

NEWSWAVE

NEWS FROM THE U.S. DEPARTMENT OF THE INTERIOR: OCEAN, GREAT LAKES, AND COASTS

NEWSWAVE—Winner of NAGC's 2015 Blue Pencil Award

Summer/Fall 2017

DOI Announces Largest Oil and Gas Lease Sale in U.S. History

Offering 76.9 Million Acres in Gulf of Mexico

By John Filostrat and Tracey Moriarty (BOEM)

On October 24, Secretary Zinke announced that DOI is proposing the largest oil and gas lease sale ever held in the United States—76,967,935 acres in Federal waters of the Gulf of Mexico (GoM), offshore Texas, Louisiana, Mississippi, Alabama, and Florida. The proposed region-wide lease sale (Proposed Lease Sale 250), offering an area about the size of New Mexico, is scheduled for March 2018 and includes all available unleased areas on the GoM's Outer Continental Shelf (OCS), surpassing last year's region-wide lease sale by about one million acres.

In addition to providing power, oil production generates economic revenues through lease sales and royalty collection.

Secretary Zinke said, "The economic terms proposed for this sale include

See Oil and Gas Lease Sale page 3



Oil production from the U.S. OCS accounted for 72% of all oil production from Federal lands in 2016. Photo credit: BSEE

Special Feature—Coastal Science Supports Communities

See story, pages 18–22



Top: Secretary Ryan Zinke (at right) traveled south to assess damages at Everglades National Park, Biscayne National Park, and Big Cypress National Preserve. He met with park superintendents and employees, toured damaged facilities, assisted the maintenance crews with cleanup, and discussed ways to help the parks recover back to full capacity. Photo credit: Tami Heilemann, DOI



Right: Assistant Secretary Doug Domenech (at left) inspects hurricane damage at Virgin Islands National Park. Photo credit: DOI

DOI Employees Respond to Hurricanes

The 2017 hurricane season has been historic, and so have the generous and brave efforts of Department of the Interior (DOI) employees. Hundreds of DOI employees are responding to the record-breaking devastation in the U.S. Virgin Islands, Puerto Rico, Texas, Florida, and other coastal areas along the East Coast.

"To those responding to this crisis in real time—thank you for all you're doing. You have my support, the

See DOI Responds page 3

Ocean, Great Lakes, and Coasts Boost Economy

By Gina Digiantonio and Ben Simon (DOI)

The DOI economic report for fiscal year (FY) 2016 released in September determined that about \$145 billion of the U.S. gross domestic product (GDP) was associated with production and activities from DOI lands in FY 2016. These activities supported an estimated 1.7 million jobs.

Ocean, Great Lakes, and coastal (OGLC) areas play a major role in these economic gains. DOI oil and gas

See Economy page 5

In This Edition

DOI Announces Largest Oil and Gas Lease Sale in U.S. History 1

DOI Employees Respond to Hurricanes 1

Ocean, Great Lakes, and Coasts Boost Economy..... 1

Science and Technology for Hurricanes..... 4

\$50 Million for National Park Infrastructure 5

\$1.1 Billion for State Wildlife Agencies 5

Wisdom “Flies” to D.C.! 6

75th Anniversary of the Battle of Midway... 7

Recreation Value for Coastal Parks..... 7

Invasive Mussel Preventative Actions..... 8

Platforms for Chesapeake Ospreys 9

Latino Conservation Week at DOI Refuges and Parks 10

The Importance of Tribal Culture and Partnerships 11

Ecosystem Restoration Projects Boost the Economy at Multiple Levels..... 12

A Communications Guide for Conserving Piping Plovers and Other Shorebirds ... 13

Science to Strike a Balance on the Beach... 14

San Francisco Bay: Decades of Water Quality Data..... 15

Continuing the MADness: Carrying on the Legacy of Margaret Davidson 17

Coastal Science Supports Communities 18

Healthy Reefs for a Healthy Economy: Task Force Checks in on Florida Corals..... 23

Sharing BOEM Science and Information.... 24

Coastal Acidification Networks 25

Understanding and Communicating Impacts of OA 26

Teamwork for Measuring OA 27

The “Wilderness Breach” 27

Florida Keys Corals: A Photographic Record of Changes from 1959 to 2015 28

Measuring Sea Ice 101 29

Development Opportunity for Knauss Fellows 31

The Surfing Bison 32

Contribute to NEWSWAVE!

If you have any questions, comments or want to receive NEWSWAVE by email, contact: Ann Tihansky: tihansky@usgs.gov

For more information, contact:

Liza Johnson, Ocean, Great Lakes and Coasts Coordinator
Office of Policy Analysis,
1849 C Street, NW, Mail Stop 3530
Washington, D.C. 20240
Telephone: 202-208-1378
liza_m_johnson@ios.doi.gov



The Wilderness Breach at Fire Island National Seashore

Follow and LIKE us on Facebook:

<https://www.facebook.com/USInterioroceancoastsgreatlakes/>



Three new videos about Hurricane Sandy and the Wilderness Breach on Fire Island National Seashore are available on DOI's Facebook page: <https://www.facebook.com/USInterioroceancoastsgreatlakes/videos/>



"Fire Island Wilderness Breach: Behind the Scenes: Aerial Survey with Charlie Flagg"

"The Breach at Fire Island National Seashore"

"Science, Restoration and Resilience"



USGS scientist Owen Brenner walks across the Fire Island wilderness breach carrying a GPS backpack that allows him to collect precise elevation data in the shallows. Photo credit: Cheryl Hapke, USGS

YouTube Fire Island NPS YouTube channel:

<https://www.youtube.com/user/FireIslandNPS>

Fire Island Breach-Physical Monitoring of the Fire Island Breach Photo Collection:

<https://www.flickr.com/photos/npsncbn/sets/72157658332281778>

See related story page 27.

NEWSWAVE is a quarterly newsletter from the Department of the Interior featuring ocean, Great Lakes and coastal activities across the Bureaus.

Visit us online: <https://www.doi.gov/pmb/ocean/newswave>

Editors: Ann Tihansky (USGS) and Gina Digiantonio (DOI)

Technical Editor: Rebekah Davis (USGS); **Layout:** Suzanne Roberts (USGS)

Contributors:

- Sarah Abdelrahim (DOI)
- Gina Digiantonio (DOI)
- Tami Heilemann (DOI)
- Ben Simon (DOI)
- Hilary Smith (DOI)
- Erica Wales (DOI)
- BIA Midwest Region
- Greg Boland (BOEM)
- John Filostrat (BOEM)
- Rebecca Green (BOEM)
- Tracey Moriarty (BOEM)
- BSEE
- Rebecca Beavers (NPS)
- A.W. Biel (NPS)
- Kristy Burnett (NPS)
- Eva DiDonato (NPS)
- Cliff McCreedy (NPS)
- Lynne Koontz (NPS)
- Elizabeth Rogers (NPS)
- Penny Wagner (NPS)
- Samantha Brooke (USFWS)
- Kelly Fike (USFWS)

- Alice Garrett (USFWS)
- Peter McGowan (USFWS)
- Meagan Racey (USFWS)
- Josh Seibel (USFWS)
- Kaiti Titherington (USFWS)
- Betsy Boynton (USGS)
- James Cloern (USGS)
- Catherine Cullinane Thomas (USGS)
- Heather Dewar (USGS)
- Jeanne DiLeo (USGS)
- Mia Drane-Maury (USGS)
- John Haines (USGS)
- Cheryl Hapke (USGS)
- Heidi Koontz (USGS)
- Ilsa Kuffner (USGS)
- Erika Lentz (USGS)
- Catherine Puckett (USGS)
- Tara Schraga (USGS)
- Eugene A. Shinn (USGS)
- Hilary Stockdon (USGS)
- Curt Storlazzi (USGS)
- Ann Tihansky (USGS)
- Kim Yates (USGS)

- Sara Zeigler (USGS)
- Alex Harper (NOAA-IOOS)
- Dept. of Defense
- Cy Rosen (U.S. Navy)
- Dagny Leonard (The Coastal Fund)
- Steve Kass (Ducks Unlimited)
- Hispanic Access Foundation
- Jill Wheeler (Hispanic Access Foundation)
- Walt Meier (NSIDC)
- Mark Serreze (NSIDC)
- Sabine Dukes (Science Buddies)
- Dr. Scott Noakes (University of Georgia)
- NOAA, National Weather Service
- NOAA, Ocean Acidification Program
- OceansLIVE
- Space Imaging®
- World Imagery
- Cole Goco (Illustrator)

Oil and Gas Lease Sale continued from page 1

a range of incentives to encourage diligent development and ensure a fair return to taxpayers.”

A previous lease sale in August 2017 offered the largest amount of acreage in the history of the Federal offshore program in the GoM. DOI lease results will help “create more good paying jobs while generating \$121 million in revenue to fund everything from conservation to infrastructure,” said Secretary Ryan Zinke.

BOEM Sets Royalty Rates for Gulf of Mexico Offshore Oil Leases

BOEM set royalty rates and held a lease sale for GoM Sale 249, during the summer of 2017, the first scheduled lease sale in the 2017–22 OCS Oil and Gas Leasing Program.

Royalty rates were set at 12.5% for leases in less than 200 meters of water depth, and 18.75% for all other leases issued pursuant to the sale. The rate of 12.5% for leases in less than 200 meters was lowered from the Proposed Notice of Sale rate of 18.75% after careful consideration of market conditions, available resources, leasing, drilling, and production trends, along with comparable international fiscal systems. The shallow water royalty-rate reduction targets the GoM shelf where exploration, development, and production are in decline and where critical infrastructure already exists.

The Bureau of Ocean Energy Management (BOEM) is currently analyzing a price-based royalty system and will be engaging stakeholders on this concept later this year. BOEM’s concept of a price-based royalty system would provide an incentive to lessees through lower royalty rates in times of lower oil prices, while also ensuring the Federal government receives a greater return for OCS resources when prices are high. BOEM expects to provide more information and provide opportunity for stakeholder input in the coming months.

DOI Responds continued from page 1

support of the entire Interior team and the support of the President during these trying times,” said DOI Secretary Zinke as Hurricane Maria savaged Puerto Rico and the U.S. Virgin Islands, and Hurricane Jose stirred up the ocean along the East Coast.

On October 13, Doug Domenech, Assistant Secretary of the Interior for Insular Areas, and a team of DOI employees visited Puerto Rico and the U.S. Virgin Islands to assess hurricane damage and discuss plans for recovery activities.

“The Department of the Interior remains committed to doing everything within our power to help the people of the U.S. Virgin Islands and Puerto Rico recover from the tragic impacts of Hurricanes Irma and Maria,” said Assistant Secretary Domenech. “During our visit to the islands, we have been touched by the overwhelming needs of the people. At the same time, we have been deeply heartened by the dedication and courage of U.S. citizens here and of Interior employees and our Federal, territorial, municipal, and private partners.”



Left: A destroyed building at Cinnamon Bay, Virgin Islands National Park. Photo credit: DOI

Right: The interagency “Arrowhead Hotshots” clear a road on St. John, U.S. Virgin Islands. Photo credit: DOI

Learn more about lease sales:

Lease Sale 250: <https://www.doi.gov/pressreleases/secretary-zinke-announces-largest-oil-gas-lease-sale-us-history>.

“We are particularly grateful to the dedicated Interior employees of our national parks and wildlife refuges in the islands as well as our USGS scientists who continue to work, despite being survivors themselves, and to the incident management teams and other emergency responders who have come from other parts of the country to assist them,” said Director Lisa Branum, whose DOI Office of Emergency Management provides cross-bureau/departmental leadership in emergencies. The Office of Emergency Management estimates that more than 550 DOI personnel from various bureaus are responding to hurricane damage and recovery in the U.S. Virgin Islands and Puerto Rico.

During the long road to recovery ahead, DOI bureaus will continue to provide science, management, and restoration support. *See related story, page 4.*

Read more: <https://www.doi.gov/blog/answering-call-interior-employees-respond-hurricanes>

Read more about recovery efforts: <https://www.doi.gov/employees/interior-department-provides-ground-support-hurricane-ravaged-us-virgin-islands-and-puerto>



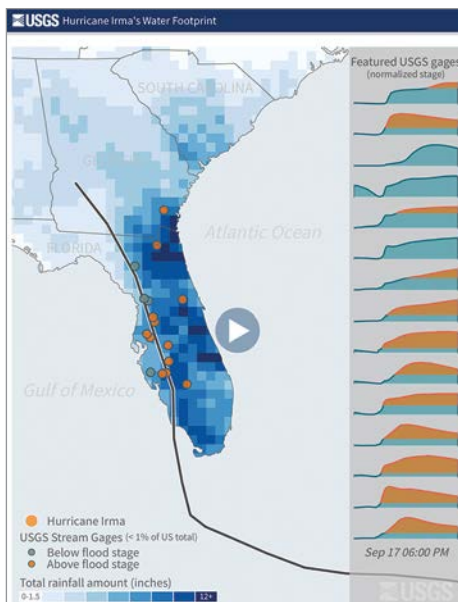
Lease Sale 249: <https://www.doi.gov/pressreleases/gulf-mexico-region-wide-oil-and-gas-lease-sale-yields-121-million-high-bids-508096>

Royalty rates: <https://www.boem.gov/note07062017/>

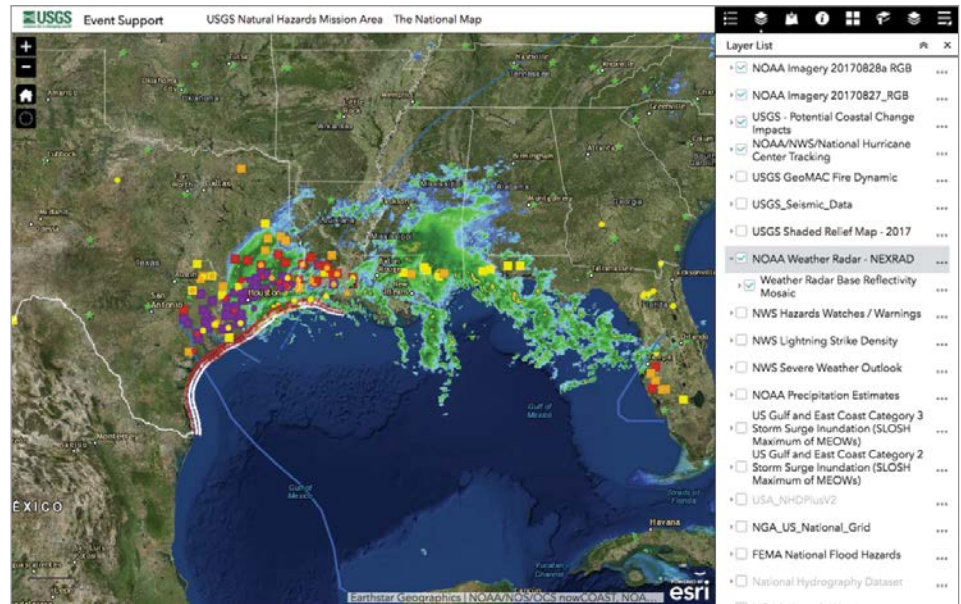
Science and Technology for Hurricanes

By Mia Drane-Maury (USGS), Heather Dewar (USGS), Gina Digiantonio (DOI), and Ann Tihansky (USGS)

During the month of September, also known as National Preparedness Month, the 2017 hurricane season tested the preparedness of many U.S. coastal areas through a range of extreme impacts. Hurricane Harvey's major and unprecedented rainfall caused flooding along the low-lying GoM coast. Powerful Hurricane Irma impacted many Caribbean islands, the Florida Keys, and south Florida followed immediately by Hurricane Jose, which stayed offshore but caused coastal flooding along much of the U.S. Eastern Seaboard. Hurricane Maria made landfall in Puerto Rico on September 20, as a Category 4 storm, with winds of 155 mph that knocked over numerous trees and took down powerlines, causing power outages for the entire island that have disrupted many critical services. The storm's rainfall triggered landslides in the mountainous areas of the island,



The USGS WaterFootprint tool (<https://owi.usgs.gov/vizlab/hurricane-irma/>) shows Hurricane Irma's path, cumulative precipitation, and impact on river gage height. Photo credit: USGS



USGS geospatial capabilities allow many different types of data to be displayed as needed for different types of concerns and responses. This screenshot is an example of combined layers of weather, coastal change forecasts, streamflow, and water levels during Hurricane Harvey's landfall. Image credit: USGS

further complicating rescue and recovery efforts.

The natural hazards associated with hurricanes are expensive, are dangerous, and can have long-term impacts. The mission of many Federal agencies involves providing guidance, tools, and resources to State and local communities for planning and emergency response. These activities rely heavily on reliable scientific information.

At DOI, the U.S. Geological Survey (USGS) provides critical scientific products that help communities prepare for coastal storm hazards and safety. When a major storm is on the horizon, the USGS uses its water monitoring, mapping, coastal change forecasting, and other modeling expertise to help prepare for, respond to, and recover from hurricanes and tropical storms. Forecasts of coastal storm impacts can help communities prepare, whereas geospatial products, imagery, and related analyses help emergency responders prioritize recovery actions by identifying impacts and the status of infrastructure.

USGS scientists, emergency planners, and administrators work together with Federal, State, and local agencies to understand associated natural hazards, along with their potential risks and impacts, and how to mitigate large-scale losses.

Read more: <https://www.usgs.gov/news/usgs-science-leads-way-national-preparedness>

Read about USGS response activities for each storm:

Hurricane Harvey: <https://www.usgs.gov/special-topic/hurricane-harvey>

Hurricane Irma: <https://www.usgs.gov/special-topic/hurricane-irma>

Hurricane Jose: <https://www.usgs.gov/special-topic/hurricane-jose>

Hurricane Maria: <https://www.usgs.gov/special-topic/hurricane-maria>

Together, USGS products and expertise support multiple agencies and enhance coastal community resilience and safety that prepares us for the next storm. #ScienceforSafety

\$50 Million for National Park Infrastructure

Secretary Zinke and Colorado Senator Gardner Announce

Secretary Zinke announced more than \$50 million for high priority infrastructure projects at 42 parks in 29 States. The funds will be used to improve trails, restore buildings, and increase visitor access to parks.

The National Park Service (NPS) centennial challenge program is providing \$20 million in congressional funding to match \$33 million from partner organizations.

“Using public-private partnerships to help address the deferred maintenance backlog remains a priority for the Department and the Trump Administration. Park infrastructure includes trails, signage, restrooms, lodges, roads, bridges, and waterlines. These funds will help us continue to provide a world-class experience to visitors and ensure that these amazing places are around for future generations,” said Secretary Zinke.

Coastal and ocean parks that benefit include:

- Acadia National Park: \$451,398 for deferred trail maintenance
- Biscayne National Park: \$337,265 for park signage and maintenance of the Elliott Key Visitor Center
- Denali National Park and Preserve: \$46,800 for research on three long-distance migration birds
- Dry Tortugas National Park: \$785,953 to reduce deferred maintenance on architectural features known as traverse magazines at Fort Jefferson
- Kalaupapa National Historic Park: \$104,598 for maintenance at the Bayview Complex and Pali Trail Overlook

Read the full list of projects:

<https://www.doi.gov/pressreleases/secretary-zinke-and-colorado-senator-gardner-announce-more-50-million-national-parks>



This satellite image of (left to right) Garden, Bush, and Long Keys, and the hexagonal shape of Fort Jefferson in the Dry Tortugas National Park in Florida, shows the vulnerability of this low-lying historical resource to tropical storms and sea-level rise. It is one of several coastal parks to receive funding for infrastructure improvements. Image courtesy of Space Imaging®

Economy continued from page 1

activity on the outer continental shelf (OCS) accounted for 45% of DOI’s total oil, gas, and coal contribution to U.S. GDP in FY 2016, an addition of \$30.8 billion. The benefits of offshore activities extended beyond the coast because the supply chain to support offshore oil and gas activities extends to inland States.

Recreation at coastal sites also had a large impact. In FY 2016, there were 112 million visits to DOI’s managed OGLC areas of the total estimated 473 million visits to DOI recreational sites. Visitor spending enhanced local and regional economies, and recreation at OGLC sites supported more than 78,000 jobs and contributed more than \$5 billion to the U.S. GDP.

Read the report: https://www.doi.gov/sites/doi.gov/files/uploads/fy_2016_doi_economic_report_2017-09-25.pdf

Data visualization: <https://doi.sciencebase.gov/doidv/index.html>

\$1.1 Billion for State Wildlife Agencies

Funding Benefits Conservation, Outdoor Recreation, and the Economy in All 50 States

In June, Secretary Zinke announced that State wildlife agencies will receive \$1.1 billion in annual funding from revenues generated by the Pittman-Robertson Wildlife Restoration and Dingell-Johnson Sport Fish Restoration acts. The Wildlife Restoration Program and Sport Fish Restoration Program funds are distributed by the U.S. Fish and Wildlife Service (USFWS) to support State conservation and outdoor recreation projects. The money is generated from excise taxes paid by the hunting, shooting, boating, and angling industries on firearms, bows, ammunition, sport fishing tackle, some boat engines, and small engine fuel.

“For nearly eight decades, the Nation’s hunters and anglers have generated billions of dollars to protect wildlife and habitat simply by purchasing items that help them engage in the outdoor activities they enjoy,” Secretary Zinke said. “Their support has helped state wildlife agencies protect our country’s environmental legacy for future generations of hunters, fishers, recreationalists, and conservationists.”

To date, the USFWS has distributed more than \$19 billion, matched by about \$6 billion from the recipient State wildlife agencies, in apportionments for State conservation and recreation projects.

More information and links to State awards:

<https://www.doi.gov/pressreleases/secretary-zinke-announces-distribution-11-billion-state-wildlife-agencies>

Wisdom “Flies” to D.C.!

By Samantha Brooke (USFWS)

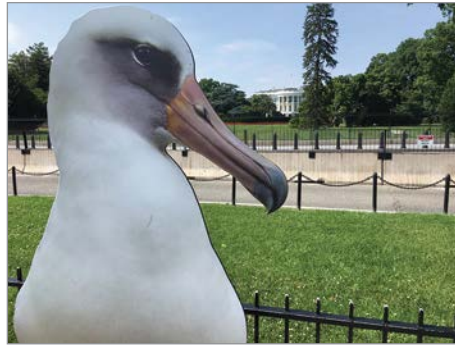
In June, a cardboard cutout image of Wisdom, a female Laysan albatross (*Phoebastria immutabilis*) and the world’s oldest known wild bird, traveled from Midway Atoll in the Pacific Ocean to Washington, D.C., where she made an “appearance” at the 2017 Capitol Hill Oceans Week (CHOW). CHOW is an annual event that brings together hundreds of policymakers, scientists, businesses, and conservation leaders to discuss pressing science, conservation, and management issues facing our ocean and Great Lakes.

“Wisdom is an ambassador for Papahānaumokuākea Marine National Monument and Midway Atoll National Wildlife Refuge,” said USFWS Papahānaumokuākea Superintendent Matthew Brown who accompanied Wisdom on her tour. “Wisdom helps raise awareness about seabirds and connect people to issues that affect them in far distant places on the Earth. Our Refuge is home to over three million seabirds, including 70% of the world’s Laysan albatross, 40% of Black-footed albatross, and the endangered Short-tailed albatross that rely upon the Refuge.”

Wisdom nests within the world’s largest albatross colony on Midway Atoll National Wildlife Refuge (NWR) in Papahānaumokuākea Marine National Monument. She is at least 66 years old and is a world-renowned symbol of hope for all species that depend upon the health of the ocean to survive.

The 6-ft tall cardboard cutout of Wisdom was first prepared for the 2016 World Conservation Congress. At CHOW, she attracted fans of all types to the DOI booth where they could pose for selfies and even try on a human-sized version of her bird band.

After her appearance at CHOW, Wisdom made a brief walking tour of D.C. sights, including the White House. She was then hosted by the



Top left: The cardboard cutout of Wisdom posed with the White House on her way to the DOI’s Main Interior Building. Photo credit: USFWS. Lower left: Dr. David Shiffman, an award-winning science communicator (@whysparksmatter), takes a selfie with Wisdom at CHOW. Above right: A passerby shows the red plastic band numbered Z333 that was designed to mimic the bird band that Wisdom the albatross wears on her right leg to allow biologists to identify her. Below: BOEM and BSEE employees pose with Wisdom. Photo credits: Ann Tihansky, USGS.



DOI museum in honor of National Ocean Month before settling into her permanent home in the Welcome Center at USFWS’s Headquarters office in Falls Church, VA.

Learn more about Wisdom the albatross here: https://www.fws.gov/refuge/Midway_Atoll/wildlife_and_habitat/Wisdom_Profile.html

75th Anniversary of the Battle of Midway

Technology Connects to Remote Ceremony Site

By Alice Garrett (USFWS)

Fought in the air, on land, and waters surrounding Midway Atoll from June 4 to 7 in 1942, the Battle of Midway was a critical turning point for the Allied Forces during World War II. In honor of its 75th Anniversary, the USFWS, in partnership with the U.S. Navy, commemorated the battle with events at Midway Atoll NWR and Battle of Midway Memorial and with associated events at locations throughout the country. The USFWS collaborated with the U.S. Navy to livestream the event with segments from the Atoll and the U.S.S. Midway including a commemoration film produced by Tandem Stills + Motion, Inc.

The livestream event was the first of its kind for the USFWS. The Atoll hosted Battle of Midway U.S. veterans Colonel John F. Miniclier (U.S. Marine Corps, retired) and

Sergeant First Class Edgar R. Fox (U.S. Army, retired) who represented the handful of remaining survivors on the Atoll. U.S. Navy Chief Petty Officer Justin Culbertson joined them in presenting a wreath in memoriam of the battle.

The ceremony featured an introduction from USFWS Acting Director Jim Kurth, brief remarks from Naval History and Heritage Command Director Sam Cox (Rear Admiral U.S. Navy, retired), a lone bugler playing “Taps,” a moment of silence, and a performance of the first stanza of “Eternal Father.”

New technology enabled the USFWS’ first national-scale event with partners that shared the broadcast worldwide via satellite so that those far away could participate in the ceremony. The event was broadcast to six additional ceremony locations in California, Washington D.C., South Carolina, Louisiana, Florida, and Hawai‘i.

Learn more about the Battle of Midway, watch the commemoration film, or see the archive of the livestream event: <http://www.midway75.org>



Battle of Midway Veterans and their daughters, USFWS representatives, and U.S. Navy representatives at the Battle of Midway Memorial and 75th Ceremonial Wreath. Resident Albatross and Midway Atoll NWR in the backdrop. Photo credit: Cy Rosen, U.S. Navy

Recreation Value for Coastal Parks

By Catherine Cullinane Thomas (USGS), Lynne Koontz (NPS), and Cliff McCreedy (NPS)

The NPS published its annual report (2016) on the NPS’s economic contributions to the national economy. In 2016, 331 million park visitors spent an estimated \$18.4 billion in local gateway regions, which has substantial secondary economic effects. These expenditures supported a total of 318.1 thousand jobs, \$12 billion in labor income, \$19.9 billion in value added (or contribution to the GDP), and \$34.9 billion in economic output in the national economy.

In 2016, OGLC parks saw increases in economic benefits associated with our 88 OGLC NPS units as compared to 2015:

- Visitor spending: \$5,340,929,600
- Jobs: 75,591 (compared to 72,237 in 2015)
- Visits: 96,259,593 (compared to 89,212,379 in 2015)

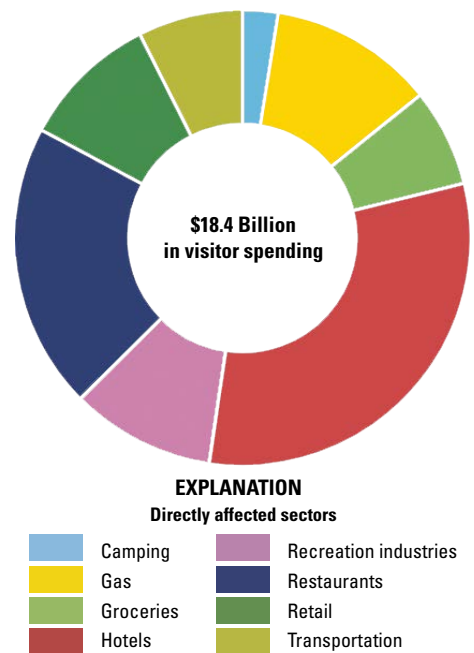


Image credit: NPS

Learn more: <https://www.nps.gov/subjects/socialscience/vse.htm>

Secretary Zinke Announces Invasive Mussel Preventative Actions

By Hilary Smith (DOI)

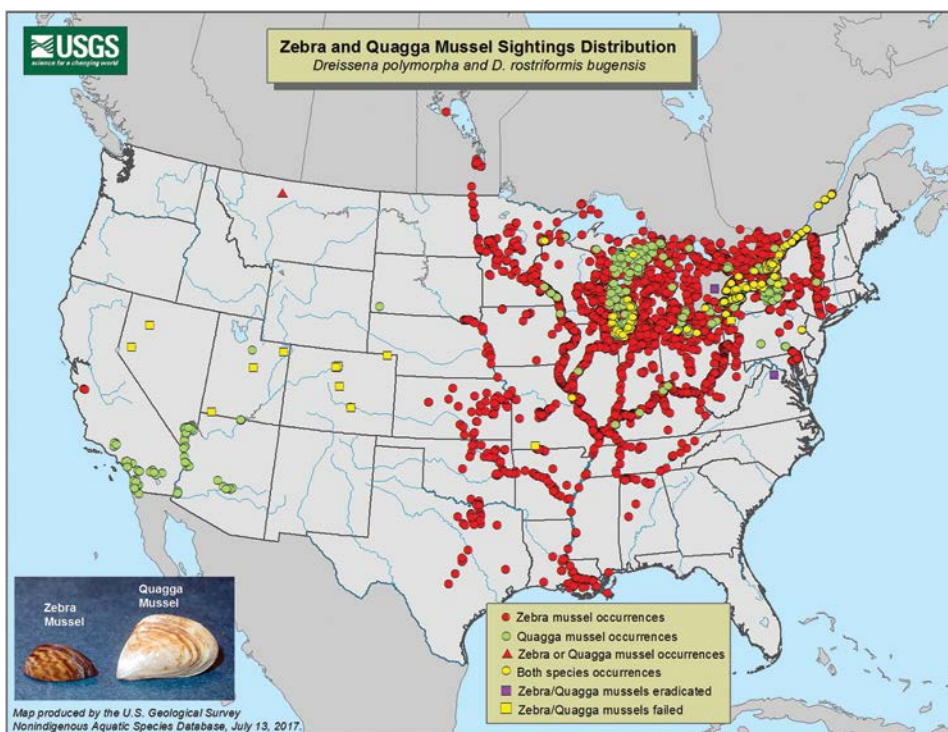
On June 26, Secretary Zinke announced actions developed through collaboration with western governors and Federal, State, and Tribal agencies to protect areas in the West from the economic and ecological threats posed by invasive mussels.

A team of more than 70 Federal, State, and Tribal government officials identified about three dozen actions to address invasive quagga mussels (*Dreissena bugensis*) and zebra mussels (*Dreissena polymorpha*) in the Columbia River Basin in the Pacific Northwest region specifically, and the West more generally. Invasive quagga and zebra mussels damage aquatic ecosystems and clog hydroelectric facilities and irrigation systems. In the Great Lakes region, invasive mussels cause more than half a billion dollars of damage a year and have dramatically changed the ecosystem. They pose a similar threat across the West—particularly in the Columbia River Basin where they have not yet established—and in others including the Colorado River Basin, where infestations were first discovered in Lake Mead in 2007.

“Stopping the spread of invasive mussels and increasing our Federal-State-Tribal coordination are both critical priorities in order to ensure that we maintain hydropower as a clean, reliable, cost-effective source of energy for the West and protect our outdoor tourism economies,” said Secretary Zinke. “Protecting our waterways and ecosystems is not a partisan issue and I’m glad to work with governors as the States, Tribes, and Federal government combat the spread of invasive species. By working as an integrated team to prevent, contain, and control invasive mussels, Americans will be



DOI leaders Scott Cameron and Aurelia Skipwith discussed Secretary Zinke's announcement of Federal actions to address invasive mussels when they joined the 100th Meridian Initiative's Columbia River Basin Team meeting in Helena, MT. Photo credit: Hilary Smith, DOI



Map of zebra and quagga mussel distribution and sightings, as of July 13, 2017, based on the USGS Non Aquatic Species Database (<https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=5>). Image credit: USGS.



At top: A display of invasive zebra mussels shows how they can propagate and foul propellers and clog pipelines. At right: Zebra mussel infestations can cause damage to ecosystems and property. Photo credits: USFWS



See Invasive Mussels page 9

Bark Rangers Detect Invasive Mussels

By Gina Digiantonio (DOI)

Similar to bomb or drug-sniffing dogs, some canines are trained to detect invasive aquatic mussels. Mussel-sniffing dogs search boats for quagga and zebra mussels to contain the threat before the invasive species can spread and establish in new waters. Canines save personnel hours by completing a boat inspection in a fraction of the time it would take a person to inspect it. This technique is suggested as an innovative and noninvasive sampling method in the NPS's Quagga/Zebra Mussel Infestation Prevention and Response Planning Guide and is implemented at Glacier National Park, MT and Amistad National Recreation Area. Other preventative management actions include looking for the visual presence of the invasive mussels, ensuring there is no standing water in the boats, and educating the public about the threats of aquatic invasive species.

Read the Quagga/Zebra Mussel Guide here:

https://www.nature.nps.gov/water/quagga/QuaggaPlanningGuide_ext.pdf

Read more about Pearl, a mussel dog at Amistad:

<https://www.nps.gov/amis/learn/nature/pearl-the-mussel-sniffing-dog.htm>



Golden retriever Tobias inspects a boat for invasive species at Glacier National Park, MT. Photo credit: A.W. Biel, NPS

Invasive Mussels continued from page 8
able to experience the full benefits of hydropower and enjoy their rivers, lakes, and streams for recreation for years to come.”

DOI is undertaking actions that include preventing and containing the spread of invasive mussels by inspecting and decontaminating recreational watercraft—one of the primary pathways of spread; enhancing sampling efforts and detection techniques to search for new introductions; and convening workshops to share best management practices on control strategies.

This effort complements strong State-Federal collaboration underway through the Aquatic Nuisance Species Task Force and its Western Regional Panel, as well as other regional networks such as the 100th Meridian Initiative Columbia River and Missouri River Basin Teams.

Read the press release:

<https://www.doi.gov/pressreleases/secretary-zinke-announces-initiatives-protect-western-ecosystems-and-hydroelectric>

See the full list of actions announced on June 26 here:

https://www.doi.gov/sites/doi.gov/files/uploads/safeguarding_the_west_from_invasive_species.pdf

Platforms for Chesapeake Ospreys

By Peter McGowan (USFWS)

Ospreys are an iconic Chesapeake Bay species that were once in trouble. In the 1970s, their populations, along with other fish-eating bird species, were severely impacted by the pesticide, dichlorodiphenyltrichloroethane (DDT), and its resulting harmful effects on reproductive success. An estimated 10,000 pairs of ospreys currently nest in Chesapeake Bay, a big improvement from the 1,450 pairs recorded 40 years ago. Banning of DDT combined with conservation efforts have brought these birds back to the Bay.

The Poplar Island Environmental Restoration Project is an international

model for restoring islands for the benefit of fish and wildlife. Thanks to a project funded by the USACE and Maryland Port Administration, dredged material is used with an emphasis on restoring habitat for nesting water birds. When completed in 2043, Poplar Island will feature more than 1,700 acres of tidal wetland and uplands.

As part of this effort, more than 24 osprey platforms were installed by March 2017 with the help of volunteers that have included the Boy Scouts of America with two Eagle Scout projects involved with osprey platform construction. When the “fish hawks” first arrive in the spring, it marks the beginning of the next monitoring season.

Read more: <https://usfwsnortheast.wordpress.com/2017/03/20/an-island-rises-from-the-bay/>



At Poplar Island in Chesapeake Bay, USFWS biologists and volunteers from the Maryland National Capital Parks and Planning Commission install one of several osprey platforms built by an Eagle Scout with Boy Scouts of America. Photo credit: USFWS

Latino Conservation Week at DOI Refuges and Parks

By Jill Wheeler (Hispanic Access Foundation)

The 2017 Latino Conservation Week (LCW) was the fourth annual event where Hispanic Access Foundation (HAF) partnered with DOI to organize activities at public lands sites across the nation to encourage the Latino community to explore the outdoors and participate in natural resource stewardship.

During the third week of July, Latino community and youth groups, schools, churches and a wide variety of non-profit organizations and government agencies hold events that support local land, water, and air conservation efforts with activities that range from hiking and camping to community roundtables and film screenings. By engaging Latino families and children in outdoor activities, the important conservation role of Latinos receives broader bilingual media coverage.

Each year, the number of sites, partners and participants has increased. LCW has grown from 16 events in 2014 to 52 events in 2015, to 109 in 2016. This summer's events engaged more than 6,500 participants and 126 partners in 103 events. In 2017, DOI hosted activities at USFWS NWRs, National Parks, and Bureau of Land Management sites. Nationwide, 12 USFWS sites participated, including coastal sites in the San Diego Bay NWR in California and Merritt Island NWR in Florida. Through 22 events, USFWS engaged about 900 people across the country.

HAF currently has agreements in place that allow the organization to place interns and fellows at Bureau of Reclamation, National Park Service, USFWS and other Federal agencies. Ivette Lopez and Michael Bonilla were first selected as HAF-USFWS interns in 2016, with assignments at Stewart B. McKinney NWR in Connecticut and at Rhode Island NWR Complex, respectively. Lopez and Bonilla led Latino Conservation Week



Ivette Lopez, Hispanic Access Foundation-sponsored intern helps engage local students in learning more about birds and marine life at the Stewart B. McKinney NWR in Connecticut. Photo credit: Hispanic Access Foundation

Hispanic Access Foundation (HAF)

Mission: To connect Latinos with partners and opportunities to improve lives and create an equitable society

The HAF team is passionate about creating a healthy natural environment for all. They do so by building and activating a network of next generation environmental stewards and outdoor recreation leaders that reflects the diversity of our nation. HAF programs focus on highly competitive internships and fellowships for undergraduates, recent college graduates and graduate students. It is a national 501(c)(3) nonprofit.

- HAF is a member of the 21st Century Conservation Service Corps. Upon completion of an HAF internship (at least 640 hours), interns can receive certification of their service hours under the Public Land Corps Act. Participants receive special noncompetitive hiring status for 120 days. After successful completion of an initial assignment, many sites have chosen to extend assignments so students can continue working part- or full-time. Several HAF program alumni have received permanent positions at DOI, bringing valuable skills and diverse perspectives to the agency.
- Participants are placed in assignments that encourage them to engage diverse communities at public land sites.
- HAF has placed and trained more than 100 college and graduate student interns with Federal government partners in the past three years. Typical HAF interns and fellows are of ages 18–30 and many are bilingual.
- HAF has developed programs for summer, semester, and full-year assignments lasting for 10, 12, 18, and 52-week periods.

For more information on LCW or internship programs:

<http://latinoconservationweek.com/>

<http://www.hispanicaccess.org>

coastal activities that were extremely popular with the participating Latino children and families. Because of their outstanding performance, both

internships were extended to continue their work for an additional year where they worked with local

See Latino Conservation page 11

Latino Conservation continued from page 10

schools and community organizations. Through strong, trusting relationships with local teachers and community leaders, they offered educational programs in schools and camps. This effort culminated in a series of public events coordinated with partners and sponsors that engaged hundreds of children, families, and college students during LCW. Lopez organized two community visits to explore marine life at McKinney's Outer Island Unit, with support from the Friends of the Outer Island, that brought together a unique mix of participants, which for many was the first time to board a boat and travel to the island. Similarly, Bonilla organized two events at Ninigret NWR and Sachuest Point NWR that provided memorable seining and fishing experiences for the enthusiastic participants.

In 2018, HAF plans to organize events around LCW, Hispanic Heritage Month, Refuge Week and Public Lands Day. HAF expects to coordinate with several partners to celebrate the 50th anniversary of the National Trails System and the National Wild & Scenic Rivers System.

HAF collaborates with Federal government and nonprofit partners on initiatives to increase diversity in the environmental field. Previous activities have highlighted the NPS Centennial and "Every Kid in a Park" initiatives. Through high impact and high visibility internships and events, these programs have engaged Latino young adults and community members at more than 12 USFWS sites in 11 states and 33 NPS sites in 15 states. The demand for career opportunities among Latino candidates is high, reflected by the strong pool of more than 540 applicants for 46 positions in the first two years. HAF supports DOI in linking diverse communities to public lands across our nation through LCW and other events. HAF looks forward to continued partnerships with DOI agencies in engaging diverse participants in outdoor recreation and stewardship.

The Importance of Tribal Culture and Partnerships

By Penny Wagner (NPS) and BIA Midwest Region

At Olympic National Park, everyone is welcome! A new welcome sign installed at the Port Angeles entrance to the park features a special message in the Klallam language: ʔənʔá č'áyəx", which means "come inside." Watch the video: <https://www.youtube.com/watch?v=PTmbFBlvbG0>

The park consulted with the local Lower Elwha Klallam Tribe to translate the welcome message ensuring that park visitors immediately understand how connected the park is with Klallam culture. The welcome sign is part of a larger project at the Park, where signs were installed at Rialto Beach and the North and South Shore Roads of Lake Quinault, as well as other sign improvements.

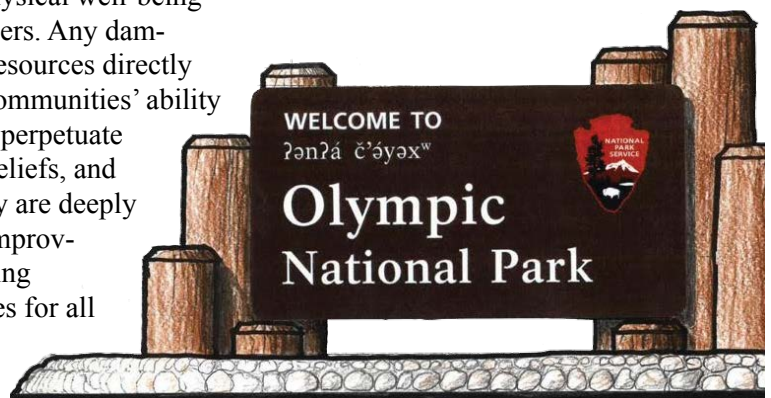
Tribes are an important part of DOI's OGLC role. From welcome signs to managing natural resources, from the coasts to the Great Lakes, DOI has a responsibility to help maintain American Indian resources, languages, and traditions. Tribes in the Great Lakes, Mississippi River, and Hudson River watersheds have a land base of almost 62 million acres, including almost 5 million acres of watersheds, and they recognize that our natural world is strongly tied to the spiritual, cultural, and physical well-being of Tribal members. Any damage to natural resources directly affects Tribal communities' ability to exercise and perpetuate their identity, beliefs, and tradition so they are deeply committed to improving and protecting natural resources for all generations.

In past years, these Midwestern tribes have used Bureau of Indian Affairs' Circle of Flight Program and the Great Lakes Restoration Initiative funding to forge valuable partnerships with Federal, State, and local agencies to restore culturally and economically important resources such as fisheries, wetlands, wild rice, and waterfowl; for example, wild rice is a staple food and the harvesting process is handed down from generation to generation, maintaining cultural traditions. In 2015, the Little River Band of Ottawa Indians monitored and assessed the genetic population structure of their local wild rice beds, and the Nottawaseppi Huron Band of the Potawatomi expanded wild rice on Tribal grounds and held a wild rice camp and workshop. These projects strengthen Tribal culture and communities, and assist DOI in fulfilling its stewardship responsibility.

Read more about the Olympic National Park signs: <https://www.nps.gov/olymp/learn/news/new-entrance-sign-in-progress-for-olympic-national-park-at-the-visitor-center-in-port-angeles.htm>

Want to learn more about the cultural history of Olympic National Park? Read here: <http://www.elwha.org/cultureandhistory/historicalvillagesites.html>

Learn more about Great Lakes Tribal Habitat Restoration projects: <https://www.glifwc.org/publications/pdf/2016Habitat.pdf>



A planned sign at the entrance to Olympic National Park welcomes visitors in the Klallam language. Image credit: NPS

Ecosystem Restoration Projects Boost the Economy at Multiple Levels

By Heidi Koontz (USGS), Catherine Puckett (USGS), and Erica Wales (DOI)

Can we put a price on the benefits nature gives us? In 2017, the USFWS-Coastal Program and Land Trust Alliance released a brochure to help communities consider and articulate the economic benefits associated with their habitat conservation activities. “Investing in Nature” describes how natural systems contribute to local economies through storm protection, clean water, and human health. Nature boosts local economies by supporting fishing, bird watching, hunting, and other recreational activities. Nationally, bird watching supports more than 660,000 jobs and \$31 billion in employment income. *See related story, page 7.* Furthermore, proximity to protected lands, like NWRs, can increase urban home values by 3–8%. The value of coastal wetlands, for example, was estimated to provide \$23.2 billion per year in storm protection from hurricanes for the United States, while each acre of protected land can save local communities an average of \$380 annually in storm water infrastructure costs.

These values add up. An economic study in 2016 determined that ecosystem restoration can provide a two- to three-fold return in economic activity that ripples through local, regional, and national economies. A previous study of 2011 Coastal Program habitat conservation projects indicated that for every dollar invested in on-the-ground projects generated \$13 in economic stimulus, totaling more than \$35 million in stimulus.

Economists from the USGS, DOI, and Bureau of Land Management evaluated 21 DOI restoration projects to quantify methods for economic impact



In November 2016, partners from more than nine different organizations set out in boats and seeded 20 acres of wild rice in Lower Green Bay, WI (<https://www.fws.gov/midwest/insider3/January17Story5.htm>). Wild rice seeding led by the USFWS and their partners is an important part of Great Lakes restoration projects. Photo credit: Steve Kass, Ducks Unlimited

analyses focusing on jobs and business activity generated through money spent on ecosystem restoration activities. Two coastal area case studies are highlighted below.

Read more: <http://www.estuaries.org/images/stories/RAEReports/coastalbookletfinalpgs.pdf>
<https://www.fort.usgs.gov/economic-impacts-restoration>

Ni-les'tun Tidal Marsh Restoration in Oregon

Bandon Marsh NWR (OR) was established in 1983 as stopover estuary habitat for migrating shorebirds and waterfowl. The NWR now has 889 acres in two units: Bandon Marsh and Ni-les'tun, both historically tidal wetlands. Ni-les'tun was diked and drained in the 1800s for agricultural purposes. In the largest tidal marsh restoration in Oregon to date, USFWS and more than two dozen public and private partners collaborated for more than a decade to restore 418 acres of tidal marshland. During the restoration, the project unearthed living sites, tools, and shells dating back more than 4,000 years, providing evidence that humans occupied the area before and after powerful earthquakes and tsunamis altered the landscape.

The total restoration cost was \$1.64 million (in 2011), 63% of which was spent locally. In total, the project provided more than \$1.13 million in labor income over the life of the project and had a local economic output of \$2.38 million (in 2014).

Piping Plover Nesting Habitat Management Program

In 1996, the North Cape Oil Spill adversely impacted piping plover nesting habitat, resulting in fewer chicks produced during the following nesting season. USFWS, Rhode Island, and National Oceanic and Atmospheric Association (NOAA) provided funds to The Nature Conservancy (TNC) to implement management actions aimed at reducing threats to piping plovers and increase the number of chicks produced in Rhode Island. TNC staff organized more than 70 public education programs, monitored nesting beaches, and removed several predators known to consume adults and chicks. During the 5-year project, more piping plover chicks (108) were produced than in the previous five years (80). *See related stories, pages 15, 16, and 32.*

The project provided an average of \$32,000 per year to the program to support three full-time seasonal positions in Little Compton, RI, each summer between 2007 and 2011. These expenditures supported more than \$41,000 per year in labor income in the local community.

The brochure, “Investing in Nature”: <https://medium.com/usfws/investing-in-nature-e33b4f09472e>

2011 booklet “Restoration Returns”: www.estuaries.org/images/stories/RAEReports/coastalbookletfinalpgs.pdf

Read more: <https://www.estuaries.org/the-economic-value-of-coasts-a-estuaries>

A Communications Guide for Conserving Piping Plovers and Other Shorebirds

By Meagan Racey (USFWS)

“Atlantic Coast Piping Plover Strategic Communications Plan: Reducing Human Disturbance,” was released by a team of representatives from State wildlife agencies, conservation organizations, and Federal agencies serving on a piping plover (*Charadrius melodus*) communications team. The plan is intended for use by people engaged in the shorebird’s conservation as a resource for community and media relations. It provides messages, tools, and strategies for communicating with various audiences, particularly beachgoers, about why and how to reduce impacts on piping plovers. Although the plan focuses on piping plovers, much of the content is transferable to other beach-nesting shorebirds. Interested collaborators are encouraged to review the steps for plan implementation and contact team members (see

Piping Plover Messaging

1. With ever-growing demands on our beaches, there are fewer places for piping plovers that depend on Atlantic Coast beaches year-round to raise families, feed, and rest.
2. Everyday activities on the beach can unintentionally harm piping plovers.
3. By following some specific steps, we can share the beach with piping plover adults and chicks to help them survive.
4. The piping plover is making a comeback in the United States! Please help do your part to make sure this shorebird is around for future generations.



general beachgoers, beach and land managers, municipal and other on-beach staff, residential audiences, and dog owners/walkers.

The plan includes strategies to promote bird-friendly behavior:

- Enable audiences by providing clear, consistent information on needed behaviors in person and online from trusted sources, and remove barriers to those behaviors.
- Encourage audiences by providing updates on progress and rewards for behaviors through online, third party, and in-person communication.
- Engage audiences by providing opportunities for education and involvement in piping plover conservation.
- Exemplify behaviors for audiences by demonstrating positive attitudes and behaviors.

page 7 of the plan). The goal of the plan is to reduce human-related disturbance of piping plovers through use of consistent communication tools by the piping plover conservation network (defined currently as the email network maintained by the Atlantic Coast piping plover recovery coordinator).

This communications effort aims to influence target audiences such that they will modify beach use to reduce disturbance, provide supportive perspectives on piping plover conservation, demonstrate stewardship, and comply with conservation guidelines. Priority target audiences include



The plan is a resource for people engaged in shorebird conservation to help with community and media relations. Read the plan: https://www.fws.gov/northeast/pipingplover/pdf/Communications_Plan_for_Reducing_Human_Disturbance_to_Atlantic_Coast_Piping_Plovers.pdf



Sandy substrates, often with shells or gravel and minimal vegetation, offer camouflage from predators, like foxes and crows, for eggs and newly hatched chicks. Photo credit: Josh Seibel, USFWS

Science to Strike a Balance on the Beach

By Sara Zeigler (USGS)

Each year, the federally threatened piping plover arrives on beaches from Maine to North Carolina, where this small migratory bird nests in open, sandy areas close to the ocean.

Although these Atlantic beaches are preferred nesting areas for the piping plovers and other bird species like least terns and American oystercatchers, they also are popular recreational spots and home to some of the highest human population densities in the United States. Beach closures, intended to protect piping plovers and other beach nesting species, often lead to contentious battles over beach access. Increases in human population and coastal development, combined with sea-level rise, are likely to increase these conflicts. A new report describes the development of scientific tools that can help coastal management achieve a balance in response to sea-level rise.

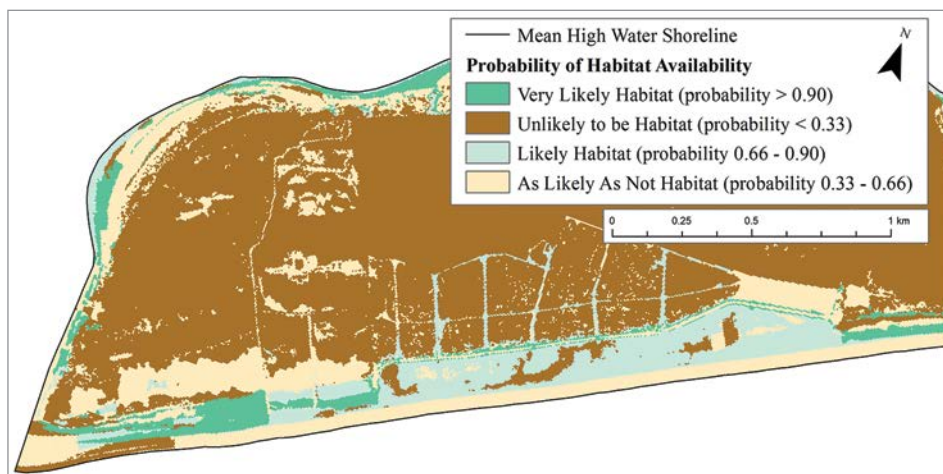
USGS scientists are part of an interdisciplinary research team in partnership with universities (the Virginia Tech Shorebird Lab), USFWS, NPS, and nongovernmental organizations (NGOs) like The Nature Conservancy



Areas with a higher probability of being habitat may be most appropriate for piping plover nesting and could be prioritized for conservation over human recreational use. Photo credits: Kaiti Titherington, USFWS; Sara Zeigler, USGS

and Mass Audubon that have been working to characterize and map piping plover habitat across the species' U.S. Atlantic coast breeding range.

Together, these partners deployed “iPlover,” a smartphone application, to characterize land cover where piping plovers nested at 97 beaches and barrier islands along the Atlantic coast. They used the data to form the backbone of a model that can predict piping plover habitat availability.



New scientific tools and products, like this predicted map of habitat availability for piping plovers, can give coastal managers the information they need to coordinate appropriate use of coastal areas that balance the needs of people—including off-road vehicle use, fishing, and sunbathing—with those of beach-nesting species like piping plovers. Image credit: Sara Zeigler, USGS

Used in conjunction with elevation datasets (for example, light detection and ranging [lidar]) and aerial photographs, the model can produce maps that probabilistically show areas that are either likely or unlikely to support habitat for this species.

While the model can display maps of “current” habitat availability, it also can be used with historical datasets to examine how habitat has changed through time; for example, the effects of Hurricane Sandy on piping plover habitat was assessed by creating three separate habitat maps in New York and New Jersey based on elevation and aerial photography collected before Hurricane Sandy (2010), just after the storm (2012), and two years later (2014). Comparisons between these maps show where coastal changes associated with Hurricane Sandy created suitable habitat.

The habitat model also can be used in conjunction with other coastal change forecast models to help predict where piping plover habitat might exist in the future under different sea-level rise scenarios. Currently, prediction efforts are underway at 21 beaches and barrier islands that support nesting piping plovers from Maine to North Carolina.

These new tools will allow managers to better understand where suitable piping plover habitat existed in the past, exists in the present, and will likely exist in the future. This information can help prioritize the protection of areas that consistently support suitable habitat while allowing the recreational use of other, less suitable areas. Through science, tools, and partnerships, coastal managers can balance the needs of both birds and people. *See related stories, pages 12, 15, and 32.*

Learn more: <https://woodshole.er.usgs.gov/project-pages/beach-dependent-shorebirds/index.html>

Read the report: <http://onlinelibrary.wiley.com/doi/10.1002/wsb.820/full>

San Francisco Bay: Decades of Water Quality Data

By Tara Schraga and James Cloern (USGS)

The USGS published 46 years of water quality measurements in San Francisco Bay, which just may be the longest record of water-quality measurements in a North American estuary! This long record has played a foundational role in understanding how and why the Nation's estuarine and coastal ecosystems change over time.

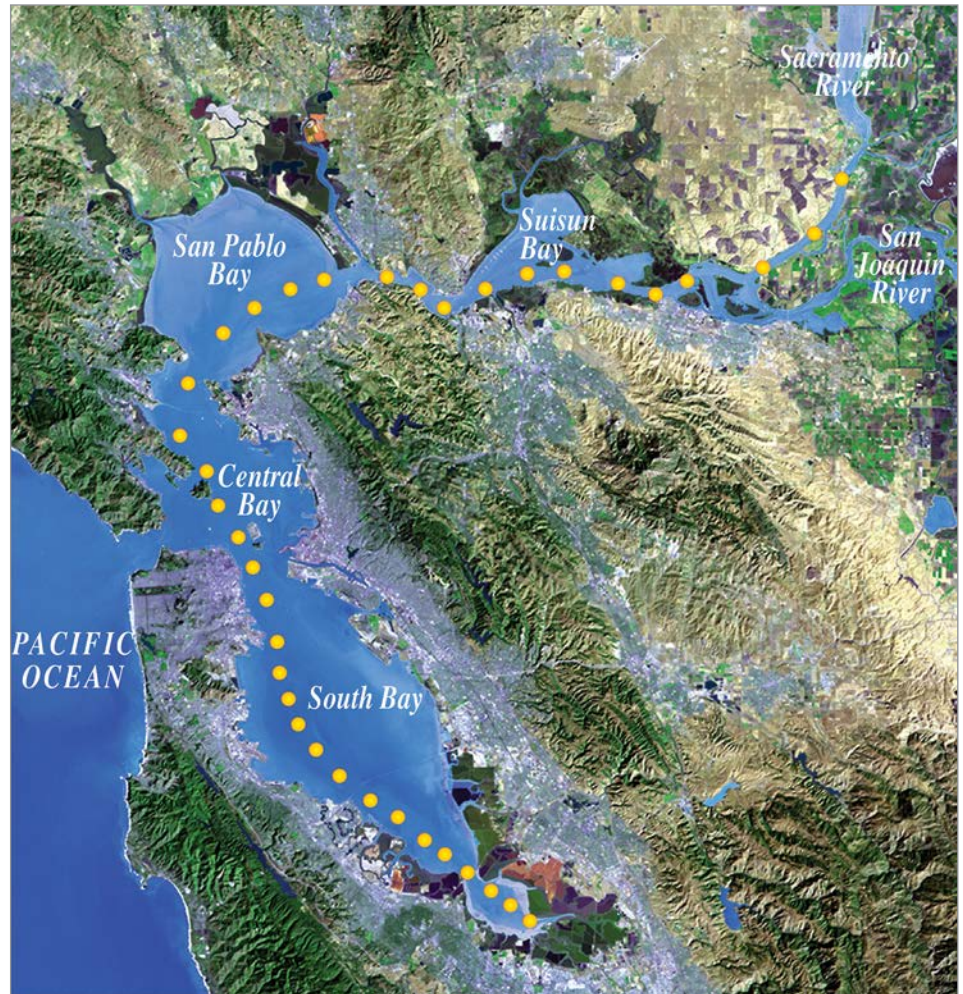
Since 1969, the USGS has maintained a place-based ecosystem research program in San Francisco Bay, CA. The program measures water quality parameters that determine the sustainability of San Francisco Bay as suitable habitat for a variety of biological communities. Parameters such as salinity, chlorophyll, and nutrients are collected along the entire salinity gradient of San Francisco Bay, allowing scientists to track trends over space and time within the largest estuary on the west coast of North America.

The new publication in *Nature's Scientific Data* journal describes this extensive data collection, details the continuity of analytical methodology over time, and summarizes how the 1969–2015 dataset has been used to understand estuarine ecosystem processes.

Read the article: <https://www.nature.com/articles/sdata201798>

Decades of Discovery

Nearly five decades of observations have provided a rich record of changes that allowed USGS and other researchers to deepen understanding of how estuaries are structured, how they function, and their differences from the rivers and oceans they bridge. The data record has been analyzed and published in hundreds of research papers and reports across diverse topics ranging from archaeology to zooplankton



A satellite imaged map of San Francisco Bay with USGS sampling stations shown in orange. Image credit: Jeanne DiLeo, USGS



All the data and much of what we know about how the San Francisco Bay works comes from collecting data on board the *R/V Polaris*. Built as a luxury yacht in 1927, the 96-foot wood boat eventually came to the USGS, where it has spent five decades supporting research across San Francisco Bay and the Delta. Photo credit: USGS

ecology. Knowledge accumulated by this program has informed numerous management strategies and regulatory decisions. These include the decision to remove San Francisco

Bay from the list of California water bodies impaired by low oxygen, flow standards to protect native fish, and

See *San Francisco Bay* page 16

San Francisco Bay continued from page 15

the inclusion of exotic species on the list of pollutants to the estuary. These data have been the basis for proposed chlorophyll standards to protect the bay from harmful consequences of nutrient enrichment. Many discoveries from this dataset were surprises and could only have been made through sustained observations over decades.

A few prime examples of discoveries:

- USGS measurements before and after the introduction of an Asian clam in 1986 showed how biological communities can be restructured by nonnative species. This discovery was a motivation for California's Marine Invasive Species Act.
- USGS measurements before and after passage of the 1972 Federal Clean Water Act demonstrated the benefits of advanced sewage treatment as problems of summer anoxia disappeared.
- USGS data were analyzed by researchers from multiple institutions to demonstrate relations between native fish populations and river inflow, providing a scientific basis for flow standards to the estuary.

- USGS captured an unexpected restructuring of biological communities, from phytoplankton to fish, after the northeast Pacific shifted from its warm to cool phase in 1999. This discovery illustrates how biological communities in bays and estuaries, and their effects on water quality, change in response to climate-driven shifts in coastal oceans.

View the data online: <https://sfbay.wr.usgs.gov/access/wqdata>

The complete dataset also is accessible through the public USGS Water Quality of San Francisco Bay website. You can also learn about the parameters measured and how we sample. You can view data from individual cruises as “snapshots” of conditions on each sampling day, or you can view the full record of variability for each parameter. The website includes a database that allows users to access and selectively download the data to make their own new discoveries. The website receives more than 700,000 views and more than 8,000 database queries each year from agencies, universities, and institutions in at least 88 countries and territories around the world.

The San Francisco Bay Water Quality Research Group

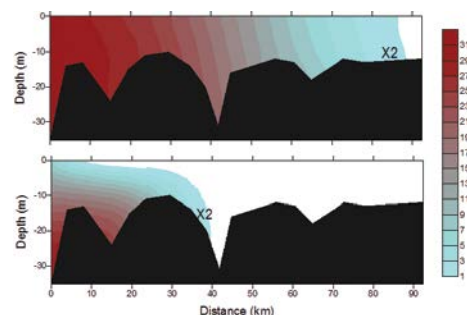
Dr. James (Jim) Cloern has directed this sampling program for the past 40 years. San Francisco Bay science is much more than a job to him; Jim finds inspiration walking his dog along the sloughs and biking to work over the bay, often arriving at the lab excited to share his newest science questions. Tara Schraga has spent the past 20 years participating in and managing the program. Charlie Martin and Erica Kress are the current sampling action heroes! Byron Richards was Captain of the *Research Vessel (R/V) Polaris* for 29 years (1980–2009) followed by Joel Fritsch (2009–2015), who continues to Captain the present *R/V David H. Peterson*. Over the years, many team members have collected, analyzed, managed, and interpreted these data in support of this program.

Learn more about the team: <https://sfbay.wr.usgs.gov/access/wqdata/overview/people/>

Read more about the colorful history of *R/V Polaris*: <http://www.sfestuary.org/estuary-news/bay-belle/>



Instruments used to measure a variety of water quality constituents are deployed off the ship's boom, with the San Francisco skyline in the background. Photo credit: USGS



These two images demonstrate how salinity distributions can vary in San Francisco Bay from inland areas (right side of graph) toward the Pacific Ocean (left side of graph) during drought periods of low freshwater inflow (top graph: August 12, 2014) and high river flow conditions (bottom graph: January 13, 1997). The salinity gradients control the spatial patterns of sediments, pollutants, nutrients, and biological communities like plankton, shrimp, and fish. White represents freshwater where salinity is zero, and black is the bottom profile of the bay. Image credit: USGS <http://onlinelibrary.wiley.com/doi/10.1002/Ino.10537/full>

Continuing the MADness: Carrying on the Legacy of Margaret Davidson

By John Haines (USGS)

This past May, all of us who are committed to the future of our coasts lost a guiding light and inspiration with the passing of Margaret Davidson. No longer will we receive her cryptic e-mails (signed, often appropriately, MAD); and no longer will we pick up the phone to hear Margaret's distinctive voice telling us in no uncertain terms what can be done, what **MUST** be done, and challenging us to look beyond barriers, bureaucracy, and our own blinders to pursue something bigger and more consequential.

Margaret was impassioned, she was audacious, she was bold and irreverent—and she was inspirational, as an advocate for our coasts and the people and communities who depend upon them. From her many positions within NOAA, she worked tirelessly to engage and encourage everyone and anyone to develop a shared vision for our coasts and to act **NOW** to see that vision become a reality. She built connections and communities that engaged all the intellectual, financial, policy, and legal resources she uniquely recognized as necessary to achieve her expansive vision. She cajoled and conscripted everyone who could or should contribute to that vision; and in her actions, she always included concern for those who are underserved, underrepresented, and most vulnerable.

She was a formidable force for good, she was generous and inclusive in spirit, and she was unmatched in the breadth of her vision for building safer, more productive, and more sustainable coasts. Among her virtues, patience was not perhaps the most apparent, but persistence certainly



At left: Margaret Davidson, at Capitol Hill Ocean Week (CHOW) in 2012, participating in a joint presentation by both NOAA and the USGS that discussed how science and policy can work together in the session, “Coastal Changes: What to Expect and What We Can Do About It.”

Photo credits: Ann Tihansky, USGS

Below: You can watch the impassioned discussion between policy and science leaders Margaret Davidson (NOAA) and Marcia McNutt (USGS) as they engaged the 2012 CHOW audience. Video: <https://www.youtube.com/watch?v=LYxpPcmDkO8>



was. The challenges we currently face, to act effectively and collectively in response to the 2017 Hurricane season, cry out for the vision, passion, and skills that she brought to every crisis and persistent coastal challenge we have faced over the past decades.

For more than 20 years, I had the privilege of knowing and working with Margaret Davidson in task forces, working groups, interagency committees, and public forums. She was a ubiquitous presence with a consistent and catalyzing message. Her public performances, as well as those e-mails and phone calls, have shaped what I believe we should do and expanded my optimism about what we **CAN** do.

Margaret, while quick to point out that she was no “pointy-headed scientist,”

unfailingly promoted science as essential to achieve safer and more resilient coasts. She also challenged the scientific community to engage with the public, policy makers, and the private sector so that the value of our science would be realized where it mattered—in the impact it has on lives and livelihoods. Margaret's legacy will be a lasting one. I, for one, will continue to preach the Gospel according to Margaret. The **Special Feature** in this edition of *NEWSWAVE* (see page 18), with its focus on science that reaches and supports coastal communities, is dedicated to the memory of our treasured colleague, Margaret Davidson, with our gratitude for all she did, all she taught, and all she inspired through her actions.

Coastal Science Supports Communities

By Hilary Stockdon and Ann Tihansky (USGS)

Coastal landscapes and communities across the United States are an essential part of our Nation's economy and culture. These vibrant commerce centers are valuable for their natural resources, which are economically beneficial for fisheries, habitat, and recreation. *See related story, page 1.* The coastal zone also provides an important buffer between the ocean and human-built infrastructure, blocking or dissipating powerful storm waves and water levels.

Coastal areas also are vulnerable to a variety of threats, such as storms and flooding, that can cause major negative economic impacts. The losses can be very high when human activity or critical facilities are in vulnerable areas. Recent Hurricanes Harvey, Irma, Jose, and Maria provide many examples of how susceptible communities can be to these impacts. Scientific data, forecasts, and models, combined with long-term scenario planning, can help reduce losses by informing decisions such as where to place or strengthen infrastructure or how best to develop strategies to mitigate these risks. Although changing sea level and climate will intensify these hazards and risks, there are forecasting tools and models that coastal communities can use to inform planning for and responding to future conditions to reduce overall negative impacts.

USGS expertise supports partners and community leaders across the Nation by providing applied science and tools to help create resilient, adaptable, and sustainable coastal communities that can maintain strong economies and resources both now and into the future.



Flooding in Kwajalein Atoll, Republic of the Marshall Islands, in 2008 inundated the island, threatening infrastructure and drinking water supplies. Photo credit: Dept. of Defense

Evaluating Sea-Level Rise Impacts on Pacific Ocean Atolls and Department of Defense Installations

As sea levels steadily rise in the central and western Pacific Ocean, waves from storms make these already low-lying islands increasingly vulnerable. Sea level models suggest that global sea level will be considerably higher by 2100. Pacific atolls, where maximum land elevations commonly do not exceed four meters above present mean sea level, have supported civilizations for millennia, yet the areas hospitable for human occupancy in terms of water and food supplies, and adaptability of terrestrial ecosystems, are limited. The susceptibility of these islands to sea-level rise and storm waves represents a threat to operations, food and water security, public safety, and environmental health. USGS experts led an interagency effort funded by the U.S. Department of Defense to develop assessments and forecasts that anticipate the consequences of more frequent and extreme marine flooding on atoll communities and the natural resources on which they depend. USGS analyses and products help identify which coastal areas are most vulnerable to sea-level rise over the next few decades so that the U.S. Department of Defense, DOI, and international managers (that is, Republic of the Marshall Islands) can prioritize actions and funding for as adaptation, relocation, and mitigation efforts. This scientific work provides critical information for understanding the timing and extent of impacts from climate change on tropical islands that in some cases may be so severe it would require abandonment and relocation of island-states.

From local to global issues, the USGS has a portfolio of expertise that brings a nationally consistent approach to providing applied science, products, tools, and guidance. Through transferability of tools and expertise, coastal resource managers and planners can make informed decisions to achieve adaptable and resilient communities and economies.

Contact: Curt Storlazzi (cstorlazzi@usgs.gov)

Learn more: <https://walrus.wr.usgs.gov/climate-change/atolls/>

See related stories, pages 16 and 22.

Preparing Communities for Coastal Hazards in California: Today and Tomorrow

More than 27 million residents of California coastal communities are dependent on comprehensive and scientifically sound coastal management strategies for future planning and investment decisions. The State has recognized the need for tools that can inform the public about their vulnerability to coastal hazards such as extreme storms, tsunamis, and erosion of beaches and coastal cliffs. Stakeholders throughout California have leveraged USGS science to better understand community vulnerabilities to storms and sea-level rise.

The USGS Coastal Processes Team, a group of modelers, geologists, engineers, and oceanographers, developed the Coastal Storm Modeling System (CoSMoS) to model physical coastal storm elements (tides, waves, and storm surge) and predict where it will flood in coastal areas. CoSMoS also can deliver coastal change projections, such as predicting how beaches and cliffs will respond to erosion and storms in the future.

USGS ensures that the modeling results meet the needs of the coastal communities it serves by working with the stakeholders to design CoSMoS products so they are easily understood and accessible and usable for community hazards planning. Through a partnership with Point Blue Conservation Science, USGS developed a user-friendly, web-based platform called "Our Coast, Our Future," where CoSMoS projections of potential flooding are publically available and viewable online.

To better understand the socioeconomic impacts from these kinds of events, the USGS developed the Hazards Exposure Reporting & Analytics Tool (HERA) that translates the flooding and erosion extents of these hazards into communities, identifying impacts on populations and critical facilities.

More than a dozen coastal cities, including the four largest (San Francisco, Los Angeles, San Diego and San Jose), and 11 coastal counties representing 20 U.S. Congressional Districts have used CoSMoS for hazard mitigation planning at local and State levels. In addition, many of the State agencies such as the California Department of Emergency Services and the California Department of Transportation as well as numerous NGOs and regional-scale collaborations have used these tools to inform, plan and prepare for coastal hazards.

Currently, CoSMoS is available for all coastal communities in Southern California, the San Francisco Bay Area and its outer coast. Modeling is underway for the Central Coast and Northern California coast, with full State coverage estimated to be completed in 2019.

Contact: Patrick Barnard (pbarnard@usgs.gov)

CoSMoS: http://walrus.wr.usgs.gov/coastal_processes/cosmos/

Our Coast, Our Future: <http://ourcoastourfuture.org>

HERA: <https://www.usgs.gov/apps/hera/>

Contact: Dr. Nathan Wood (nwood@usgs.gov)



The waterfront in Capitola, California, underwent severe flooding from a large storm in March 2014. Photo credit: Courtesy of Sabine Dukes, Science Buddies



What Do Coastal Scientists Say?

Listen to USGS Woods Hole Coastal and Marine Science Center Director Rob Thiel: <http://wcai.drupal.publicbroadcasting.net/post/facing-coastal-change-massachusetts-one-most-forward-looking-states>

Coastal storm water levels and waves overwhelm the roadway in Scituate, MA, in 2013. Photo credit: National Weather Service

Coastal Change Forecasting Tools Improve Emergency Planning and Promote Smart Coastal Management

Coastal flooding and erosion can cause big headaches for local communities—severing transportation paths, creating economic loss through business downtime or product loss, and sometimes leading to costly cleanup. The risks of coastal flooding can be very localized—with weather and wave events having major impacts in one community but posing no risk to another just a few miles down the coast.

The USGS, working together with NOAA and the National Weather Service, developed an operational forecast for total water levels so that local communities are empowered to prepare for and respond to specific local hazards. The forecast tool provides a 6-day forecast of shoreline water levels, giving users valuable information on the magnitudes and timing of high water events. The coastal change impacts of these events on the coast is determined by comparing water levels elevations to local beach morphology—or the shape and elevation of the beach and dunes. With these predictions, information about coastal erosion and inundation hazards is available on-demand for all weather conditions, allowing users to focus on events that are hazardous to them but may not make national news, such as sunny-day or nuisance flooding.

These tools provide guidance that allows local communities to take specific actions to reduce threats and risks. They can help emergency planners pinpoint coastal vulnerability such as where and when evacuation routes will be threatened, coastal dunes will be inundated, or barrier islands may be breached. The information can assist in dispatching emergency responders by identifying proper evacuation routes and enabling them to give specific warnings about how high the water levels will be and for how long. Private citizens can use the same model output to learn where high water levels, caused by tides or storms, might restrict safe beach access. Most recently, the operational version of the model was used during Hurricanes Irma, Jose, Maria, and Nate to provide coastal scientists and residents with actionable information about shoreline coastal flooding.

The model was based on almost two decades of research, combining observations of coastal erosion with models of how waves, water levels, and dunes interact. USGS scientists are continuing to validate and improve the model predictions by collecting observations of shoreline water levels and related coastal changes.

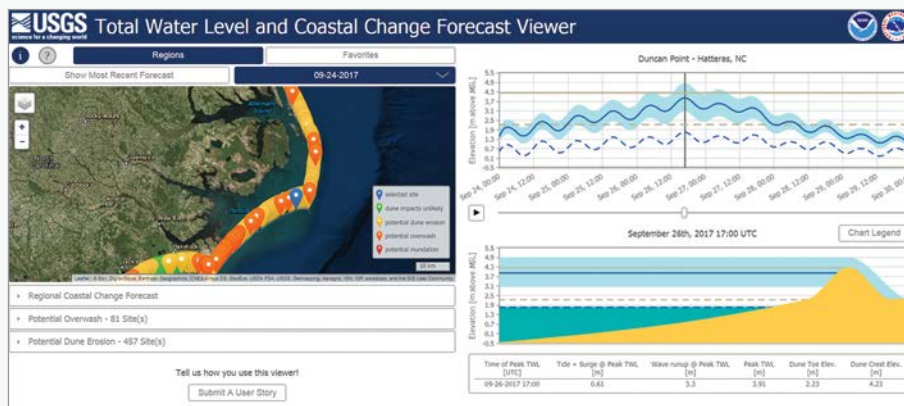
NOAA plans to provide the water level forecast for all U.S. coastlines. The water level forecasts, as well as their relation to local beaches and dunes elevations, are currently available for about one-third of the Atlantic and Gulf coasts.

The USGS Total Water Level and Coastal Change Viewer: <https://coastal.er.usgs.gov/hurricanes/research/twviewer/>

Read more: <https://coastal.er.usgs.gov/hurricanes/research/video-remote-sensing.php>

Contact: Joe Long (jwlong@usgs.gov)

Learn more: <http://coastal.er.usgs.gov/hurricanes/research/twviewer>



Total water level time series and dune impact prediction for the North Carolina coast during the passage of Hurricane Maria in September 2017. Elevated water levels caused by large waves were predicted to reach the base of the coastal dunes and cause dune erosion in Hatteras, NC, for multiple days. Image credit: USGS



The USGS Coastal Change Hazards Portal (<https://marine.usgs.gov/coastalchangehazardsportal/>) provided updated forecasts of coastal impacts as Hurricane Irma moved. This forecast was made on September 9 at 8:00 a.m. Image credit: USGS

What Managers Need to Anticipate Sea Level Rise Impacts: Tools for User Communities

Coastal managers and communities require improved understanding of the likelihood and magnitude of future sea-level rise impacts on infrastructure, natural resources, and habitat to evaluate the consequences of different management actions (or inactions). Broad-scale projections of the coastal response to sea-level rise typically simplify the impacts to flooding, with a need to determine whether or not an area is likely to become submerged; however, this inundation or “bathtub” approach to examining sea-level rise impacts doesn’t reflect the coast’s potential to adapt; for example, although heavily developed areas or rocky coasts will become incrementally submerged, other natural environments, such as marshes or beaches, can adapt to keep pace with sea-level rise by moving and changing. Barrier islands may migrate inland, build dunes, change shape, or be split by new inlets as tides, winds, waves, and currents sculpt their sands. Marshes trap sediment and break down decaying plants into new soil, which may elevate them sufficiently in some areas to keep pace with sea-level rise.



The effects of sea-level rise will vary based on differences in the geomorphology, ecology, and human influence on the type of coastal landscape: marsh (top left), rocky coast (top right), barrier beach (bottom left), and coastal bluff (bottom right). Photo credits: Erika Lentz, USGS

The USGS, in collaboration with Columbia University Earth Institute, has developed a model to account for natural adjustments of the landscape. It is used to make detailed predictions about the likelihood of inundation as well as dynamic coastal change in ecosystems that have the capacity to change over the next several decades in response to rising seas.

The model produces a more nuanced picture of sea-level rise as a mosaic of dry land, wetlands, and open seas, rather than as a uniform response across the landscape. Developed in conjunction with resource managers across the northeastern U.S. Atlantic coast, this probabilistic modeling framework better reflects the widely recognized and more complex implications of sea-level rise impacts along an extensive and variable stretch of coast from Maine to Virginia. By identifying where land is likely to exist in current or altered form versus where it is likely to be submerged, these outcomes can be used to identify and prioritize areas more likely to adapt or change that may provide near- and longer-term tradeoffs in a regional context.

The USGS model has been well received by a variety of audiences and users, from coastal and natural resource managers to academic departments and environmental journalists, emphasizing the public’s need for this specific information. More recently, the results have been integrated into several parallel modeling efforts evaluating species, habitat, and landscape impacts across the region through academic partners, NGOs, and Federal agencies to help them address the issue of planning in the coastal zone.

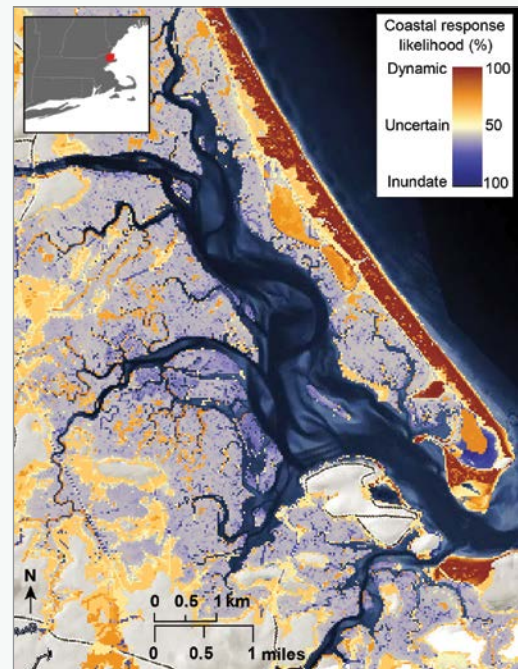
Contact: Erika Lentz (elentz@usgs.gov)

Learn more: USGS: https://woodshole.er.usgs.gov/project-pages/coastal_response/

University of Massachusetts: <http://www.umass.edu/landeco/research/dsl/dsl.html>

The Nature Conservancy: <http://www.nature.org/resilientcoasts>

USFWS: <http://naturesnetwork.org/>



Predicted likelihoods of coastal response for 2080 sea-level rise scenarios showing areas where dynamic change (red) and inundation (blue) are more likely, and where uncertainty in response is highest (light brown). Image credit: Erika Lentz, USGS

Science Partnerships in Support of Restoring Gulf Coast Barrier Islands

As a part of their mission, NPS and USFWS serve as stewards of public lands. This includes managing barrier islands, protecting natural and cultural resources, and preserving economical and ecologically valuable species. USGS provides coastal managers with scientific data and develops tools, collaboratively with public and private organizations, to evaluate the costs, consequences, and trade-offs of different management options.

As part of this work, USGS scientists are developing predictions of how barrier islands will evolve under different scenarios and are incorporating these into decision-support tools, including how islands evolve naturally and when they are restored in some way. These products can benefit State agencies and local communities by improving the decision-making process and reducing overall project costs, such as identifying which design alternative is the most resilient to storm damage or will require the least cost to maintain in the future.

- Ship Island, MS: USGS collaborated with Federal and State partners to develop a structured decision-making tool that will be used by the U.S. Army Corps of Engineers (USACE) in deciding how to cost effectively repair midconstruction damage that could occur during restoration activities, while still meeting objectives that include increasing protection of the mainland from storm surge and waves, adding acreage to land managed by the NPS for shorebird and sea turtle nesting, and preserving water quality in Mississippi Sound.
- Breton Island, LA: USGS worked with a private engineering firm to develop a new model for evaluating the potential outcomes of several restoration designs, both the storm-induced and long-term responses.

The USFWS is using the analysis results to identify a design that maximizes the potential to meet bird restoration goals associated with the Deepwater Horizon National Resource Damage Assessment.

- Dauphin Island, AL: USGS is developing and applying a modeling and decision-support framework for predicting how the island and its habitats will evolve over time based on potential restoration alternatives. This framework will be used by the State of Alabama, the National Fish and Wildlife Foundation, and USACE to evaluate the impacts of restoration decisions on this island, which is a popular tourist destination, home to 1,200 people, supports fishing and petroleum industries, and hosts a variety of coastal ecosystems and species.

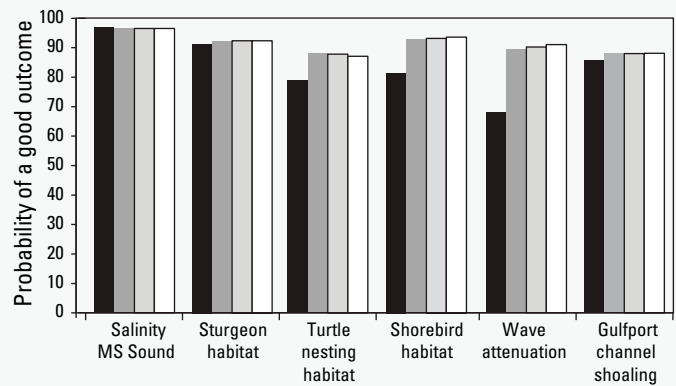
Contact: P. Soupy Dalyander
(sdalyander@usgs.gov)

Learn more:

- <https://gom.usgs.gov/web/>
- <https://gom.usgs.gov/doi/breton/>
- <https://gom.usgs.gov/web/Projects/View/1>
- <http://www.gulfspillrestoration.noaa.gov/restoration/early-restoration/phase-iii>



Three barrier islands (Ship Island, MS; Breton Island, LA; and Dauphin Island, AL) in the northern Gulf of Mexico where USGS science has been used to enable better decisions in coastal restoration. Image credit: World Imagery



EXPLANATION

- Unrepaired, more-extensive
- Unrepaired, less-extensive
- Repaired with fine sand
- Repaired with medium sand

Impacts of different options for repairing damage to Ship Island on the probability of a good outcome for various project objectives. Shown are the impacts of unrepaired, more-extensive damage; unrepaired, less-extensive damage; and damage that is repaired with either medium-grain sand or finer sand that is easier to wash away. Image credit: USGS

Healthy Reefs for a Healthy Economy: Task Force Checks in on Florida Corals

By Gina Digantonio (DOI)

The theme for the 38th U.S. Coral Reef Task Force (USCRTF) was “Healthy Reefs for a Healthy Economy.” Shawn Buckner, DOI’s Acting Director of the Office of Policy Analysis and Acting Co-Chair of the USCRTF joined nearly 300 participants representing Federal, State, and U.S. jurisdiction leaders, marine managers, and members of the public in Fort Lauderdale, FL, August 7–13. This theme underscored the close relation between the 330 miles of the Florida reef tract and the about 6 million residents that live within close proximity of Florida coasts and offshore reefs. The State of Florida hosted the meeting, with great interest and involvement from the State and local partners and businesses in planning and supporting the meeting.

The USCRTF business meeting included panel discussions on (1) economic value of Florida’s coral reefs, (2) balance of ecosystem services and project economics, and (3) stakeholder and community engagement. The



Margaret Goodro, the Superintendent of Biscayne National Park, addressed the USCRTF on community engagement efforts. Photo credit: Gina Digantonio, DOI

USCRTF showed the Ocean Conservancy Film, “Deeply Invested,” which highlighted the connection between reefs and local businesses, and featured USGS research on Ocean Acidification (OA) by scientist Kim Yates. *See related story, page 25.* Biscayne National Park Superintendent Margaret Goodro shared NPS work to enhance visitor experiences. USGS scientist Curt Storlazzi highlighted research focused on coastal protections reef structures provide. Three workshops focused on marine debris, sediment and turbidity, and coral ecosystem restoration. Together, the program facilitated important dialogue on the economic importance of coral reefs through storm and flood-protection, tourism, and sustainable fishing.

Another important topic was the multiyear coral disease outbreak in Florida. Members of the USCRTF saw the impact of the disease during site visits, and a panel discussion during the business meeting identified the lessons learned from the outbreak. Twenty-one species of corals have been affected by the outbreak, resulting in partial or total mortality of millions of corals across the Florida Reef Tract. The exact cause and contributing factors of the outbreak has yet to be identified, but ongoing research is investigating the disease identity, prevalence, and various treatment options. Other U.S. coral jurisdictions were encouraged to create a response plan before an outbreak and to establish coral response funds to rapidly deploy the response strategy. *See related story, page 28.*

While in the area, DOI’s Shawn Buckner toured with Biscayne National Park and Loxahatchee NWR leadership to see and learn about priorities and challenges in managing invasive species, infrastructure needs, enforcement, and other topics.

The next USCRTF meeting will be held in Washington, D.C., February 20–22, 2018.

The USCRTF website: <http://www.coralreef.gov>



This brain coral (*Pseudodiploria strigosa*) at Fowey Rocks in Biscayne National Park was infected with a disease in 2015 (left) and died by 2016 (right). The skeletal features of the colony degraded after death, but the three Christmas Tree worms (*Spirobranchus giganteus*) are alive and well, despite the death of their coral host. Photo credit: Ilsa Kuffner, USGS

Sharing BOEM Science and Information

27th Gulf of Mexico Information Transfer Meeting

By Rebecca Green (BOEM)

The BOEM GoM Region held an Information Transfer Meeting (ITM) August 22–24 in New Orleans. Held regularly since 1980, the meeting serves a dual role of information sharing among BOEM scientists as well as with the broader stakeholder community. It continues to bring partners together and disseminate regional scientific information from BOEM's Environmental Studies Program and is one of many different ways the Bureau shares updates on its GoM research programs. The ITM is especially important as it helps coordinate related science needs and partnerships that are funded through multiple programs in the region.

This year's ITM featured a plenary session that provided perspectives on the need for sustained observations of ecosystem health and productivity as it supports planning and regional decision-making. BOEM coordinates closely with the Gulf community on long-term environmental monitoring initiatives and welcomed plenary presentations that spanned monitoring programs from nearshore to deep waters and strategically broadened the scope to include the Gulf Large Marine Ecosystem.

The scientific sessions were organized around 10 topical themes relevant to BOEM's management needs, which included (1) long-term monitoring and ocean observation, (2) species and habitat, (3) offshore renewable energy, (4) marine and coastal oil interactions, (5) marine minerals, (6) air



Debra Vigil, BOEM Program Analyst and lead meeting organizer, welcomes participants to the ITM in New Orleans. Photo credit: Rebecca Green, BOEM

quality, (7) direction in social science research, (8) deep-water benthic communities, (9) marine protected species, and (10) applied physical science. About 80 speakers from across a range of Federal and State agencies, academic institutions, nonprofits, and businesses participated in the meeting. They presented research on a wide variety of topics related to regional environmental, social, and economic issues, as well as future research directions.

Abstracts and presentations: <https://www.boem.gov/Information-Transfer-Meeting-2017/>

Proceedings of previous meetings: <https://www.boem.gov/Environmental-Stewardship/Environmental-Studies/Gulf-of-Mexico-Region/GOMR-Proceedings-of-Information-Transfer-Meetings.aspx>

BOEM's Environmental Studies Program: <https://www.boem.gov/Studies/>

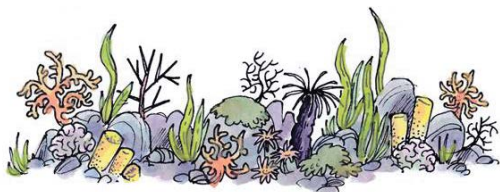
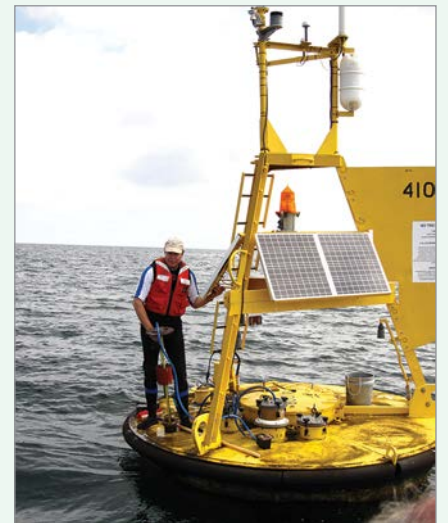


Illustration by Cole Goco.

What is Ocean Acidification (OA)?

Seawater chemistry is changing fundamentally throughout the world's oceans. Since the beginning of the industrial revolution, the release of carbon dioxide (CO₂) from humankind's industrial and agricultural activities has increased the amount of CO₂ in the atmosphere. The ocean absorbs about a quarter of the CO₂ we release into the atmosphere every year, so as atmospheric CO₂ levels increase, so do the levels in the ocean. Initially, many scientists focused on the benefits of the ocean removing this greenhouse gas from the atmosphere; however, decades of ocean observations now show that there also is a downside—the CO₂ absorbed by the ocean is changing the chemistry of the seawater, a process called OA.

Read more: <https://www.pmel.noaa.gov/co2/story/Ocean+Acidification>



This buoy is equipped to measure CO₂ in seawater in Gray's Reef National Marine Sanctuary—40 nautical miles southeast of Savannah, GA. Support is provided by NOAA National Data Buoy Center, Ocean Acidification Program, Pacific Marine Environmental Laboratory and in collaboration with the Office of National Marine Sanctuaries and the University of Georgia. Here, Scott Noakes of the University of Georgia does maintenance on the buoy system. Photo credit: Dr. Scott Noakes, University of Georgia

Coastal Acidification Networks (CANs): Regional Partnerships to Prepare the Nation

By Alex Harper (NOAA–IOOS)

OA is a global change in ocean chemistry that causes pH levels to lower as the ocean uptakes increasing levels of atmospheric CO₂ (see *info box page 24*).

The lower pH levels can limit the ability for many kinds of marine organisms to secrete calcium carbonate, the process they use to build their shells or skeletons. OA poses risks to coral reefs, which serve as essential habitats for many marine species, and can affect the distribution and abundance of plankton, which can impact entire food web dynamics. Coastal environments are nursery grounds for many organisms' early life-stages, which are particularly sensitive to OA. These conditions pose serious risks to many important coastal industries such as commercial fishing, shellfish harvesting, aquaculture, and associated economies.

In nearshore coastal areas, OA can result from local changes in freshwater river inputs from storms and contaminants in run-off. The ability of a local ecosystem to cope with changes caused by ocean and coastal acidification (OCA) is affected by the amount and severity of environmental stressors present. By minimizing local stressors through management strategies, some ecosystems may prove more resistant to impacts from the overall trends in OA.

As policymakers and resource managers begin to address OCA, they require high-quality scientific information. To prepare for and respond to the impacts from OA, operating businesses need objective information to help them predict, mitigate, and adapt to impacts to marine resources. The scientific community is using input from stakeholders and decision makers to design monitoring and research

This map shows the locations of the six current (2017) CANs operating around the Nation. This network of CANs is working to coordinate and build capacity to adapt to changes in local ocean chemistry. Image credit: NOAA, Ocean Acidification Program



strategies that provide the information needed to address changes in ocean chemistry through mitigating and adapting to the regional drivers and impacts of OCA.

The NOAA Ocean Acidification Program, in collaboration with the U.S. Integrated Ocean Observing Systems (IOOS) Regional Associations, is developing a network of regional Coastal Acidification Networks (CANs) around the country as part of the national strategy for adapting to and mitigating the harmful effects of OCA. Many of DOI Bureaus participate with IOOS Regional Associations to advance coastal and ocean observations in support of DOI's overall mission. The development of the network will support an integrated approach to understanding the rate, magnitude, and variability of coastal and OA and its impacts.

Beginning with the establishment of the California Current Acidification Network (C-CAN) in 2009, subsequent CANs are supporting the transmission of research needs from stakeholder communities to scientists and policymakers. The CANs enhance regional collaborations about current state of the science and approaches to monitoring, and identify vulnerable species and ecosystems across the Nation. They also enhance communications by providing an ongoing regional forum to synthesize the latest scientist, stakeholder, and participant observations and needs.

Coastal Acidification Networks (CANs)

A collaboration of interdisciplinary scientists, resource managers, industry, and others from local, State, Federal, and Tribal levels are dedicated to advancing the understanding of OA and its effects on the biological resources. To date, there are six operational networks around the country with members from academia, industry, and both governmental and NGOs working together to inform and equip U.S. regions with the tools needed to adapt to OCA.

Alaska Ocean Acidification Network
<http://www.aos.org/alaska-ocean-acidification-network/>

California Current Acidification Network (C-CAN) <http://c-can.info/>

Gulf of Mexico Coastal Acidification Network (G-CAN)
http://gcoos.tamu.edu/?page_id=11083

Mid-Atlantic Coastal Acidification Network (MACAN)
<http://midatlanticocean.org/acidification-network-launch/>

Northeast Coastal Acidification Network (NECAN)
<http://www.necan.org/>

Southeast Ocean and Coastal Acidification Network (SOCAN)
<http://secoora.org/socan/>

Understanding and Communicating Impacts of OA

By Ann Tihansky and Kim Yates (USGS)

The USGS is collaborating with a team of experts including Federal and State agencies, academic institutions and NGOs to understand and educate people about the impacts of coastal and ocean acidification (OA) in coastal regions. The USGS is specifically focusing on how acidification contributes to, or can exacerbate, coastal hazards.

Coral reefs are natural barriers that protect coastlines from storms, waves, tsunamis, and erosion. OA causes decreases in coral reef growth rates and chemical erosion (dissolution) of reef structures and carbonate sand in adjacent environments that contributes to loss of sea floor elevation.

USGS research by Kim Yates was highlighted along with other scientists investigating these impacts in the debut of an educational video, “Deeply Invested,” in June 2017 at the Florida House in Washington, D.C. Produced through the Ocean Conservancy by award-winning film producers Benjamin Drummond and Sarah Joy Steele, the video highlights how coastal economies and related businesses are affected by OA and what scientists are doing to help find solutions.

Yates and fellow researcher Chris Langdon of University of Miami-Rosenstiel School of Marine and Atmospheric Science attended the film’s premier along with Ocean Conservancy staff. They all had the opportunity to meet Congresswoman Ileana Ros-Lehtinen, who expressed appreciation for the scientific efforts needed to address this topic and its related impacts on South Florida.

Yates represents the USGS in a larger network of researchers working together to better understand OA



USGS researcher Kim Yates, on film and in person, met Florida Congresswoman Ileana Ros-Lehtinen at the debut of the Ocean Conservancy educational film, “Deeply Invested.” Photo credit: Ann Tihansky, USGS

processes and related impacts. She is a member of the U.S. Interagency Working Group on OA and serves on the Southeast Ocean and Coastal Acidification Network (SOCAN) as a Steering Committee member and as Chair of the Science Working Group. SOCAN recently held a workshop February 27–28, 2017, in Charleston, SC, that brought together Federal, State, and academic researchers to identify research gaps, prioritize science and monitoring directions, and identify key locations for OA monitoring in the Southeast Region as part of the SOCAN network.

Watch USGS scientist Kim Yates discuss this topic with other OA experts in a panel recorded during CHOW in 2016, “Brewing a New Sea: Acidification in a Changing Ocean,” hosted by OceansLIVE: <https://www.youtube.com/watch?v=0FFE-VSpVeY&index=8&list=PL7X5o1oiYY2fYoFuoE1co2bAWVJCYpqaS>

See related stories, pages 25–27.

Learn more: <https://coastal.er.usgs.gov/crest/research-themes/reefscape.html>

Land-based sources of pollution can magnify the effects of OA through nutrient-driven bioerosion: <http://dx.doi.org/10.1002/2017JC013264>



In 2016, Kim Yates (far right) participated on an ocean acidification panel with Oceans Live as part of Capitol Hill Ocean Week. Photo credit: OceansLIVE

Teamwork for Measuring OA

By Kristy Burnett and Eva DiDonato (NPS)

The NPS teamed up with NOAA on a 35-day voyage aboard NOAA's R/V, the *Ronald H. Brown*, as part of the Gulf of Mexico Ecosystems and Carbon Cycle 2017 Cruise. They departed on July 18, 2017, and scientists on board took a multidisciplinary approach, using physical, chemical, and biological data, to evaluate OA conditions in the Gulf.

On land, NPS staff collected water samples in Dry Tortugas National Park, Everglades National Park, and Biscayne National Park in Florida and Padre Island National Seashore in Texas, coordinating with the researchers on the R/V offshore to make sure the samples were collected on the same day and along transects that connected from shore to ship.

“Changing conditions may affect park resources and how visitors use and enjoy our coastal parks. Being able to analyze data from offshore samples along with ones collected within parks gives us a more complete and relevant view of ocean acidification.” said Eva DiDonato, Chief of Ocean and Coastal Resources Branch of the NPS.

Once analysis is complete, the data will be shared among the agencies. These data will provide the most up-to-date, best available OA science that allows park managers to make resource decisions that help preserve our ocean and coastal resources for future generations.

Read more: <https://www.nps.gov/articles/science-at-sea-in-the-gulf-of-mexico.htm>



Illustration by Cole Goco.

The “Wilderness Breach” Opportunity to Study Coastal Response to Storms

By Cheryl Hapke and Heather Dewar (USGS)

In 2012, when Hurricane Sandy struck the south shore of Long Island, NY, storm waves cut what is now known as “the wilderness breach” through the Otis Pike Hugh Dune Wilderness Area on Fire Island National Seashore. The new channel allowed water to flow between the Atlantic Ocean and Great South Bay. It also offered an opportunity for one of the most detailed scientific examinations ever done of the early stages in the life of a barrier island breach.

“Storm strikes are the force that drives the geomorphology—the geologic shape and evolution—of barrier islands along the Northeast coast,” said USGS research oceanographer

Cheryl Hapke, the lead author of a USGS report published in September 2017. “But until this event, no one ever had the opportunity to watch a breach open and evolve, and to study that process in depth.”

The study highlights the dynamic relation between storms and coastal barrier islands, pinpointing seasonal changes in the breach’s channels and shoals and the likelihood that future storms will change the opening again.

Information from the USGS was provided to the NPS to develop a Breach Management Plan/Environmental Impact Statement, currently under review.

Read more: <https://www.usgs.gov/news/usgs-tracks-evolution-a-fire-island-hurricane-made-breach>

See page 2 for links to videos that highlight the breach and the science behind the management strategies.



The “Wilderness Breach” on Fire Island was created by Hurricane Sandy in 2012. USGS coastal scientist Owen Brenner wades across the Fire Island wilderness breach collecting precise elevation data in the shallows that is advancing coastal processes science to help inform management strategies. Photo credit: Rebecca Beavers, NPS

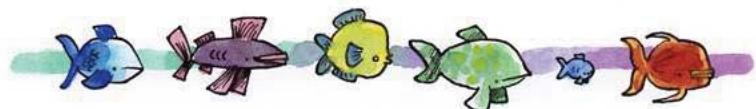


Illustration by Cole Goco.



Florida Keys Corals: A Photographic Record of Changes from 1959 to 2015

By Eugene A. Shinn (USGS)

See the entire collection of images: https://coastal.er.usgs.gov/african_dust/gallery.html

These photographs are part of a larger collection of photographs that document changes at six specific sites in the Florida Keys reef tract.

The images show a time-series of changes in corals and coral habitats in the Florida Keys since 1959. The original intent was to show coral reef

recovery after Hurricane Donna devastated the area in 1960.

Corals, especially elkhorn and staghorn coral, grew prolifically after the storm until the late 1970s, then began to decline, with the maximum period of decline centered around 1983 and 1984. Similar declines occurred

throughout the Caribbean. This photo database is still being updated today. The images document disease, bleaching and successions in coral reef species. Such successions can be seen in fossil coral reefs exposed in Windley Key Fossil Reef State Park in the Florida Keys.

Carysfort Reef Site 1

In 1960, this brain coral (*Diploria* sp.) was implanted with stainless steel pins to measure growth (shown with arrows). By 1986, the uppermost parts of the brain coral head were dying. By 2015, all of the head was dead.



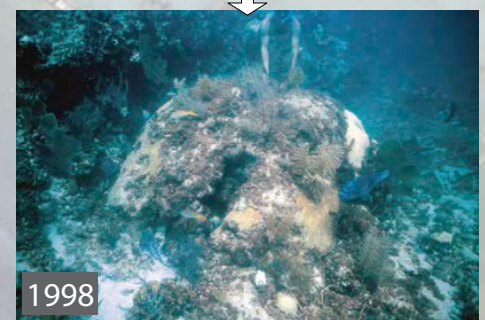
Grecian Rocks Site 2

In 1988, this large star coral (*Montastraea annularis*) at Grecian Rocks was being attacked by black-band disease. In 2003 some living tissue remains at the lower right. By 2015, little living coral remains.



Grecian Rocks Site 4

In 1959, this brain coral (*Colpophyllia natans*) had a star coral attached at left and a species of *Diploria* on the right. By 1988, the star coral was gone (see cavity). By 1998 the head was mostly dead. This site cannot be located today.



Graphics credit: Betsy Boynton

Measuring Sea Ice 101

By Mark Serreze and Walt Meier (NSIDC), Sarah Abdelrahim (DOI), and Gina Digiantonio (DOI)

Accurate measures of sea ice are important for DOI scientists, managers, and policy makers to monitor and predict changing conditions in the Arctic. It also is important for them to communicate clearly among themselves the different metrics and methods that are used for these sea ice measurements.

Sea ice plays a role in our global climate by reflecting sunlight and affecting the movement of ocean waters. It also is important for the safety and well-being of wildlife and communities in the Arctic; for example, many marine mammals, such as polar bears and walrus, use the sea ice as a platform for foraging. Sea ice also serves as a buffer for coastal communities against severe storms.

USGS scientist Aimee Devaris said, “Changes and trends in sea ice extent are of great interest to USGS, and we pay close attention to NOAA’s and the National Snow and Ice Data Center’s (NSIDC) sea ice observations and analyses. Sea ice is relevant to our work in both the hazards and ecosystems mission areas, specifically coastal erosion and shoreline change assessments as well as research on species of management concern such as polar bears and walruses.”



Sea ice extent and thickness are lost as sea temperatures warm. Photo credit: NPS

Here are some common sea ice measurements and trends from NOAA, NSIDC, and the 2017 update to the Arctic Council’s Snow, Water, Ice and Permafrost in the Arctic (SWIPA):

Sea ice extent—Sea ice extent is measured by satellites, and the annual maximum and minimum extents are typically recorded to describe these fluctuations in the Arctic. Sea ice extent is often designated as areas in the ocean where there is at least a minimum of 15% sea-ice concentration. Despite variations in recent year-to-year measurements of Arctic sea ice extent, a long-term downward trend continues. According to the NOAA 2016 Arctic Report Card, Arctic sea ice extent reached a minimum extent of 4.14 million km², which was 29% less than the average minimum ice extent for 1981–2010 and matched 2007 as the second lowest in satellite record. The 2016 extent of 14.52 million km² sea ice winter maximum matched 2015 as the lowest maximum value on satellite record, and was 7% below the 1981–2010 average.

Sea ice thickness—Sea ice grows thicker as it ages because more layers are added over subsequent winters. Sea ice thickness is harder to measure than sea ice extent, and there is less long-term data. Data on sea ice thickness is collected by submarines, satellites, and models. Despite the limited spatial extent and timing of the data, it is clear that the thickness of sea ice is declining.

The NOAA 2016 Arctic Report Card states, “In 1985, 16% of the ice pack (relative to the total sea ice areal coverage) was four years old and older, but by March 2016 old ice only constituted 1.2% of the ice pack.” First-year ice now dominates ice cover in the Arctic.

Tracking sea ice extent and thickness is important to several DOI bureaus; for example, variations in sea ice are important to the Bureau of Safety and Environmental Enforcement because such variations can impact safety and oil spill response capabilities in the Arctic region. The NPS has been monitoring sea ice loss and coastal erosion to plan for potential impacts on coastal Alaska NPS sites, such as Cape Krusenstern National Monument, which is one of the case studies in the Climate Resilience Toolkit. Monitoring variations and long-term changes in sea ice continues to be important to several DOI bureaus as it informs the DOI stewardship mission.

Read more: <http://www.amap.no/documents/doc/Snow-Water-Ice-and-Permafrost.-Summary-for-Policy-makers/1532>

<https://toolkit.climate.gov/case-studies/developing-monitoring-programs-protected-lands-alaska>

NOAA report card: <http://arctic.noaa.gov/Report-Card/Report-Card-2016/ArtMID/5022/ArticleID/286/Sea-Ice>

SWIPA assessment: <http://www.amap.no/documents/doc/Snow-Water-Ice-and-Permafrost.-Summary-for-Policy-makers/1532>

NSIDC website: <http://nsidc.org/cryosphere/quickfacts/seaice.html>



Sea ice in Prudhoe Bay, Beaufort Sea, Alaska. Photo credit: Greg Boland, BOEM

Silver Lining for Hurricane Sandy

By Elizabeth Rogers (NPS)

When Hurricane Sandy made landfall on October 29, 2012, in addition to the impacts to human infrastructure, it altered the landscape dramatically by leveling dunes, flattening beaches, and flooding salt marshes. Hurricane Sandy relief aid supported recovery and restoration projects at Federal lands impacted by the storm, and more than \$100 million was invested in 31 projects at NWRs and other sites across the Northeast. Through Sandy-funded science, habitat restoration projects, and national park improvements, DOI bureaus set aim to work together and with partners to rebuild stronger, more resilient coastal communities.

But How to Evaluate the Success of Such Work?

"If resilience is built through a [restoration] project and there is no perfect measure to assess it, does it really exist?" asked

USFWS Regional Scientist Rick Bennett. This question challenged him and other Federal agency leads as they worked to develop a framework for assessing restoration projects.

DOI experts came together to establish standardized measures to evaluate Sandy-funded projects and better understand how an investment in natural systems can make the coast more resilient. The measures, referred to as "core metrics," were developed to quantify how restoration techniques help sustain healthy natural habitats and how this in turn can benefit coastal communities. Standardizing these measures across several projects and tying them to socioeconomic benefits is new for DOI.

The ecological metrics developed are habitat-specific and help quantify how ecosystem components like plants, animals, soil, and water at restored sites change over time. Ecological metrics will continue to be monitored for as much as seven years at each site. The information collected through this effort will help

USFWS assess how nature responds to restoration techniques.

Improved conditions within a natural system are just one anticipated outcome of habitat restoration. Healthy coastal habitats support recreation and tourism, enhance property values and water quality, and reduce risks to homes and human health. Changes in these conditions are being tracked so that these socioeconomic metrics can help demonstrate that the value of habitat restoration extends beyond the natural system and supports coastal resilience on a broader scale. The core metrics will help the USFWS understand what it takes to build a stronger coast for wildlife and people—and how to invest wisely in future restoration efforts.

The support for this robust assessment of Sandy-funded projects has been an unexpected silver lining to the storm.

"Sandy funding gave us the chance to fund and prioritize the collection of information that may have otherwise taken decades," said Rick Bennett.

Building a More Resilient Coast—Science and Coastal Management Go Hand in Hand

Five years ago Hurricane Sandy devastated communities along the Atlantic Coast with record storm surge, fierce winds and torrential rain. This year's destructive storm season only underscores how vulnerable our coastal areas are and the important role of nature in helping to protect communities and ensure a future for fish and wildlife. In this blog, Wendi Weber, U.S. Fish and Wildlife Service Northeast Regional Director, shares her vision of a stronger East Coast—one that uses natural infrastructure for the benefit of people and wildlife.

<https://usfwsnortheast.wordpress.com/2017/10/27/using-nature-to-build-a-stronger-coast/>

Severe weather has always been a factor for coastal communities, but now storms are happening with greater frequency and intensity. The deadly storms of the 2017 hurricane season are harsh reminders of our coastal vulnerability. Hoping for a solution that prevents damage entirely is foolhardy, but developing strategies that minimize the damage is necessary and possible. Protecting and restoring natural infrastructure—alone or combined with hybrid and gray infrastructure—can help reduce the impacts of storms and sea-level rise and help communities recover more quickly.

Visit this website for an extensive look at ongoing Hurricane Sandy recovery activities: <http://fws.maps.arcgis.com/apps/MapSeries/index.html?appid=7b655fd1e5ce460eaa1f9ff145ece4d8>



At right: Planting marsh grasses at Blackwater National Wildlife Refuge, Maryland. Credit: Dagny Leonard, The Conservation Fund



Salt marshes, such as this one at Parker River NWR in Newburyport, MA, attenuate storm wave energy and reduce damage. Photo credit: Kelly Fike, USFWS

Development Opportunity for Knauss Fellows

By Gina Digiantonio (DOI and Knauss Fellow Class of 2017)

In July, the DOI OGLC Activity Team hosted the 2017 Class of Sea Grant John A. Knauss Fellows for a professional development opportunity to learn more about DOI's ocean role and hear from a range of representatives working across DOI bureaus.

The Sea Grant Knauss Fellowship provides a unique educational and professional experience to graduate students who have an interest in OGLC resources and in the national policy decisions affecting those resources. The fellowship, named after one of Sea Grant's founders, former NOAA Administrator John A. Knauss, matches highly qualified graduate students with "hosts" in the legislative and executive branch of government in the Washington, D.C., area for a one year paid fellowship. Learn more: <http://seagrant.noaa.gov/Knauss>

Dubbed "The 2017 DOI Day for Knauss Fellows," this tradition was started in 2013 by previous DOI Knauss Fellow Nicole Bransome. This year's event gave 25 Knauss Fellows the chance to interact with various professions working in DOI's blue portfolio with panel representatives from the USFWS, BOEM, USGS, and NPS. Fellows heard panelists' perspectives on their careers and were able to spend time asking questions related to career advice, job opportunities, and the challenges of communicating DOI's diverse ocean role to the public. The Fellows came from diverse host agencies including NOAA, USACE, Congress, U.S. Navy, the Committee on Marine Transportation, and Treasury; and after this event, many expressed increased appreciation for the scope of DOI's role for OGLC resources.



2017 Sea Grant Knauss Fellows and the panelists (seated from left to right: William Brown, BOEM; Cliff McCreedy, NPS; Abigail Lynch, USGS; Ann Tihansky, USGS; Samantha Brooke, USFWS) at 2017 DOI Day for Knauss Fellows event. Photo credit: Ann Tihansky, USGS



Visiting Knauss Fellows, led by Jason Jurgena of DOI's museum staff, were able to see coastal-themed murals that are part of the historical collection on display within the Main Interior Building. Photo credit: Ann Tihansky, USGS

After the panel discussion, DOI museum staff led the fellows on a customized tour of coastal-related displays and artwork in the Main Interior Building. Founded in 1849, the DOI has a long history of responsibilities that are highlighted in murals and in the Interior Museum, which had

just opened a permanent exhibition, "People, Land & Water."

Plan a visit to the DOI Museum:
<https://www.doi.gov/interiormuseum/Plan-a-Visit>

The Surfing Bison



Coastal Miwok Culture at Point Reyes National Park

Learn more:

https://www.nps.gov/pore/learn/historyculture/people_coastmiwok.htm



By NPS

Before European occupation of California, the Coast Miwok people inhabited what is now called Marin and southern Sonoma Counties. The Coast Miwok formed village communities of 75 to several hundred people where their lives and economies were closely linked to the environment. Women gathered crab, clams, mussels, abalone, limpets, oysters, and other seafood from the tidal zone as food. Shells were used to create ornaments or beads for trading across northern California. The ocean also provided kelp to be eaten fresh or dried and stored for the winter.

The men used a variety of fishing techniques such as dip nets and traps to catch halibut and rockfish. Dip nets were used to scoop up fish, and woven surf nets were used along the open beaches. Cone-shaped traps of woven gray willow were set up in creeks and mouths of rivers. Traps also were used to capture smaller game, and deer were hunted with bow and arrow. The Coastal Miwok knew and blended with this bountiful land for thousands of years, developing a rich economy based on gathering, fishing, and hunting.



Artist's view of the San Agustín wreck. Photo credit: NPS

In the late 1500s, indigenous hunter-gatherers on the northern California coast met Spanish and English voyagers for the first time. In 1595, the Manila Spanish galleon (a trading ship) named *San Agustín*, shipwrecked in Tamál-Húye, the Coast Miwok name for present-day Drakes Bay. The Tamál-Húye Archaeological Project focuses on the intercultural interactions and processes of culture change and continuity in 16th century northern California as a result of this meeting.

In addition to archaeological research, NPS Point Reyes National Seashore offers ranger-guided walks and school programs at Kule Loklo, which means Bear Valley in Miwok. This recreated Coast Miwok village preserves the history and culture of the Coast Miwok by hosting an annual "Big Time Festival" every July. Throughout this special day, demonstrators exhibit their skills in basketry, flint knapping, clamshell bead making, and traditional Pomo dancing.



The recreated Coast Miwok village of Kule Loklo is a teaching ground for members of the public to learn about the Coast Miwok way of life. Photo credits: NPS



Traditional basketry, fishnet weaving, and dancing at the Big Time Festival at Kule Loklo, Point Reyes National Seashore. Photo credits: NPS

