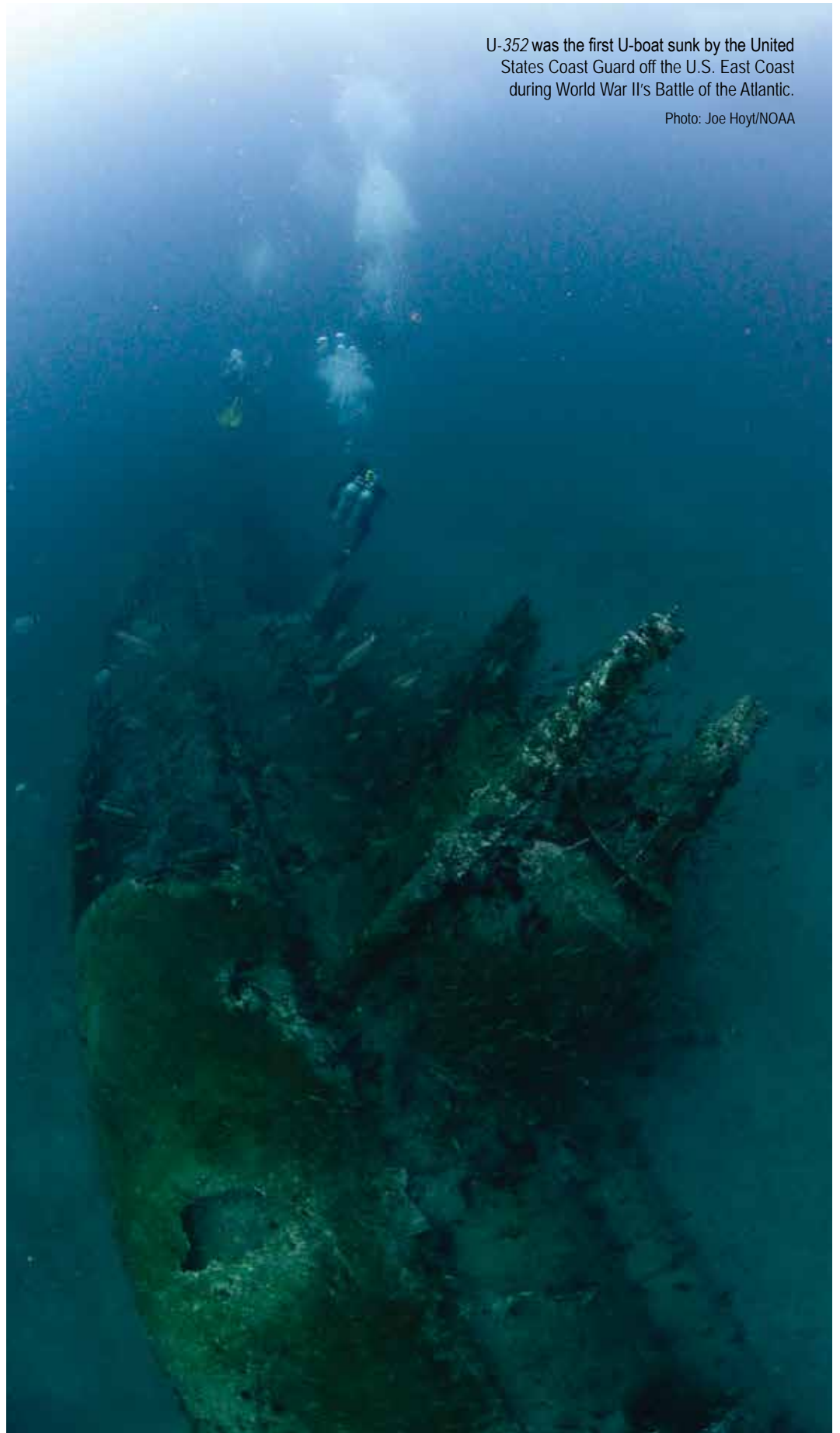
U-352 was the first U-boat sunk by the United States Coast Guard off the U.S. East Coast during World War II's Battle of the Atlantic.

Photo: Joe Hoyt/NOAA



A NOAA diver documents the wreck of U-701, a German U-boat that was sunk by Allied forces off the coast of North Carolina.

Photo: Steve Sellers/NOAA





DON'T BE THAT GUY.

5

TIPS

for Seeing and Protecting Sanctuary Animals

National marine sanctuaries are some of the best places in the world to see wildlife. From birdwatching to whale watching, these special places have something for everyone. But what are the best ways to watch wildlife without disturbing the animals or putting yourself in harm's way?



1. LEARN BEFORE YOU GO

Read about the wildlife, viewing sites, and local regulations to get the most from your wildlife viewing experience. Research online, stop by your sanctuary visitor center, buy regional viewing guidebooks, and hire local guides to increase your chances of seeing marine wildlife.



2. DON'T BE THAT GUY

While that elephant seal may be the first one you've seen all day, you're probably not the first human it's seen, and you may be interrupting time it needs to rest or eat. Always give animals plenty of space—if it's looking at you, or if you're close enough to take a selfie, you're too close.



3. BINOCULARS ARE YOUR FRIEND

Come prepared to watch from afar! Binoculars can help you see a distant whale, and a zoom lens can help you snap the perfect photo.



4. TAKE ONLY PICTURES

Souvenirs are best left on the beach! Resist the temptation to collect shells, rocks, or other underwater artifacts, because they provide homes for sea creatures and good surfaces for young plants to hold to. If you must collect something, gather your friends together for a beach cleanup.



5. KEEP YOUR DISTANCE

If you're paddling or boating around whales, keep your distance and let them come to you. Never follow a whale or get between a mother and calf.

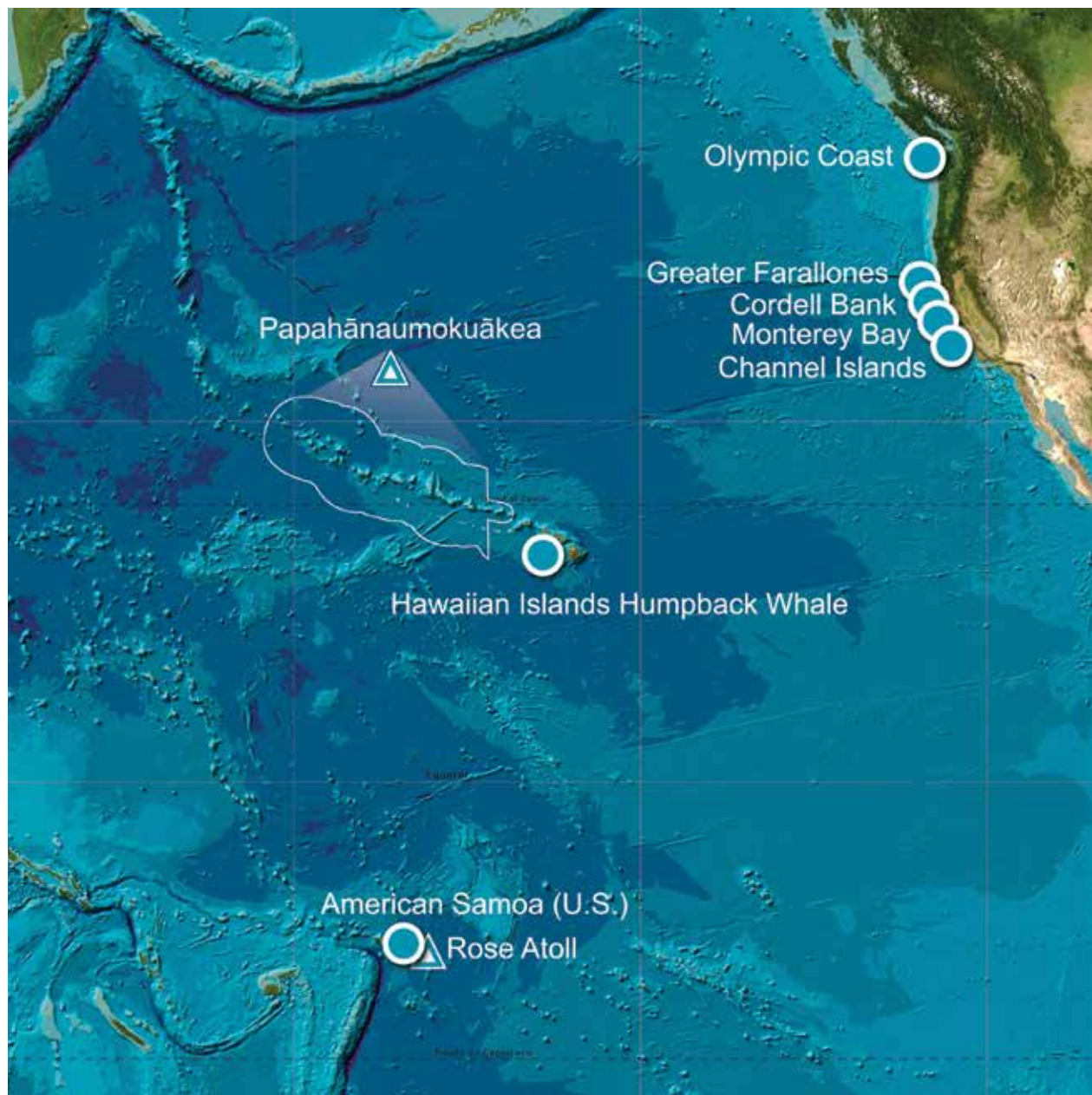
This poster was created by Cal Poly San Luis Obispo students Reid Vizcarra, James Butler, Felix Ng, Emma Lacey, Alice Terz, and Hannah Jacobson to help protect the wildlife of Monterey Bay National Marine Sanctuary. It was modified to fit this magazine. Original image courtesy of Cal Poly SLO

For more information, visit:

[SANCTUARIES.NOAA.GOV/PROTECT/OCEANETIQUETTE.HTML](https://sanctuaries.noaa.gov/protect/oceanetiquette.html)

TREASURES OF THE BLUE

Do you know which site of the National Marine Sanctuary System is the biggest? Which is the smallest? Which protects coral reefs, and which protects fallen shipwrecks? Where you'll find sea lions, and where you'll find whale sharks? Take a tour of the *Treasures of the Blue* to find answers to these questions and more.





Photos (clockwise from bottom left): Greg McFall/NOAA; Matt McIntosh/NOAA; Ariel Bauman; UNCW-UVP & NOAA; Bryan Dort; Matt McIntosh/NOAA; Laura Howes; Joe Hoy/NOAA; Matt McIntosh/NOAA





LOCATION:..... Washington's outer coast
SIZE:..... 3,188 square miles
DESIGNATED:..... 1994
HABITAT:..... Tide pools:
 kelp forests: open ocean:
 rocky reefs: deep sea

OLYMPICCOAST.NOAA.GOV



OLYMPIC

Photos (clockwise from top): Mary Sue Brancato/NOAA; Howard Cunningham; Gary L. Friedrichsen/NOAA; NOAA

OLYMPIC COAST

NATIONAL MARINE SANCTUARY

Sea stars clinging to rocky shorelines. Orcas swimming swiftly through the waves. Towering kelp swaying in the currents. Deep-sea corals sprouting from the seafloor. These are just a few examples of the diversity of life found in Olympic Coast National Marine Sanctuary—which this year celebrates its 25th anniversary.

This Pacific Northwest sanctuary includes the waters off the rugged and undeveloped Olympic Peninsula coastline, bordering the coastal area



of Olympic National Park much of the way. Olympic Coast protects a productive upwelling zone home to rich marine mammal and seabird faunas, major fisheries, diverse populations of kelp and algae, and thriving invertebrate communities.

Visitors to the sanctuary can spot orcas, gray whales, sea otters, harbor seals, and sea lions from land, as well as bald eagles, tufted puffins, and common murre. It's the perfect place to take a hike along wilderness beaches and to experience one of the most wild areas in the lower 48 states. The Olympic Coast Discovery Center in Port Angeles, Washington, offers visitors an easily-accessible glimpse into the sanctuary.

The Olympic Coast occupies a maritime cultural landscape that has supported humans from time immemorial. The sanctuary works closely with the Quinault Indian Nation and the Hoh, Quileute, and Makah tribes to protect this vital region for generations to come.



THUNDER BAY

NATIONAL MARINE SANCTUARY



Photos (above, left to right): David J. Ruck/NOAA; Bryan Dort. Photo (below): David J. Ruck/NOAA

Unpredictable weather, murky fog banks, sudden gales, and rocky shoals earned northwestern Lake Huron the name “Shipwreck Alley.” Fire, ice, collisions, and storms have claimed more than 200 vessels in and around the lake’s Thunder Bay. Today, these historic wrecks are protected by Thunder Bay National Marine Sanctuary.

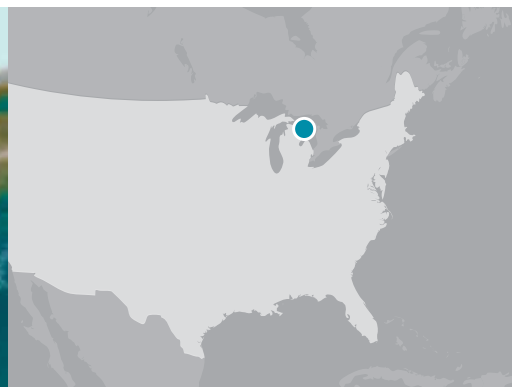
Lake Huron’s cold, fresh water ensures that Thunder Bay’s shipwrecks are among the best-preserved

in the world. From an 1838 sidewheel steamer to a modern 500-foot-long German freighter, the shipwrecks of Thunder Bay represent a microcosm of maritime commerce and travel on the Great Lakes.

Thunder Bay National Marine Sanctuary encourages paddlers, divers, and snorkelers to visit the area’s historic shipwrecks. Some, such as the wooden schooner *Portland* and the paddle-wheel steamer *Albany*, rest in shallow enough water that they can easily be explored from a paddleboard or

a kayak. Other wrecks, like *Lucinda Van Valkenburg* and *W.P. Thew*, provide opportunities to new and experienced divers alike. Seasonal mooring buoys provide a safe attachment point for visiting boats, limiting damage to the shipwrecks.

The sanctuary also maintains the Great Lakes Maritime Heritage Center in Alpena, Michigan. With 10,000 square feet of immersive exhibits, the heritage center is the perfect gateway to get to know Thunder Bay.



LOCATION:..... Northwest Lake Huron
 SIZE:..... 4,300 square miles
 DESIGNATED:..... 2000 (expanded 2014)
 KNOWN SHIPWRECKS:..... 99
 SHIPWRECKS YET TO BE LOCATED: 100+

THUNDERBAY.NOAA.GOV

THUNDER BAY



LOCATION:.....Off the northern and central California coast

SIZE:.....3,295 square miles

DESIGNATED:.....1981 (expanded in 2015)

HABITAT:..... Estuaries; continental shelf; islands; deep sea, open ocean; kelp forests; sandy and rocky shores

FARALLONES.NOAA.GOV

FARALLONES

Photos (clockwise from top): Scot Anderson; USGS; Matt McIntosh/NOAA; Douglas Croft/Monterey Bay Marine Life Studies, under NMSF Permit #20519; Sara Heintzelman/NOAA

GREATER FARALLONES

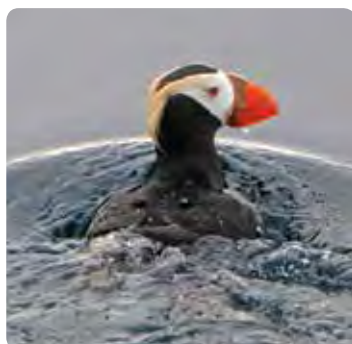
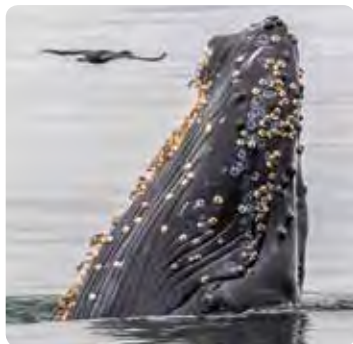
NATIONAL MARINE SANCTUARY

The California Current sweeps down the West Coast of North America from Alaska to Mexico. The cold waters carried by this current are loaded with nutrients—and these nutrients are what make Greater Farallones National Marine Sanctuary such an incredible place.

Reaching from south of San Francisco north to the scenic Redwood Coast, Greater Farallones Nation-

al Marine Sanctuary protects the wildlife and habitats of one of the most diverse and bountiful marine environments in the world. It provides breeding and feeding grounds for at least 25 endangered and threatened species, 37 marine mammal species, over a quarter-million seabirds, and one of the most significant white shark populations on the planet. Here, you'll see blue and humpback whales, seals and sea lions, dolphins, and seabirds like tufted puffins and pigeon guillemots.

The diversity of habitats in Greater Farallones means that visitors will never be at a loss for something to do. Join a day cruise for whale watching and world-class birding at the largest seabird rookery in the contiguous United States. Enjoy kayaking in a lagoon, go surfing and boogie boarding, or stroll along beaches to experience unusual geological formations and flocks of shorebirds. Explore a tide pool to discover intriguing forms of marine life amid the pounding surf!



STELLWAGEN BANK

NATIONAL MARINE SANCTUARY

Each spring, hundreds of humpback whales make their way to the waters off Cape Cod. There, they hunt for a small fish known as the sand lance, gathering in spectacular feeding displays. Their feeding grounds are located in Stellwagen Bank National Marine Sanctuary, and the sanctuary boasts some of the best whale watching in the world.

Stellwagen Bank National Marine Sanctuary hosts one of the most biologically-diverse ecosystems in the Gulf of Maine. In addition to humpback whales, fin whales and minke whales travel many miles to feed here; visitors can also see dolphins, porpoises, and seals. The sanctuary's rich waters serve as a stopover location for large numbers of migrating birds, including shearwaters, storm petrels, fulmars, gannets, and more.

The sanctuary works to protect this crucial habitat for current and future generations. Researchers study humpback whales through the use of non-invasive tags that record data on feeding habits, dive times, and movement; track seabird flight paths and prey



Photo: Matt McIntosh/NOAA

distribution; and measure the effects of man-made noise on right whale communication. The sanctuary has also collaborated closely with vessel operators and the Port of Boston to minimize the effects of ship traffic on the whales visiting the region.

In addition to wildlife watching, visitors to the Boston region can get to know Stellwagen Bank National Marine Sanctuary through boating, fishing, and diving, and exhibits at the New England Aquarium, Maritime Gloucester, and other local museums.



Photos (clockwise from top left): Peter Flood; Laura Howes; Matt McIntosh/NOAA; Matt McIntosh/NOAA



LOCATION:..... 25 miles east of Boston
 SIZE:..... 842 square miles
 DESIGNATED: 1992
 HABITAT: Open ocean;
 sand and gravel banks; boulder
 reefs; rock ledges; mud basins

STELLWAGEN.NOAA.GOV

CORDELL BANK

NATIONAL MARINE SANCTUARY

LOCATION:..... 52 miles west-northwest of San Francisco

SIZE:..... 1,286 square miles

DESIGNATED:..... 1989 (expanded 2015)

HABITAT:..... Continental shelf and slope; deep-sea canyon; open ocean; rocky reefs

CORDELLBANK.NOAA.GOV



Photos (above, clockwise from top left): Matt Vieta/BAUE; Robert Lee/BAUE; Robert Lee/BAUE. Photo (below): Kip Evans

You might not expect it, but in the cold, deep waters off of Northern California, a technicolor paradise awaits. This is the rocky habitat of Cordell Bank.

Cordell Bank sits at the edge of the continental shelf and rises abruptly from the soft sediments to within 115 feet of the ocean surface. The craggy ledges here provide a home to colorful and abundant invertebrates, algae, and fishes. Bright pink strawberry anemones cling to the rock, while thousands of juvenile rockfish shelter among them.

Cordell Bank National Marine Sanctuary doesn't just protect Cordell Bank itself, though. In 2015, the sanctuary expanded north and west to include additional waters and submerged lands, such as the deep-sea Bodega Canyon. These productive waters attract migratory seabirds and marine mammals from all around the Pacific Ocean to feed in this dynamic food web.

Because of its depths and strong currents, Cordell Bank is not accessible to most divers. Still, the sanctuary provides excellent wildlife watching: from June to November, humpback and blue whales feed throughout the sanctu-

ary, and seabirds visit these waters throughout the year. You can also visit the sanctuary without getting wet at the Oakland Museum of California, the Bear Valley Visitor Center, and the Point Reyes National Seashore Lighthouse.





Image (above): *Harper's Weekly* (engraving), 1863. Photo (below): NOAA

MONITOR

NATIONAL MARINE SANCTUARY

On January 30, 1975, Monitor National Marine Sanctuary was designated as our nation's first national marine sanctuary. Lying just off the North Carolina coast, the sanctuary protects the wreck of the USS *Monitor*.



As the prototype for a class of U.S. Civil War iron-clad warships, *Monitor* significantly altered both naval technology and marine architecture in the 19th century. The Union vessel fought against the CSS *Virginia* in the infamous Battle of Hampton Roads, and although the battle ended in a draw, it initiated the dawn of iron warships.

Less than a year after its launch, *Monitor* sank on December 31, 1862, in a storm while under tow to Beaufort, North Carolina. Sixteen men went down with the ship. The vessel was lost for more than a century before a team of maritime archaeologists located the wreck site in 1973. Today, Monitor National Marine Sanctuary protects the wreck for future generations and shares this iconic vessel's legacy with the public.

With a free research permit, *Monitor* can be visited by divers, but its depth and strong current make technical diving experience a must. However, through a partnership with The Mariners' Museum and Park in Newport News, Virginia, anyone can experience *Monitor* by visiting its USS *Monitor* Center, home to the vessel's turret, artifacts, and exhibits on its history and legacy.



LOCATION:.....16 miles off the coast of Cape Hatteras, North Carolina

SIZE:..... One mile in diameter

DESIGNATED:.....1975

HABITAT:.....Shipwreck; open ocean

MONITOR.NOAA.GOV

MONTEREY BAY

NATIONAL MARINE SANCTUARY

Where in the world can you see Pacific leatherback sea turtles, Risso's dolphins, northern elephant seals, southern sea otters, nudibranchs, leopard sharks, wolf eels, and more? Monterey Bay National Marine Sanctuary!

Known as the "Serengeti of the Sea," Monterey Bay supports an incredible abundance of wildlife. The sanctuary is home to 36 species of marine mammals, more than 180 species of seabirds and shorebirds, 525 species of fish, and a multitude of invertebrates and algae. It's one of the most diverse assemblages of marine life in the world.

With more than 50 research institutions in the area, the greater Monterey Bay community has emerged as a global leader in marine science. By collaborating with local organizations, the sanctuary keeps tabs on the health of marine species, habitats, and ecosystems, so that Monterey Bay will remain spectacular in the future.

Monterey Bay is a wildlife watcher's dream, and there are plenty of ways to experience your sanctuary. Whether it's watching whales, paddling in the slough, reeling in salmon, exploring tide pools, or diving among kelp forests, there is no more spectacular place to enjoy the ocean and outdoors.



LOCATION:..... Central California coast
SIZE:..... 6,094 square miles
DESIGNATED:..... 1992
HABITAT:..... Kelp forests; rocky shores; seamounts; submarine canyon; estuary; sandy beaches; open ocean

MONTEREYBAY.NOAA.GOV

Photos (clockwise from top right): Rob Cala; Douglas Croft; Douglas Croft; Michael Alyono; Ariel Bauman; Allison Formica; Michael Alyono



LOCATION:.....Off the coast of Georgia
 SIZE:..... 22 square miles
 DESIGNATED: 1981
 HABITAT:..... Ledges and crevices:
 slopes and sandy areas

GRAYSREEF.NOAA.GOV

Photos: Greg McFall/NOAA

GRAY'S REEF NATIONAL MARINE SANCTUARY

Off the coast of Georgia, a hidden treasure awaits: Gray's Reef National Marine Sanctuary.

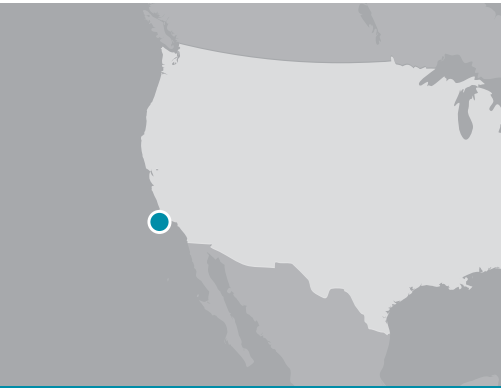
This sanctuary is remote—19 miles east of Sapelo Island, Georgia—and it's a trip worth taking. The scattered rocky outcroppings and ledges of Gray's Reef provide homes for an abundance of marine life. The reef attracts more than 200 species of fish, including black sea bass, snappers, groupers, and mackerels. With a wealth of sport fish, Gray's Reef is a popular fishing location, especially with anglers looking to catch the big ones.

While Gray's Reef is known for fishing, the diving here is spectacular as

well. In addition to the variety of fish, the reef is home to crabs, lobsters, soft corals, sponges, sea stars, and other organisms that form a dense, vibrant carpet of living creatures in every color of the rainbow. It is common to see loggerhead sea turtles, which forage and rest year-round at the reef. The reef fauna changes seasonally, ensuring that no two dives are ever alike.

No need to get your feet wet to experience Gray's Reef National Marine Sanctuary! The sanctuary has exhibit partnerships with the Fernbank Museum of Natural History in Atlanta, the Tybee Island Marine Science Center, the South Carolina Aquarium, and more.





LOCATION:..... Southern California, about 23 miles from Santa Barbara

SIZE:.....1,470 square miles

DESIGNATED:.....1980

HABITAT:..... Kelp forests: open ocean: rocky reefs: seagrass meadows: shallow sand bottoms

CHANNELISLANDS.NOAA.GOV

Photos: (above) Nathan Coy; (below) Robert Schwemmer/NOAA

CHANNEL ISLANDS

NATIONAL MARINE SANCTUARY

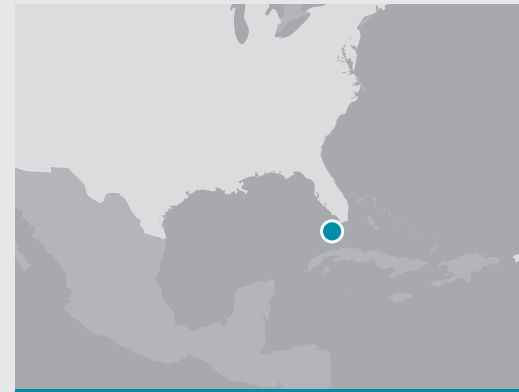
In kelp forests among five islands off the coast of Southern California, sea lions play, giant sea bass lurk, and California brown pelicans feed. Welcome to Channel Islands National Marine Sanctuary.

This remote sanctuary encompasses 1,470 square miles off of Anacapa, Santa Barbara, Santa Cruz, San Miguel, and Santa Rosa islands. The ancestral

home of the Chumash people, these islands have a long, rich maritime history and lasting cultural significance. Today, the sanctuary protects exceptional biodiversity, productive ecosystems, sensitive species and habitats, prized fishing grounds, and shipwrecks and other maritime heritage artifacts. With everything from deep-sea coral communities to lush kelp forests, this national marine sanctuary is often called the “Galapagos of North America.”

Nearshore waters within the sanctuary are co-managed with Channel Islands National Park and the state of California. Channel Islands Naturalist Corps volunteers provide educational programming aboard local whale watch vessels and educational cruises. There’s tons to do in this varied sanctuary, from scuba diving and kayaking, to boating and tide pooling—and, of course, spectacular wildlife watching.





LOCATION:.....Florida Keys
 SIZE:.....3,803 square miles
 DESIGNATED:.....1990
 HABITAT:.....Coral reefs; mangrove forests;
 sand flats; seagrass meadows

FLORIDAKEYS.NOAA.GOV

Photos (above, clockwise from top left): Beata Lerman; David J. Ruck/NOAA; Matt McIntosh/NOAA; Bonefish & Tarpon Trust. Photo (below): Daryl Duda

FLORIDA KEYS NATIONAL MARINE SANCTUARY

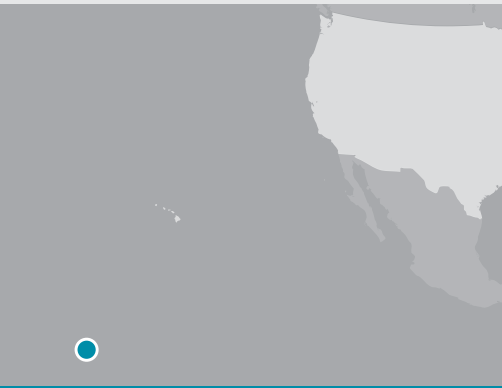
Known for its world-class diving and fishing, Florida Keys National Marine Sanctuary protects one of North America's most diverse and economically-valuable communities of underwater plants and animals.

Here, you'll find the only barrier coral reef in the continental United States, extensive mangrove forests, seagrass meadows, and more than 6,000 marine species, from tropical reef fish to bottlenose dolphins. This national marine sanctuary also protects historic shipwrecks that tell stories of our nation's maritime heritage.

Visitors to Florida Keys National Marine Sanctuary are encouraged

to take advantage of the many recreational activities this amazing region has to offer while adhering to regulations that ensure this special place will be preserved for future generations. You can help protect the natural and cultural resources of the Florida Keys by choosing charter operators that participate in the sanctuary's Blue Star programs. These programs support and encourage sustainable recreational diving and fishing practices. On the water, Team OCEAN volunteers are also available to help you reduce your impact on the coral reef ecosystem. Plus, you can pitch in to keep your Keys clean by participating in Goal: Clean Seas Florida Keys and other marine debris cleanup initiatives.





LOCATION:..... American Samoa
SIZE:..... 13,581 square miles
DESIGNATED:..... 1986 (expanded 2012)
HABITAT:..... Coral reefs; mesophotic reefs, deep sea; open ocean; shallow reef flat

AMERICANSAMOA.NOAA.GOV



Photos (above, clockwise from top left): The Ocean Agency/Coral Reef Image Bank; Greg McFall/NOAA; David J. Ruck/NOAA; David J. Ruck/NOAA. Photo (below): The Ocean Agency/XL Catlin Seaview Survey

NATIONAL MARINE SANCTUARY OF AMERICAN SAMOA

National Marine Sanctuary of American Samoa was once our nation's smallest marine sanctuary, but in 2012 it expanded to become one of the largest. Today, the sanctuary protects 13,581 square miles throughout the American Samoa archipelago. It safeguards extensive coral reefs, including some of the oldest and largest *Porites*

coral heads in the world. This sanctuary celebrates six protected areas, in which you'll also find seamounts, hydrothermal vents, deep-water reefs, and vast open ocean. The sanctuary encompasses important fishing grounds, the southernmost point in the United States, and Rose Atoll Marine National Monument, which celebrates its 10th anniversary this year.

At the heart of National Marine Sanctuary of American Samoa is *Fa'a Samoa*, or the traditional Samoan way. It is the foundation of Polynesia's oldest culture, dating back some 3,000 years. *Fa'a Samoa* places great importance on the dignity and achievements of the group rather than the individual. With this in mind, NOAA co-manages this diverse sanctuary with the government of

American Samoa and works closely with communities that live adjacent to the sanctuary, all within the context of Samoan cultural traditions and practices.

National Marine Sanctuary of American Samoa provides programs and events that engage local, regional, national, and international communities. Visitors can experience spectacular diving and snorkeling, learn about Samoan culture, and visit the Tauese P.F. Sunia Ocean Center.



FLOWER GARDEN BANKS

NATIONAL MARINE SANCTUARY

When fishermen off the coast of Texas looked down at the coral reefs below in the early 1900s, they were reminded of their gardens back home. Thus, the Flower Garden Banks got their name. Today, these coral reefs include some of the healthiest coral in the world, and are protected by Flower Garden Banks National Marine Sanctuary.

Seventy to 115 miles off the coasts of Texas and Louisiana, East Flower Garden Bank, West Flower Garden Bank, and Stetson Bank emerge from the depths of the Gulf of Mexico. These reefs are built on small underwater mountains called salt domes. They rise 200 to 500 feet from the seafloor, separated from each other by miles of open ocean. The tops of the banks are covered by gardens of coral, sponges, and algae that provide habitat for a variety of tropical wildlife.

These reefs offer excellent opportunities for experienced divers. Visitors can see a variety of shallow-



Photos: G.P. Schmah/NOAA

water Caribbean reef fish and invertebrates, as well as coral heads bigger than cars. Lucky divers may even see manta rays, sea turtles, and whale sharks!

Not a diver? You can still experience the magic of Flower Garden Banks National Marine Sanctuary at the Texas State Aquarium, Tennessee Aquarium, and the Aquarium at Moody Gardens.



LOCATION:.....Gulf of Mexico, off the coast of Texas and Louisiana

SIZE:..... 56 square miles

DESIGNATED:..... 1992 (Stetson Bank added 1996)

HABITAT:..... Coral reefs; algal-sponge communities; sand and mud flats; mesophotic reefs; open ocean

FLOWERGARDEN.NOAA.GOV

HAWAIIAN ISLANDS HUMPBACK WHALE

NATIONAL MARINE SANCTUARY

The humpback whale is one of the most spectacular ocean creatures in the world. At 45 feet long and weighing 40 tons, these whales are surprisingly acrobatic, and can be spotted throughout the National Marine Sanctuary System. Every winter, thousands of humpback whales travel to the warm, shallow waters of Hawai'i to mate, give birth, and raise their young. There, Hawaiian Islands Humpback Whale National Marine Sanctuary protects them and their habitat.

The sanctuary encompasses five separate marine protected areas accessible from six of the eight main Hawaiian Islands. These areas support more than half of the North Pacific humpback whale population. From December to March, visitors to the sanctuary can see whales from shore and at sea.

Collaboration is key to success in Hawaiian Islands Humpback Whale National Marine Sanctuary. Researchers from the sanctuary work closely with institutions and universities to better understand the whales and how to best manage their habitat. Each year, volunteers participate in the Sanctuary Ocean Count, a citizen science program designed to help track the number of whales visiting Hawai'i. The sanctuary collaborates with local communities, recognizing the importance of Native Hawaiian cultural traditions and their relationship to the long-term health of the ocean.

LOCATION:..... Main Hawaiian Islands
 SIZE:..... 1,366 square miles
 DESIGNATED:..... 1992
 HABITAT:..... Shallow waters; coral reefs; seagrass beds

HAWAIIHUMPBACKWHALE.NOAA.GOV



Clockwise from top right: NOAA, under NOAA MMHSRP Permit #932-1489; Ed Lyman/NOAA, under NOAA Permit #15240





PAPAHĀNAUMOKUĀKEA



LOCATION:..... Northwestern Hawaiian Islands

SIZE:.....582,578 square miles

DESIGNATED:.....2006 (expanded 2016)

HABITAT:.....Atolls; coral reefs;
seamounts; open ocean, deep seaPAPAHANAUMOKUAKEA.GOV

Photos (above, clockwise from top left): John Burns/NOAA; Steven Gnam/NOAA; Andrew Gray/NOAA; Stephen Matadobra/NOAA

PAPAHĀNAUMOKUĀKEA

MARINE NATIONAL MONUMENT

The name Papahānaumokuākea commemorates the union of two Hawaiian gods—Papahānaumoku and Wākea—who gave rise to the Hawaiian Archipelago, and the Hawaiian people. Papahānaumokuākea Marine National Monument protects the largest conservation area in the United States, and one of the largest in the world. The monument encompasses the waters around the remote Northwestern Hawaiian Islands, and is a UNESCO World Heritage Site.

The 582,578 square mile stretch of islands, seamounts, banks, and coral reefs supports an incredible diversity of coral, fish, birds, marine mammals, and more, many of which are unique to the Hawaiian Archipelago. Many of the islands and shallow water environments are important habitats for rare species such as the threatened green turtle and the endangered Hawaiian monk seal. Here, 14 million seabirds representing 22 species breed and nest.

Papahānaumokuākea is of great importance to Native Hawaiians, with significant cultural sites



found on the islands of Nihoa and Mokumanamana. Mokumanamana is known for its numerous *wahi pana* (religious places) and *mea makamae* (cultural objects) and has spiritual significance in Hawaiian cosmology. Monument staff work closely with Native Hawaiian researchers and leaders to preserve and honor these culturally-important areas.

The monument is co-managed by NOAA, the U.S. Fish and Wildlife Service, the state of Hawaii, and the Office of Hawaiian Affairs. Access is limited and managed through a robust permitting process. However, you can get to know your monument by visiting the Mokupāpapa Discovery Center in Hilo, which features a saltwater aquarium, interactive educational exhibits, and more.



There's SOME-FIN Special About Sanctuaries

— By ELIZABETH WEINBERG

Close your eyes and picture a shark. Any shark. What do you see? What do you hear?

Odds are, the first sound that comes to mind is *dun dun, dun dun*, the building strings of the *Jaws* theme song making the hairs on your arms stand on end. Perhaps the shark you picture is an enormous white shark coming toward you.

But the truth is, sharks are so, so much more than their scary reputation. These ancient ocean creatures began their evolutionary journey some 400 million years ago. All that time has given them plenty of opportunities to evolve into diverse animals that play key roles in ecosystems in your National Marine Sanctuary System and beyond. From tiny, five-inch pocket sharks to 40-foot whale sharks, sharks are as varied as they are amazing. And the truth is, we pose a whole lot more threat to them than they do to us.

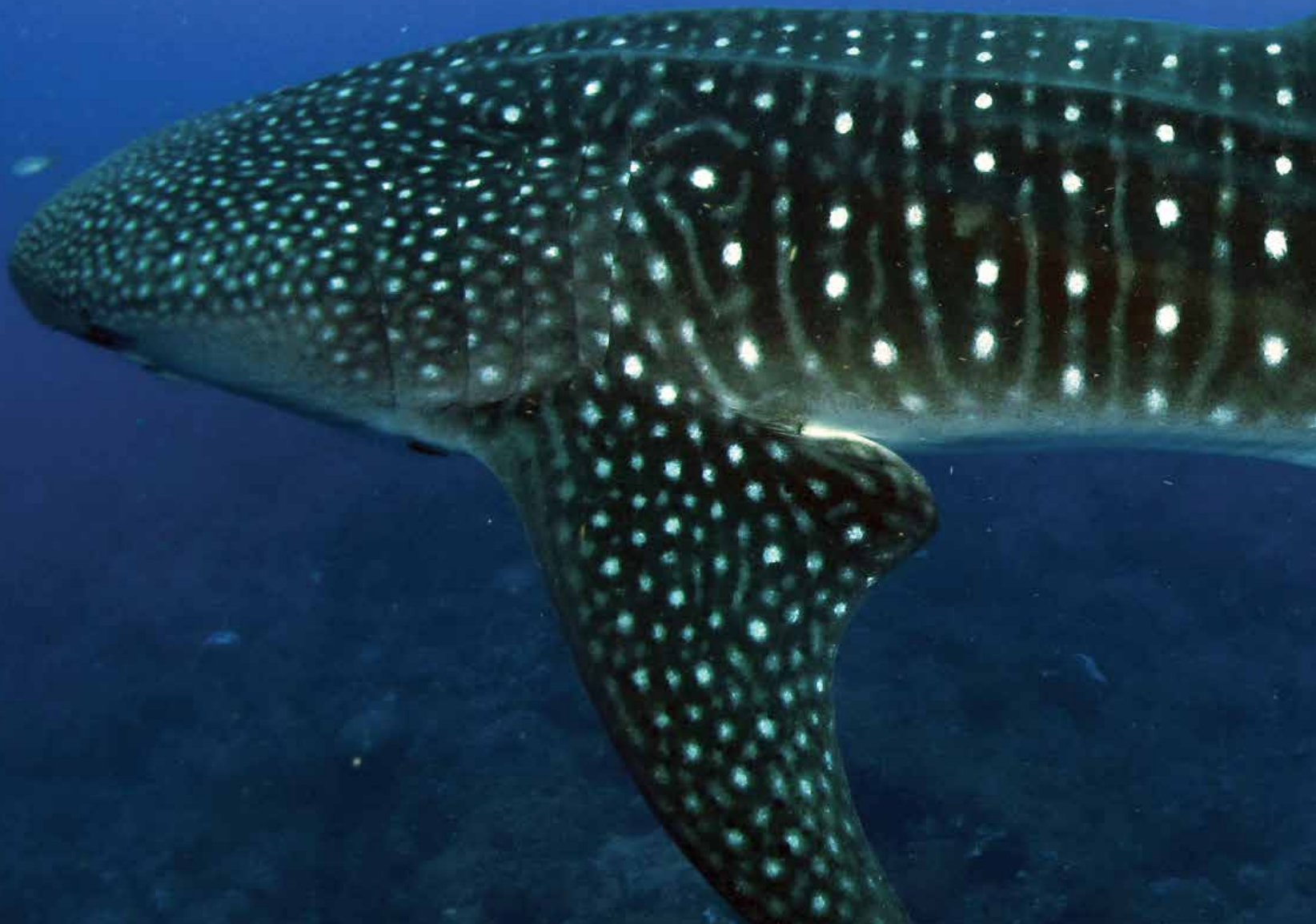
HOME SWEET HOME

Sharks make their homes throughout the ocean, from the shallows to the depths. Your National Marine Sanctuary System protects these habitats so shark populations can thrive into the future.

In Florida Keys National Marine Sanctuary, mangrove roots provide a nursery habitat for all sorts of animals, including the lemon shark. Female lemon sharks give birth to live young in shallow areas like mangrove forests. For several years as they grow up, tiny baby lemon sharks find refuge among the mangrove roots. Here, they're safe from predators like groupers and other, larger sharks.

A tiger shark swims near the surface in Papahānaumokuākea Marine National Monument.

Photo: Koa Matsuoka



Go a little deeper into the ocean, to coral reefs, and you'll find sharks like blacktip reef sharks, whitetip reef sharks, and Galapagos sharks. These medium-size sharks patrol the reef throughout the day and night. In the open ocean, farther from the reef zone, you'll find bigger sharks like blue sharks, salmon sharks, and porbeagle sharks.

But that's not all! Even in the depths of the ocean, thousands of feet down, sharks can survive. During a 2017 expedition aboard the research vessel *E/V Nautilus*, researchers spotted numerous bluntnose

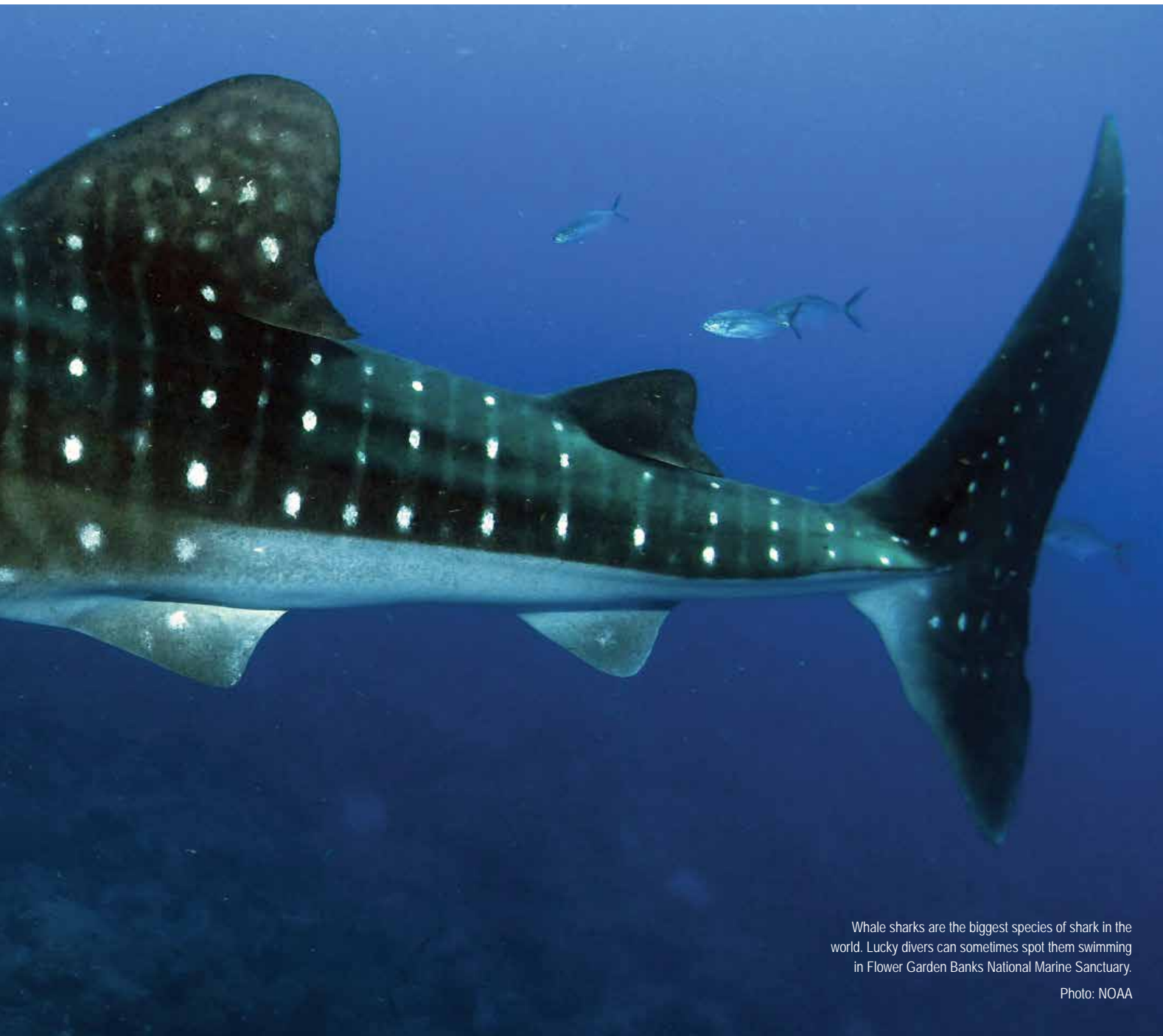
sixgill sharks in the deep waters of Channel Islands National Marine Sanctuary. These sharks spend the day resting in depths of up to 6,000 feet (more than a mile down!) and forage for fish, invertebrates, and other sharks closer to the surface at night.

COSMOPOLITAN SHARKS

Pop quiz: what's the only national marine sanctuary where you won't find sharks, no matter how hard you look?

Thunder Bay National Marine Sanctuary!

Located in Lake Huron, this freshwater sanctuary is the only place in the National Marine Sanctuary System not inhabited by sharks. Like many marine organisms, sharks' cells are salty enough to keep them in balance with ocean water. If a shark were to swim into freshwater, its kidneys would be strained by the effort to get rid of all that water. A few shark species, like bull sharks, are able to survive for short periods of time in freshwater, but the water of Lake Huron is far too cold and far from the ocean for them to survive long-term.



Whale sharks are the biggest species of shark in the world. Lucky divers can sometimes spot them swimming in Flower Garden Banks National Marine Sanctuary.

Photo: NOAA

But if you're looking for sharks, we've got you covered. Every other site within the sanctuary system has sharks, from the charismatic leopard sharks of Monterey Bay National Marine Sanctuary to the beautiful blacktip reef sharks of National Marine Sanctuary of American Samoa.

SHARKS OF GREAT SIGNIFICANCE

An ocean without sharks would be a drastically poorer environment than the one we know and love today. That's because sharks play an important role in food webs. Some species of sharks,

like white sharks and tiger sharks, are apex predators—they're at the top of the food web.

In places like Greater Farallones National Marine Sanctuary off the coast of California, "white sharks keep our burgeoning populations of seals and sea lions in check," explains Mary Jane Schramm, the sanctuary's outreach specialist. By keeping seal and sea lion populations in check, the sharks free salmon from the risk of predation. With fewer seals and sea lions hunting them, salmon can thrive and reproduce.

"White sharks keep the food web healthy," says Schramm. Given sharks' important role, when their numbers decrease, it can send ripples throughout the ecosystem.

Other sharks, like reef sharks, are known as "mesopredators." They eat smaller fish and invertebrates, but also have to watch out, lest they be eaten by larger sharks and other fish. As mesopredators, these sharks work diligently to keep the food web balanced and species healthy by eating weak or elderly animals.

SHARKS OF THE BLUE

No matter where sharks are in the food web, they play an important role—and for that reason, it's important that we help protect these animals.

ELECTRIC SLIDE

How do sharks hunt even in low light or poor visibility? They have a sixth sense—electricity.

Organs known as the ampullae of Lorenzini help sharks of all types sense electrical fields. This sensory perception helps sharks sense and locate predators and prey, even if they're buried in the sand or out of view in murky water.

Hammerhead sharks, like the great hammerheads of Florida Keys National Marine Sanctuary, are some of the best at sensing electricity. Their famous broad head provides these sharks with more space for ampullae of Lorenzini. More ampullae means more elaborate sensing ability, making it even easier for hammerheads to find their prey!

MORE THAN THE PALEO DIET

Some of the most well-known sharks in your sanctuaries have a reputation for taking on large animals like seals, sea lions, and whales. But not all sharks are into big food.

Nurse sharks, which can commonly be spotted in Gray's Reef and Flower Garden Banks national marine sanctuaries, eat crustaceans, mollusks, and stingrays off the seafloor—when they're not napping. Flower Garden Banks National Marine Sanctuary research coordinator Emma Hickerson once came across three nurse sharks, all stuffed into the same crevice while they rested. "I wanted to ask them what movie they were watching," she jokes.

And whale sharks, the biggest shark on Earth, actually eat the smallest prey. These common visitors to the Flower Garden Banks are filter feeders, primarily consuming plankton and small fish. In areas close to the sanctuary's proposed expansion sites, says Hickerson, whale sharks "sometimes aggregate in the hundreds, very likely feeding on the eggs of spawning fish." Closer to the Flower Garden Banks, small aggregations of up to 30 whale sharks can be seen sometimes. "We never expect to see a whale shark swim through when we are diving," says Hickerson, "but on the rare occurrence when we do, we get mighty excited!"



Mackerel scad clear the way for an adult white shark as it swims near the surface off the coast of Mexico's Isla de Guadalupe biosphere reserve.

Photo: George T. Probst



SHARKS: THEY CARE ABOUT HISTORY, TOO

Sharks are a common sight throughout your sanctuaries, and seeing one in the wild can be an awesome experience.

Monitor National Marine Sanctuary maritime archaeologist Tane Casserley encountered sharks on his first dive off North Carolina in the Graveyard of the Atlantic. "As we made it to the seafloor and oriented ourselves, I saw my first sharks swimming in and out of the schools of baitfish and through the openings of the shipwreck," he says. He estimates that there were at least 20 sand tiger sharks, all gliding past the divers within an arm's reach.

Though sand tiger sharks look fearsome with their jagged teeth and creepy grins, they, like so many other shark species, are generally harmless to humans. "I was so in awe of these gentle giants that I barely moved for 15 minutes," says Casserley. "It changed my life."

Sharks have lives outside our imagination, and they need us to rethink the way we conjure them in our minds. Whether you experience sharks while diving or snorkeling, or just admire them from afar through photos and videos, we hope they change your life, too. Their lives depend on it.

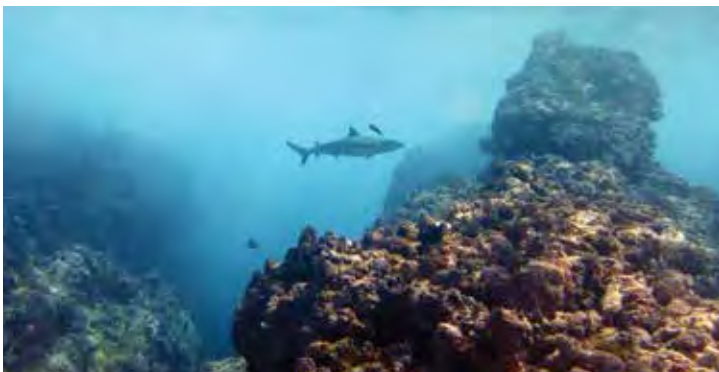
Opposite page, clockwise from top: Leopard sharks, Monterey Bay NMS; Sand tiger shark on USS *Tarpon*; Porbeagle shark, Stellwagen Bank NMS; Blacktip reef shark, NMS of American Samoa; Tiger shark attacking juvenile Laysan albatross, Papahānaumokuākea MNM.

Photos: James Watt/NOAA; Adam Obaza/NOAA; Tane Casserley/NOAA; Peter Flood; NOAA and Richard Pyle Bishop Museum; Kevin Lino/NOAA; Ilana Nimz/NOAA

A whitetip reef shark investigates a diver at French Frigate Shoals in Papahānaumokuākea Marine National Monument.

Photo: James Watt/NOAA





LIFE IN THE BLUE

Some of the most diverse and bountiful ecosystems are just in your backyard, in your National Marine Sanctuary System! These ocean and Great Lakes parks protect everything from endangered species like Hawaiian monk seals to iconic ones like white sharks and corals. Here, you'll find everything from the charismatic creatures you know from the ocean surface, to mysterious fish and invertebrates of the deep sea. It's all part of *Life in the Blue*.





A Hawaiian monk seal and green sea turtle rest together on a beach in Papahānaumokuākea Marine National Monument.

Photo: Mark Sullivan/NOAA



CONSERVATION PHOTOGRAPHY




Photo courtesy of Keith Ellenbogen

STORIES FROM THE BLUE: Keith Ellenbogen

Look at Keith Ellenbogen's photographs and it's clear that environmental conservation drives his art. A renowned underwater photographer, Keith's images have been displayed everywhere from the New England Aquarium to the lobby of the United Nations. In 2018, Keith received a Hollings Ocean Awareness Award from the National Marine Sanctuary Foundation, which took him to Stellwagen Bank National Marine Sanctuary to photograph marine life underwater. This is his Story from the Blue.

One August day in 2018, I was out with the Stellwagen Bank National Marine Sanctuary team, looking for marine animals to photograph. The coastal waters off Massachusetts are turbid with limited visibility, and that makes identifying and photographing large animals extremely challenging. On a good day—and it was a good day—the visibility in New England is only about 20 feet. I could see the light dancing through the emerald green sea as I approached what I thought was a basking shark.



“ I’d like to change the public’s perception of where wild is.”

Ellenbogen gets an unexpectedly close portrait of a white shark in Stellwagen Bank National Marine Sanctuary.

Photo © Keith Ellenbogen

As I approached the shark, I realized this was not a basking shark but rather an enormous white shark, swimming straight towards me. I’m fortunate—I have a lot of experience filming other sharks in the wild, and know how to stay calm. I kept my heartbeat slow and steady and the camera stable. As the shark passed me, it made strong and direct eye contact. I could hardly believe its enormous size. We later identified the shark as Large Marge, a white shark who has been tagged by the Massachusetts Division of Marine Fisheries. We estimated her size at about 17 feet long, six feet wide, and 3,000 pounds.

This encounter is evidence that white sharks aren’t man-eaters—though people still shouldn’t try to swim with them—but rather beautiful apex predators that are part of a healthy ocean ecosystem. That to me is what Stellwagen Bank National Marine Sanctuary is all about. There’s such an extreme diversity of animals here. Schools of mackerel and sand lance are the food for larger iconic animals—sharks, dolphins, seabirds, and whales.

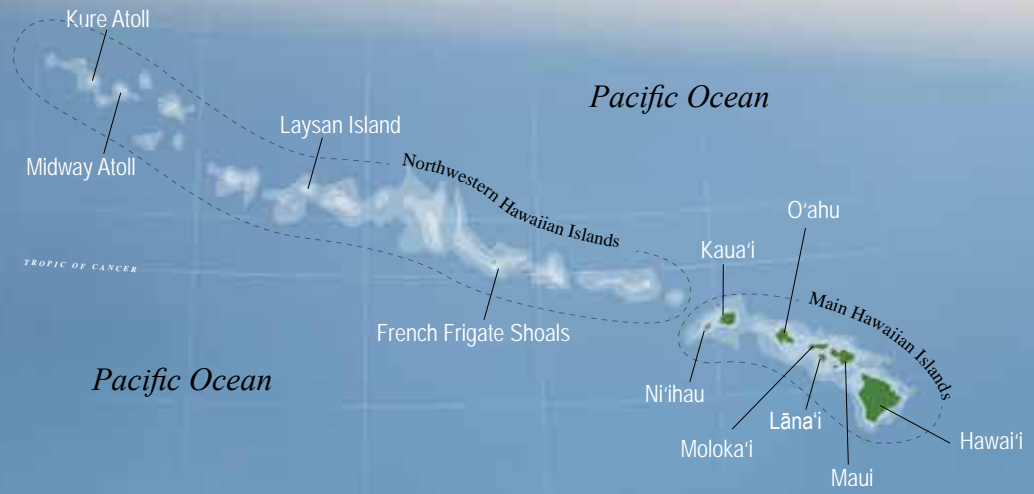
My project focuses on using the artistry of wildlife photography to communicate complex environmental and scientific issues, and to inspire peo-

ple about the sanctuary. When I get up close and personal with a lot of marine life, I’m struck by their beauty and diversity. They’re all unique in their own way—the way they move, the way they behave, their coloration. I’m always inspired.

I grew up in Boston, and people always say “Wow, you’re going to the Mediterranean” or “Wow, you’re going to Africa.” But what they don’t often realize is that some of the most extraordinary animals are right here off our coast, just 25 miles from Boston. I’d like to change the public’s perception of where wild is.

Hawaiian Monk Seal

CREATURE FEATURE



‘ĪLIO HOLO I KA UAUU

“dog that runs in rough seas”

Hawaiian monk seals are endemic to the Hawaiian Islands, meaning they are found nowhere else in the world. In Hawaiian, their name is ‘Īlio holo i ka uauu, which means “dog that runs in rough water.” These seals are one of the most endangered marine mammals in the world – only about 1,400 remain, most of which live in the protected waters of Papahānaumokuākea Marine National Monument. Researchers from NOAA and our partners are working hard to bring this species back from the brink. Thirty percent of the Hawaiian monk seals alive today are here because of those lifesaving efforts.



Fun Facts:

SCIENTIFIC NAME:

Neomonachus schauinslandi

DIET: Fish, cephalopods, and invertebrates

AVERAGE SIZE: 6-7.5 feet

AVERAGE WEIGHT: 400-600 pounds

LIFE SPAN: 30 years

GESTATION PERIOD: ~10-11 months

AVERAGE LITTER SIZE: 1 pup

MAXIMUM DIVE DEPTH: 2,000 feet

LOCATION: Main Hawaiian Islands and Northwestern Hawaiian Islands

Hawaiian monk seals face a number of threats from humans, including toxoplasmosis from cats, intentional killing, and fisheries interactions. If you see one, give it plenty of space and email pifsc.monksealsightings@noaa.gov.

Main photo: Koa Matsuoka. Inset photos (top): Koa Matsuoka; (bottom): Karen Bryan/HIMB



Above: The ghostly umbrella octopus (*Grimpoteuthis* sp.) drifted past ROV *Hercules* flapping wing-like fins, then inverted its webbed arms to reveal eight rows of suckers. Below: *Hercules* investigates a large gathering of *Muusoctopus* octopuses.

Photos: OET/NOAA

OCTOPUS'S GARDEN

While conducting deep-sea research in Monterey Bay National Marine Sanctuary, scientists aboard the *E/V Nautilus* got a treat that will octopi their hearts forever. Near Davidson Seamount, they encountered a beautiful umbrella octopus that flapped past on wing-like fins. Later in the dive, they encountered more than a thousand *Muusoctopus* octopuses tucked into nooks with their arms inverted in a brooding posture.



Scientists aboard *E/V Nautilus* witnessed the largest grouping of *Muusoctopus* ever recorded. The octopuses were positioned in a brooding posture, protecting their eggs.

Photo: OET/NOAA

OASIS IN THE DEEP

Coral reefs aren't just for the shallows! Far beneath the ocean surface, deep-sea corals and sponges sprout from the seafloor. These creatures provide habitat for sea stars, fish, shrimp, and more. Thanks to ever-improving technology, sanctuary researchers are getting a closer look at these remote coral ecosystems.

Above: Corals and other invertebrates create technicolor scenery on the pinnacles of Cordell Bank National Marine Sanctuary.

Opposite page, top to bottom: A crab explores bamboo coral in Bodega Canyon in Cordell Bank National Marine Sanctuary; Crinoids and *Primnoa* coral grow in the Juan de Fuca Canyon in Olympic Coast National Marine Sanctuary.

Photos: Robert Lee/BAUE; OET/NOAA; OET/NOAA



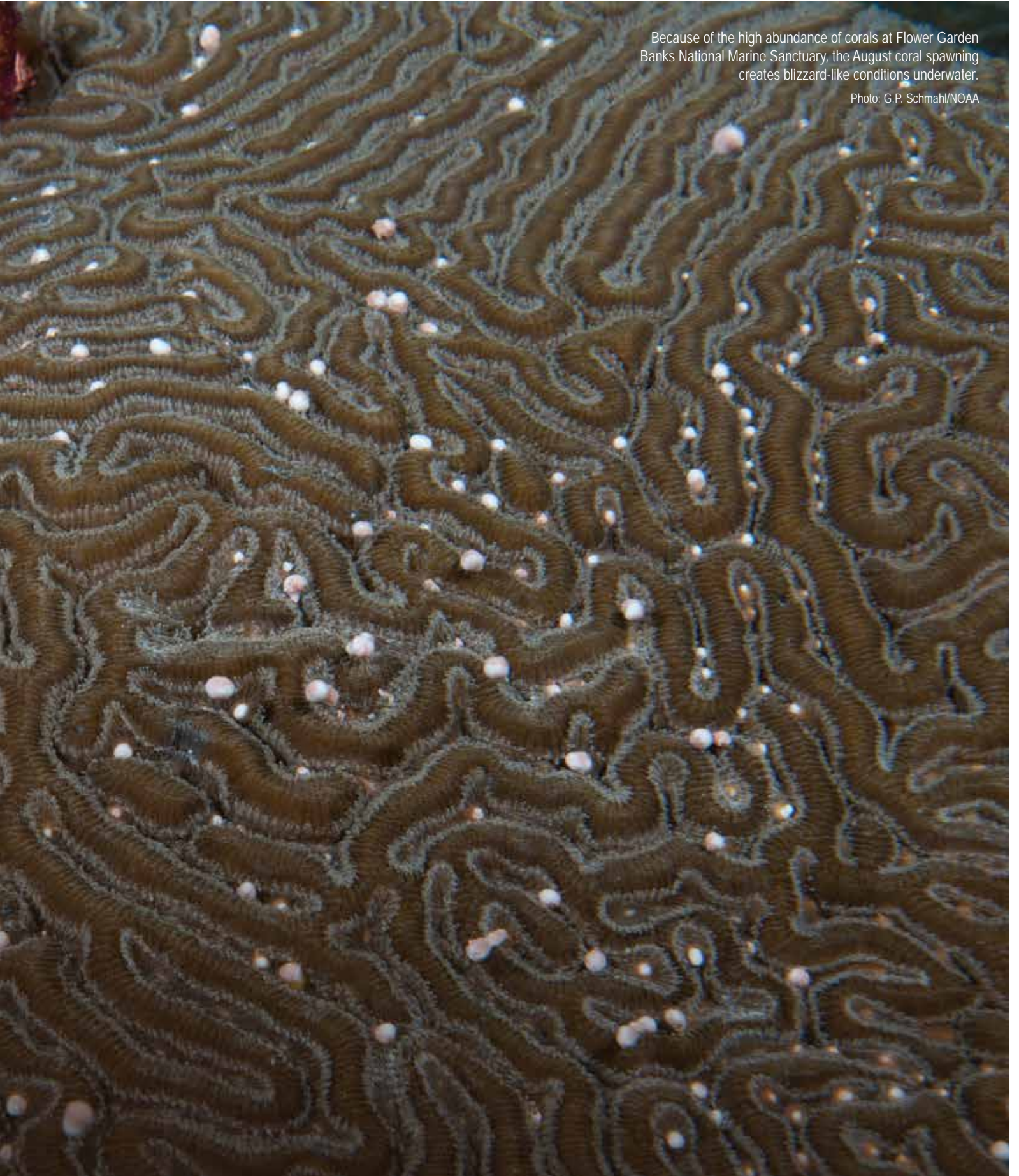


SPAWNTANEOUS GENERATION

Every August, several species of reef-building corals at Flower Garden Banks National Marine Sanctuary put on a fantastic spawning display. It may be the most prolific spawning event in the entire Caribbean and Gulf of Mexico! A few nights after the full moon, large numbers of corals broadcast reproductive material into the water column where it has the opportunity to mix and produce larvae. Those larvae will drift along in the ocean until they find a suitable place to settle and produce a new generation. Coral spawning can connect reefs over long distances, and makes sure that reefs have a high degree of genetic diversity.

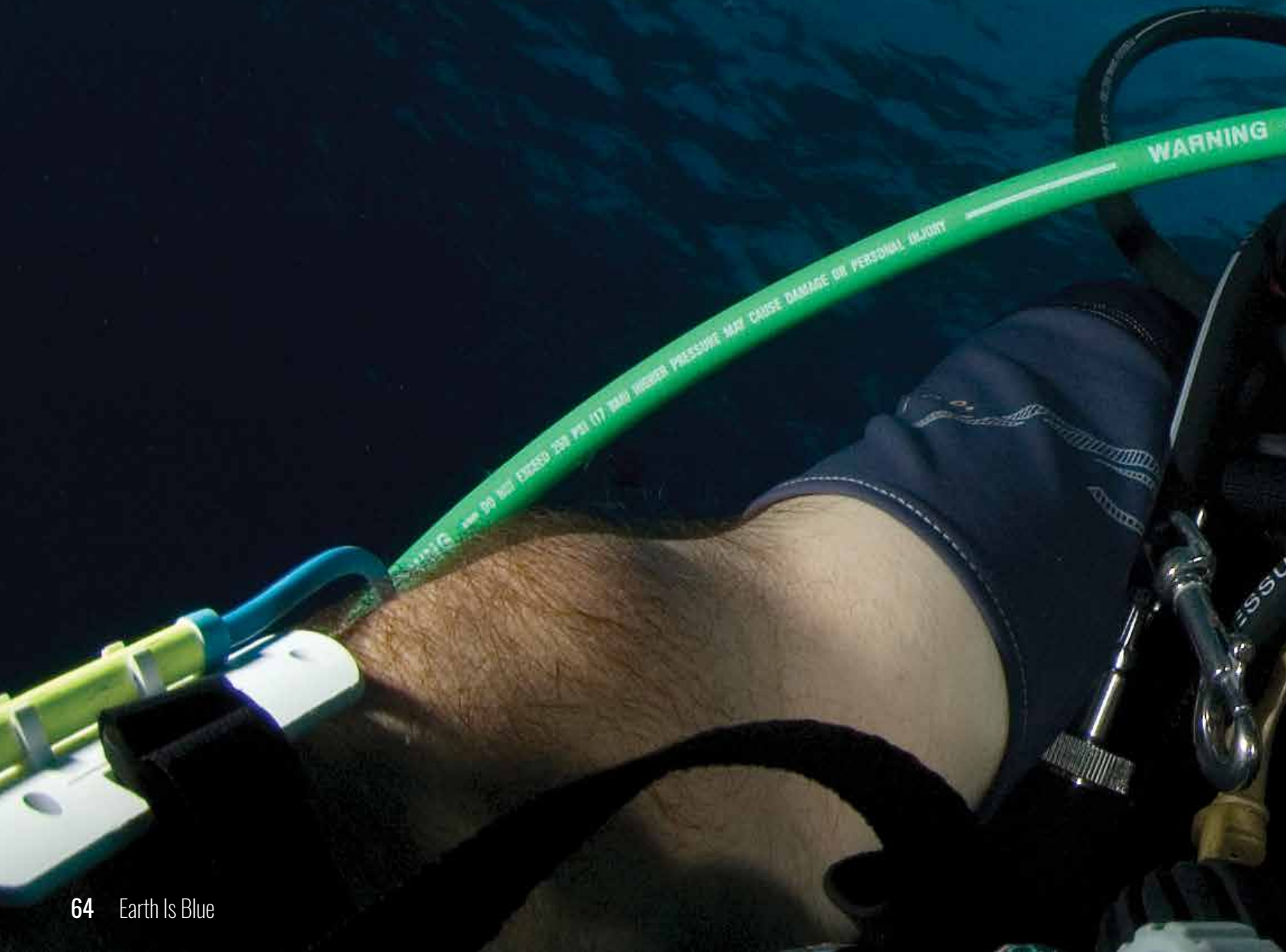
Because of the high abundance of corals at Flower Garden Banks National Marine Sanctuary, the August coral spawning creates blizzard-like conditions underwater.

Photo: G.P. Schmalh/NOAA



EXPLORE THE BLUE

On shore and at sea, scientists work tirelessly to better understand the animals and ecosystems of your National Marine Sanctuary System. Through long-term monitoring, researchers are able to respond to disease and changes in population. Listening in to sanctuary soundscapes and observing from close by and afar, researchers get a better sense of animal behavior. All the information they gather while they *Explore the Blue* helps us all better care for these ocean and Great Lakes treasures.





NOAA diver Greg McFall takes a quick selfie during an open-circuit technical dive in Florida Keys National Marine Sanctuary.
Photo: Greg McFall/NOAA



PAWS UP FOR SCIENCE



Photo: Kate Thompson/NOAA

STORIES FROM THE BLUE: Jessie Hale

— By ELIZABETH WEINBERG

Jessie Hale may have the most beautiful research location in the entire world. For the past several years, the sea otter researcher and Dr. Nancy Foster Scholar has been setting up a spotting scope on a bluff overlooking Olympic Coast National Marine Sanctuary, among sword ferns, verdant moss, and Sitka spruce. Sea

stacks rise from the water, cutting through early morning mist, and the ocean swell crashes on the beach below. Bald eagles fly overhead—so many it's hard to believe they're real—and hopefully, out in the water, sea otters dive for meals.

Hale comes out here, and to several other locations along Washington's Olympic Peninsula, to study sea otter feeding habits. A graduate student at the University of Washington, she's interested in what sea otters are eating and in what quantity. The data she collects will help her and other researchers understand how healthy the population along the Washington coastline is.



“The Dr. Nancy Foster Scholarship gave me the freedom to do the science that I wanted to do.”

of the small town of Moclips onto a dirt logging road on land owned by the Quinault Indian Nation, who grants Hale a permit to research on the reservation. Roosevelt elk appear out on the road like ghosts, then disappear again into the undergrowth. Then, miles down the logging road, Hale parks on the side of the road and walks down a rough, sloping path to the bluff edge. This is one of Hale's more accessible sites, too—most of the time, she backpacks several miles to get to her observation sites. If it takes this much effort for a dedicated researcher to find the sea otters, it's understandable that not many people would know about them.

Though sea otters may be the unsung heroes of the coast, they're definitely important. Sea otters are what's known as a keystone species in coastal environments. “If you envision an arch, there's a keystone in the middle of the arch that supports the whole thing. Without the keystone, the whole arch collapses,” Hale explains. That's because sea otters eat invertebrates, particularly sea urchins. Left unchecked, sea urchins will devour all the kelp in an area; with sea otters eating the urchins, the kelp grows into lush forests that provide habitat for all kinds of creatures. “It's the difference between a homogenous environment with primarily sea urchins, versus a very diverse marine ecosystem,” she says.

But for years, sea otters didn't exist on the Washington coastline. They were hunted to local extinction in the early 20th century, valued for their thick, soft fur. In 1969 and 1970, researchers reintroduced 59 sea otters from Alaska to the Olympic Coast. In the decades since, the sea otter population has grown: now more than 2,000 sea otters live in Washington, most of them in waters protected by Olympic Coast National Marine Sanctuary.

Because of their habitats' remoteness, these otters haven't been well-studied since they were transplanted, and Hale is working to change that. At her study sites, she logs what sea otters eat, how long they take to find their prey, and how much time they spend on the surface eating. These observations help her understand if the otters are getting enough food to survive and what prey they're preferring. “Based on how much food there is available in the environment,” she explains, “there are only so many otters that can successfully survive and reproduce in an area.” Knowing how much sea otters are eating can help Hale understand whether the population may soon be leveling off.

Olympic Coast National Marine Sanctuary plays a key role in this equilibrium, says Hale. The National Marine Sanctuary System “prioritizes the Olympic Coast as a special place that we care about and want to keep healthy. Sea otters are an important piece of that.” Plus, she points out, the sanctuary helps raise awareness about sea otters, so that future conservationists and scientists alike will grow up knowing that Washington is home to a thriving population of these adorable, and important, animals.

The Dr. Nancy Foster Scholarship has been key to Hale's research. It “gave me the freedom to do the science that I wanted to do,” she says. She was able to come up with the topic for her research and has undertaken the data collection and analysis herself. After she finishes her Ph.D., she'd like to continue with her work helping sea otters and other marine predators that need conservation support. “There are a lot of questions that need to be answered” about marine mammals, Hale says, and she'd like to be the one to answer them.

Hale has seen sea otters eat some pretty odd things. The first time she was out observing, she witnessed an otter carry an entire giant Pacific octopus to the surface, eat half of it, and then fall asleep with it draped across his chest.

Photo: Aura Leaf Kaila Edmondson

Sea otters are well-known residents of central California and Alaska, but not many people know they live in Washington, too. In fact, though she grew up in Seattle, Hale wasn't aware of her state's sea otters until she started volunteering for Washington's annual sea otter count. “You've been here the whole time!” she realized. “Where have I been?”

Washington sea otters' lives are so mysterious in part because the outer Olympic Peninsula is incredibly remote. To get to this particular research site, Hale drives an hour from a campsite outside

Sea Otter

CREATURE FEATURE



YOU OTTER LOVE THEM

Sea otters are totally pawsome! These fluffy marine mammals can be found in several of your national marine sanctuaries on the West Coast, including Olympic Coast, Monterey Bay, and Greater Farallones. Their population was drastically reduced in the 18th and 19th centuries due to hunting, but sea otters' numbers are now on the rise. In Washington, they were completely extinct until 59 otters were reintroduced from Alaska in 1969 and 1970. Now, more than 2,000 live in the waters in and around the Olympic Coast!



Fun Facts:

SCIENTIFIC NAME: *Enhydra lutris*

DIET: Invertebrates (sea urchins, lobster, abalone, clams, etc.)

AVERAGE SIZE: 4-5 feet

AVERAGE WEIGHT: 70-100 pounds

LIFE SPAN: 15-20 years

GESTATION PERIOD: 9-10 months

AVERAGE LITTER SIZE: 1-2 pups

HAIRS PER INCH: >1 million

LOCATION: Coastal waters of Japan, Aleutian Islands, Gulf of Alaska, Pacific coast of North America to Baja California



Unlike other marine mammals, sea otters don't have a thick layer of blubber to keep them warm. Instead, they rely on thick, waterproof fur. They spend much of their time grooming this fur to keep it in tip-top shape.

Main photo: Douglas Croft. Inset photos, top to bottom: Jenni Peters; Douglas Croft

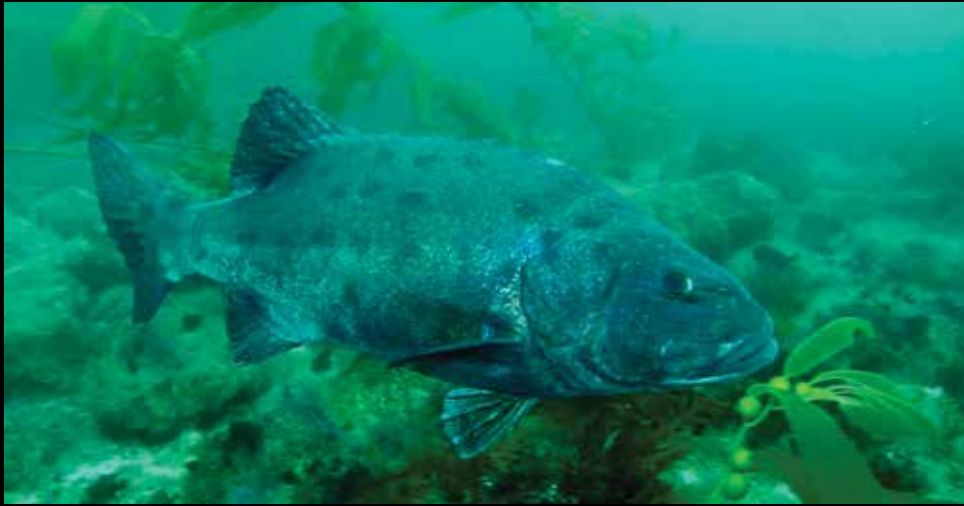
RETURN OF THE KING

While wandering through the kelp forests of Channel Islands National Marine Sanctuary, lucky divers may see the elusive king of this watery realm—the giant sea bass. These fish are at the top of the kelp forest food web, but little is known about them. Due to a history of overfishing, the population has been critically low for at least four decades. But that may be changing: there have been recent consistent sightings of the enormous fish in sanctuary waters. A new multi-year research project led by Ryan Freedman and other sanctuary researchers is using technology to track giant sea bass and to listen in to their environment and vocalizations. A regional collaboration between the sanctuary and partner research organizations is also seeking to better understand the fish's role in the marine environment, as well as how humans affect it. Using modern technology, researchers will have front row seats to watch giant sea bass return to the kelp fronds. Long may they reign!



A NOAA diver swims through strong currents to tag elusive giant sea bass in Channel Islands National Marine Sanctuary.

Photos: Nick Zachar/NOAA



Researchers can distinguish individual giant sea bass by the black spots that adorn their bodies.

Photo: Robert Schwemmer/NOAA





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

Photo: J. Moore/NOAA, under NOAA Permit #15240



NAVIGATING AN OCEAN OF CHANGE

In late 2015, researchers and whale watch companies began seeing fewer humpback whales throughout the waters of Hawaiian Islands Humpback Whale National Marine Sanctuary. Normally, thousands of whales visit the sanctuary each winter to mate, give birth, and raise their young. But all across the islands of Hawai'i, their numbers seemed to be reduced.

The sanctuary reached out to researchers around the islands and in Alaska, where the Hawaiian population of whales travels every summer to feed. It turned out that the whales had been spotted in lower numbers in transects and shoreline surveys, heard less on underwater microphones, and seen less frequently in Alaska's Glacier Bay National Park and other regions.

Most researchers agree that a likely culprit is food. Recently, warmer waters in Alaska have reduced humpback whale food sources like krill. But researchers are still trying to determine the impacts of that change—are whales spending more time feeding before returning to Hawai'i? Have they gone elsewhere? Has the population declined?

Although whale sightings have decreased throughout Hawai'i during the past three seasons, many humpback whales do still visit sanctuary waters each year. Visitors still have amazing opportunities to view these majestic animals in their natural habitat.

However, now more than ever, it's important to help mother and calf pairs thrive within the sanctuary. While a whale watcher may only see one mother and calf pair in a day, that pair may see hundreds of people, interrupting time they would otherwise spend resting or nursing. The sanctuary is asking whale watchers and other boaters to be extra careful and give the whales plenty of space.

Hawaiian Islands Humpback Whale National Marine Sanctuary is facilitating further discussions among humpback whale researchers. The more people working on this issue, the more likely we are to understand it, and the better chance we have of offering a helping hand—or fin.



A NOAA research diver photographs a transect during long-term monitoring of coral reefs in Flower Garden Banks National Marine Sanctuary.

Photo: G.P. Schmahl/NOAA

TRACKING SANCTUARY TRENDS

National marine sanctuaries serve as crucial sites to track changes to the health and wellbeing of the ocean environment. Researchers throughout sanctuaries return to the same sites year after year to evaluate whether conditions are improving, declining, or remaining the same. The Flower Garden Banks National Marine Sanctuary long-term monitoring program, which began in 1989, is one of the longest-running monitoring programs of a coral reef anywhere in the world! The data collected help researchers all over the world understand reef health.



THE BLUE AND YOU

The National Marine Sanctuary System protects more than 620,000 square miles of ocean and Great Lakes waters—but none of it could be protected without *you*. Volunteers, visitors, students, and local communities are the backbone of the sanctuary system. You restore fragile ecosystems, remove marine debris from impacted habitats, conduct science, and speak up on behalf of your national marine sanctuaries and marine national monuments. *The Blue and You* are indelibly linked, and it's thanks to you that the sanctuary system continues to thrive.



A Laysan albatross and chick look curiously at a pile of disposable cigarette lighters cleaned up by NOAA responders in Papahānaumokuākea Marine National Monument.

Photos: David Slater/NOAA



GUARDIANS OF THE OCEAN



“ Through the Ocean Guardian School Program, Gault students are becoming empowered to make positive changes in their environment.”

— Dr. Bill Henry

STORIES FROM THE BLUE: Susan Dahlgren, Gault School



Photo: Bill Henry

NOAA Ocean Guardian Schools make a commitment to protecting their local watersheds, ocean, and national marine sanctuaries. As of 2019, more than 110 schools have implemented a school- or community-based conservation project to fulfill that promise. Under the leadership of Life Lab teacher Susan Dahlgren, one school, Gault Elementary School, has been making a huge difference for their local beach and the nearby Monterey Bay National Marine Sanctuary. Read on for Dahlgren's Story from the Blue.

Five years ago, two Gault parents who are seabird ecologists asked if I was interested in growing some native plants at the school. I like native plants and hadn't grown them before, so I thought it was a great idea. They then connected me with Bill Henry of the nonprofit Groundswell, which works with communities to restore California's coastline, and we applied for an Ocean Guardian School grant.

As part of their Ocean Guardian Stewardship project, the third-graders grow native plants such as California poppy, buckwheat, seaside daisy, yarrow, and lizardtail in our school greenhouse every September. They learn about the benefits of native plants and the hazards of ice plant, a non-native plant found throughout California that is originally from South Africa. People thought this plant would help stabilize the land where they were putting in railroads. But instead, it's

heavy, has shallow roots, and causes erosion. It blankets the coast so native plants can't grow. It provides hiding places for rats but doesn't provide food or shelter for any of our native species.

Each December, the students walk to Seabright State Beach and plant the native plants. In the spring, they return and conduct a plant transect comparing the area that's been restored to the unrestored area. Students see the differences not only in the plant diversity and plant growth, but also the diversity of animal species. In the barren sand or the ice plant area, they may see ants or a spider. But in the native plant areas, they find lizards, bees, beetles, butterflies, and birds. The students see the difference that coastal restoration can make.

In the first year of the project, the seedlings we planted at the beach grew a foot or two. We only water them once, and then they're left to Mother Nature. Since we've had a drought in California for several years, the plants' survival is evidence they're adapted to this climate and belong here. Now, the plants that we planted five years ago are mature: they've flowered, gone to seed, and are reproducing.

Several bird species live at our beach now, including white-crowned sparrows and black phoebes. A burrowing owl—a species of concern—overwintered last year and has returned again this year; it's claimed its home. Threatened snowy plovers are nesting in the dunes again.

Some of our students live near the beach and visit with their families, teaching them about the plants and the environment. Other students have presented to the city council about the importance of biodiversity along our coast. All of our students paint colorful signs to educate the public about habitat restoration. Gault students live next to Monterey Bay National Marine Sanctuary, and now they're learning that they can have an impact. They can change the environment for the better.

Above: A Gault Elementary School student prepares a native plant she grew from seed. Inset: A Gault student collects data at Seaside State Beach.

Photos: Nick Zachar/
NOAA: Bill Henry

Laysan Albatross

CREATURE FEATURE



FREQUENT FLIER MILES



Laysan albatrosses and other albatross species are among the great travelers of the ocean. After they fledge, they may spend as many as five years at sea before returning to land to nest. Mature Laysan albatrosses nest at large colonies in Papahānaumokuākea Marine National Monument, and may travel all the way to national marine sanctuaries along the West Coast during non-breeding seasons. The oldest known bird in the world, Wisdom, is a Laysan albatross. She is at least 68 years old, and is still laying eggs with her partner, Akeakamai!

Fun Facts:

SCIENTIFIC NAME:

Phoebastria immutabilis

DIET: Squid, fish eggs, crustaceans

AVERAGE WINGSPAN: 6-7 feet

LIFE SPAN: 68+ years

OLDEST KNOWN BIRD: Wisdom

AVERAGE CLUTCH SIZE: 1 egg

LONGEST JOURNEY: 4000+ miles

HAWAIIAN NAME: *Mōli*

Laysan albatrosses often ingest floating plastic, mistaking it for food. An estimated five tons of plastic are fed to albatross chicks each year at Midway Atoll. You can help Laysan albatrosses by reducing, reusing, recycling, repurposing, and refusing plastic.

At left: Wisdom tends to her just-hatched chick on Midway Atoll. Photo: Ann Bell/USFWS

THE BLUE AND YOU

Clockwise from top right: DiveN2Life has removed many derelict spiny lobster traps; Cleanup divers with Rainbow Reef Dive pause for a safety stop; A volunteer with Florida Bay Outfitters stacks debris on a kayak; Big Kahuna Surf volunteers remove debris from mangrove forests; Key Dives leads a monthly cleanup dive.

Photos: DiveN2Life: John Nussbaum; Kris Sarri/National Marine Sanctuary Foundation; Jessica Hogan; Key Dives



GOAL: CLEAN SEAS

In September of 2017, Hurricane Irma tore through Florida Keys National Marine Sanctuary, carrying large amounts of marine debris into the ocean. In response, Florida Keys National Marine Sanctuary and the National Marine Sanctuary Foundation launched Goal: Clean Seas Florida Keys to clean up underwater debris. The program issues permits and trains professional dive shop staff to lead underwater cleanup efforts in the sanctuary. In its first year, the initiative removed more than 18,000 pounds of marine debris from sanctuary waters.



Diver Kris Sarri carefully works to remove marine debris that is tangled in the reef.

Photo: Alisia Carlson

REEF's first surveys through the Volunteer Fish Survey Project took place in Florida Keys National Marine Sanctuary.

Photo: Matt McIntosh/NOAA



PARTNERS THAT COUNT

Reef Environmental Education Foundation (REEF)

— By AMY LEE

In July 1993 in Florida Keys National Marine Sanctuary, a small group of pioneering conservationists conducted the first surveys as part of REEF's Volunteer Fish Survey Project. Today, the project represents the world's largest marine life database. It contains more than 233,000 surveys conducted by volunteer divers and snorkelers worldwide, including nearly 40,000 surveys from all national marine sanctuaries except Thunder Bay.

By conducting surveys, recreational divers and snorkelers learn about and develop an appreciation for the marine life found in our national marine sanctuaries, while making a meaningful contribution to the marine science community. The

information collected by these volunteers serves as a baseline of biodiversity trends while documenting changes in the marine environment, such as non-native species, range shifts, and declines in species with commercial or ecological importance. Over 65 scientific publications have included the citizen science data from the Volunteer Fish Survey Project.

"I consider REEF's survey technique to be one of the best for assessing fish diversity and relative abundances, and detecting and tracking invasive species," says Dr. Steve Gittings, chief scientist for NOAA's Office of National Marine Sanctuaries. "The technique also engages high quality, trained members of the public in sanctu-

ary characterization and monitoring."

REEF data are collected year-round, but as summer water temperatures increase, so do fish counting efforts. Each July, REEF coordinates the Great Annual Fish Count in partnership with national marine sanctuaries. Originally called the "Great American Fish Count," this event was first held in 1992, as a "fish census" in Channel Islands National Park. It officially became part of REEF in 1997 when the Volunteer Fish Survey Project expanded to the Pacific Ocean.

Similar to the Audubon Society's Christmas Bird Count, the goal of the Great Annual Fish Count is to engage divers and snorkelers in citizen



Clockwise from top: REEF surveyors pause for a photo in Florida Keys National Marine Sanctuary; A citizen scientist counts fish in Florida Keys National Marine Sanctuary; A surveyor notes data in Olympic Coast National Marine Sanctuary. Photos: Daryl Duda; Paul Humann; Janna Nichols

science. For divers and snorkelers who want to make a difference, it's the perfect opportunity to collect valuable data about our national marine sanctuaries that would not be available otherwise.

"We are proud to support REEF surveying in all ocean-based national marine sanctuaries, providing a unifying volunteer opportunity for sanctuary visitors," says Dr. Christy Patten-gill-Semmens, REEF director of science. "Our partnership with the sanctuaries is a valued part of our 25-year history, from our beginnings in the Florida Keys, to our collaboration with National Marine Sanctuary of American Samoa to bring the Volunteer Fish Survey Project to the South

Pacific, and everywhere in between. The project provides a concerted and persistent data collection effort that generates information vital to effective environmental conservation, protection, and restoration."

Anyone can participate in the Great Annual Fish Count by joining or hosting fish identification classes, survey dives, or post-dive celebratory cookouts. Events are organized annually in nearly all national marine sanctuaries. To find one in a national marine sanctuary near you, visit www.fishcount.org, and check out www.REEF.org for more information and data summaries.

Amy Lee is the trips program and communications manager for REEF.





earth is blue

Each year, in honor of the annual Get Into Your Sanctuary celebration, the NOAA Office of National Marine Sanctuaries holds a photo contest. Please join us in congratulating the winners of the 2018 contest, pictured here! Through photography, these sanctuary visitors show the world our special ocean and Great Lakes treasures through their eyes.

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, Tumblr, and Flickr for more incredible images of your National Marine Sanctuary System.

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VOLUME 4



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sanctuaries.noaa.gov

Winner of the "Sanctuary Portraits" category: Bryan Dort (background photo).
A stand-up paddleboarder floats over the shipwreck of the steamer *Albany* in Thunder Bay National Marine Sanctuary.

Winner of the "Sanctuary Views" category: Donna Hendricks (top photo). Inspiration Point on Anacapa Island, Channel Islands National Marine Sanctuary.

Winner of the "Sanctuary Life" category: Douglas Croft (bottom photo). Humpback whales feed on anchovies in Monterey Bay National Marine Sanctuary.



**COMMUNITY.
CONSERVATION.
COLLABORATION.**

From humpback whale feeding grounds off Cape Cod to coral reefs in American Samoa, NOAA's Office of National Marine Sanctuaries protects treasured places in the ocean and Great Lakes. The communities of the National Marine Sanctuary System work together to leave these ocean treasures better than we left them, for people and the planet.

LEARN MORE. JOIN US.



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