Office of National Marine Sanctuaries
National Oceanic and Atmospheric Administration

STELLWAGEN BANK NATIONAL MARINE SANCTUARY

STELLWAGEN BANK *E*-NOTES: *sanctuary news & events* March-April 2016

Sanctuary's new inflatable humpback whale cruises into Connecticut

Salt, the sanctuary's inflatable whale modeled after the grand dame of Stellwagen Bank's humpback whale population, made her way to The Maritime Aquarium in Norwalk, Connecticut for nine days in January. Find out more about that visit to new territory on page 2. There she met Sharky – the aquarium's mascot (photo above; credit: Anne Smrcina, NOAA).

.

Name a Shearwater!

Sanctuary scientists will be tagging great shearwaters this summer with satellite trackers. They need to name these birds for easy identification. You can help by suggesting possible names. Winners will be announced in June. See page 3 for more information. Photo: Peter Flood

In This Issue:

EDITOR: Anne Smrcina

To receive notices about new issues or to provide feedback on this publication, contact us at stellwagen@noaa.gov or 781-545-8026 and provide your e-mail address. This information will be held securely and not released to any outside organization or individual.

Find us on Facebook www.facebook.com/SBNMS

YouTube www.youtube.com/user/SBNMS

@NOAASBNMS

Salt wows visitors at Maritime Aquarium

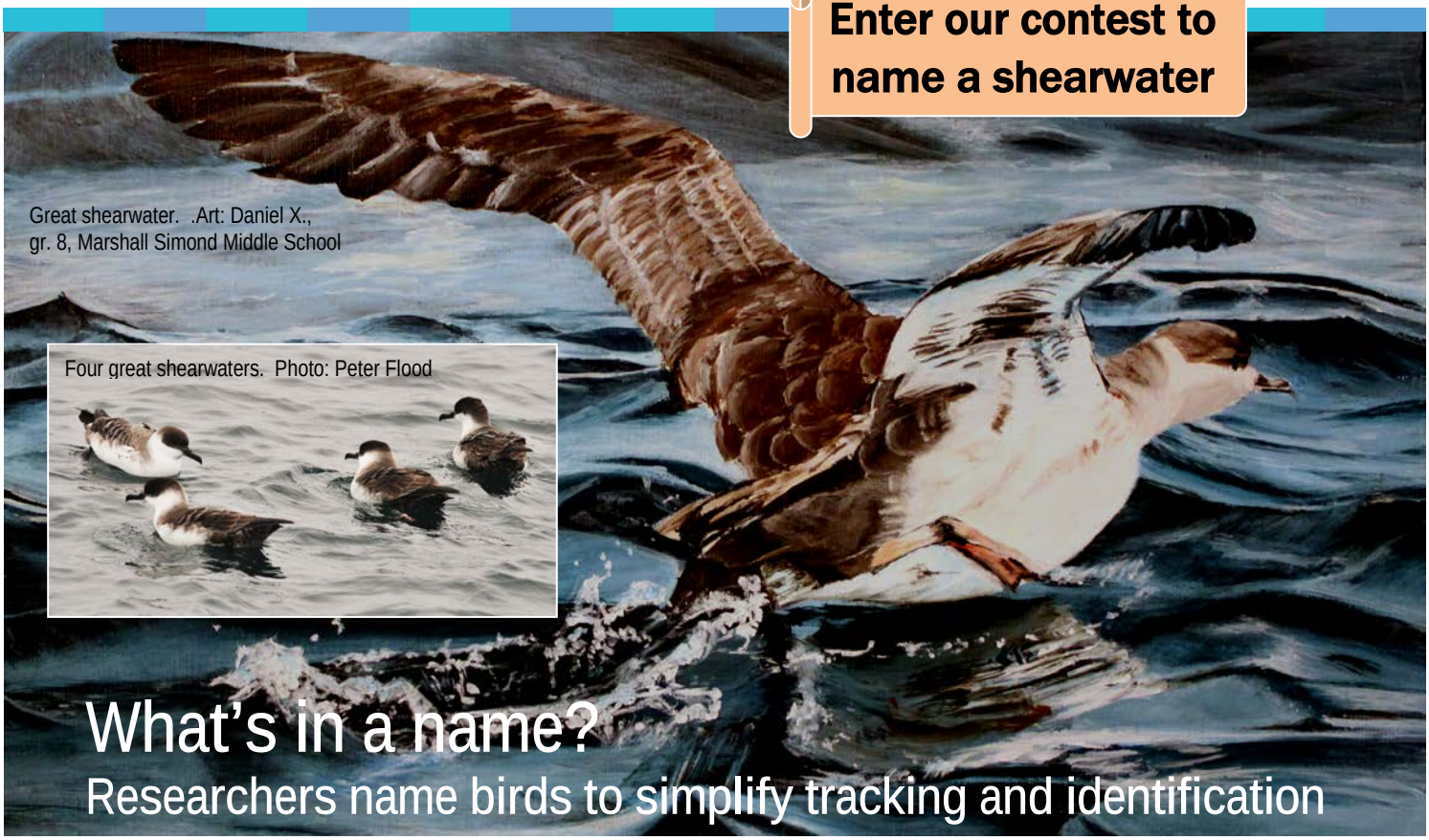
Salt, an inflatable model of the sanctuary's most famous humpback, undertook a migration of her own this past January. During a nine-day visit to The Maritime Aquarium in Norwalk, Connecticut, she attracted hordes of curious visitors. Some 6,400 individuals got a chance to walk into the belly of our beast, see some of the internal organs and learn a bit about whale biology.

The visit was timed to coincide with the formal opening of the sanctuary's larger traveling exhibit – *Animals without Passports*, which will be residing at the aquarium for the entire year. *Animals without Passports* examines humpback whale biology, behavior and migration, recent sanctuary research on humpback whales, and our Sister Sanctuary program with other North Atlantic nations with marine mammal protected areas.

Sanctuary staff provided training for aquarium educators and volunteers about the operation of the exhibits and background information about Stellwagen Bank National Marine Sanctuary, the National Marine Sanctuary System, and the population of North Atlantic humpback whales, some of whom visited Long Island Sound last summer.

(Top photo) Aquarium visitors line up for a chance to go inside Salt, the sanctuary's inflatable whale. More than 4,000 aquarium-goers ventured into the whale during the Martin Luther King weekend. (Middle) Two children get a close-up look at the whale after creating their own sanctuary whale hats. (Bottom) The sanctuary's *Animals without Passports* exhibit has found a home for 2016 in the lobby of the aquarium's IMAX Theater. Photos: Anne Smrcina, NOAA/SBNMS

Enter our contest to name a shearwater



Great shearwater. .Art: Daniel X., gr. 8, Marshall Simond Middle School

Four great shearwaters. Photo: Peter Flood

What's in a name?

Researchers name birds to simplify tracking and identification

Among the great shearwaters feeding in the sanctuary this past summer, there were a very special few – birds with names. The animals had been captured by a Stellwagen Bank National Marine Snctuary/U.S. Fish and Wildlife team and fitted with satellite tags. The tiny instruments were attached to the skin on the back of each bird, while blood, feather and exhalation samples were taken to test for sex, prey and health. Once the birds were released, signals received by satellites overhead allowed the researchers to track flight paths.

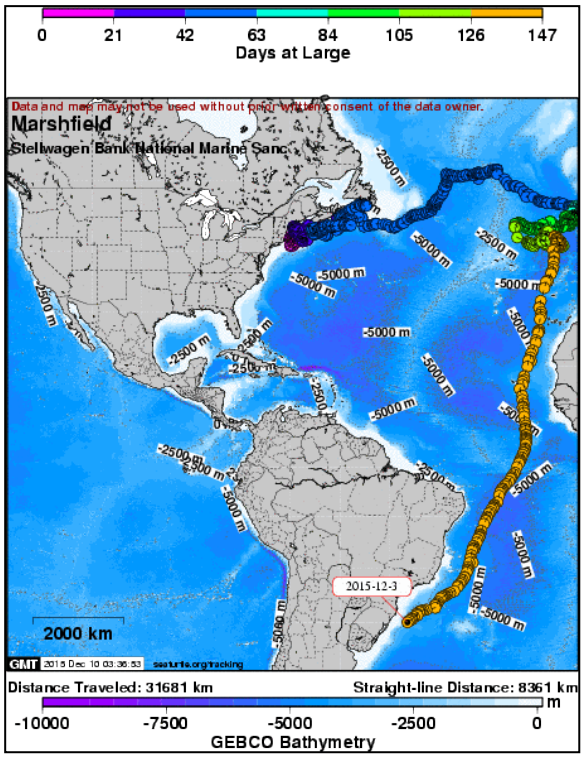
During the summer, some birds ranged widely in the Gulf of Maine. For several of these shearwaters, the tags retained power and continued to transmit as these long-distance travelers made their annual commute to the eastern North Atlantic and then down to South America and Tristan de Cunha, an island in the south-central part of the South Atlantic.

Over the past three years, 30 birds have been tagged and named. But, researchers now have a problem. They have run out of names (originally selected from town names in Massachusetts).

This year, the team is calling upon the public to help name the study subjects. Each winning entrant will get a photo of his/her bird and mention in an issue of *E-Notes*. The research team will judge and select the names that work best with the on-going program.

Rules for our Name the Great Shearwaters Contest:

1. Entries should be gender neutral and not human names;
2. Entries can be a single name for one bird or a series of related names up to 10 (judges have the right to select one, several or all names from a single entry);
3. Names should be easy to read and pronounce, and should be approximately 5-10 letters long;
4. Names should not be hyphenated or combine two words.
5. Deadline for submission (email to: stellwagen@noaa.gov) is May 15. Names will be selected and winners notified by June 1.



2015 track of a bird named "Marshfield." To learn more about the project, view photos and all 2015 tracks, go to http://stellwagen.noaa.gov/science/shearwater13.html

Northern fulmar photographed during the 2015 Stellwagen Bank Christmas Bird Count and Winter S4 Survey. Photo: Peter Flood

Stellwagen Bank Christmas Bird Count Totals Announced

On December 26, a hearty group of dedicated birders boarded the sanctuary's Research Vessel *Auk* before dawn for a full day's cruise to count birds. The trip incorporated the annual Christmas Bird Count (the Stellwagen Bank contribution to this nationwide citizen science effort) and the Stellwagen Sanctuary Seabird Stewards (S4) winter monitoring cruise. S4 cruises are scheduled four times a year to track seasonal changes, and, over time, to detect possible distribution changes due to climate change or other environmental factors.

Christmas Bird Counts started 116 years ago as a means of refocusing attention on birds and transition from shooting them (winter hunts) to counting and appreciating them. Stellwagen Bank counts have been occurring since 1987, with the sanctuary participating as a co-sponsor starting in 1999. In 2010, the sanctuary and Massachusetts Audubon moved from a traditional count circle to a more scientifically rigorous track that covers the entire bank.

TABLE: S4 = viewing from one side only, 0-90 degrees from front of vessel, 0-300 meters from the vessel, entire trip.
S4-2 = viewing from second side, 0-90 degrees from front of vessel, as far out as the observers can confidently identify the birds, entire trip.
CBC = viewing from both sides, 360 degrees around the vessel, as far as the observers can see (including fishing vessels) along the established Stellwagen Bank CBC track line.

BIRDS	S4	S4-2	CBC
Alcid species	5	13	0
Atlantic puffin	1	0	1
Black-legged kittiwake	3	42	41
Common eider	0	22	46
Common loon	0	1	0
Common murre	10	11	38
Great black-backed gull	21	40	263
Great shearwater	15	8	56
Gull species	0	19	76
Herring gull	15	22	257
Iceland gull	0	0	1
Jaeger species	0	2	3
Large alcid sp.	0	0	38
Northern fulmar	16	19	76
Northern gannet	28	111	131
Pomarine jaeger	1	2	3
Razorbill	13	16	25
Red-throated loon	0	1	1
Scoter species	1	37	0
Surf scoter	10	0	0
Unknown tubenoses	0	1	0
Unknown murre	0	0	1
White-winged scoter	0	2	3
TOTAL BIRDS	139	370	1,060

Razorbills photographed in December 2015 off Provincetown. Photo: Peter Flood

Microbeads banned – important step to reduce marine debris

On Monday, December 28, 2015, President Barack Obama signed into law H.R. 1321, the "Microbead-Free Waters Act of 2015," which prohibits the manufacture and introduction into interstate commerce of rinse-off cosmetics containing intentionally-added plastic microbeads. The bill passed unanimously through Congress and offers a important step in reducing the amount of microplastic marine debris in the ocean. The law halts manufacturing of microbeads by July 1, 2017 and bans the delivery of new cosmetic products containing microbeads by July 1, 2018.

"Microplastics" are pieces of plastic that are less than 5mm long. Some microplastics can come from larger pieces of plastic that have broken down over and over again. But many microplastics are manufactured, such as pre-production industrial plastic pellets and plastic "micro-scrubbers" or "microbeads," which are found in face washes, body soaps and cosmetics.

Microplastics may be one of the more prevalent and little understood marine debris threats in the sanctuary.

Plastic may harm fish and other wildlife in two main ways.
Direct Impacts - Studies show that fish and other marine life eat plastic. Plastics can cause irritation or damage to the digestive system. If plastics are kept in the gut instead of passing through, the animal could feel full, leading to malnutrition or starvation.
Indirect Impacts - Plastic debris accumulates pollutants such as PCBs (polychlorinated biphenyls) up to 100,000 to 1,000,000 times the levels found in seawater. PCBs, which were mainly used as coolant fluids, were banned in the U.S. in 1979 and internationally in 2001. It is still unclear whether these pollutants can seep from plastic debris into the organisms that happen to eat the debris. There is also the issue of the exact source of these pollutants as they can come from sources other than plastic debris.

Adapted in part from NOAA Marine Debris website http://marinedebris.noaa.gov/

Microbeads and other small plastics collected with a plankton net during a Sea Education Association research cruise. Photo: SEA

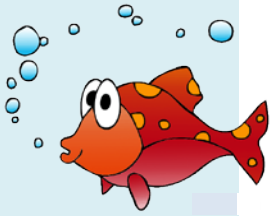
Northwest Atlantic Ocean may get warmer, sooner

A new study by NOAA researchers suggests future warming of ocean waters off the Northeastern U.S. may be greater and occur at an even faster rate – about twice as fast as previously projected and almost three times faster than the global average.

Over the past ten years, the Gulf of Maine has warmed faster than 99% of the global ocean. Recent studies indicate that the enhanced warming is associated with a northerly shift in the Gulf Stream. Changes in the distribution and species composition are already evident. Warming of 5 to 7 degrees F, as projected by a NOAA climate model will likely cause more extreme effects on the ecosystem.

The study was based on four global climate models and reported in the *Journal of Geophysical Research – Ocean*. Lead author of the paper was Vincent Saba, a scientist at the NOAA Northeast Fisheries Science Center in Woods Hole.

For more information on the study,see http://www.nefsc.noaa.gov/press_release/pr2016/scispot/ss1601/



Fish species reacting to changing ocean conditions

NOAA scientists have found that fish in the Northeast have been moving away from their traditional ranges.

Species associated with warmer, shallower waters in the Mid-Atlantic Bight and Georges Bank are shifting strongly northeast, tracking shifts in temperature along the shelf.

In contrast, species in the Gulf of Maine are shifting to the southwest, possibly tracking the cooler bottom waters in the deeper basins. Species in the Gulf of Maine associated with cooler and deeper waters also tended to shift deeper, with little North-South change.

Differences in how species respond to regional climate changes may have implications for predator-prey interactions and competition as species shift into new areas and undergo range expansion or contraction. The changes can affect fisheries management, too. Increasingly concentrated species could result in increased vulnerability to capture by fishing, and subsequently a decline in abundance.

For more information on this study, go to http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0149220

The NOAA press release can be found at http://www.nefsc.noaa.gov/press_release/pr2016/scispot/ss1604/


Photo: Anne Smrcina, NOAA/SBNMS

A Guster Connection

Musician Adam Gardner of the rock band "Guster" discusses marine conservation with David Wiley, the sanctuary's research coordinator by the sanctuary boulder reef exhibit at the New England Aquarium. Adam's nonprofit environmental organization REVERB brought a video team to the session and is now making two short public service programs – one on the sanctuary and one on climate change, to be released soon on YouTube. Keep checking the sanctuary website and social media outlets for links.

David Wiley's shearwater research project (see page 3) has led to other tangential research. A paper in *Conservation Letters*, Jan/Feb 2016, indicates that identification of commercial fishing grounds and seabird habitats can suggest areas of high bycatch risk, leading to better resource management. "Integrating Satellite-Tagged Seabird and Fishery-Dependent Data: A Case Study of Great Shearwaters (*Puffinus gravis*) and the U.S. New England Sink Gillnet Fishery" was written by Joshua M. Hatch, David Wiley, Kimberly T. Murray and Linda Welch.

Sanctuary staffer in award-winning film

Sanctuary marine ecologist/bioacoustician Leila Hatch was a "cast member" in a new and award-winning film called *Sonic Sea*. The film covers the issue of rising noise levels in the ocean and how these sounds may affect marine life. It was produced by the National Resources Defense Council and the International Fund for Animal Welfare.

Leila has worked in the sanctuary studying the loss of right whale communication space, is part of a team that is identifying cod spawning grounds based on male cod grunting, and was instrumental in the effort to place listening stations in the shipping lanes to detect right whales. She is now devoting much of her time to a NOAA program that is developing a soundscape for the nation's coastal waters.

Other individuals in the film include the musician Sting, oceanographic explorers Sylvia Earle and Jean Michel Cousteau, famed Cornell University bioacoustics specialist Chris Clark, and others.

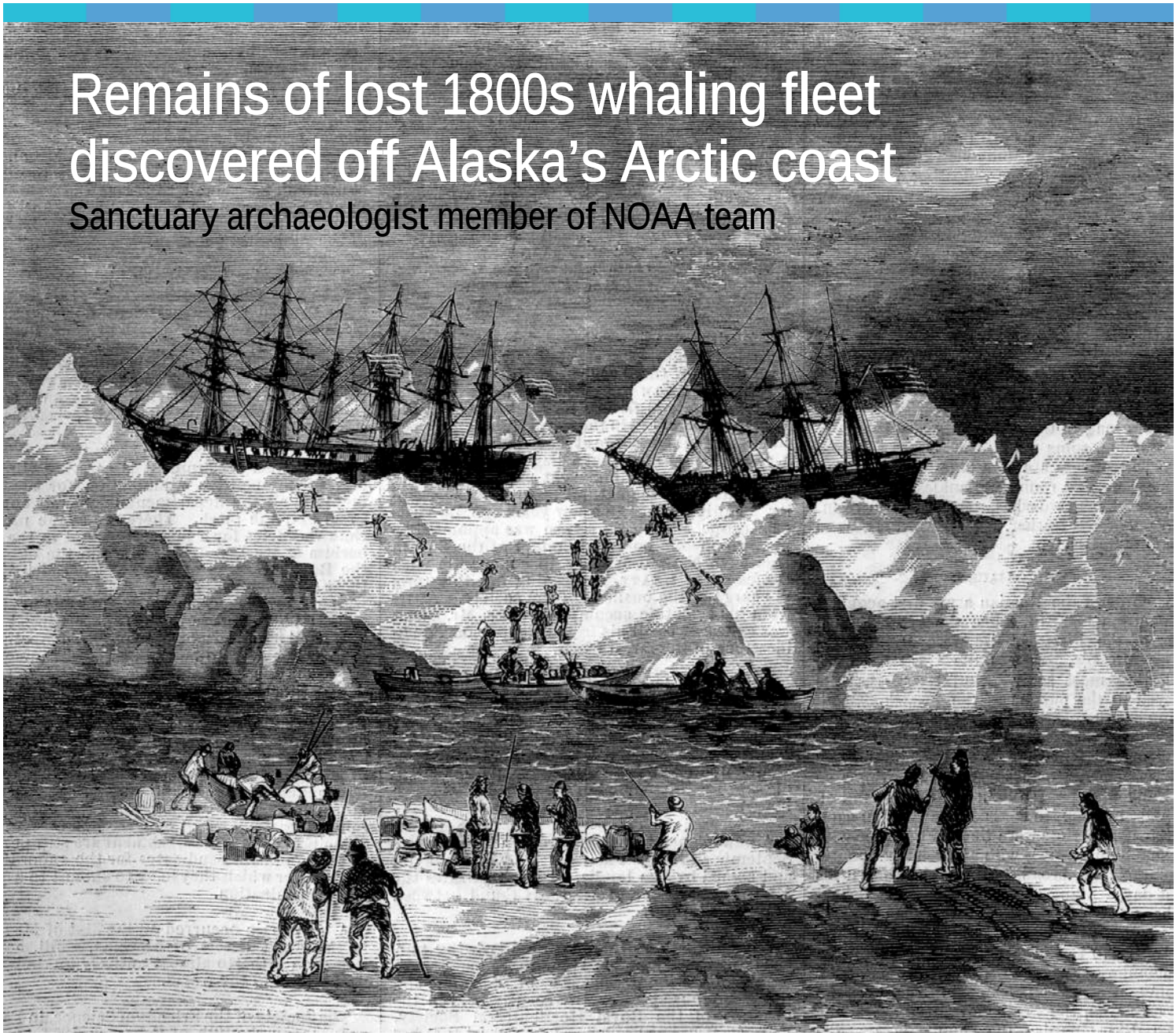
Sonic Sea's Boston premiere on April 12

New England Aquarium's IMAX Theater will be the site for the local premier of the film *Sonic Sea*. Tickets are free but must be reserved through the aquarium's online ticketing service. After the screening, Leila will serve as moderator for a panel of experts who will answer questions about sound in the sea and the making of the film. Check the *Sonic Sea* website for a listing of additional screenings and more information about the topic and film.


Leila Hatch on board R/V Auk. Photo: Michael Thompson, SBNMS

Remains of lost 1800s whaling fleet discovered off Alaska's Arctic coast

Sanctuary archaeologist member of NOAA team



New England whalers abandoning the barks "*George*," "*Gayhead*" and "*Concordia*" in the ice off Point Belcher on Sept. 14, 1871. Scanned from the original 1871 issue of *Harper's Weekly* courtesy of Robert Schwemmer Maritime Library.

The following material was released by NOAA in January after a successful research cruise in the Arctic Ocean. Stellwagen Bank National Marine Sanctuary maritime archaeologist Matthew Lawrence served as a member of the NOAA team.

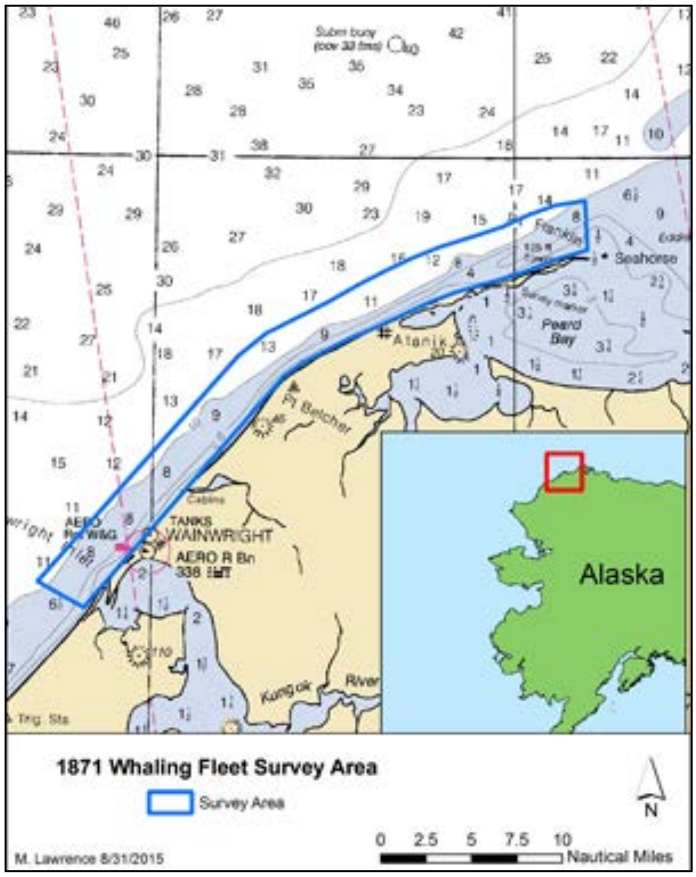
NOAA archaeologists have discovered the battered hulls of at least two 1800s whaling ships nearly 144 years after they and 31 others sank off the Arctic coast of Alaska in one of the planet's most unexplored ocean regions.

The shipwrecks, and parts of other ships, that were found are most likely the remains of 33 ships trapped by pack ice close to the Alaskan Arctic shore in September 1871. The whaling captains had counted on a wind shift from the east to drive the ice out to sea as it had always done in years past.

The ships were destroyed in a matter of weeks, leaving more than 1,200 whalers stranded at the top of the world until they could be rescued by seven ships of the fleet standing by about 80 miles to the south in open water off Icy Cape. Surprisingly, no one died in the incident but it is cited as one of the major causes of the demise of commercial whaling in the United States.

With less ice in the Arctic as a result of climate change, archaeologists now have more access to potential shipwreck sites than ever before. In September, a team of archaeologists from the Maritime Heritage Program in NOAA's Office of National Marine Sanctuaries scoured a 30-mile stretch of coastline in the nearshore waters of the Chukchi Sea, near Wainwright, Alaska. Previous

continued on next page



The map shows the area that was surveyed during NOAA's Lost Whaling Fleets expedition. Map: NOAA

searches for the ships had found traces of gear salvaged from the wrecks by the local Inupiat people, as well as scattered timbers stranded high on the isolated beaches that stretch from Wainwright to Point Franklin.

Using state-of-the-art sonar and sensing technology, the NOAA team was able to plot the "magnetic signature" of the two wrecks, including the outline of their flattened hulls. The wreck site also revealed anchors, fasteners, ballast and bricks used to form the tryworks that rendered whale blubber into oil.

"Earlier research by a number of scholars suggested that some of the ships that were crushed and sunk might still be on the seabed," said Brad Barr, the project's co-director. "But until now, no one had found definitive proof of any of the lost fleet beneath the water. This exploration provides an opportunity to write the last chapter of this important story of American maritime heritage and also bear witness to some of the impacts of a warming climate on the region's environmental and cultural landscape, including diminishing sea ice and melting permafrost."

James Delgado, maritime heritage director for NOAA's Office of National Marine Sanctuaries, said he believes the wrecks were pressed against a submerged sand bar that rests

continued on next page

Sanctuary archaeologist ranges far from home in quest for whaleships

The timing of the mission mirrored that of the lost whaling fleet of 1871, but this time the conditions were very different. Due to a changing climate and local weather patterns, this part ocean above the Arctic Circle held no pack ice during the August 2015 expedition. But, for Matthew Lawrence, Stellwagen Bank National Marine Sanctuary maritime archaeologist, and the NOAA expedition team, this was no walk in the park – with winter coats needed to protect from wind and frigid temperatures and strong stomachs to combat the rough seas.

Matt, who has been actively searching for and documenting shipwrecks off the Massachusetts coast, supervised magnetometer and side scan sonar operations, which helped lead to the discovery of two ships from that unfortunate fleet. "It was an amazing opportunity to work in such a remote location, with the unusual twist of attempting to find ships that once sailed near our sanctuary's waters," he said.

Matt is no stranger to whaleship history. In 2014, he provided technical commentary during three days of online broadcasts from the last surviving wooden whaleship – the *Charles W. Morgan* – when it sailed in Stellwagen Bank National Marine Sanctuary during its 38th voyage as an ambassador for whale conservation.

Office of National Marine Sanctuaries archaeologists Matthew Lawrence (left) and Hans Van Tilburg on board the R/V *Ukpik* anchored off Barrow, Alaska. Photo courtesy of Hans Van Tilburg.

Lost Whaling Fleet continued from previous page

about 100 yards from shore. Working from first-hand accounts of the loss of the fleet, he said the ice opened the ships, scattering their timbers on the beach, while the lower hulls, weighed down with ballast, and in some cases still anchored, stayed in place against the sand bar.

"Usually, the Arctic does not destroy ships if there is a natural obstacle like a sand bar, large rocks or a sheltered cove to partially divert the force of tons of ice," Delgado said.

On Sept. 12, 1871, the captains of the 33 whaling ships caught in the ice convened aboard the *Champion* to consider their options for saving the 1,219 officers, crew, and in some cases, families, from their fate. Although, their situation was dire, there was some small glimmer of hope for rescue by seven nearby ships.

However, to save such a large party, the rescuing whale ships had to jettison their precious cargoes of whale oil, bone and their expensive whaling gear to make room for the survivors. The rescue ships were able to sail safely out of the Arctic and back to Honolulu, where hundreds of native Hawaiian whalers aboard the stranded vessels lived, while others sailed on to San Francisco, New Bedford and other cities.

The search for the abandoned whaling fleet was funded by NOAA's Office of Exploration and Research, in collaboration with the NOAA Office of Coast Survey and the Alaska Region of the Bureau of Ocean Energy Management. Additional support and expertise was provided by technology partners Edgetech, Applanix, and Hypack.

To see sonar images and historical photos, and to learn more about the mission, visit these NOAA websites:

http://oceanexplorer.noaa.gov/explorations/15lostwhalingfleets/welcome.html

http://sanctuaries.noaa.gov/shipwrecks/lost-arctic-whaling-fleet/

http://sanctuaries.noaa.gov/whalingfleet/

(Top) NOAA researcher Brad Barr readies a drop camera system for deployment. Photo: Hans Van Tilburg, NOAA/ONMS.
(Bottom) The camera system photographed a small anchor, a chain plate that held rigging to support masts, and an iron knee, which was likely part of the ship's tryworks, on the Arctic seafloor. Photo: NOAA

Beyond borders protection: Progress through partnerships

The North Atlantic Sister Sanctuary Program, initiated by Stellwagen Bank National Marine Sanctuary (2007) in collaboration with marine mammal sanctuaries in the Dominican Republic, Bermuda, French Antilles and the Caribbean Netherlands, is a pioneering program of the United Nations Environment Programme's Specially Protected Areas and Wildlife's Marine Mammal Action Plan for the Wider Caribbean Region.

With the addition of "Yarari", the Caribbean Netherland's Marine Mammal Sanctuary in 2015, the multi-sanctuary, science-based program has increased protection for North Atlantic humpback whales from 811 square miles to 270,058 square miles over the past eight years. With education, conservation and science exchanges, this marine mammal protected areas network (MaMPAN) is the first such international partnership in the world protecting one of the ocean's most iconic and beloved species throughout its migratory range. As additional sites join, this chain of sister sanctuaries will help to ensure a safer future for the endangered North Atlantic's humpback whales—our international citizens.

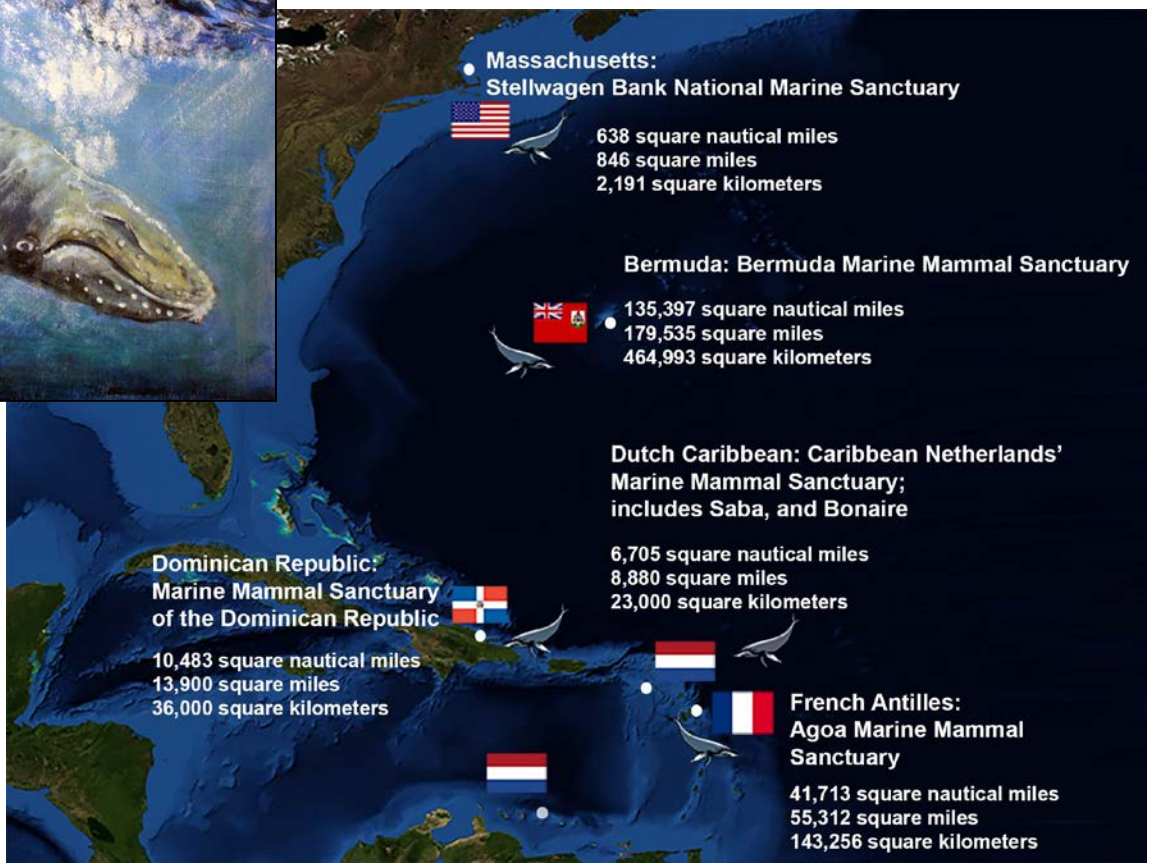
In 2014, MaMPAN launched CARIB Tails—a citizen science program that enlists yachters and cruisers to take on a special role to assist with marine mammal research, by photographing the distinct patterns on the tails of humpback whales in their Caribbean breeding grounds. The information submitted is used in mark-recapture studies (analyzed by the College of the Atlantic, Bar Harbor, Maine) to help monitor the recovery of this endangered species. This program was developed by Nathalie Ward, Stellwagen Bank National Marine Sanctuary external affairs coordinator.

Tail flukes gathered/analyzed from CARIB Tails and sister sanctuary research partners offer new perspectives to the timing and movement patterns of humpback whales from the southeastern Caribbean. Recent data shows that the whales mating and calving in this region *are not* a representative subset of those that winter in the Dominican Republic. There is a strong tendency for whales from the southeastern Caribbean to migrate to feeding areas in the eastern North Atlantic, notably to Norway; and, therefore, the whales using the southeastern Caribbean represent a previously un-described and behaviorally distinct population segment within the North Atlantic. This new data will help to redefine the West Indian humpback whale breeding stock and provide the opportunity for continued evaluation and caution about changing the conservation status of this population.

This article was excerpted from the NOAA in the Caribbean Newsletter (Spring 2016 Issue).

Above: Humpback whale art from 2015 Massachusetts Marine Educators annual marine art contest by Maiia B., gr. 6, Kennedy Middle School.

Right: Sister Sanctuaries. Map: NOAA/SBNMS



2015 was the warmest year on record for land and ocean

According to NOAA, the globally averaged temperature over land and ocean surfaces for 2015 was the highest among all years since record-keeping began in 1880. It was 0.29°F higher than the 2014 average, and marked the fourth time a global temperature record had been set this century. In addition, this was the largest margin by which the annual global temperature record has been broken.

During December, the combined global land and ocean average surface temperature was the highest on record for any month in the 136-year record. Record warmth was broadly spread around the world, include a swath of the western North Atlantic. You can read more about this global analysis at this NOAA website: http://www.ncdc.noaa.gov/sotc/global/201513

The pattern on the underside of a humpback whale's tail is unique to that animal. This humpback was named Joust. Can you see why it got its name? The black pigmentation and scarring at the center of the tail resembles a knight on horseback – the horse's head on the left fluke and the knight with jousting pole on the right. Joust (the whale) has been photographed in both Stellwagen Bank National Marine Sanctuary and Agoa Marine Mammal Sanctuary off Guadeloupe. Photo: Center for Coastal Studies

CARIB Tails produces a "*Joust*ing" match

The photos were taken eight years apart, but researchers were able to confirm they were a match – of a humpback whale named "Joust." The CARIB Tails program asks boaters in the Caribbean Sea to photograph humpback whale tails. The photos are then sent to a technical team where the dark/light patterns on the undersides of the tails are compared to some 8,000-plus known individuals in the North Atlantic Humpback Whale Catalog. In this case, the photograph taken on February 5 of this year in the Agoa Marine Mammal Sanctuary off Guadeloupe in the French Antilles proved to be that of a whale seen in the Stellwagen Bank National Marine Sanctuary and Gulf of Maine in 2008.

C. Milton and the Observatoire des Mammiferes Marins de l'Archipel Guadeloupeen provided this year's photo; the 2008 photo was supplied by the Center for Coastal Studies in Provincetown, which, along with Allied Whale at the College of the Atlantic, undertook the matching and cataloging efforts.

First humpback of season identified

"Ursa," an adult female with distinctive rake marks on her tail (probably from an orca attack when she was a calf), was spotted in the sanctuary on March 30. Boston Harbor Cruises reported that she was undertaking deep dives, most likely feeding to restore fat reserves after the long winter. She was accompanied by another whale named "Batcave."

Climate Change and the Sanctuary Region: Update

Goosefish..
Photo: NOAA Fisheries

This article, summarizing a major study, was released by NOAA Fisheries in February. It focuses on the status of commercially important fish species for the Northeast Region (Maine-Virginia), of which many are found in the Gulf of Maine. As waters continue to warm, we may see these projected changes in species distribution and resilience in Stellwagen Bank National Marine Sanctuary. Look for timely climate change articles in upcoming issues of Stellwagen Bank E-Notes

Young of the year haddock are pictured here. Researchers have already determined that cod stocks are moving deeper and northward. Photo: NOAA Fisheries.

Warming ocean may bring major changes for U.S. northeast fishery species

NOAA scientists have released the first-ever multispecies assessment of just how vulnerable U.S. marine fish and invertebrate species are to the effects of climate change. The study examined 82 species that occur off the Northeastern U.S., where ocean warming is occurring rapidly. Researchers found that most species evaluated will be affected, and that some are likely to be more resilient to changing ocean conditions than others. The study appears today in PLOS ONE, an online scholarly science journal.

"Our method identifies specific attributes that influence marine fish and invertebrate resilience to the effects of a warming ocean and characterizes risks posed to individual species," said Jon Hare, a fisheries oceanographer at NOAA Fisheries' Northeast Fisheries Science Center and lead author of the study. "This work will help us better account for the effects of warming waters on our fishery species in stock assessments and when developing fishery management measures."

continued on next page

continued from previous page

The study is formally known as the Northeast Climate Vulnerability Assessment and is the first in a series of similar evaluations planned for fishery species in other U.S. regions. Conducting climate change vulnerability assessments of U.S. fisheries is a priority action in the NOAA Fisheries Climate Science Strategy. Similar assessments are now underway for the Bering Sea and California Current Ecosystems.

The 82 Northeast species evaluated include all commercially managed marine fish and invertebrate species in the Northeast, a large number of recreational marine fish species, all marine fish species listed or under consideration for listing on the federal Endangered Species Act , and a range of ecologically important marine species.

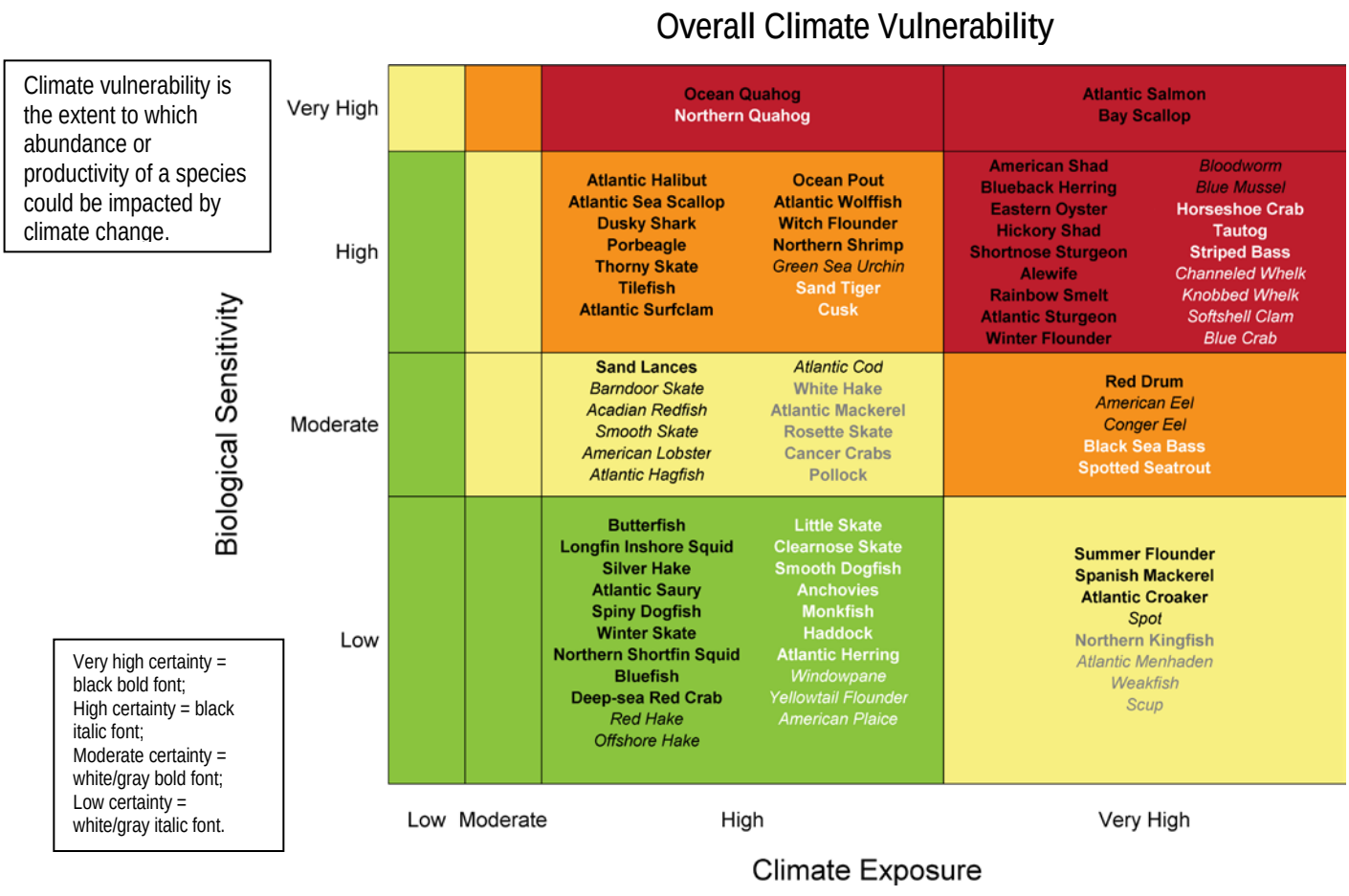
Researchers from NOAA Fisheries and NOAA's Office of Oceanic and Atmospheric Research (OAR)'s Earth System Research Laboratory, along with colleagues at the University of Colorado's Cooperative Institute for Research in Environmental Sciences (CIRES), worked together on the project. NOAA OAR and CIRES scientists provided climate model projections of how conditions in the region's marine environment are predicted to change in the 21st century. The method for assessing vulnerability was adapted for marine species from similar work by the U.S. Fish and Wildlife Service to characterize the vulnerability of wildlife species to climate change.

The method tends to categorize species that are "generalists" as less vulnerable to climate change than are those that are "specialists." For example, Atlantic cod and yellowtail flounder are more generalists, since they can use a variety of prey and habitat, and are ranked as only moderately vulnerable to climate change. The Atlantic sea scallop is more of a specialist, with limited mobility and high sensitivity to the ocean acidification that will be more pronounced as water temperatures warm. Sea scallops have a high vulnerability ranking.

The method also evaluates the potential for shifts in distribution and stock productivity, and estimates whether climate change effects will be more negative or more positive for a particular species. "

"Vulnerability assessments provide a framework for evaluating climate impacts over a broad range of species by combining expert opinion with what we know about that species, in terms of the quantity and the quality of data," Hare said. "This assessment helps

continued on next page



continued from previous page

us evaluate the relative sensitivity of a species to the effects of climate change. It does not, however, provide a way to estimate the pace, scale or magnitude of change at the species level."

Researchers used existing information on climate and ocean conditions, species distributions, and life history characteristics to estimate each species' overall vulnerability to climate-related changes in the region. Vulnerability is defined as the risk of change in abundance or productivity resulting from climate change and variability, with relative rankings based on a combination of a species exposure to climate change and a species' sensitivity to climate change.

Each species was evaluated and ranked in one of four vulnerability categories: low, moderate, high, and very high. Animals that migrate between fresh and salt water (such as sturgeon and salmon), and those that live on the ocean bottom (such as scallops, lobsters and clams) are the most vulnerable to climate effects in the region. Species that live nearer to the water's surface (such as herring and mackerel) are the least vulnerable. A majority of species also are likely to change their distribution in response to climate change. Numerous distribution shifts have already been documented, and this study demonstrates that widespread distribution shifts are likely to continue for the foreseeable future.

A specific summary of results has been prepared for each species to help put the rankings into context. These narratives discuss what is known about the effects of climate change on the species and provide the foundation for future research.

PLOS ONE article:
http://dx.plos.org/10.1371/journal.pone.0146756

This juvenile sea scallop is less than one year old. A changing, more acidic environment may detrimentally affect its ability to grow. Photo: Deborah Hart, NEFSC/NOAA Fisheries.

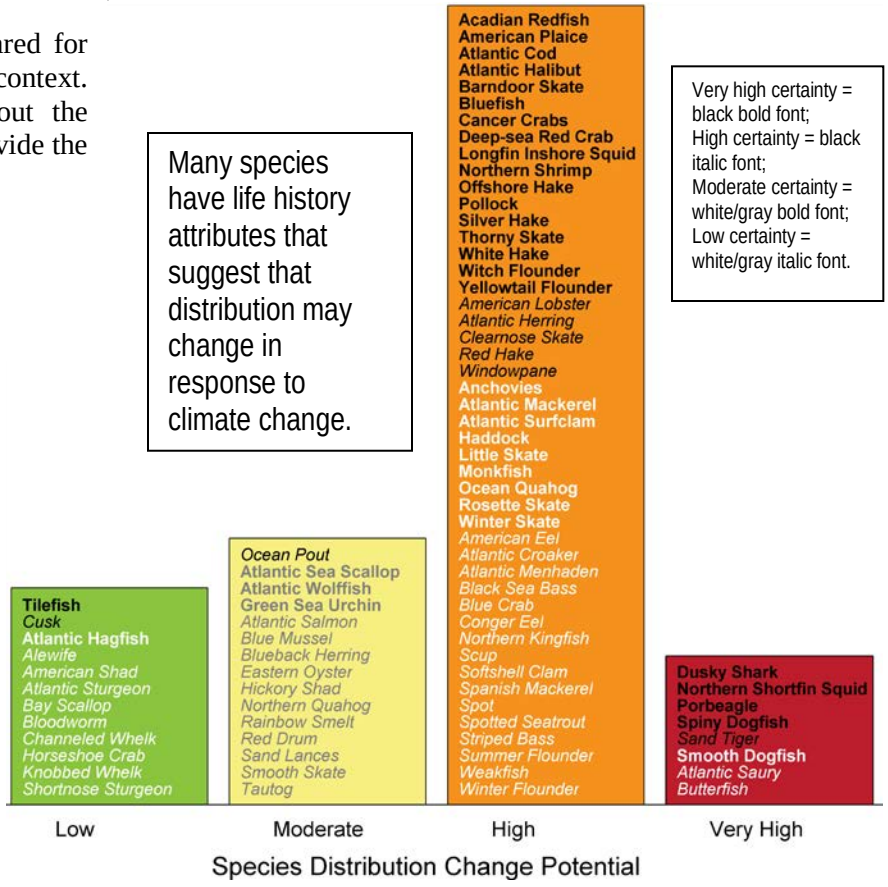
The threat of a more acid ocean

For more than 200 years, or since the industrial revolution, the concentration of carbon dioxide (CO_2) in the atmosphere has increased due to the burning of fossil fuels, such as coal, oil and gas. This rising level of CO_2 acts like a heat trapping blanket, warming the earth. But, this increased level of CO_2 creates another problem – ocean acidification. When the atmosphere comes into contact with the ocean, some 30 percent of this CO_2. is absorbed in the water. As levels of atmospheric CO_2 increase, so do the CO_2 levels in the ocean.

When CO_2 is absorbed by seawater, a series of chemical reactions occur resulting in the increased concentration of hydrogen ions. This increase causes the seawater to become more acidic and causes carbonate ions to be relatively less abundant

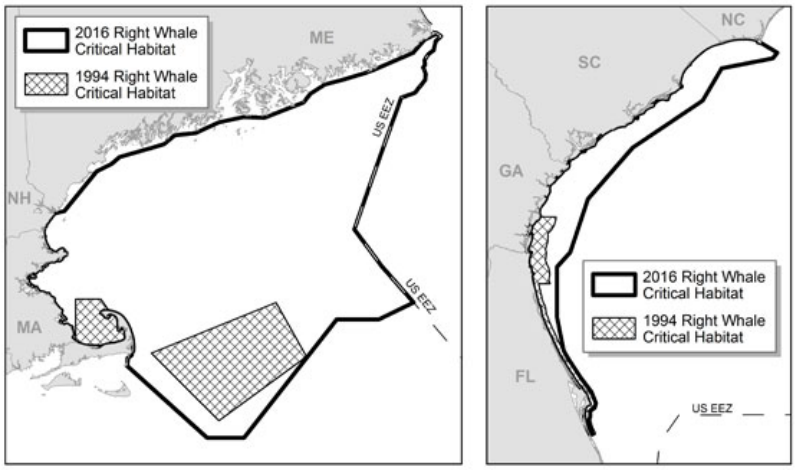
Carbonate ions are an important building block of structures such as sea shells and coral skeletons. Decreases in carbonate ions can make building and maintaining shells and other calcium carbonate structures difficult for calcifying organisms, such as scallops, oysters, clams, sea urchins, corals and calcareous plankton. This weakening of shells has been termed "the osteoporosis of the ocean."

These changes in ocean chemistry can also affect the behavior of non-calcifying organisms. The ability of certain species of fish to detect predators is decreased in more acidic waters. When these organisms are at risk, the entire food web may also be at risk.



NOAA expands critical habitat for endangered right whale

New area includes entirety of Stellwagen Bank National Marine Sanctuary



Above: North Atlantic right whale swimming at the surface. The photo was taken during an aerial patrol. Photo: NOAA

Left: Comparison of 1994 and 2016 North Atlantic right whale critical habitat designations. Maps: NOAA

Using new information not previously available, NOAA Fisheries is expanding critical habitat for endangered North Atlantic right whales to cover its northeast feeding areas in the Gulf of Maine/Georges Bank region and southeast calving grounds from North Carolina to Florida. The entire Stellwagen Bank National Marine Sanctuary is now included in the revised critical habitat.

This final rule, which was initially proposed in February 2015, received 261 general comments over a 60-day comment period. It does not include any new restrictions or management measures for commercial fishing.

The rule is based on 35 years of aircraft and ship borne surveys of right whale distribution, and research into foraging and prey availability. Together, these data provide a far more robust understanding of the factors critical to species recovery. Based on this information and public comments, NOAA scientists and managers determined a critical habitat expansion associated with feeding in the North and calving in the South is necessary for species recovery.

"With two decades of new information and improved understanding since we first designated critical habitat for the species, we believe the expansion will further protect essential foraging and calving areas to further improve recovery of this animal," said Eileen Sobeck, assistant NOAA administrator for NOAA Fisheries. "We're making significant progress in reversing the population decline of the species, and are seeing signs of recovery – up to about 500 animals from the estimated 300 in 1994. But we still have a long way to get to complete recovery."

Under the Endangered Species Act, critical habitat within the range of the species consists of areas that contain physical or biological features essential to conservation of the species. The new designation does not create preserves or refuges or any other restrictions that directly affect the public. However, federal agencies conducting, funding or permitting activities in these areas, and project proponents that need federal permits or funding for such activities, are required to work with NOAA Fisheries to avoid or reduce impacts on critical habitat.

Stellwagen Sanctuary View

November 2015 Photo

Photo: SBNMS

Do you know what's happening here? Choose from these three answers (HINT: two of them are wrong).

1. Like an ocean ballerina, this shark spins on the tip of its tail.
2. The shark is confused because of its unbalanced tail.
3. This thresher shark in the sanctuary breached in a near vertical position. The thresher has an asymmetrical tail, with a larger dorsal lobe. The shark may have been hunting or disturbed by noise.

CORRECT ANSWER: 3

Traveling Marine Art Exhibit

Winning art from the Massachusetts Marine Educators 2015 marine art contest for students in grades K-12 continues its tour with a move to the Cape Cod National Seashore Salt Pond Visitor Center for the month of April.

2016 K-12 Art Contest

Massachusetts Marine Educators has announced the 2016 Marine Art Contest for grades K-12. The contest is open to all students and is free of charge; divisions are High School (grades 9-12), Middle School (4-8), Elementary School (K-4), Scientific Illustration (all grades) and Computer Graphics (all grades). Joining MME as sponsors are Stellwagen Bank National Marine Sanctuary, New England Aquarium, Marine Genome Legacy at Northeastern University., Center for Coastal Studies, and Whale and Dolphin Conservation. The deadline is April 29, 2016; and the theme is "Marine Biodiversity of Stellwagen Bank National Marine Sanctuary. Contest rules can be obtained from the MME website at www.ma-marine-ed.org or the sanctuary website http://stellwagen.noaa.gov.

earth is blue

View amazing daily photographs and interesting weekly videos at http://sanctuaries.noaa.gov/earthisblue.html

National Marine Sanctuary System

Scale varies in this perspective. Adapted from National Geographic Maps.

National Oceanic and Atmospheric Administration

National Ocean Service

Office of National Marine Sanctuaries

Gerry E. Studds Stellwagen Bank National Marine Sanctuary

NOAA

National Marine Sanctuaries