

NEWSWAVE

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

Special Feature—Responding to the 2017 Hurricane Season

Winter 2018

Huge Landslides on California's Big Sur Coast

USGS Collaborates with California Department of Transportation for Public Safety

By Helen Gibbons, Jonathan Warrick, Andrew Ritchie, and Kevin Schmidt (USGS)

On May 20, 2017, an almost one-third mile-wide landslide on California's Big Sur coast buried part of California State Highway 1 under more than 65 feet of rubble and added about 13 acres of new land to the coast.



Mud Creek landslide blocks Highway 1 along Big Sur Coast, May 27, 2017. Photo credit: USGS

USGS scientists, in cooperation with the California Department of Transportation (Caltrans), shot aerial photos of the Big Sur coast in March and May 2017 to help monitor a prolonged period of slow movement in the area. Using "structure-from-motion" software, they used these and earlier

See Landslides page 3

Responding to the 2017 Hurricane Season



Four major hurricanes affected the United States in 2017. From left to right: Harvey, Irma, Jose, and Maria. Photo credits: NASA

A collection of stories about the 2017 hurricane season from across the Department captures the broad range of responsibilities and the dedicated service of DOI employees. From supporting staff who were impacted, to assisting the public during flooding, DOI mobilized to support a wide range of missions. From volunteering in local communities to leveraging new technology to appraise damage, staff responded during emergency conditions and continue to assess impacts on wildlife and coastal communities.



Puerto Rican parrot aviary at Rio Grande after Hurricane Maria. Photo credit: USFWS

Storms Damage Critical Aviary

By Mark Davis (USFWS)

Hurricane Maria damaged Puerto Rico's El Yunque National Forest, which is important habitat for the imperiled Puerto Rican parrot. Most of the forest canopy was destroyed during Hurricane Maria, which knocked out power, fouled water supplies, and toppled trees.

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Changing Tides—The Ocean Connection

A video clip takes you to the Alaska coast adventuring with brown bears.

<https://www.youtube.com/watch?v=GPPL9W4jMII>

See *Surfing Bison* feature, page 32.



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

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photos to create three-dimensional (3D) maps that have allowed them to measure areas and changes in ground elevation precisely. The team, led by research geologist Jon Warrick, thought they had an exciting story to tell when photos shot on May 19 documented a moderate-sized landslide blocking the highway at Mud Creek. As the scientists were analyzing the May 19 photos, however, they learned of the much larger slide that occurred the next day, May 20.

“We were utterly impressed by the landslide we saw on May 19, so when the entire mountainside failed on May 20, we were stunned,” said Warrick. On May 27, Warrick’s team collected and processed a fresh set of aerial photos. Comparing 3D maps derived from the May 27 photos with those from May 19 enabled them to calculate changes in ground elevation and measure the area, thickness, and volume of the slide.

The U.S. Geological Survey (USGS) has continued to monitor the slide area with aerial photos taken using airplane and drone flights. Photo processing has helped identify parts of the upper slopes that continue to move and where waves are eroding the lobe

of sediment extending into the sea. Warrick plans to deploy instruments on the seafloor to measure currents and waves. These offshore studies will help the researchers determine what happens to landslide debris that ends up beneath the water and will support Caltrans management and engineering projects in the area.

“We have been utilizing data and information from the USGS for landslide modeling and risk management at the Mud Creek landslide complex,” said Tom Whitman, senior engineering geologist with Caltrans. “Given the size and magnitude of the landslide complex and its remote location, the information from the USGS has given us the opportunity to evaluate the landslide complex through its development and post failure in a way that no other data could. I look forward to additional reports over the next year.”

“We have a special opportunity to track how the land and ocean respond to these rare but large landslide events. We know that there has been a long history of landsliding along the U.S. west coast, and this recent slide will allow us to better understand how the coast changes over time,” said Warrick.

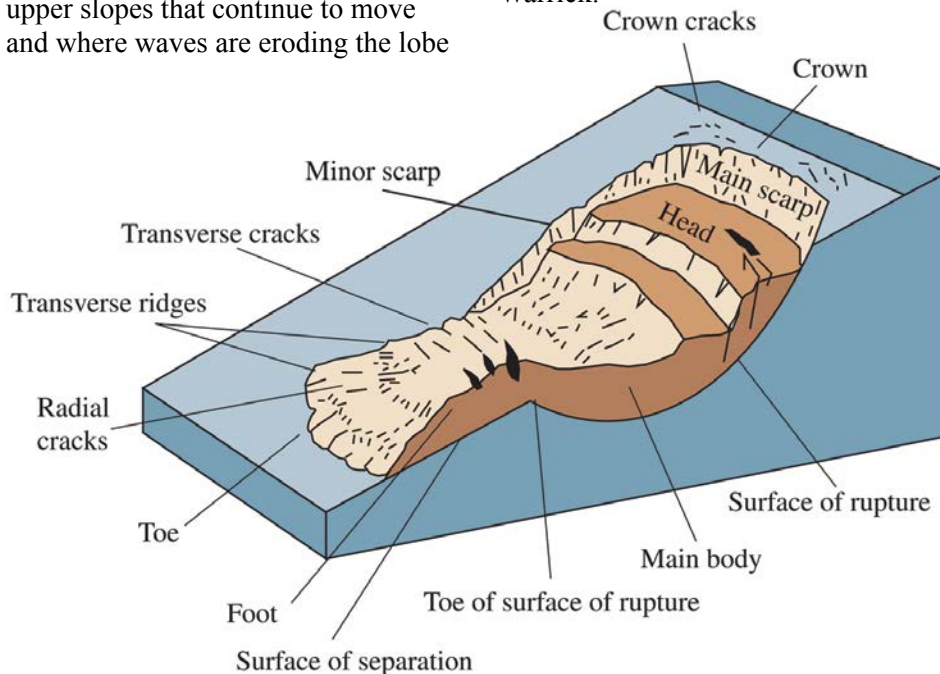
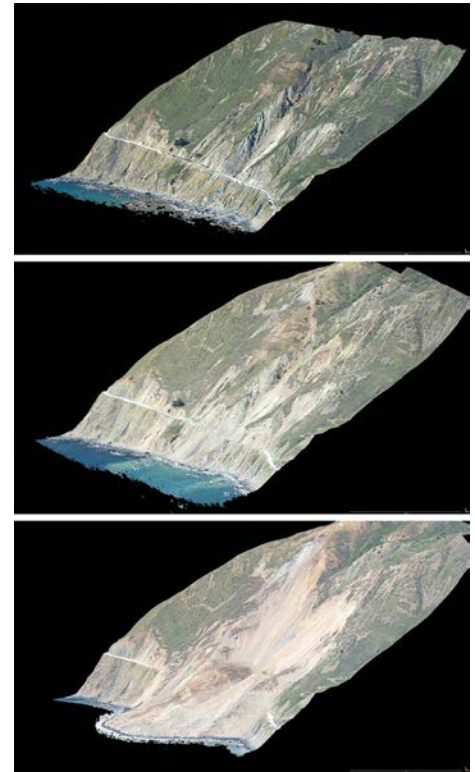
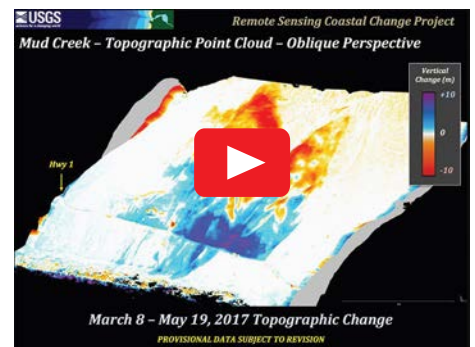


Diagram of the parts of a deep-seated landslide from USGS Fact Sheet 3004–3072, “Landslide Types and Processes” (<https://pubs.usgs.gov/fs/2004/3072/fs-2004-3072.html>). Image credit: USGS



Topographic “point clouds” (or 3D maps) created by computer processing of aerial photo data show the Mud Creek area on March 8 (top), May 19 (center), and May 27 (bottom), 2017. Image credits: USGS



Watch an animation of USGS computer-generated “before” and “after” images at Big Sur landslide: <https://walrus.wr.usgs.gov/news/images/MudCreekAnimation.gif>

Read the original article: <https://soundwaves.usgs.gov/2017/10/fieldwork.html>

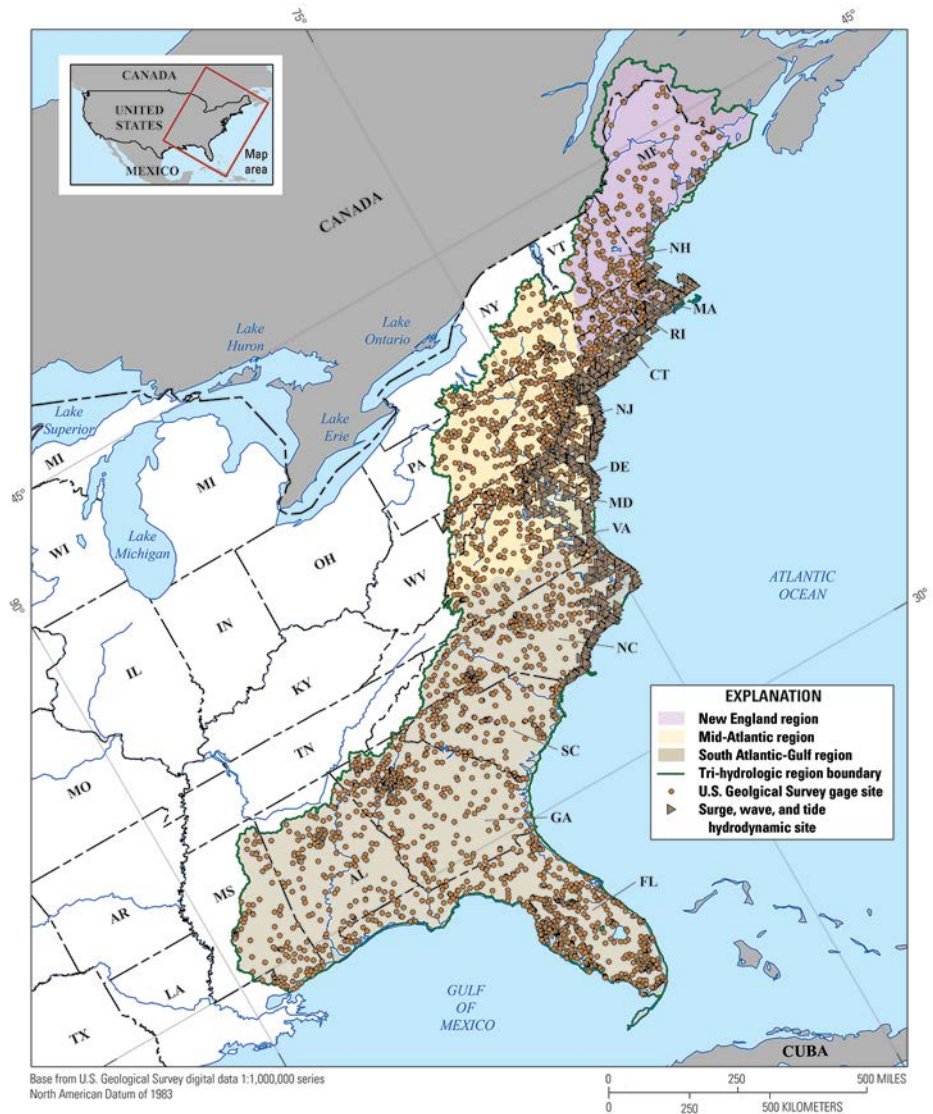
USGS Remote Sensing Coastal Change website: <https://walrus.wr.usgs.gov/remote-sensing/>

Datums Get an Upgrade

By Paul H. Rydlund, Jr., and Michael L. Noll (USGS)

Consistent and accurate elevation data are fundamental to collecting hydrologic data and conducting the science that is used to ensure that water resources are managed and protected effectively. These data also are critical to emergency planners and managers working to minimize the loss of life and property because of water-related hazards. The conversion of geodetic datums at gaging stations does not involve one specific uniform, consistent, and transferrable approach for all gages in a region but instead requires an evaluation of the local gaging network datum and methodologies for conversion to ensure consistency and to further plan and evaluate costs associated with datum conversions. These methodologies include a simplistic datum transformation using computer software(s) or a resurvey using a conventional or satellite-based approach.

Accurate elevation data define metrics used for flood protection, water capacity, and water availability. The USGS operates a network of nearly 10,000 streamgages throughout the country in cooperation with Federal, State, Tribal, and local agencies. Data from coastal gages are used to determine variability and long-term trends of sea level necessary for oceanic navigation and ports, along with coastal subsidence; determine water-quality conditions within marine environments; calibrate models that predict future sea level change; and provide critical information during intense coastal storms that can be used to protect life and property. The main purpose of the inland and coastal gage network is to provide water-quality and quantity information for the protection of life and property; provide information about flood, drought, and poor water-quality conditions; inform water-supply, sustainability, and regulatory



This map shows part of the tri-hydrologic region with approximately 3,200 sites, plus the SWaTH network, where local gaging network datums and methodologies for conversion are being evaluated to ensure consistency and to guide future datum conversion activities. Image credit: USGS

decision making; guide infrastructure design, such as bridges, roads, and dams; and provide information for recreational activities.

In the tri-hydrologic region, three nationally recognized hydrologic units—the New England, Mid-Atlantic, and South Atlantic-Gulf—are delineated based on natural drainage areas. The region lies within 22 States along the eastern seaboard from Maine to Florida and along the Gulf coast from Florida to Louisiana. Approximately 70 percent of the estimated 3,200 inland and coastal gages within the tri-hydrologic region



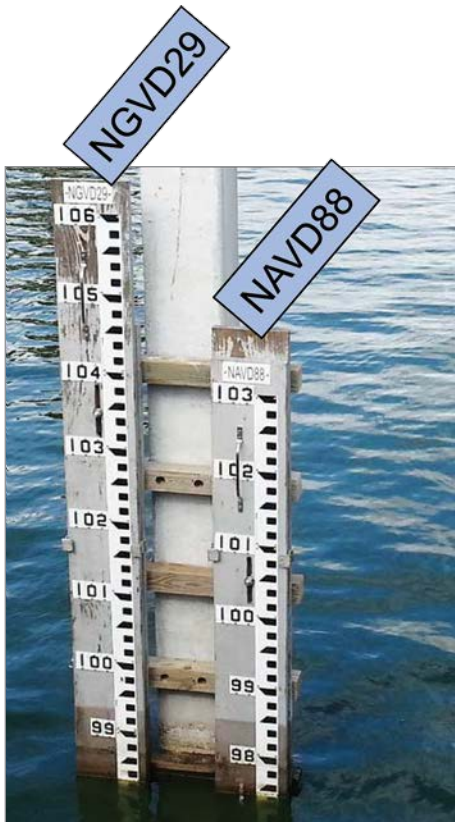
Waters rising with Hurricane Sandy carried this vehicle up onto the bushes where it was stranded in Great Kills, Staten Island, NY. Photo credit: Rob Gross

See Datums page 5

Datums continued from page 4

reference a vertical datum other than the North American Vertical Datum of 1988 (NAVD 88), and about half of the gages reference the National Geodetic Vertical Datum of 1929 (NGVD 29). These sites may require datum conversion to meet the needs of the cooperative water community and the public.

After Hurricane Sandy in October 2012, the USGS developed a coastal monitoring network within the tri-hydrologic region that consists of long-term tide gages, rapid-deployment gages, and meteorological and storm-tide sensors that can be deployed rapidly and recovered during coastal storm events. The overland Surge, Wave, and Tide Hydrodynamics (SWaTH) network comprises approximately 750 sites and disseminates data in real time by way of the Internet to emergency responders and flood forecasters who track flood impacts, provide accurate warnings



Significant differences in measured elevation levels can occur depending on which datum is used. Photo credit: USGS



Sailboats floated up the street with floodwaters and were left stranded in Great Kills, Staten Island, NY. Photo credit: BoatUS Marine Insurance Program

and advisories, assess flood damage, and rush appropriate assistance to flooded communities. Currently, these elevation data are reported in NGVD 29, NAVD 88, or a local vertical datum; however, the need may exist to reference these data to a single vertical datum for accurate modeling, mapping, and flood-zone delineation.

Historically, NOAA and the USGS coordinated datum transformation efforts that tied coastal bathymetry to topographic digital elevation models resulting in the development of software geared to addressing vertical movement of coastal water levels and land in both space and time. There are 23 tidal regions or modeled grids within the tri-hydrologic region that are delineated by different oceanic characteristics. Tidal datum is specific to each modeled grid, requiring geodetic datum to relate tidal datums between grids.

Oversight and control, and decisions regarding datum conversion or datum change, are managed at the local USGS Water Science Center (WSC) level; however, implications may be far reaching to the cooperative water community and the public. The impacts of a datum change at inland and coastal gages are time sensitive among cooperating agencies such as National Weather Service

(NWS) and CO-OPS as well as to USACE because of daily forecasting and water-control operations. In addition to forecasting and water-control operations, deterministic flood-inundation mapping has gained momentum over the past decade as another time-sensitive operational product available by NWS and USGS. Probabilistic flood-insurance studies generated by the Federal Emergency Management Agency generally are not as time sensitive as forecasting products, but mapping products are heavily dependent on accurate elevations. USGS WSC staff must ensure appropriate planning, collaboration, and communication regarding datum changes.

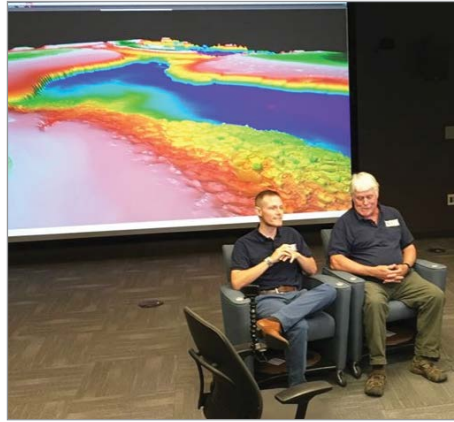
By working across States, across hydrologic areas, and with critical partners, USGS data collection, analysis, and data management prepares the Nation from local to national levels with consistent, dependable, and accurate information available for decision-makers, policy makers, and emergency planners and responders. The recently published process document provides a blueprint for converting between terrestrial, tidal, and local vertical datums accurately and efficiently.

Read more: <https://pubs.er.usgs.gov/publication/tm11B8>

High Resolution Map of the Gulf of Mexico

By Kody Kramer and William Shedd (BOEM)

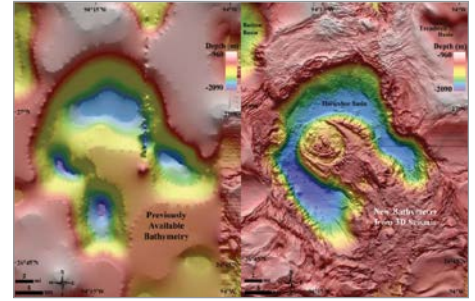
Amazing new updates to seafloor imagery in the Gulf of Mexico, more than 19 years in the making, are now available from the Bureau of Ocean Energy Management (BOEM). The map products are publically available in a deepwater bathymetry grid of 1.4 billion 40-by-40 foot cells. The regional seafloor dataset created by BOEM reveals many details that have not been available publically before. The data include detailed seismic surveys originally shot by 15 different companies involved in the oil and gas industry. BOEM gained permission to release the relevant proprietary data publicly in a freely downloadable aggregate map of the seafloor. BOEM's new map, derived exclusively from the 3D seismic data, doesn't cover as large an area as the previous NOAA/NGDC/GCOOS map, but its enhanced resolution and consistent pixel size reveal undiscovered and previously poorly resolved



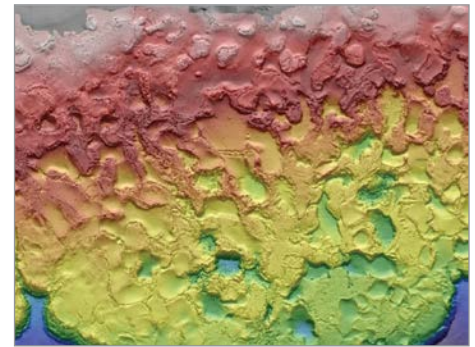
Gulf of Mexico Geologist Kody Kramer and Geophysicist William Shedd were interviewed on September 11 by WWL-TV about their 3D seafloor map. Photo credit: BOEM

geologic features over the continental slope, salt minibasin province, abyssal plain, Mississippi Fan, and Florida Shelf and Escarpment. BOEM scientists Kody Kramer and William Shedd published many selected images in a detailed article in The American Geophysical Union's *EOS* in May 2017.

Read the *EOS* article here: <https://eos.org/project-updates/a-1-4-billion-pixel-map-of-the-gulf-of-mexico-seafloor>

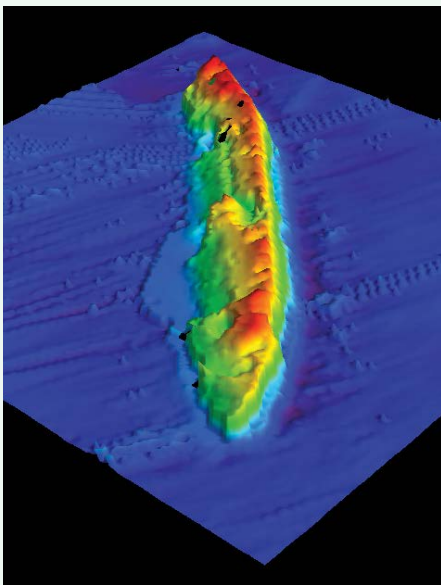


Horseshoe Basin in the western Gulf of Mexico, as compared using (left) the historic NOAA bathymetry map and (right) BOEM's new map. Image credit: BOEM



Part of a new bathymetry map, created by integrating many 3D seismic surveys, reveals the Gulf of Mexico's seafloor in unprecedented detail. Image credit: BOEM

Find the data: www.boem.gov/Gulf-of-Mexico-Deepwater-Bathymetry/



Preliminary bathymetric image of the *S.S. Virginia* looking from the stern to the bow. The ship is resting on its port side as mudflows move it downslope. Image credit: Jason Chaytor, USGS

Shipwreck Tells of Submarine Mudflow

By Jason Chaytor (USGS)

A 75-year old shipwreck sliding downslope in the South Pass area offshore of the Mississippi River Delta is giving geologists insight into offshore submarine mudflow processes.

The oil tanker named *S.S. Virginia*, sunk by a U-boat in 1942 resulting in the loss of 27 lives, was discovered during an oil and gas survey in 2001 in a mudflow-prone area off the Mississippi River Delta. In a subsequent survey in 2006, the shipwreck had moved more than 1,000 feet downslope. The movement of a 500-foot-long historic oil tanker in mudflow-prone areas potentially could affect oil and gas-related or other infrastructure downslope, so the USGS partnered with BOEM and LSU to acquire new survey data in this area to see if it has moved since 2006 and, if so, how far. In May 2017, during a cruise aboard the *Research Vessel (R/V) Point Sur*, the USGS and other scientific partners found the wreck 200 feet farther downslope from where it was in 2006.

Working together, the USGS and BOEM are advancing our understanding of submarine geologic processes to better constrain sources of natural hazards and inform management of oil and gas activity in areas such as these while managing and protecting our submerged cultural resources.

Read the original article: <http://www.sciencemag.org/news/2017/08/germans-torpedoed-ship-during-world-war-ii-wreck-now-revealing-secrets-about-submarine>

Accomplishments for our Sweetwater Seas

The Great Lakes Restoration Initiative (GLRI) was launched in 2010 to accelerate efforts to protect and restore the largest system of fresh surface water in the world, the Great Lakes. The GLRI is critical to address the most persistent and challenging environmental problems by identifying the most significant ecosystem problems that exist in the Great Lakes Basin and ways to solve them.

The GLRI has been a catalyst for unparalleled Federal agency coordination—through the Interagency Task Force and the Regional Working Group, which are led by the U.S. Environmental Protection Agency (EPA). This coordination has produced unprecedented results. GLRI resources have supplemented agency base budgets that have funded more than 3,500 projects that prevent and control invasive species, improve water quality, protect and restore native habitats and species, and address other additional Great Lakes environmental problems.

GLRI Action Plan II Focus Areas

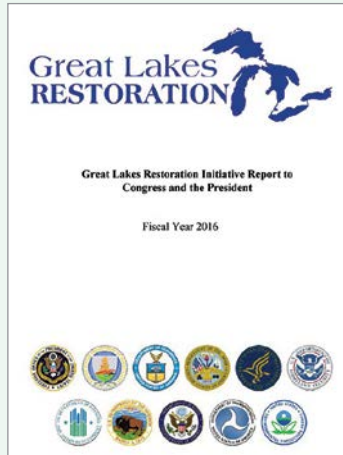
Toxic Substances and Areas of Concern (AOC)

In FY 2016, Federal agencies and their partners finished all the management actions needed to delist the St. Clair River AOC in Michigan.



Map showing locations of GLRI Invasive Species Control Projects (FYs 2010–16)

Building on Success



Read the report to Congress and the President: <https://www.glri.us/pdfs/fy2016-glri-progress-report-to-congress-and-president-20170803-35pp.pdf>

Success stories were selected to help illustrate progress during fiscal year (FY) 2016 for each focus area with detailed information on funding and performance information for Action Plan II measures of progress. This new report builds on the GLRI Action Plan II, released in September 2014. <http://greatlakesrestoration.us/actionplan/pdfs/glri-action-plan-2.pdf>

During FY 2016, substantial progress was made towards the completion of management actions needed to delist four other AOCs, including St. Mary's River (MI), Lower Menominee River (MI), River Raisin (MI), and Rochester Embayment (NY).

Invasive Species

During FY 2016, Federal agencies and their partners continued efforts to prevent the introduction of new invasive species and control existing invasive species populations throughout the Great Lakes ecosystem. Ongoing work in the Chicago, IL, Area Waterway System and new efforts in Eagle Marsh, IN, are stopping the upward migration of silverhead and bighead carps and preventing them from becoming established in the

Great Lakes. Federal agencies and their community partners expanded control activities in FY 2016 by over 14,000 acres. Since the inception of the GLRI, Federal agencies and their partners have taken actions to control invasive species on over 115,000 acres.

Nonpoint Source Pollution Impacts on Nearshore Health

The GLRI implemented focused conservation activities to reduce sources of phosphorus loadings that threaten the Great Lakes nearshore regions. During FY 2016, Federal agencies and their partners worked collaboratively to reduce nonpoint sources of phosphorus runoff that contribute to harmful algal blooms around the Great Lakes in priority watersheds such as Lake Erie, Saginaw Bay, and Green Bay. Federal agencies project that more than 402,000 pounds of phosphorus have been prevented from entering the Great Lakes cumulatively because of GLRI-funded projects.

Habitat and Species

Since the start of the GLRI, Federal agencies and their partners have been protected, restored, or enhanced more than 180,000 acres of habitat for native species throughout the Great Lakes basin. During FY 2016, Federal agencies and their partners implemented 45 projects. These efforts add to the more than 920 habitat and species projects started during the course of the GLRI including 642 miles of Great Lakes shoreline and riparian corridors and 17,500 acres of coastal wetlands through FY 2016.



Illustration by Cole Goco

New Transmitter Design

By USGS

A new transmitter design is being tested on a male Surf Scoter. This newly designed lightweight, solar-powered Global Positioning System (GPS) transmitter has the potential to revolutionize our understanding of seabird movement and behavior. Researchers have tracked raptors and other birds using GPS-based transmitters with great success, but to date there has been limited success using these transmitters on seabirds because they can interfere with the birds' ability to move underwater for food. In 2015, BOEM supported a pilot project initiated by USGS Patuxent Wildlife Research Center, USFWS Northeast Region, and other partners to explore the utility of solar-powered GPS tags in evaluating migration and fine-scale movement of surf scoters and northern gannets on the Atlantic coast, and to explore innovative attachment techniques.

We are continuing this work with our partners to design a transmitter that does not impact the bird while providing us the much-desired high resolution movement data to inform management decisions for seabirds in the offshore environment. Read more: <https://www.boem.gov/espis/5/5635.pdf>

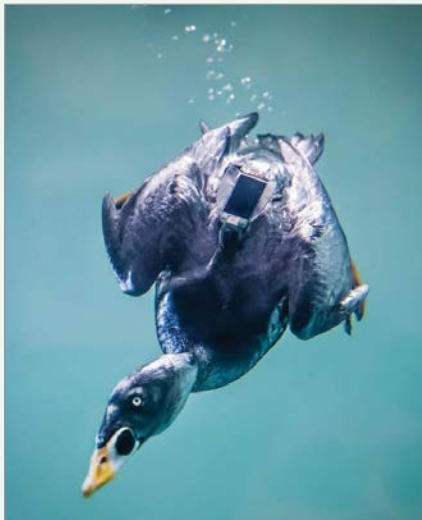


Photo credit: Jonathan Fiely, USGS

Understanding Diving Birds Movement Patterns in Federal Mid-Atlantic Waters

By Caleb Spiegel (USFWS)

Between 2012 and 2016, the USFWS-led study tagged and tracked nearly 250 Northern Gannets (*Morus bassanus*), Red-throated Loons (*Gavia stellate*), and Surf Scoters (*Melanitta perspicillata*) and analyzed tracking data for more than 400 individuals.

The BOEM released the final project report for a groundbreaking 5-year long satellite tracking study, which is one of the most comprehensive satellite tracking studies of marine birds ever done in Atlantic North America. *See related story, page 23.*

The study was designed to better understand how three representative diving marine bird species used mid-Atlantic U.S. Federal waters (5.6 kilometers from shore) during migration and winter to provide preconstruction baseline data that can be used to inform decisions of offshore energy facilities.

The project analyzed information for all three species during winter, and identified locations of breeding areas

One of the most comprehensive satellite tracking studies of marine birds ever done in Atlantic North America.

and associated migratory distances traveled by the three species. In addition to BOEM and USFWS, major project partners included Biodiversity Research Institute, Memorial University of Newfoundland, USGS Patuxent Wildlife Research Center, and Sea Duck Joint Venture.

The study species concentrated use in or around large bays, and winter use of the species was primarily located inshore of current designated Wind Energy Areas (WEAs) and Lease Areas. The Northern Gannet distribution overlapped with the entirety of all WEAs and Lease Areas between North Carolina and New York, but these areas made up a very small proportion (just over 4 percent) of the total area used by gannets in winter. Similarly, all species ranged farther offshore during migrations compared to winter and therefore had a greater overlap in distribution with WEAs and Lease Areas, but only small overall portions overlapped.

Read the project report: <https://www.boem.gov/BOEM-2017-069/>



A satellite-tagged Northern Gannet in Delaware Bay. Gannets have the potential to use waters encompassed by WEAs and Lease Areas, but these areas make a small area of the species distribution. Photo credit: Jonathan Fiely, USGS

GoMMAPPS Celebrates a Successful First Field Season!

By Rebecca Green (BOEM), Jenny Litz (NOAA), Jeff Gleason (USFWS), and Meg Lamont (USGS)

A large team of collaborative scientists spent months in the field during spring/summer 2017 collecting data from multiple observing platforms, including aircraft, oceanographic vessels, and satellite-tagged animals. The scientists support a multiagency effort known as the Gulf of Mexico Marine Assessment Program for Protected Species (GoMMAPPS) that was established in 2016 as an interagency partnership program across the U.S. Department of the Interior (DOI) and U.S. Department of Commerce, including the BOEM, National Oceanic and Atmospheric Administration (NOAA), USFWS, and USGS. The overarching goal of the program is to collect broad-scale information on the abundance and distribution of marine mammals, seabirds, and sea turtles in the Gulf of Mexico to inform seasonally and spatially explicit species density models.

“This BOEM-led interagency effort to survey the Gulf of Mexico’s protected species has been immensely valuable to date,” said Vicki Cornish of the Marine Mammal Commission, an independent U.S. government agency that provides oversight of science, policy, and management actions affecting marine mammals. “We hope the GOMMAPPs surveys will



Closeup of a Black-capped Petrel showing a satellite tag, Loma del Toro, Dominican Republic. Photo credit: Robert Ronconi, Acadia University



NOAA ship *R/V Gordon Gunter* supported a busy summer of GoMMAPPS fieldwork. Photo credit: NOAA

continue to help us learn more about Bryde’s whales and other little-known marine mammals in the Gulf so that we can minimize the impacts of human activities in the ocean.”

NOAA scientists and team members spent July and August aboard NOAA *R/V Gordon Gunter* conducting visual line transect and passive acoustic monitoring surveys, as well as conducting aerial surveys for marine mammals and sea turtles from a NOAA Twin Otter aircraft. The highly successful first season of fieldwork and data collection is contributing to improved abundance and spatial distribution estimates of protected species. Exciting observations from the field included a sighting of killer whales (*Orcinus orca*) in July about 200 nautical miles west of Sarasota, FL, and several sightings of Bryde’s whales (*Balaenoptera brydei*), which recently were proposed for listing as endangered under the Endangered Species Act.

For seabirds, this first field season represents perhaps the most comprehensive effort ever for pelagic seabirds in the Gulf of Mexico. Fieldwork began in late April and was ongoing through the summer aboard NOAA vessels of opportunity (five seabird surveys were completed between April and August), as well as with a USFWS Kodiak aircraft survey. On the first cruise, which included both the continental shelf and deeper waters, no fewer than 25 species of pelagic, offshore, and coastal marine seabirds were counted. Researchers have been surprised by the diversity and abundance of seabirds observed in 2017, including multiple observations of the



Kemp’s Ridley sea turtle (*Lepidochelys kempii*) captured in the Gulf of Mexico for genetic assessment and satellite tagging. Photo credit: Meg Lamont, USGS

rare Black-capped Petrel (*Pterodroma hasitata*).

A variety of innovative tools are being used by USGS scientists and team members to better understand sea turtle distributions and genetics in the Gulf of Mexico. Sea turtle nesting and in-water captures were done and are ongoing at several western Florida locations, resulting in the collection of tissue samples and the deployment of a host of satellite-tracking tags. Habitat modeling efforts are ramping up to combine historical satellite tracks with aerial survey data collected by partners, including the hundreds of sea turtle observations collected during the summer surveys. Progress also is being made toward integrating automated imaging systems during the aerial surveys and extending sea turtle fieldwork to all Gulf Coast States.

Through GoMMAPPS, BOEM’s Environmental Studies Program and partnering agencies are committed to providing robust, multiyear field surveys and analyses for marine mammals, seabirds, and sea turtles in the Gulf of Mexico. As a “use-inspired” program, this data collection will directly inform decision making related to ocean energy and marine minerals management in the region.

Read more: <https://www.boem.gov/GOMMAPPs/>

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

Learn more about the Bryde’s whale: <http://www.fisheries.noaa.gov/pr/species/mammals/whales/brydes-whale.html>

Save the Date!

Capitol Hill Ocean Week 2018

June 5–7, 2018

Capitol Hill Ocean Week (CHOW) convenes opinion leaders, business executives, military officials, scientific luminaries, and leaders in the nonprofit sector from across the country to engage in a dialogue and debate on significant issues affecting our ocean and Great Lakes and to propose innovative policies and partnerships to address these issues.

CHOW 2018 will focus on our changing ocean, restoration and resiliency, and public-private partnerships. New in 2018, the conference will include breakout sessions for deeper discussions. We hope you will join us to be part of the dialogue!



**CAPITOL HILL
OCEAN WEEK 2018**

PRESENTED BY
NATIONAL MARINE SANCTUARY FOUNDATION

Image credit: National Marine
Sanctuary Foundation



Illustration by Cole Goco

Reducing Risk Where Tectonic Plates Collide

By Drew La Pointe, Joan Gomberg, and Kris Ludwig (USGS)

Most of the world’s earthquakes, tsunamis, landslides, and volcanic eruptions are caused by the continuous motions of tectonic plates that make up the Earth’s outer shell. The most powerful of these natural hazards occur in subduction zones, where two plates collide and one is thrust over another. Subduction zone events pose substantial threats to lives, property, economic vitality, cultural and natural resources, and quality of life. The tremendous magnitudes of these events are unique to subduction zones, and they can have cascading consequences that reverberate around the globe.

The report, “Reducing Risk Where Tectonic Plates Collide—A USGS Plan to Advance Subduction Zone Science,” is a blueprint for building the crucial scientific foundation needed to inform the policies and practices that can make our Nation more resilient to subduction zone-related hazards.

The Earth’s many tectonic plates can be thousands of miles across and underlie continents and oceans. These plates collide, slide past, and move apart from each other. Where the plates collide and one plate is thrust (or subducted) beneath the other is where the most powerful earthquakes, tsunamis, volcanic eruptions, and landslides occur. The physical and economic impacts of these natural hazards can be felt worldwide. Multiple subduction zones exist in the States of Alaska, Washington, Oregon, and California; the commonwealths of Puerto Rico and the Northern Marianas; and the territories of American Samoa, Guam, and the U.S. Virgin Islands (USVI; see map on next page). One or more of these regions will likely experience a catastrophic subduction zone event in the coming



The 2004 Indian Ocean earthquake M9.1 generated a powerful tsunami that caused major destruction along the coast and low-lying areas in Banda Aceh, Indonesia. Photo credit: USGS

decades, as well as smaller, more frequent, but still potentially destructive, events.

The USGS science plan, “The Plan to Advance Subduction Zone Science,” recognizes that making our Nation more resilient to these inevitable natural hazards requires a solid, scientifically based foundation. This plan defines USGS science priorities and identifies potential partnerships with other organizations involved in related scientific research, emergency management, policymaking, and planning.

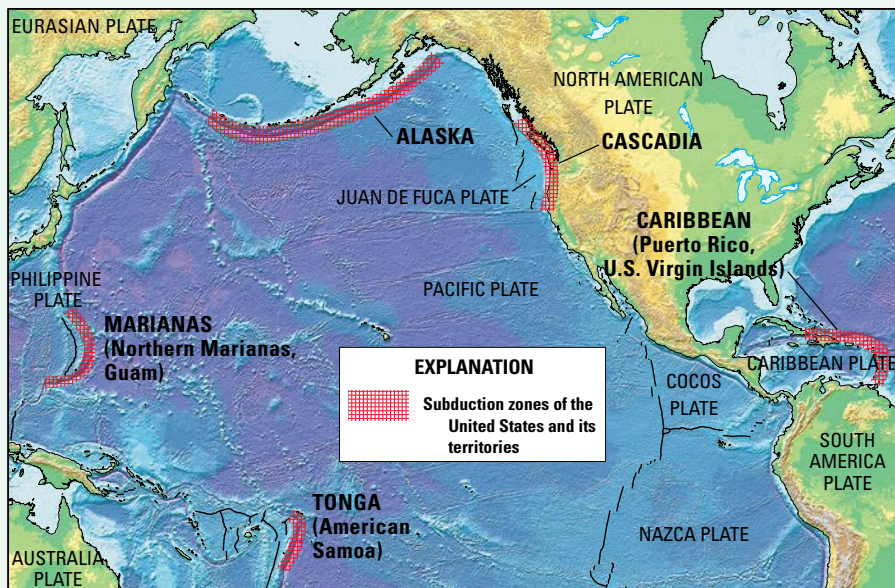
Read the USGS Feature Story: <https://www.usgs.gov/news/usgs-publishes-a-new-blueprint-can-help-make-subduction-zone-areas-more-resilient>

USGS Fact Sheet 2017–3024: <https://pubs.usgs.gov/fs/2017/3024/fs20173024.pdf>

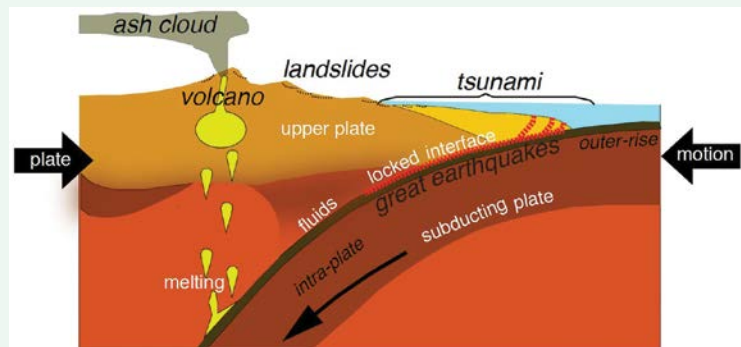
USGS Circular 1428, <https://doi.org/10.3133/cir1428>

What is a Subduction Zone?

The planet we live on is constantly shifting beneath our feet. Creeping along at speeds undetectable to you and me, Earth's massive tectonic plates are on the move continually, and nowhere is our home planet more geologically active than where these plates converge. For example, the States of Alaska, Washington, Oregon, northern California; the commonwealths of Puerto Rico and the Northern Mariana Islands; and the territories of American Samoa and Guam are all situated where two tectonic plates collide, putting them at risk from the world's largest earthquakes, powerful tsunamis, explosive volcanoes, and massive landslides on land and offshore. Scientifically speaking, these areas are called "subduction zones." See related story, page 10.



Subduction zones in the United States and its territories. Subduction zones surrounding the Pacific Ocean belong to the "Ring of Fire." Image credit: USGS (modified from Geologic Investigations Map I-2800, This Dynamic Planet: <http://pubs.usgs.gov/imap/2800/>).



Schematic cross section of a typical subduction zone. Image credit: USGS



HayWired Scenario: Preparing the Public

The USGS is a lead partner on the HayWired project; an earthquake scenario designed to model and study impacts on the San Francisco Bay area from a magnitude 7 earthquake on the Hayward Fault. The study builds upon understanding of the last large earthquake to occur on the Hayward Fault in 1868, but with the realization that modern urban infrastructures are made vulnerable by multiple layers of interdependencies between lifelines, with a major reliance on the Internet.

Learn more: <https://outsmartdisaster.com/>



Illustration by Cole Goco

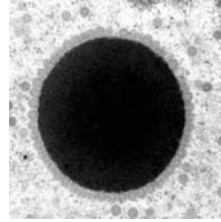
Help for Turtle Disease—Reptile Skin Grown in Lab for First Time

By Marisa Lubeck and Gail Moede Rogall (USGS)

In an international collaboration, USGS researchers reconstructed the skin of endangered green sea turtles (*Chelonia mydas*) in the laboratory, marking the first engineering of nonmammal skin. By growing the skin, the scientists observed biological processes, such as viral systems, in a way that is much closer to reality than traditional laboratory techniques and is hoped to help advance understanding of disease.

For this reason, researchers grew a chelonid herpesvirus 5 (ChHV5) virus on the engineered reptile skin. ChHV5 is associated with a tumor disease called fibropapillomatosis (FP) that affects green sea turtles worldwide. FP causes disfiguring tumor growth internally and externally that affect the turtle's immune system and ability to swim, leading to emaciation and often death.

“Fibropapillomatosis is the most common infectious disease affecting endangered green turtles,” said Thierry Work, a USGS scientist and the lead author of the study.



This sun-shaped area within turtle skin cells marks the virus replication center of ChHV5. The virus capsids, or protein shells, are arrayed like a corona around the circle. Photo credit: Thierry Work, USGS

“Our findings provide a significant advancement in studying FP, and may eventually help scientists better understand other herpes virus-induced tumor diseases, including those of humans.”

By growing the virus, scientists were able to observe virus replication in unprecedented detail, including sun-shaped replication centers where the viruses formed within cells. By understanding how ChHV5 grows in turtle skin, researchers are closer to fighting the viral disease in threatened turtles and also can gain insights into herpes virus-induced tumor diseases that affect humans.

Read the original article: <https://www.usgs.gov/news/reptile-skin-grown-lab-first-time-helps-study-endangered-turtle-disease>

Unearthing Creatures of the Coastal Past

By BLM

Our public lands aren't only home to diverse modern day flora and fauna, they also can be important sources of fossils for paleontologists to study ancient creatures, evolutionary forces, and climate change. The processes and changes of the past can help us to predict what will happen in the future. Much of the scientific value of a fossil depends on condition of the fossil and the context of the area it is located. For that reason, paleontologists collect precise information on the original location, rock type, and other environmental data in the area where fossils are found. The Bureau of Land Management (BLM) ensures proper storage and care of paleontological resources on BLM lands, and scientifically significant fossils are housed in museums so that they can remain available for study and public enjoyment.

In 2006, BLM Paleontologist Alan Titus unearthed the remains of a *Deinosuchus hatcheri*—a predator of dinosaurs—at Grand Staircase-Escalante National Monument. What kind of animal can take down a dinosaur? *Deinosuchus* means “terrible crocodile,” and at more than 40 feet long, this reptile was one of the largest crocodylians ever. The *Deinosuchus* was covered with armor plates called osteoderms (or scutes) and had large teeth that would grow back when lost. Similar to the alligators of today, the *Deinosuchus* would lie just below the surface of the water and grab the prey as it came close. Although it could ambush a dinosaur, fish and turtles were more common prey for the *Deinosuchus*. It was



DOI's Ocean, Great Lakes and Coasts 2017 Knauss Fellow, Gina Digiantonio, stands next to a cast of a *Deinosuchus* skull measuring 6 feet long in the BLM hallway of the Main Interior Building. Photo credit: Ann Tihansky, USGS

the top predator in the coastal regions of North America 70–80 million years ago.

Read more about paleontology in the BLM: <https://www.blm.gov/programs/cultural-resources/paleontology>

Read more in the BLM blog post: <http://mypubliclands.tumblr.com/post/165546408356/small-finds-big-discoveries-story-by-greg>

Monitoring Life Stages of Gulf Sturgeon

By Nadine Siak (USFWS)

All organisms go through life changes as they age because environmental stressors have various impacts or benefits at different stages. The odd-looking Gulf sturgeon (*Acipenser oxyrinchus desotoi*) moves through four life stages; egg, larval, fry, and juvenile (including subadult), until it reaches mature adulthood.

Until recently, USFWS biologists have focused on monitoring populations of adults. However, in a new strategy, USFWS biologists have set their sights on juvenile Gulf sturgeon, in addition to long-term monitoring of adults.

“The reason for shifting attention more strongly to the juvenile life stage is that it is the most accurate measure of response to recent changes,” said Glenn Constant, the project leader at the Baton Rouge Fish and Wildlife Conservation Office. “Adults mature over such a long period—eight to 10 years or more—that identifying drivers of increases in adult population size comes with a great deal of uncertainty.”

Kayla Kimmel, another USFWS biologist monitoring Gulf sturgeon, said focusing on juveniles will allow biologists to observe the response to a change in their environment very quickly (that is, on a yearly basis). “Once we have accurate counts of the juvenile population, we will be able to detect changes in the number of juvenile fish that successfully reach the next year, specifically in response to restoration,” she said. “This is so significant because being able to learn which specific restoration activities have positive effects on the population will bring us one step closer to recovery of this threatened species.”

Historically, Gulf sturgeon were abundant in river systems that enter the Gulf of Mexico from Tampa Bay, FL,



USFWS biologists conduct studies on Gulf sturgeon that will help restore and manage this species. Photo credits: USFWS; Kayla Kimmel, USFWS (inset)

What has a backbone of cartilage like a shark, whiskers like a catfish, rows of heavy armor-like plates, and a toothless, vacuum-like mouth?
If you guessed "Gulf sturgeon," you're right.

to the Mississippi River. They are still found regularly in the Pearl, Pascagoula, Escambia, Blackwater, Yellow, Choctawhatchee, Apalachicola, and Suwannee Rivers of northwest Florida. However, substantial declines in the overall population, led the USFWS to list Gulf sturgeon as a threatened species in 1991 under the Endangered Species Act. Overexploitation for their flesh and roe, habitat destruction and (or) fragmentation caused by passage barriers, water quality deterioration, and other factors contributed to the population downturn. In 2010, the *Deepwater Horizon* oil spill in the Gulf of Mexico also had a negative impact on the species' recovery, potentially exposing between 1,100 and 3,600 Gulf sturgeon to the oil. As a result, restoration



A young Gulf sturgeon held by a USFWS employee. Photo credit: USFWS

activities in the Gulf of Mexico and recovery of the Gulf sturgeon are linked fundamentally.

“As we initiate this new strategy, we may learn enough about what makes good juvenile Gulf sturgeon habitat to make a stronger connection between population stability of Gulf sturgeon and the condition of coastal rivers and estuaries,” Constant concludes. “That would be the best scenario for informing, designing, and implementing Gulf restoration.”

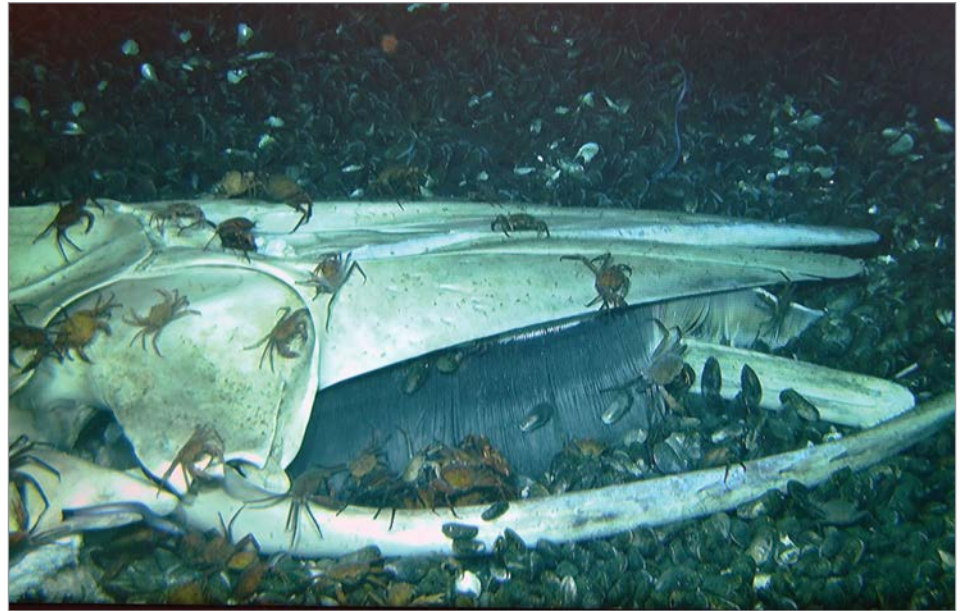
Read more about the Gulf sturgeon: <https://www.fws.gov/panamacity/gulfsturgeon.html>

Deep Sea Exploration IMMeRSS—Engaging the Public Through Telepresence and Video Streaming

By Andrea Toran, Carolyn Ruppel, Amanda Demopoulos, and Nancy Prouty (USGS)

From May 3 to 11, 2017, USGS scientists teamed with collaborators from the British Geological Survey and with a team of remotely operated vehicle (ROV) experts from Oceaneering, Inc., to explore the seafloor at methane seeps on the U.S. Mid-Atlantic margin aboard the *R/V Hugh R. Sharp*. Outreach activities were a critical component of the research cruise, which was funded by the NOAA Office of Ocean Exploration and Research (OER), with additional support from the USGS, the British Geological Survey, and the U.S. Department of Energy. The NOAA Office of Ocean Exploration and Research has long emphasized the use of telepresence, which features two-way audio between the ship and shore and high-resolution video feeds from the ROV to shore. Telepresence enables shore-based scientists to participate in guiding and interpreting ROV seafloor explorations and features in real time and allows cruises to sail with only a small scientific staff. Telepresence also gives the public access to the thrill of discovery-based research bolstered by simultaneous expert explanations from the scientific community.

For the recent USGS-led Interagency Mission on Methane Research at Seafloor Seeps (IMMeRSS), real-time video streaming was provided from the Global Explorer ROV operating at the seafloor and reached the shore over a dedicated satellite link. NOAA hosted a low-resolution stream of the IMMeRSS video, and the USGS supplemented the video feed with official social-media postings because real-time audio was not available. Managers in Reston, VA, and a



Seafloor image of the skull of a baleen whale (*Balaenoptera* sp.) covered with crabs picking away at the remaining flesh, discovered by the Global Explorer ROV at a water depth of about 3,300 feet. Photo credit: Oceaneering, Inc.

cross-section of scientists and administrative staff at the USGS Coastal and Marine Geology Program field centers were engaged in watching the live video stream and communicating with shipboard scientists about the findings.

In addition to providing scientific context for the dives and photographs of postdive laboratory analyses, the Facebook format allowed Andrea Toran, the cruise outreach specialist from the USGS Woods Hole Coastal and Marine Science Center, to develop human-interest postings on life at sea, the ship's crew, and the scientific party. In the lead up to Mother's Day, the focus was on women in science highlighting women research cruise participants: Chief Scientist Carolyn Ruppel (Geophysicist), Co-Chief Scientist Amanda Demopoulos (Benthic Ecologist), Co-Investigator Nancy Prouty (Oceanographer), and Diana Sahy of the British Geological Survey who was joined by Daniel Condon. Other USGS scientists included biologist Jill Bourque, lab manager Jennifer McClain Counts, Chuck Worley, Eric Moore, and Wayne Baldwin, who collaborated with Ruppel on acquisition of geophysical data to support the choice of ROV dive sites. Half of

the scientific party and most of the women had children 12 or younger at home. In some cases, these children were avid followers of the live video stream. On the ship, their parents decorated commemorative Styrofoam cups that were attached to the outside of the ROV and then shrunk by the pressures at great water depths during the dives.

NOAA Office of Ocean Exploration and Research determined that more than 22,000 real-time video viewers watched the IMMeRSS sites during the first few Global Explorer dives. USGS Coastal and Marine Geology Facebook page also experienced a cruise-related spike in viewership. The IMMeRSS Mid-Atlantic margin expedition demonstrated the interest and impact of sharing real-time exploration. The combination of social media and live video streaming was an inexpensive, yet efficient, way to convey seafloor discoveries and meet outreach goals associated with the expedition. *See related story, page 15.*

Read the original article: <http://oceanexplorer.noaa.gov/explorations/17atlantic-margin/welcome.html>

DEEP SEARCH—Deep Sea Exploration and Research of Coral/Seep Habitats

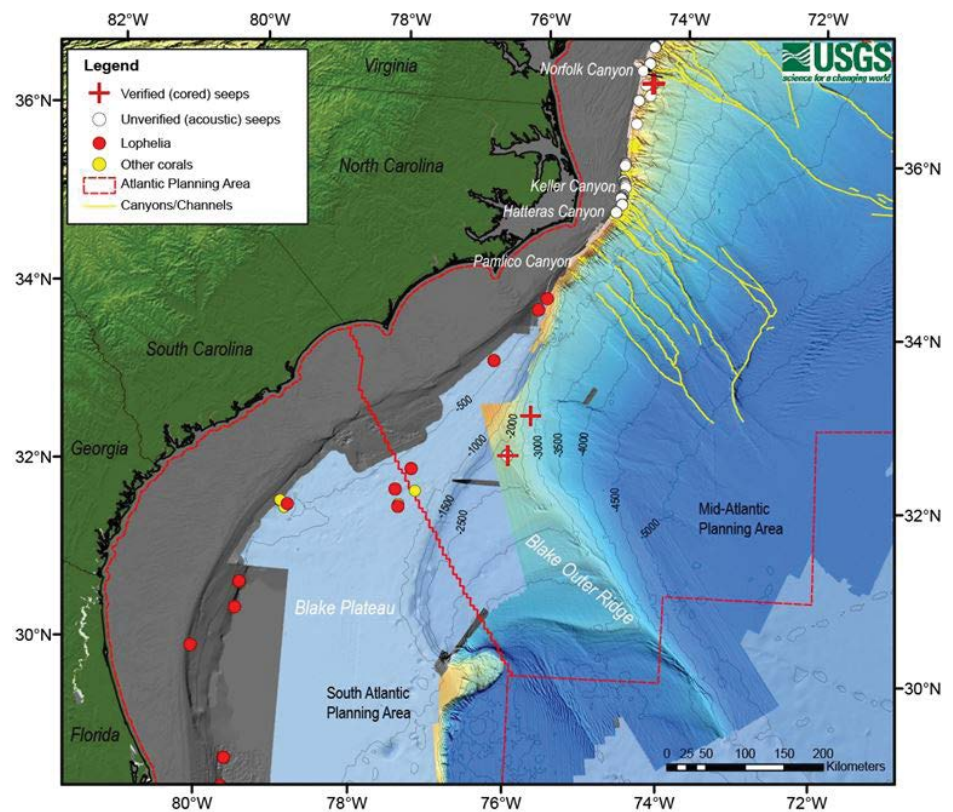
By Marjorie Weisskohl (BOEM), Heather Dewar (USGS), and Monica Allen (NOAA)

On September 12, scientists began a new study of deep-sea coral, canyon, and gas seep ecosystems in the mid- and south Atlantic Ocean that will last four and a half years. The BOEM, USGS, and NOAA are collaborating to learn more about little-known natural resources of the deep ocean off the United States' southeast coast.

The research is organized through the National Oceanographic Partnership Program, with TDI-Brooks International, Inc., as the prime contractor for BOEM, and scientists from the USGS and seven participating academic institutions.

The interdisciplinary team of researchers spent about three weeks at sea aboard the NOAA ship, Pisces, exploring geological processes and biological features—such as corals and naturally occurring gas seeps, and the organisms that inhabit them—in deepwater habitats between 30 and 130 miles offshore North Carolina, South Carolina, and Georgia. *See related story, page 14.*

“This study brings together experts who will collaborate to improve our understanding of the distribution, ecology, and underlying geological foundation of sensitive deep-sea environments within this region,” said Amanda Demopoulos, who serves as the chief scientist for the first expedition and USGS’ project chief for the multiyear study. “The results will also yield insights into potential marine natural hazards such as landslides and tsunamis, which may have a future impact on sea floor and coastal infrastructure within the Atlantic region. Ultimately, the research will provide the essential baseline information



Map of target areas to be surveyed during the first phase of the Deepwater Atlantic Habitats II study, DEEP SEARCH, including seep targets. Image credit: USGS

needed to guide management of these deep-sea resources.”

This is the first of three planned collaborative deep-sea expeditions in the region over the next three years. The project will provide baseline information needed by each agency. BOEM will obtain new scientific data to inform environmental reviews and offshore energy decisions; the USGS and NOAA will gain new scientific understanding of the region’s physical and biological resources.

Support for the study is shared equally among the three Federal agencies in either partner funding or in-kind support. BOEM developed the study concept, funded the competitive contract, and brought together scientific personnel, ships, and equipment from the USGS and NOAA’s OER. Temple University’s Erik Cordes is the project manager for TDI-Brooks International, Inc., and lead principal

investigator for the multiyear study. Five USGS science teams, led by Demopoulos, representing various disciplines will collaborate with other partners and researchers from Temple University, the University of Georgia, Nova Southeastern University, Florida State University, Harvey Mudd College, the University of New Hampshire, and the Royal Netherlands Institute of Sea Research.

Read the press release: <https://www.boem.gov/press09122017/>



Illustration by Cole Goco

Special Feature continued from page 1

For the Puerto Rican Parrot (*Amazona vittata*), Maria was another blow against a species with a tenuous grasp on survival. The parrot is listed as endangered under the Endangered Species Act. The U.S. Fish and Wildlife Service (USFWS), along with the Puerto Rico Department of Natural and Environmental Resources, are assessing how the birds fared in the category 4 storm. The preliminary verdict indicates that most of the birds in three aviaries survived, despite extensive damages to the facilities. USFWS and Puerto Rican officials are making a list of repairs the aviaries need, including replacing breeding cages, security and observation cameras, and perimeter fences.

Read the original article:

<https://www.fws.gov/southeast/news/2017/10/a-tale-of-two-photos/>

Hurricane Maria photos:

<https://www.flickr.com/photos/usfwssoutheast/sets/72157661075967258/>

Hurricane Irma photos:

<https://www.flickr.com/photos/usfwssoutheast/sets/72157686649313044/>



In 2016, biologists fitted 30 Puerto Rican Parrots with radio collars to help track them after being released into a natural environment of the Bosque del Estado, Puerto Rico. Photo credit: Jan Paul Zegarra, USFWS

Corals Take Hurricane Impact, Protect the Coast

By Gina Digiantonio (DOI)

Hurricanes Irma and Maria barreled through Florida and the Caribbean islands, sending large waves and heavy winds through the area and leaving a visible trail of destruction across the land. Underwater resources are difficult to see, making it hard to assess damage to coral reefs that serve as a line of defense for coastal structures by defusing some of the power of the waves. With funding from the USGS and the DOI Office of Insular Affairs, USGS scientists are using a modeling and evaluation framework to characterize the hazard risk reduction provided by coral reefs. It has been theorized that coral reef structures may reduce the energy of incoming waves by as much as 97 percent. Data from the recent hurricanes will allow the researchers to put their results to the test, and to quantify how much the reefs off the USVI, Puerto Rico, and south Florida mitigated damage.

Although the coral reefs help reduce coastal flooding and shoreline damage with their “green” infrastructure, it can reduce the health of the reef unfortunately. Storms damage coral structure and increase sediment, nutrient, and contaminant runoff from rivers and flooded coastal areas, decreasing water quality. Together, these further stress coral communities. The University of Puerto Rico and the USGS received a U.S. National Science Foundation grant for Rapid Response Research (RAPID) to assess the impact of hurricane flood sediment on the coral reefs off the southwest coast of Puerto Rico. The scientists will geochemically trace the flood sediment found on the reefs back to source drainages to better direct watershed restoration efforts. NOAA supported two RAPID grants from the National Fish and Wildlife Foundation



At Buck Island Reef National Monument, hurricane damages included extensive broken branches of Elkhorn coral. Photo credit: Andrew Crowder, USGS

and partnered with local partners and veterans to assess and stabilize corals along the Florida Coral Reef Tract.

Damage to corals was patchy across the landscape and in unexpected places. Corals near crab and lobster traps were broken because the traps were moved around by the waves. Unanticipated impacts occurred in Florida’s northern reefs in response to changes in seabed geology. The U.S. Coast Guard worked in the months after the hurricanes to remove thousands of displaced vessels. The assessment teams stabilized and secured larger coral fragments.

Storms, ocean acidification, thermal stress events, and other conditions degrade coral reefs and diminish their ability to coastal defensive capability of the reefs. “If you reduce coral reef health—if you go from a really rough coral reef with lots of live coral to a degraded coral reef with a relatively low coral coverage and thus a smooth surface—that will result in increased flooding that impacts coastal communities, infrastructure, agriculture, and ecosystems,” said Curt Storlazzi, a research geologist with the USGS.

By quantifying the value of coral reefs for coastal protection,

See Corals page 17

Corals continued from page 16

researchers provide information that can be used to set insurance rates to promote reef protection, support prestorm reef restoration based on projected hazard risk reduction benefits, and pay for defense through reduced cost of insurance bonds. In this way, mechanisms that typically are used to fund seawalls, breakwaters, and other “gray” infrastructure can be applied to the restoration of coral reefs.

Data collection is an important component of the scientific process, and natural disasters can affect scientific activities causing the loss of local experiments sites and damages to research facilities. Storlazzi and other researchers had the largest physical processes experiment ever used in a U.S. Coral Reef Task Force priority study area, the Rio Loco/Guanica watershed off south Puerto Rico, during hurricanes Irma and Maria. The experiment was designed to determine how sediment moved out of Rio Loco and Guanica Bay onto the coral reefs in that priority study area. As part of the experiment, they also used the deepest benthic boundary layer hydrodynamics and sediment transport instrument package ever in a coral reef ecosystem (see: <https://walrus.wr.usgs.gov/news/index.html#aug17b>). The researchers recovered 43 of the 51 instruments after the storm, and have captured a historic event that can be used to project impacts of future storms.

Read about coral reef risk reduction: <https://www.usgs.gov/news/coral-reefs-are-critical-risk-reduction-adaptation>

Read about the RAPID assessments: <https://floridakeys.noaa.gov/whatsnew/releases/2017/20171024-noaa-partners-assess-coral-reef-damage-following-hurricane-irma.html>

Sea Turtles Weather Category 5 Hurricanes

By Kristen Hart (USGS)

Two category 5 hurricanes (Irma and Maria) hit the U.S. Virgin Islands and delayed a planned September research trip to the island of St. Croix. The USGS scientists visited in November 2017, using the delay to continue their long-term sea turtle capture-mark-recapture and turtle sampling and tracking research project at Buck Island Reef National Monument (BIRNM) and assess impacts of the hurricanes on the sea turtle population at BIRNM as well as the reef environment.

In partnership with the National Park Service (NPS), Kristen Hart’s team spent six days in the water capturing turtles and assessing impacts to the reef at BIRNM. The most notable hurricane impact to the reef was the damage done to the Elkhorn coral (*Acropora palmata*), which typically colonizes shallow water. The branching coral, which had been abundant in the upper reef in spring 2017, had many fragmented branches with some heads completely broken off. The team also noted several coral heads of at least two different species that had experienced recent bleaching.

The team captured 27 turtles (20 recaptures and seven new captures) during the posthurricane trip, continuing to build on the total of 207 sea turtle individuals captured and tagged since the study began in 2012. Using an array of more than 100 passive acoustic receivers, the scientists continue to track the fine-scale movement patterns of these and other similarly tagged individuals over long periods. Only two receivers were lost due to the hurricanes.

The team successfully captured 20 endangered green sea turtles (*Chelonia mydas*) and seven critically endangered hawksbill sea turtles



This adult male hawksbill turtle received new satellite tag and can be tracked online: http://www.seaturtle.org/tracking/index.shtml?project_id=663. Photo credit: Andrew Crowder, USGS

(*Eretmochelys imbricata*). Two of the juvenile hawksbills captured had previous acoustic tags that still were attached securely. One of the individuals had an acoustic tag applied in the spring of 2012, and the other had been tagged in the spring of 2015. A highlight of the recent trip was the capture of a new adult male hawksbill that the team outfitted with a satellite tag; his movements can be followed online: http://www.seaturtle.org/tracking/index.shtml?project_id=663

The team also sampled each turtle for blood and tissue samples, tagged them with Passive Integrated Transponder and Iconel flipper tags, and conducted gastric lavage to assess sea turtle diet. Green sea turtles are omnivorous, but feed primarily on seagrass and algae. On this trip the gastric lavage sampling provided evidence of green sea turtles at BIRNM feeding on *Halophila stipulacea*, an invasive sea grass species. As this invasive species spreads, it overtakes and replaces native seagrass beds, having possible implications for green sea turtle populations in the area. The team plans to return in the spring of 2018 to continue their research.

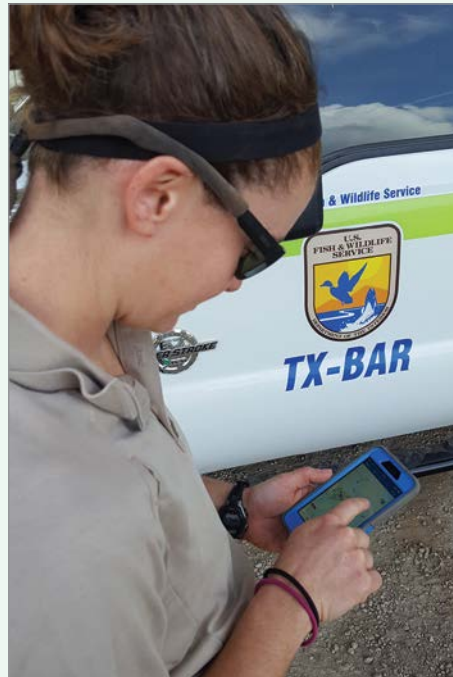
This work is done under NMFS permit 20315 (National Marine Fisheries Service Endangered Species Permit, issued to K. Hart for in-water sea turtle work).

After the Storm— Leveraging Technology to Appraise Hurricane Damage

By Keenan Adams (USFWS)

On Friday August 25, Hurricane Harvey made landfall in Texas near Aransas National Wildlife Refuge (NWR) and then moved northward—at a tortuously slow pace. As the storm bore down on many other USFWS personnel, facilities, and refuges, the USFWS urgently needed a way to perform rapid damage assessments to account for people and resources.

The past informed the future; with hurricanes Rita and Ike in 2005 and 2008, respectively, refuge staff in the Southwest Region knew they needed to use the most advanced technologies with a skilled response and recovery team. Scott Bearer, a Landscape Ecologist with the USFWS, found himself in the middle of the USFWS Hurricane

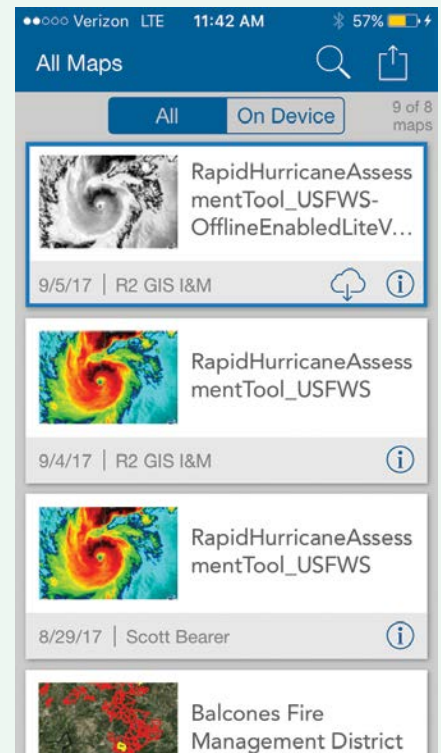


Kathryn Sebes collects information on Hurricane Harvey damage. Photo credit: Jeff Adams, USFWS

Harvey response using his geospatial skills efficiently to track employees and families hit by the hurricane as well as the status of refuges' buildings, infrastructure, and employee's homes.

Bearer coordinated an interdisciplinary hurricane response team that brought a diversity of skills and experiences to deploy a Rapid-Hurricane Assessment Tool they called "R-HAT." After the hurricane hit, R-HAT allowed the team to assess hurricane damage to refuge assets quickly in real time, and to communicate that information to any appropriate level of the organization.

Since August 28, the response team has assessed 451 of 485 total assets in the Hurricane Harvey-affected zone. Traditionally, this would have been performed with pencil and paper, over the phone, or through many emails, and then transcribed to a database. R-HAT saved substantial time and resources by providing an efficient and effective way to assess USFWS personnel, lands, and structures. It has



A view of the R-HAT Collector application on an iPhone used by the Incident Management Teams across the Texas Coast during Hurricane Harvey.

kept responders safe by providing real-time intelligence of local hazards. Through ongoing Hurricane Response coordination with the USFWS's Southeast Region, the Southwest Geographic Information System team rapidly worked to update the application so it could be deployed in time for Hurricane Irma before it fell on Florida.

Loren DeRosear, the regional fire coordinator, stated, "This is a leadership example of applying the latest technology to account for our greatest asset: our people. We are saving money and maximizing safety of emergency responders using remote technology to assess damages so informed decisions can be made to recover our lands and communities."

Read the original article: <https://www.fws.gov/southwest/hurricaneinfo/harvey/newsstories/2017/techassess.html>

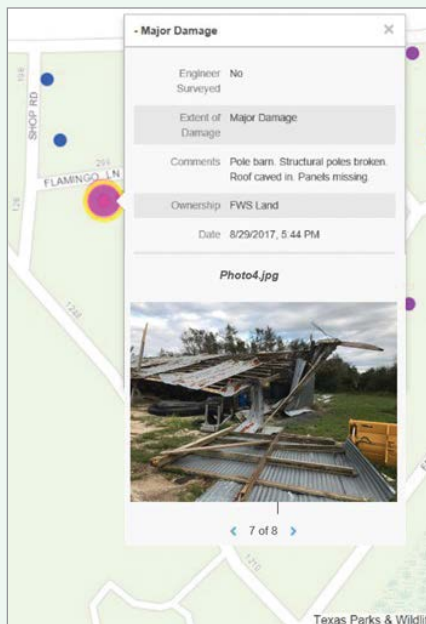


Image showing part of the Rapid Hurricane Assessment Dashboard. Photo credit: USFWS

Hurricane Irma had Little Impact on Key Deer Population

A new USFWS survey has found that the overall population of Florida's endangered Key deer (*Odocoileus virginianus clavium*) remains healthy after Hurricane Irma.

Before Irma, the USFWS estimated approximately 1,100 deer roamed their core habitats on Big Pine Key and No Name Key. After Irma, USFWS staff estimated the population at 949 Key deer in the same areas.

"We are happy to report Key deer numbers are well within the range we observed before Irma," said National Key Deer Refuge manager Daniel Clark.

Refuge staff helped Key deer in the wake of Hurricane Irma by monitoring fresh water areas suitable



A thirsty deer drinks water provided by USFWS at National Key Deer Refuge on Big Pine Key. Photo credit: Dan Chapman, USFWS

for wildlife use. Due to the storm surge from Hurricane Irma, salinity levels in some fresh water wetlands were, on average, higher than acceptable levels for most wildlife species. Rainfall since Irma's passing has decreased salinity in wetlands so that supplemental wildlife watering was no longer required.

The USFWS is partnering with Florida International University to seek funding for poststorm habitat assessments in the pine rocklands. Of all refuge plant communities, saltwater storm surge events from hurricanes and sea-level rise now pose the greatest risks for the pine rocklands. Even before Irma, only 2% of the globally endangered habitat found only in south Florida and the Bahamas remained. Pine rocklands provide important habitat for a diverse plant and animal community, including 18 plants found nowhere else and eight federally listed animal species. Some of these species include the Key deer, Bartram's scrub-hairstreak butterfly, Big Pine partridge pea, wedge spurge, and sand flax.

The USFWS will continue to work with partners, such as Texas A&M University and the Florida Fish and Wildlife Conservation Commission, and concerned citizens for Key deer and other wildlife management post-Hurricane Irma.

Read the original article: <https://www.fws.gov/southeast/news/2017/10/new-survey-shows-hurricane-irma-had-little-impact-on-key-deer-population/>

Floating Fire Ants Threaten Rare Dancing Bird

By Al Barrus (USFWS)

In addition to widespread flooding and devastation, Hurricane Harvey also brought a plague of floating fire ants (*Solenopsis geminata*) to the Houston region. Whole colonies of the noxious biting red insects—including the young, eggs, and larvae—can survive floods by linking themselves together into a tight knit raft of individual insects. The spaces between the links are so small that the raft doesn't break the water's surface tension, which allows the colony to float. The ant raft flows with the water and once the colony reaches a dry object (which can be anything; a fence post, a bird, or a person), individual ants break away and crawl onto the object. This is a dangerous prospect for people and animals in flooded areas because the ants' stings can be fatal.

The invasive fire ants developed their floating mechanism to survive in the flood plains in South America. Sometimes called ginger ants, they inadvertently were brought to

See Fire Ants page 20



A cluster of fire ants floats on the water. Photo credit: Rob Albright

Fire Ants continued from page 19

port in Mobile, AL, in the 1930s. The economic impact associated with red imported fire ants costs Texas' economy around \$1.2 billion each year.

During floods, the threats from floating fire ants can be destroyed by spraying them with a biodegradable dish soap spray. The soapy water lowers the surface tension of their floating colony, drowning the ants. While soaping down a flood-floating colonies of fire ants can wipe out the immediate danger, the species continues to plague the people and animals of the southeastern United States long after flood waters recede.

One native animal that's been especially affected by the ants is the endangered Attwater's prairie chicken (*Tympanuchus cupido attwateri*), a subspecies of the Greater prairie chicken. Endemic to the coastal prairies of Texas and Louisiana, this grouse species known for its elaborate dancing, once numbered up to one million birds. As farms, towns, and cities sprung up, the population diminished. West of Houston, the Attwater Prairie Chicken NWR, established in 1972, has found that the greatest gains in improving wild Attwater's prairie chicken populations have come in the form of controlling fire ants. But by 1988, less than 1,000 remained in the wild.



Attwater's prairie chicken. Photo credit: George Lavendowski, USFWS



Newly hatched chicks depend on small insects for their survival. Photo credit: USFWS

It was the proliferation of the red imported fire ants that nearly dealt a final blow to the wild Attwater's prairie chicken population. Not only do the ants prey directly on the birds, but they also prey upon native insects, impacting the diet of young chickens. Due to this competition for food, Attwater's prairie chicken chicks die of starvation. Because the wild chicken's life span is short, successful reproduction is key.

After intensive study in 2014, refuge personnel began treating for fire ants, which has led to an increase in native insect populations, along with an increase in the survival rate for Attwater's prairie chicken chicks. Between 2012 and 2016, wild chicken numbers increased 170 percent, from 48 to 130 individuals.

Attwater's prairie chicken habitat is limited to the pristine coastal prairie of southeast Texas, of which less than one percent of the original habitat area remains. Although the adults are strong flyers and they seek out dry land when floodwaters inundate low lying areas, these small coastal areas are further reduced, and the Attwater's predators—such as coyotes, bobcats, raccoons, and snakes—also are driven to the same small slivers of dry land. In April 2016, the Attwater's prairie chicken refuge faced flooding threats, negatively impacting their nests on the ground and hampering

reproduction of the 130 birds in the wild.

Because the prairie chicken population is so small, great efforts are made to protect individuals from harm. In summer 2017, as Hurricane Harvey threatened the Texas Gulf coast, 20 captive-bred birds scheduled for release at the Refuge were returned to the Houston Zoo for safety, which was spared the worst of Harvey's effects. Those birds are doing well and gaining weight. The flooding associated with Hurricane Harvey is the second year in a row that the wild prairie chickens have been driven into small dry areas enriched with predators who take advantage of the circumstance to feed.

Now that the floodwaters associated with Hurricane Harvey have receded, the staff at the Attwater Prairie Chicken NWR are assessing what's left of the remaining wild population of this very rare dancing bird.

Read the original article: <https://medium.com/@USFWS/invasive-fire-ants-make-problems-for-attwaters-prairie-chicken-c055dd2e02f8>

Video of a dancing Attwater's prairie chicken and USFWS conservation efforts: https://youtu.be/tyIOPXsm_W4

BSEE Employees— Hurricane Heroes

By BSEE

In the wake of Hurricane Harvey, several Bureau of Safety and Environmental Enforcement (BSEE) employees in the Lake Jackson District, TX, joined the “Texas Navy” while other employees provided direct aid to those in need. Some of these heroic BSEE employees had already suffered losses of their own but were undeterred from joining with relief agencies and volunteer rescuers to provide assistance to the victims of this historic storm.

Inspector Kirby Calhoun volunteered his boat and time to conduct more than 24 rescue operations that saved about 75 lives in one day. Inspector Joe Trevino cooked and served food to displaced people and first responders, and Inspector Jacob Trevino used his lifted truck to rescue a family member from a flooded



Inspector Kirby Calhoun volunteered his boat and time to conduct 24 rescue operations in the aftermath of Hurricane Harvey. Photo credit: BSEE

row of houses. Michelle Shockley, Operations Assistant, rescued a puppy and searched for its owner.

The stories of other BSEE heroes may not make headlines, but are important for maintaining the safety

of personnel and facilities at offshore energy sites. As severe weather systems move into the Gulf of Mexico and threaten oil and gas production facilities and drilling rigs, operators begin the process of shutting-in production and evacuating personnel from the offshore facilities and rigs. During these events, the BSEE Gulf Region Hurricane Response Team is activated and monitors and reports production shut-in and evacuations. In spite of the tremendous impact of the disaster, the work of these heroes, as well as the massive outpouring of aid and relief from all parts of the Nation, is inspiring.

BSEE’s Hurricane Season Information web page: <https://www.bsee.gov/resources-tools/hurricane>

Read more about BSEE’s Lake Jackson District Heroes: <https://www.bsee.gov/sites/bsee.gov/files/hurricane-harvey-inspires-bsee-heroes-08312017-final.pdf>

Calamity Sami—A Tough Woman Gets the Job Done

By Dan Chapman (USFWS)

On October 16, 2017, a week after Irma and her 180 mph winds came ashore in the Florida Keys, the challenges were daunting. No power. Mountains of debris. Growing fire risk. Returning and distraught residents. Dehydrated deer. Poisonwood rashes. Yet, through exemplary leadership, USFWS’s recovery efforts in and around the National Key Deer Refuge were near-Herculean.

When such calamity calls, Sami Gray answers. Gray served as the Incident Commander in charge of the USFWS’s Irma recovery work in Florida. The job requires a host of logistical, tactical, and diplomatic skills to get a refuge, its employees, and a neighboring community back on its feet.

“Sami is exceptional at walking into a chaotic situation and making sense of it. She has a strong bias for action. She makes a decision and moves forward,” said Jon Wallace, a deputy regional fire coordinator with the USFWS who has shared 17 years’ worth of calamitous assignments with Gray. Gray has tackled countless wildfires, hurricanes, oil spills and the New World



Incident Commander Sami Gray directs a crew of recovery workers in the Florida Keys after Hurricane Irma. Photo credit: Dan Chapman, USFWS

screwworm infestation. She served as a “hotshot” in 1996, fighting fires in Oregon, Alaska, and northern California. The elite, and physically tough, firefighters hiked into the

See Calamity Sami page 22

Calamity Sami continued from page 21

belly of the fire beasts with chain saws, shovels, and 45-pound packs.

Gray was hired full-time by USFWS in 1995. Hurricane Katrina, the monstrosity destructive 2005 storm that inundated the Gulf coast and killed 1,800 people, was Gray's first big leadership challenge. She was the de facto incident commander in Mississippi tasked with rescuing survivors, securing homes, stanching oil spills, opening roads, and fighting fires. These experiences prepared Gray to tackle Irma's aftermath at National Key Deer Refuge.

"We need to help the impacted people, but I make sure the crews have everything they need to do their jobs," Gray said. "One of the main reasons I do this is because I feel we can make a difference and get people back on their feet."

Gray ordered her troops to do "wellness checks" on refuge volunteers and offered food, water, and help clearing debris from their yards. Gray expects no less of herself. She fretted about a deer's health (*see related story, page 19*) and hauled water from the marsh so toilets could be flushed. She picked up a dead Key deer off U.S. 1. She volunteered to clean up chicken poop at a refuge employee's home. And she also got poisonwood—nastier than poison ivy—while hauling tree limbs from the road. All while wearing a brace on the leg she broke in July.

Read the original article: <https://www.fws.gov/southeast/articles/incident-commander-sami-grays-training-in-wildfires-prepared-her-for-hurricane-irma/>

Saving Money by Rebuilding Smarter and Stronger

By Mark Davis and Dan Chapman (USFWS)

Hurricanes are never welcome, but they can prompt changes in buildings to make them better, stronger, and more capable of handling high water and even higher winds.

The USFWS has prioritized constructing and rebuilding facilities that can weather hurricanes. Recent storms in the United States show that the USFWS' money and effort have been well spent.

Structures battered a dozen years ago by Hurricanes Katrina, Rita, and Wilma, then rebuilt to tighter construction standards, have withstood the 2017 hurricane season. The same is true of buildings in harm's way in 2008, when Hurricanes Gustav and Ike rolled across coastal Louisiana and Texas.

There may be no better example than structures at the National Key Deer Refuge in the Florida Keys. The refuge, home to the federally endangered Key deer, got hit by high winds, torrential rains, and a storm surge upwards of four feet when Hurricane Irma came ashore in September.



Employee residences on J.N. "Ding" Darling NWR on Sanibel Island, FL, were rebuilt to withstand storm surge and severe storms. Photo credit: USFWS

"Overall, we were pretty fortunate," said Dan Clark, the refuge manager. "Some of our structures are pretty tough. We had some water intrusion and mold and we need some repairs, but we didn't have a whole lot of houses and offices destroyed."

Exhibit A: the refuge's administration building, erected to replace the structure destroyed in 2005's triple-punch of storms. A fortress of concrete, metal roof and all-weather shutters perched 16 feet above the storm surge line, the building suffered only minor leaks this time around.

The new visitor's center along U.S. 1 on Big Pine Key, a modular building with concrete piers built atop relatively high ground, suffered nary a scratch from the storm.

The refuge did not escape without injury, however. Although most of the complex reopened for business November 1, remaining repairs and replacements will take additional time and money.

"The USFWS is committed to smart expenditures," said Mike Oetker, the Southeast Region's acting regional director. "Our managers and leaders for more than 20 years have perfected response to big storms like Irma and Maria," he said. "They've also built a strong track record for smart recovery by rebuilding facilities to the strongest hurricane standards and in some cases also relocating them to more secure areas. The result is that we save a lot of money because we don't have to rebuild those structures later."

Read the original article: <https://www.fws.gov/southeast/articles/service-facilities-built-to-withstand-natures-worst/>

Tracking Movements of High Priority Seabird Species

By Pamela Loring (USFWS) and David Bigger (BOEM)

Since 2013, the USFWS Division of Migratory Birds, in collaboration with the University of Massachusetts, Amherst, the University of Rhode Island, and other State and nongovernmental organization partners, have completed BOEM-funded studies to track the movement of high-priority bird species along the U.S. Atlantic coast. In particular, the researchers are determining the extent to which **common terns** (*Sterna hirundo*), endangered **roseate terns** (*Sterna dougallii*), and threatened **piping plovers** (*Charadrius melodus*) fly over Federal waters that have the potential to be developed for offshore energy development.

Estimating the movements of small-bodied birds is particularly challenging in marine environments, where limited technologies exist for remote tracking of electronically tagged individuals. The use of digital nano-tag transmitters and automated radio telemetry stations has proven to be an effective technique. The tags collect data around the clock and during all types of weather conditions, and the position of the tags can be located with an optimal accuracy of about 500 meters.

After a pilot field season in 2013, researchers tracked common terns from Monomoy NWR, MA, and Great Gull Island, NY. The researchers expanded the automated telemetry array to 16 stations positioned at strategic coastal and offshore island sites throughout the southern New England region. The expanded array allowed them to quantify the coastal versus offshore movement patterns and habitat associations of terns throughout the study area during the



View of the first offshore wind turbines in U.S. waters near Block Island, RI, as seen from an antenna used for tracking tagged birds. Photo credit: Brett Still, University of Rhode Island

breeding, postbreeding, and premigratory staging periods.

The project continued to expand in the subsequent years. In 2015, additional species, the federally threatened piping plover and the federally endangered roseate tern, were tagged at major nesting areas. Scientists tracked their movements using an expanded array of 20 automated radio telemetry stations distributed from Cape Cod, MA, to Long Island, NY. In 2016, additional automated radio telemetry arrays were added. These efforts have allowed researchers to track the coastal versus offshore routes of roseate terns, common terns, and piping plovers effectively across the southern New England study area during the breeding and postbreeding periods, and during their migratory departure flights from the study area.

Researchers are now analyzing the movement patterns of the species and using a model to estimate future flight paths. Offshore movements will be modeled relative to temporal, demographic (that is, sex and breeding population), and atmospheric conditions. The data and results from this study will increase knowledge of seabird behavior, and will allow for better-informed decisions regarding



Brett Still assembling an antenna used for tracking tagged birds on Block Island, RI. Photo credit: Pamela Loring, USFWS

offshore energy siting along in the U.S. Atlantic coast.

Watch the video, “Tracking Endangered Coastal Birds in Areas of Potential Wind Energy Development,” here: https://www.youtube.com/watch?v=wgG_7AqhzQ8

Key Coastal Species Help Determine Ecological Tipping Points

By Nadine Siak (USFWS)

Salt marshes, mangrove forests, and barrier beaches are home to a diversity of wildlife species. When these coastal ecosystems are intact and functional, they benefit communities as well as wildlife. They provide communities with a host of economic, recreational, and cultural benefits including protection from storm surge, a means to trap and store carbon, and nursery areas for commercially important groundfish; for example, the eastern oyster (*Crassostrea virginica*) is a cornerstone of a lucrative shellfish industry, filters water as it feeds, and helps stabilize the shoreline by creating reefs.

Some species also play an instructive role as indicators of environmental changes that can threaten coastal systems people and wildlife depend upon. These indicator species may experience “ecological thresholds,” the tipping points at which changing environmental conditions will lead to a disruption in a species’ life cycle or habitat. By looking at ecological thresholds for key species, we can better prepare for and respond to threats that can affect their homes—and ours.

A team of scientists from the USGS and USFWS synthesized existing information on ecological thresholds related to environmental changes (for example, sea-level rise and coastal storms) for 45 species of coastal fish, wildlife, and plants selected because of their ecological, economic, and cultural importance. Published in *Ocean & Coastal Management*, the article offers insights on strategies for managing coastal resources to help managers make effective decisions. These strategies can protect natural systems that sustain wildlife and the health and well-being of people and communities.



Red mangrove (*Rhizophora mangle*) is a valuable, salt tolerant coastal tree species that grows in estuarine tropical regions. The characteristic prop roots create habitat and stabilize sediment. Photo credit: Ann Tihansky, USGS

“This paper is meant to give you a measuring stick,” said co-author John Tirpak, science coordinator for USFWS’ Gulf of Mexico Restoration Office. “The identification of the ecological tipping points for species is a rapid assessment tool for evaluating the impacts of hurricanes and similar events. If you know that a sea turtle needs this kind of beach, this kind of slope—if the beach no longer meets these particular criteria after an event like a hurricane, you will know it will have a large impact on sea turtles that warrants further assessment and management response.”

“By pairing [ecological] thresholds for highly vulnerable species responses with sea-level rise projections and coastal landscape responses, managers can prioritize which species need immediate action...to reach conservation goals,” explained co-author Michelle Staudinger, science coordinator for the Northeast Climate Science Center (CSC).

Each of the eight CSCs provides decision-focused research, information products, and tools to inform landscape-scale conservation plans developed by Landscape Conservation Cooperatives (LCCs). Both entities are nonregulatory conservation partnerships that have been established to help respond to environmental stressors that transcend State lines and are beyond the organizational ability of any one agency.



A shorebird forages within an eastern oyster reef exposed at low tide. Photo credit: Woody Woodrow, USFWS

Stakeholders from six LCCs, three CSCs, State wildlife agencies, and other partners from across the U.S. Atlantic and Gulf coast regions identified a need for information on thresholds that can help managers act strategically despite uncertain future conditions. This paper provides the synthesis and timely information to help coastal States implement updated State wildlife action plans (SWAPs), which identify species of greatest conservation need in each State and outline strategies for protecting them in the face of challenges.

“In the latest generation of SWAPs, we focused on setting measurable objectives for species, so having quantitative information on thresholds helps us know if we are moving in the right direction,” said Amanda Shearin, Maine’s SWAP coordinator. “The fact that this study was based on regional collaboration makes it that much more valuable. Coastal change is a big picture issue, and being able to look at impacts across the region is so useful, especially when it gives us guidance that we can apply locally.”

Read more: <http://northatlanticlcc.org/news/all-news/collaborative-study-offers-insight-on-protecting-valuable-coastal-resources-based-on-201ctipping-points201d-for-indicator-species>

Read the article: <https://www.sciencedirect.com/science/article/pii/S0964569117306038>

A Day at Poplar Island with Ornithologists

By Gina Digiantonio (DOI) and Diann Prosser (USGS)

With long migrations, quick flight, and camouflaged nests, gathering data on seabirds is a challenging task. USGS scientists have been undertaking this challenge for over a decade, with an extensive monitoring program of least tern (*Sternula antillarum*) and common tern (*Sterna hirundo*) populations on Poplar Island. Below are photos from a day in the field with USGS Wildlife Research Ecologist, Diann Prosser's team.



The team spreads out to cover a wider area more quickly while counting scrapes, nests, and eggs. Minimizing time in nesting areas reduces negative impacts on birds, chicks, and eggs. Photo credit: Ann Tihansky, USGS

Poplar Island, 34 miles south of Baltimore in the Chesapeake Bay, provides nesting habitat for a variety of the region's most sensitive bird species, including common and least terns, cattle egret (*Bubulcus ibis*), snowy egrets (*Egretta thula*), and osprey (*Pandion haliaetus*); however, the island was eroding at a rate of more than 13 feet per year because of combined sediment loss, subsidence, and sea-level rise. By 1990, the island was divided into three pieces and was on the path to disappearance until the Poplar Island Environmental Restoration Project (PIERP) began in 1998. PIERP is designed to restore 1,100 acres of wetland and upland habitat within the historical island footprint using dredged materials from Baltimore's shipping-channel.



The team uses spotting scopes to avoid disturbing the birds while they observe and count. Credit: Ann Tihansky

Below: Close-up of bird with PFR band. Photo credit: Diann Prosser, USGS

The USFWS Chesapeake Bay Field Office has been involved with the conceptual design, habitat creation, monitoring, and vegetation planting of the Poplar Island Restoration Project, and many researchers study the restored habitat of the PIERP area.

USGS Patuxent Wildlife Research Center's Diann Prosser and her team (consisting of qualified students, volunteers, and interns) has been monitoring colonies of least and common terns in the PIERP area since 2002. Over the years, these seabird populations have shown variable hatching and fledging success rates. In 2013, Prosser began a project to improve the data estimates of success rates for hatching and fledging of least and common terns. This has included the team increasing colony counts during the nesting season.

During counts, researchers are careful to look before they step to avoid accidentally crushing the well-camouflaged eggs. The construction on Poplar Island ultimately provides habitat to enhance seabird and wildlife



Terns create "scrapes" (small indentations) in the ground where their 1-3 eggs are to be laid. Photo credit: Ann Tihansky, USGS



populations, but the actual process of construction is a challenge for bird managers. Decoy birds are placed around Poplar Island to encourage the terns to nest in safe areas away from dangerous construction activities.

To improve fledging estimates, the team does a mark-resight study by banding hatchlings with a USGS metal band and a plastic field-readable (PFR) band. By observing the PFR band, they can identify the birds in subsequent years. The detection data is entered into a model to obtain estimates of survival.

In 2017, the team successfully banded more than 300 common tern chicks and 20 least tern chicks. The teams also counted other species such as snowy egret, cattle egret, glossy ibis (*Plegadis falcinellus*), little blue heron (*Egretta caerulea*), and black-crowned night-heron (*Nycticorax nycticorax*).

Read more about the project: https://www.usgs.gov/centers/pwrc/science/productivity-species-concern-least-tern-and-common-tern-poplar-island?qt-science_center_objects=1#qt-science_center_objects

Building a Naturally #StrongerCoast

By Darci Palmquist and Lauri Munroe-Hultman (USFWS)

The 2017 hurricane season exposed the vulnerability of coastal communities to powerful storms. More than 100 people died in the United States and its territories as a result. Two category 5 (Irma and Maria) and two category 4 (Harvey and Jose) hurricanes left millions still struggling to recover from these destructive storms.

In an era of rising seas and more frequent and intense storms, our coastlines are tested as never before. Increased flooding and greater storm surge threaten wildlife habitat, private property, and human lives. Although there is no perfect solution to protecting the shore, the USFWS supports a natural response.

Natural infrastructure can't stop the storms from coming, but it can reduce the damage—immediately, and long into the future. It lessens the impacts of storms and sea-level rise and helps communities recover more quickly. These natural areas also benefit



The restored salt marsh at Chafee NWR in Rhode Island will support wildlife like the saltmarsh sparrow and help protect private property from sea-level rise and storm surge. Photo credits: Ayla Fox

wildlife and have huge value for people year round in the form of ecotourism, outdoor recreation, cleaner water, purer air, improved health, and more. As communities engage in the arduous task of rebuilding what was lost, it's important to consider how “natural” infrastructure—marshes, wetlands, beaches, free-flowing rivers, and oyster reefs—can make coastlines more resilient by absorbing storm energy and reducing flooding. *See related story, page 16.*

The USFWS, along with partners at the Federal, State, and local levels, is working with nature to create a stronger coast by restoring marshes

and beaches, building living shorelines, removing dams, and conducting innovative science to guide future conservation efforts.

In commemoration of the fifth anniversary of Hurricane Sandy, the USFWS highlighted select coastal projects supported by Federal funds for Hurricane Sandy recovery. These projects illustrate approaches that create a more resilient coast—one that uses natural infrastructure to lessen the damage of storms and sea-level rise while providing important natural areas that wildlife and people need. It's called #StrongerCoast, and here are some examples of how it works.

#StrongerCoast—Selected Blog Excerpts



Taking Marsh Restoration to a New Level

USFWS and its partners, including The Conservation Fund, are raising the level of a salt marsh at Blackwater NWR to help it keep pace with sea-level rise and continue to provide wildlife habitat and protection for private property.

Link: <https://usfwsnortheast.wordpress.com/2017/10/19/taking-marsh-restoration-to-a-new-level/>

Erik Meyers, vice president for climate and water sustainability with the Conservation Fund, works to restore salt marsh at Blackwater NWR. Photo credit: Dagny Leonard



Building a Stronger Delaware Bay

A project to restore eight beaches is helping bring back horseshoe crabs, birds and people's hope for the future.

Link: <https://usfwsnortheast.wordpress.com/2017/10/24/building-a-stronger-delaware-bay/>

Tim Dillingham, American Littoral Society executive director, tosses shell bags to Beth Freiday of USFWS during the 3rd Annual “Shell-A-Bration” at Thompsons Beach, New Jersey. Photo credit: David Hawkins, American Littoral Society

#StrongerCoast—Selected Blog Excerpts—Continued



Improving Habitat and Protecting Communities at Wreck Pond

A culvert project in coastal New Jersey is helping build a #StrongerCoast by providing flood mitigation for the nearby community and passage for fish.

Link: <https://usfwsnortheast.wordpress.com/2017/10/24/improving-habitat-and-protecting-communities-at-wreck-pond/>

A view from Spring Lake Beach, NJ, of the completed fish passage culvert and pipe that connect Wreck Pond to the Atlantic Ocean. Photo credit: American Littoral Society



A River Runs Free in Rhode Island

USFWS and partners are removing dams to restore a natural flow to the Pawcatuck River, benefiting wildlife and people.

Link: <https://usfwsnortheast.wordpress.com/2017/10/26/a-river-runs-free-in-rhode-island/>

Removing dams on the Pawcatuck River opens it once again to migratory fish and reduces the risk of flooding. Photo credit: Ayla Fox



Using Nature to Build a Stronger Coast

Wetlands, marshes, beaches, oyster reefs, and undammed rivers can serve as natural infrastructure, protecting coastal communities from damage and providing benefits for people and wildlife.

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

USFWS restored the beach near Harry and Claire Bailey's home in Reeds Beach, New Jersey, along the Delaware Bay. Photo credit: Steve Droter



Beyond the Storm: Science for Managing Our Changing Coast

Blackwater NWR is a "coastal strongholds," meaning it has both the physical space and functional processes, like inputs of sediment and freshwater, enabling the marsh habitat to migrate inland in response to changing conditions. Scientists from The Nature Conservancy identified thousands of other coastal sites that have the potential to migrate, and in doing so, to offset more than 50 percent of the total predicted tidal habitat loss in the northeast coastal region.

Read the Blog: <https://usfwsnortheast.wordpress.com/2017/11/02/beyond-the-storm-science-for-managing-our-changing-coast/>

Visit the USFWS Northeast Region blog to read more: <https://usfwsnortheast.wordpress.com/2017/10/04/october-is-building-a-stronger-coast-month/>

The Nature Conservancy included Blackwater NWR in Maryland on its list of coastal strongholds. By identifying Resilient Coastal Sites for Conservation, managers working at any scale can make strategic decisions toward helping coastal systems and communities adapt. Photo credit: Steve Droter

Your Gateway to DOI Science, Management, and Conservation Activities

By Gina Digiantonio (DOI) and Ann Tihansky (USGS)

The DOI has diverse stewardship roles and obligations for our ocean, Great Lakes, and coasts, which are guided by scientific findings. Below are links to some key scientific publications where you can learn more about DOI research science, management, and conservation activities in these areas. Some of the topics covered in these publications include:

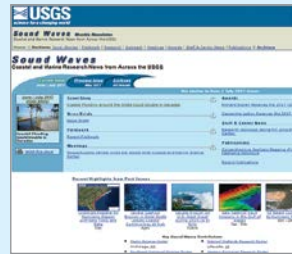
- Estimating the waterfowl carrying capacity for Edwin B. Forsythe NWR;
- Conservation planning for the terrestrial freshwater aquatic and marine ecosystems of the South Atlantic LCC;
- Potential for coastal flooding to double around the globe in the next coming decades;
- Studying coral cores as a way to track land-use changes;
- Detecting human and bovine viruses in Great Lakes tributaries;
- Presenting the Presidential Early Career Award, the highest honor bestowed on early career U.S. Government science and engineer professionals, to Environmental Health Researcher Diann Prosser;
- Evaluating the behavior and survival of adult sockeye salmon (*Oncorhynchus nerka*) following passage through the 1,700 foot Whooshh fish transport system in the Cle Elum Dam, WA; and
- Initiating science education and science, technology, engineering, and math (STEM) outreach in all four Outer Continental Shelf (OCS) regions.



The Fish and Wildlife *Journal of Fish and Wildlife Management*

<http://www.fwspubs.org/doi/pdf/10.3996/1944-687X-8.1.1a?code=ufws-site>

A peer-reviewed public domain journal that accepts submission on scientific papers on conservation and management of native North American fish, wildlife, plants, and their habitats. Although this publication is not ocean and coastal in theme, it is a good resource on many topics that relate to aquatic resources.



USGS Sound Waves

<https://soundwaves.usgs.gov/>

A bimonthly newsletter covering coastal and marine science news and activities in the USGS.



USGS GeoHealth

https://www2.usgs.gov/envirohealth/geohealth/v14_n02.html

A newsletter that provides information on USGS environmental health science activities related to the health of the environment, fish and wildlife, domesticated animals, and people.



USGS Western Fisheries Science News

<https://wfrc.usgs.gov/newsletter/>

This newsletter features news, research, and events from the Western Fisheries Research Center.



BOEM Science Notes

<https://www.boem.gov/Science-Notes/>

A publication that informs stakeholders on ongoing research as it takes place in the field; each issue features a BOEM study or other item of interest.



BOEM Ocean Science

<https://www.boem.gov/Ocean-Science/>

Ocean Science is the science and technology journal of the BOEM. Data gained from BOEM-funded studies inform policy decisions regarding offshore oil, natural gas, and renewable energy development. The information also is used by other Federal and State agencies in decision-making and by members of academia and experts in the private sector.

Listening for Storm-petrels in the California Coastal National Monument

By Emma Kelsey (USGS)

The California Coastal National Monument (CCNM) includes more than 20,000 offshore rocks, sea stacks, and islands off the California coast. These offshore ecosystems provide prime real estate for wildlife, including an estimated 200,000 breeding seabirds and a few thousand marine mammals. However, much about the wildlife resources of the CCNM remains unknown, and this can create challenges for resource managers looking to preserve its ecosystems. Together with industry partners, scientists with the USGS and BLM scientists and staff are studying the range and population size of an elusive, sensitive seabird in the CCNM to inform management and conservation of its species.

The Ashy Storm-petrel (*Oceanodroma homochroa*) nests primarily within the Monument boundaries and is considered “Endangered” by the International Union for Conservation of Nature, although it presently has no federal status for protection. This ashy-gray seabird makes its home in burrows and crevices on offshore rocks and islands, and only enters and leaves nests under the cover of darkness. Although these behaviors help the Storm-petrel avoid predators, they also make it difficult for biologists who wish to study this cryptic species. The development of a study plan to better understand the distribution and population trends for this species required collaboration, smart planning, and novel technology.

The project is a collaboration between the BLM Central Coast Field Office (CCFO), USGS Western Ecological Research Center (WERC), and Conservation Metrics, Inc. To overcome the challenges of studying this



Emma Kelsey (USGS) setting up acoustic monitor for deployment, Hurricane Rock, Big Sur, CA. Photo credit: SeanPaul La Selle, USGS

secretive species, and to decrease impacts on Storm-petrel habitat, the team deployed passive digital acoustic recorders on 14 rocks and islands within the CCNM. Scientists and managers at BLM CCFO organized and facilitated access to the offshore rocks, analysts at Conservation Metrics prepared field equipment and analyzed the data collected, and scientists at USGS WERC led field research, digital acoustic recorder deployment, and visual inventories on offshore rock habitats. The digital acoustic recorders record the call of Storm-petrels and other species returning to offshore colonies at night. Three similar storm-petrel species

breeding within the CCNM will also be monitored as part of the project: Leach’s Storm-Petrel (*O. leucorhoa*), Fork-tailed Storm-Petrel (*O. furcata*), and Black Storm-Petrel (*O. melania*). In addition, the researchers’ acoustic surveys may also capture the vocalizations of other sensitive seabirds: Tufted Puffin (*Fratercula cirrhata*), and Scripps’s (*Synthliboramphus scrippsi*), Guadalupe (*S. hypoleucus*), and Marbled Murrelets (*Brachyramphus marmoratus*).

Understanding the health and status of wildlife populations within the Monument will establish the scientific basis for future management and conservation efforts. This project assesses the use of passive acoustic surveys in ascertaining trends in relative abundance and habitat use of crevice and burrow-nesting seabirds within the CCNM. The results of this study will not only deliver data on the status and distribution of Ashy Storm-petrels and other important seabird species in the CCNM, but will also provide land and wildlife managers with an effective, affordable, and repeatable method for monitoring species on a CCNM-wide scale.

Read about this project: <https://www.usgs.gov/centers/werc/science/seabird-health-and-adaptive-management>



Ashy Storm-petrel. Photo credit: Max Czapanskiy, USGS

West Coast Regional Planning Body Holds its Annual Meeting in Southern California

By Sara Guiltinan (BOEM)

The tribal, State, and Federal representatives of the West Coast Regional Planning Body (WCRPB) convened for their annual in-person meeting on December 5–7, 2017, aboard the historic *Queen Mary* in Long Beach, CA. During the first day of the meeting—which was open to the public—WCRPB members shared West Coast marine planning activity updates and held several evaluation sessions to confer on what is working well and what needs improvement.

Public participants were invited to provide comments on all the WCRPB's activities and evaluations.

These three days of discussing regional coordination, subregional planning efforts, and the West Coast Ocean Assessment (an information resource which provides foundational data sets for planning, stakeholder engagement, and data availability through the West Coast Ocean Data Portal), led the group in establishing several goals and next steps for 2018. These efforts will continue to enhance coordination, communication, and data sharing around the planning and management for ocean uses for the West Coast.

DOI is represented on the WCRPB meeting by Joan Barminski, Pacific Regional Director for BOEM with staff from the NPS and USFWS also participating in the meeting.

Learn more: <http://www.westcoastmarineplanning.org/meetings/>



WCRPB members and stakeholders listen to a recap of the WCRPB's history and activities in a stateroom aboard the *Queen Mary*. Photo credit: Kris Wall, NOAA



The *Queen Mary* provided an historic on-the-water venue for the WCRPB meeting. Photo credit: Sara Guiltinan, BOEM

BOEM Ocean Science

By Melanie Damour (BOEM)

The BOEM *Ocean Science* Aug/Sept/Oct/Nov 2017 issue highlights recent updates with BOEM's Marine Minerals Program (MMP). The MMP leases OCS sand and gravel for coastal restoration and beach renourishment projects in coastal U.S. States. Coastal resilience is important for protecting and enhancing coastal communities; tourism; sensitive wetlands, dunes, beaches, barrier islands; and infrastructure. BOEM, through the MMP, has executed 54 leases, authorized the use of 145 million cubic yards of OCS sediment, and helped to restore more than 320 miles of coastline since 1995.

Currently, BOEM is creating a National Offshore Sand Inventory that will allow the Bureau to be better stewards of this finite resource. In addition, available marine minerals geological, geophysical, and environmental information is being compiled into the Marine Minerals Information System to be launched and shared with the public and other stakeholders in 2018. The issue also highlights recent marine minerals studies and coastal restoration projects supported by BOEM.

Read the issue: <https://www.boem.gov/Ocean-Science-Aug-Sept-Oct-Nov-2017/>

Stay up to date with BOEM's Environmental Studies Program and ongoing studies through BOEM Ocean Science: <https://www.boem.gov/Ocean-Science/>



Photo credit: BOEM

Predicting Flooding on Coral Reef-Lined Coasts

By Helen Gibbons and Curt Storlazzi (USGS)

Scientists have developed a computer simulation tool called “BEWARE” (Bayesian Estimator of Wave Attack in Reef Environments) for predicting short-term flooding that threatens human lives and property on coral reef-lined coasts. BEWARE also can assess longer-term impacts from climate change.

The new tool estimates how different combinations of wave, water level, and reef types lead to coastal flooding. It allows users to play “what-if” games and ask questions such as, “How will flood risk change if the coral on this reef dies, or if sea level rises by more than 1 meter?” Researchers can use the results to project societal or economic risk and damage. Deltares (a Dutch research institute), the USGS, and Delft University of Technology developed BEWARE. *See related story, page 18.*

Read more: <https://walrus.wr.usgs.gov/climate-change/atolls/news.html>



Aerial image of waves breaking over the coral reefs around an island on Kwajalein Atoll, RMI. Photo credit: Tom Reiss, USGS

Bottom-up Boost for Coastal Habitat

By Elizabeth Rogers (USFWS)

Salt marshes provide habitat for fish, birds, and invertebrates and purify water by taking up nutrients that can be harmful in excess. Marshes and the many benefits they provide are threatened by accelerated sea-level rise, per Dr. Bart Wilson, the USFWS Northeast region coastal resiliency coordinator. *See related story, page 26.*

“Marsh elevation builds naturally from the bottom up,” said Wilson. “Organic material, like the roots of saltmarsh grasses, gives the surface a lift.” For thousands of years, tidal marshes have “kept their heads above water by building up roots below the surface,” said Blackwater NWR Supervisory Biologist Matt Whitbeck.



Sediment is sprayed onto a marsh at Blackwater National Wildlife Refuge, MD, to compensate for its natural tendency to sink and the effects of sea-level rise. Photo credit: Dave Harp, Chesapeake Photos

“Only recently has the natural ability of these systems to grow vertically not been enough and as a result,” says Whitbeck, “the marsh is essentially sinking.” In response to this trend, nearly three decades ago, scientists began looking for a way to give salt marshes a lift.

To the plants and animals in tidal marshes, elevation is everything. Higher ground is home to plants and animals adapted to survive occasional flooding, and species that can withstand daily flooding by high tide live at lower elevations within the marsh. Smooth cordgrass (*Spartina alterniflora*) is salt-tolerant and typically grows where high marsh and low marsh meet, near the mean high-water mark.

In addition to the bottom-up boost from plant roots below ground, marsh elevation can slowly increase as sediments accumulate at the surface. Sediment may come from a nearby creek or river, or from the adjacent marine environment. Salt marshes tend to thrive in locations where these elevation gains are in a natural balance with elevation losses due to sea-level rise, erosion, and the gradual compaction of sediments.

According to Wilson, dredging sediment from nearby rivers or other waterways and spreading it onto high marsh free of vegetation builds “elevation capital.” The technique, called thin-layer deposition or TLD,

helps salt marshes better withstand sea-level rise and subsidence.

The USFWS first tested TLD in 2003 at Blackwater NWR, MA. This small demonstration project succeeded but left managers and scientists with more questions, including how to decrease costs while maximizing results.

After Hurricane Sandy in 2012, Federal funding for recovery and resiliency offered the opportunity to begin to answer those questions. Sandy funds have been supporting five TLD projects at four national wildlife refuges in the Northeast.

Restoration techniques like TLD are giving salt marshes a fighting chance against sea-level rise and subsidence. And Hurricane Sandy Relief Aid gave the USFWS an opportunity to apply and study this technique. With an improved understanding of TLD and help from partners, the USFWS and DOI can continue to work to ensure that salt marshes are healthy, sustaining species, and making coastal communities more resilient to future storms.

The USFWS is working with partners like The Nature Conservancy and Save the Bay using this technique to enhance elevation in specific marshlands in Rhode Island, the Edwin B. Forsythe NWR, NJ, and Blackwater NWR in the Chesapeake Bay, MD. Read more: <https://usfwsnortheast.wordpress.com/2017/08/16/a-bottom-up-boost-for-coastal-habitat/>



Photo courtesy of Debi Ropken

Changing Tides—Intertidal Invertebrates, Bears, and People

<https://www.nps.gov/katm/learn/changing-tides.htm>

By Gina Digiantonio (DOI) and Jim Pfeiffenberger (NPS)

The Surfing Bison



Pictured above: Brown bears along the coast of Katmai and Lake Clark national parks exploit exposed mudflats during low tides to feed on razor clams. They use their long claws to get the razor clams out of the sediment and open the shells.

The Changing Tides project is a three-year study examining the link between the marine and terrestrial environments in Southwest Alaska, specifically between coastal brown bears, clams and mussels, and people. These coastal brown bears are the largest of their kind in the world, deriving much of their bulk from the abundant salmon resources that pulse into the rivers from the sea each summer. The bears also spend many hours in

the mudflats digging, chomping, and slurping intertidal resources such as clams and mussels as well as seaweed and other vegetation. The bears are such regular visitors to these coastal areas, a bear viewing industry has developed around them.

To understand how natural and human-related pressures can affect coastal brown bears and the intertidal invertebrates, a whole suite of data is being gathered through a cooperative project between the NPS, the USGS, the Alaska SeaLife Center, and various universities. Through this study, researchers spend hours in the field examining bear health, observing their

behavior, and tracking their movements using GPS and video cameras. Fieldwork is aimed at understanding two main components: (1) brown bear fitness and use of marine resources; and (2) the abundance, distribution, and health of clams and mussels. Throughout the project, the team uses photos, blogs, story maps, and videos to share stories of the interconnectedness of life in these coastal environments.

Bear's Eye View: Travel with Coastal Brown Bears in this Story map with video clips <https://www.nps.gov/gis/storymaps/mapjournal/v1/?appid=e0b1c5fe2f64476b8ad278e61e16a598>



Visitors view a bear foraging for clams and other invertebrates in the mudflats of Chinitna Bay in Lake Clark National Park and Preserve. Photo credit: Jim Pfeiffenberger, NPS



Bear 085 is one of several bears that was fitted with a GPS collar to track the bear's movements. In this photo, she and her cubs dig for clams at Hallo Bay. Photo credit: Kaiti Chritz, NPS

What is it Like to Perform Research in the Wilderness?

The research team wrote blog posts with stories of what it is like to do research in the wilderness, reflections on the ethics of science, and observations of bears, wolves, and other Alaskan wildlife. Read the blog: <https://www.nps.gov/katm/blogs/katmai-terrane-blog.htm?tagID=2CE7E35C-1DD8-B71C-0769D935D58C42D3>



Scientists use spotting scopes to monitor bear activity from a distance so as not to disturb them. Photo credit: Kaiti Chritz, NPS



Scientists work rapidly to collect a variety of measurements from a tranquilized brown bear at Katmai National Park. Photo credit: Kaiti Chritz, NPS



Researchers travel from one sampling location to another along the Katmai coast by small boat. Photo credit: Jim Pfeiffenberger, NPS