

## START WITH SCIENCE TO BUILD SAFER COMMUNITIES

# Hurricane Sandy Science Plan—Impacts to Coastal Ecosystems, Habitats, and Fish and Wildlife

“The understanding we gain from these studies will set the stage for better models addressing future hazard scenarios and will help coastal communities be better prepared to withstand and respond to catastrophic storms.”—*Suzette Kimball, U.S. Geological Survey Acting Director*

### Meeting the Science Needs of the Nation in the Wake of Hurricane Sandy—A U.S. Geological Survey Science Plan for Support of Restoration and Recovery

Hurricane Sandy devastated some of the most heavily populated eastern coastal areas of the Nation. With a storm surge peaking at more than 19 feet, the powerful landscape-altering destruction of Hurricane Sandy is a stark reminder of why the Nation must become more resilient to coastal hazards. In response to this natural disaster, the U.S. Geological Survey (USGS) received a total of \$41.2 million in supplemental appropriations from the Department of the Interior (DOI) to support response, recovery, and rebuilding efforts. These funds support a science plan (Buxton and others, 2013) that will provide critical scientific information necessary to inform management decisions for recovery of coastal communities, and aid in preparation for future natural hazards. This science plan is designed to coordinate continuing USGS activities with stakeholders and other agencies to improve data collection and analysis that will guide recovery and restoration efforts. The science plan is split into five distinct themes:

- Coastal topography and bathymetry
- Impacts to coastal beaches and barriers
- Impacts of storm surge, including disturbed estuarine and bay hydrology
- Impacts on environmental quality and persisting contaminant exposures
- Impacts to coastal ecosystems, habitats, and fish and wildlife

This fact sheet focuses on impacts to coastal ecosystems, habitats, and fish and wildlife.

### Theme Stakeholders

Natural coastal ecosystems are among the Nation’s most important resources. They help attenuate the energy of storms, filter sediment and pollution, provide wildlife habitat, provide recreation, and other valued ecosystem services. All of these ecosystem services are important to people living on the Northeast and mid-Atlantic coasts, as well as agencies including the U.S. Fish and Wildlife Service (USFWS), National Park Service (NPS), National Oceanic and Atmospheric Administration (NOAA), U.S. Army Corps of Engineers, and other Federal and state agencies tasked with protecting coastal resources. In support of these informational needs the USGS seeks to



A pair of photos both showing the same site looking west across Smith Island, Virginia, in 2009 (top) and after Hurricane Sandy in 2012 (bottom). The differences in the two images show how Hurricane Sandy’s winds, high tide, and storm surge carried sand from beaches and dunes far inland to cover coastal dune vegetation and wetlands. Salt water was also pushed inland by the storm.

specifically understand how marshes, forests, and wildlife on public and adjoining lands were affected by the storm, and to use that knowledge to help predict how these may be affected by future storms. An improved understanding of the impacts of Hurricane Sandy on coastal wetlands, and how those wetlands can help attenuate storm energy, is valuable not only to managers of coastal USFWS National Wildlife



Refuges and NPS National Parks, but also for coastal communities that can benefit from coastal barriers.

## Coastal Ecosystems, Habitats, and Fish and Wildlife Projects

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The Department of the Interior (DOI) is responsible for management of public lands and species affected by Hurricane Sandy. These include approximately 30 National Wildlife Refuges and 6 National Parks and Seashores that provide critical habitat for migratory waterfowl and federally listed species. They include coastal barriers that protect wetlands and coastal communities, and provide recreational opportunities for millions of visitors, including those from nearby urban and metropolitan areas in the Boston to Washington, D.C. corridor. These habitats support social systems, economic and food security, environmental stability, and other ecosystem services.

It is essential that the USGS, as the DOI science agency, provides science to support assessment, response, recovery, and increased resiliency of these natural resources. Natural resource managers of DOI lands have trust responsibilities under the Federal Endangered Species Act and the Migratory Bird Treaty Act, as well as additional cooperative responsibilities with State and local authorities responsible for the protection of native, commercial, and recreationally harvested fish and wildlife species. Decisionmakers need to understand the long-term consequences of hurricane effects on wildlife and their habitats in order to effectively develop and implement conservation strategies. How animal species fared along the coast during Hurricane Sandy, and how their food supplies, habitats, and reproductive success may have been impacted, are all questions of importance. The information produced from post-hurricane studies conducted by the USGS and its partners will provide essential baseline and long-term support for coastal zone planning, conservation planning, resource management, hazard reduction, and risk mitigation in the wake of natural disasters such as Hurricane Sandy.

## Assess Storm Impact to Wetland Integrity and Stability to Support Recovery Decisions

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USGS expertise with wetland ecology and remote imagery will be applied to document changes to Northeast and mid-Atlantic coastal wetland changes resulting from Hurricane Sandy. Fine-scale elevation changes can be determined using data from the Surface Elevation Table (SET) (<http://www.pwrc.usgs.gov/set/>) network currently (2013) maintained by the USGS and partners. Remote imagery, the data from SETs, and marsh sediment cores will be collected and analyzed along the Northeast coast to produce regional assessments of coastal marsh conditions. Additionally, the Submergence Vulnerability Index (Stagg and others, 2013) will be used to assess wetland vulnerability to future sea-level rise and storm events. This project also will document multidecadal changes to the Nation's Northeast and mid-Atlantic coastline.

## Assess Storm Impact to Waterfowl and Migratory Birds to Support Conservation

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The USGS will document the impacts of Hurricane Sandy on coastal birds using historic and current data. To document these impacts, the USGS will:

- Establish pre-storm and current population numbers;
- Establish study sites on DOI trust lands and other public lands to study declining populations of secretive marsh and shore birds;

- Gather radar and field data on migratory bird flight patterns pre- and post-storm, and assess potential for changes to their migratory stop-over habitats, resident habitats, food sources, reproductive capacities, and phenology;
- Calculate mean bird density for multiple migration seasons to establish a baseline of bird distributions before the storm; and
- Gather data necessary for mapping changes to wildlife habitat.

## Document Wetland Conditions and Food Supply for Bird Migration and Breeding, and Assess Coast-Wide Storm Impacts to Coastal Forests

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The USGS will gather information on the complex relations linking forest type, structure, and size thresholds to coastal buffering capacity, which is needed to improve risk assessment and mitigation. This information will classify coastal forest types and storm impacts across the Nation's entire Atlantic coastal zone for national parks and wildlife refuges based on forest condition, mortality, species composition, woody debris and wrack deposits, high water survey of flooding extent, and residual soil salinity correlated with storm force of wind speed and surge penetration. Salinity and water-level data from available USGS and NOAA streamgages will be used to generate isohaline maps across the coastal zone. A coast-wide map will show the various forest types and conditions of coastal forest affected by tides and storm surges, which will be useful for predicting forest recovery and prioritizing potential success and alternatives for forest restoration.

## Develop Data-Driven Models and Monitoring Networks

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The USGS will use monitoring network data to develop models of storm impacts to vegetation and coastal morphology, and to forecast how alterations in barrier configuration and processes impact the location and health of wetlands, submerged habitats, and ecosystem services. Synthesis of these network data will deliver numerical models of impacts to habitats and wildlife to help assess Hurricane Sandy impacts on the composition, distribution, and productivity of vegetation. The USGS will modify current web-based tools to deliver existing and new ecological models, data standards, visualization and analysis tools, and decision support tools to aid scientific research and resource management in the Hurricane Sandy impact areas.

## References Cited

- Buxton, H.T., Andersen, M.E., Focazio, M.J., Haines, J.W., Hainly, R.A., Hippe, D.J., and Sugarbaker, L.J., 2013, Meeting the science needs of the Nation in the wake of Hurricane Sandy—A U.S. Geological Survey science plan for support of restoration and recovery: U.S. Geological Survey Circular 1390, 26 p., <http://pubs.usgs.gov/circ/1390/>.
- Stagg, C.L., Sharp, L.A., McGinnis, T.E., and Snedden, G.A., 2013, Submergence Vulnerability Index development and application to Coastwide Reference Monitoring System Sites and Coastal Wetlands Planning, Protection and Restoration Act projects: U.S. Geological Survey Open-File Report 2013-1163, 12 p., <http://pubs.usgs.gov/of/2013/1163/>.

## For More Information:

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- <http://coastal.er.usgs.gov/hazards-events/sandy/>